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EFFECT OF INTEGRATED APPLICATION OF INORGANIC FERTILIZER AND ORGANIC SOURCES ON GROWTH ATTRIBUTES, YIELD PARAMETERS AND YIELDS OF TRANSPLANTED RICE UNDER INCEPTISOL ORDER OF SOIL

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ABSTRACT

The research experiment was conducted at the Agricultural Research Farm situated within the campus of the Institute of Agricultural and natural sciences, Deen Dayal Upadhyay Gorakhpur University, Gorakhpur (U.P.) during the Kharif season of 2024 -25 to find out the effect of combined use of inorganic fertilizer and organic manure on growth and yield attributes and yields of transplanted rice under Inceptisol clearly demonstrated the beneficial role of integrated nutrient management practices. The experiment comprised seven treatment viz; control, 50% NPK + compost @ 5 t/ha, 50% NPK + compost @ 5 t/ha + crop residue, 100% NPK + compost @ 5 t/ha, 100% NPK + compost @ 5 t/ha + crop residue, 150% NPK + compost @ 5 t/ha and 150% NPK + compost @ 5 t/ha + crop residue laid out in Randomized Block Design with three times replicated. Results showed that the combined application of organic and inorganic nutrient sources significantly improved growth parameters, yield attributes and yields compared to lower nutrient treatments. Among all the treatments of 150% NPK + Compost @ 5t/ha + Crop Residue proved to be the most effective treatment and recorded the maximum plant height, number of tillers hill^{-1}, panicle length, panicle weight and number of grains per panicle. Superior vegetative and reproductive growth under 150% NPK + Compost @ 5t/ha + Crop Residue ultimately resulted in the highest grain yield, straw yield, biological yield and harvest index. The improvement in crop performance may be attributed to balanced nutrient supply, enhanced nutrient uptake, better photosynthetic activity and efficient translocation of assimilates from source to sink.

Keywords **:** Inorganic fertilizers, organic sources, transplanted rice, inceptisol soil order.

Introduction

Rice (*Oryza sativa* L.) primarily cultivated in tropical and subtropical regions and plays a crucial role in ensuring food and nutritional security, particularly in Asia. Its continues to be one of the most important cereal crops globally, with steady growth in production due to increasing demand and improvements in agricultural technologies. The global rice production during the 2023-24 season was estimated at about 523.7 million tones (milled basis), which increased to approximately 537.7 million tonnes in 2024-25, reflecting a growth of nearly 3% over the previous year. Asia dominates global rice production, contributing nearly 90% of total output. Among the leading producers, India and China together account for more than half of the world's total rice production (Anonymous, 2025). Integrated Nutrient Management (INM) has emerged as a holistic and sustainable approach to nutrient supply in rice cultivation. INM refers to the judicious and combined use of organic,

inorganic, and biological sources of nutrients to maintain soil fertility and ensure optimal crop productivity. It aims to maximize nutrient-use efficiency while minimizing nutrient losses and environmental impacts. This integrated approach not only supplies essential nutrients but also promotes nutrient cycling and long-term soil fertility (Sande *et al.*, 2024; Paramesh *et al.*, 2023). The present study hypothesizes that the adoption of Integrated Nutrient Management involving the combined use of organic manures, inorganic fertilizers, and biofertilizers, will significantly enhance the growth, yield, and yield attributes of rice compared to the sole application of chemical fertilizers. It is further hypothesized that INM practices will improve soil health by enhancing soil physical, chemical, and biological properties, including soil organic carbon, nutrient availability, and microbial activity. Additionally, INM is expected to increase nutrient-use efficiency by minimizing nutrient losses and ensuring better synchronization between nutrient supply and crop demand. Therefore, the purpose of this study was to be considering the significance of rice in global food systems and the challenges associated with its production, continuous research efforts are required to improve yield, resource use efficiency, and sustainability.

Materials and Methods

The experiment was conducted during the Kharif season of 2024–2025 at the Agricultural Research Farm situated within the campus of the Institute of Agricultural and Natural Sciences, Deen Dayal Upadhyay Gorakhpur University, Gorakhpur (U.P.). The research farm provided suitable conditions for studying the effect of nutrient management practices on crop growth, yield, and soil properties under alluvial soil conditions. Gorakhpur is located in the eastern part of Uttar Pradesh and lies at 26°46′ North latitude and 83°02′ East longitude, with an elevation of about 75 meters above mean sea level. The region receives most of its annual rainfall during the monsoon period extending from mid-June to September, with an average precipitation of about 108.83 mm and nearly 86 wet days annually. The relative humidity of the region generally remains around 68%, though it fluctuates considerably with seasons, ranging from nearly 38% during the summer months to about 84% during the monsoon season. The summer season extends from March to June, when the average daily temperature often exceeds 34.44℃. The winter season in the region persists approximately from December to February, with average daily temperatures remaining below 24.44℃. The soil was found to be low in available nitrogen (181.12Kg ha^{-1}) and phosphorus (13.92Kg ha^{-1}), while the available potassium content (151.48Kg ha^{-1}) was comparatively high. The soil of the experimental field was fairly uniform in nature with sandy loam texture, good fertility status, and satisfactory drainage conditions. The soil pH (6.90) and EC (0.35 dsm^{-1}) at different sampling sites. In addition, the soil contained medium levels of organic carbon (0.39g Kg^{-1}). The field experiment was laid out in a Randomized Block Design (RBD) in order to minimize experimental error and to obtain reliable results. The study comprised eight different treatment combinations along with one untreated control, and each treatment was replicated three times to ensure precision and accuracy in the observations recorded during the investigation. The details of treatments i.e. T-1: Control, T-2: 50% NPK + Compost @ 5t/ha, T-3: 50% NPK + Compost @ 5t/ha + Crop Residue, T-4: 100% NPK + Compost @ 5t/ha, T-5: 100% NPK + Compost @ 5t/ha + Crop Residue, T-6: 150% NPK + Compost @ 5t/ha and T-7: 150% NPK + Compost @ 5t/ha + Crop Residue. The transplanting of rice (Kalanamak Kiran) in puddle field in spacing at 20cm X 15cm was done on 25 july, 2025 by manually. Harvesting of crops in all plot was done at maturity on 25 November, 2025 with handle sickles by manual labour.

Results and Discussion

(A) Growth and yield attributes

The data regarding growth and yield attributes viz.; plant height, tillers/hill, panicle length, panicle weight, grain per panicle and test weight at harvesting stage is presented in Table 1. The results indicated that plant height increased progressively under all treatments and the differences among treatments were found significant at harvest. Among the various treatments 150% NPK + Compost @ 5 t/ha + Crop Residue recorded significantly maximum plant height of 93.09 cm at harvest. This was followed by 150% NPK + Compost @ 5 t/ha which produced plant height of 90.28 cm at corresponding stage. In contrast, the minimum plant height was recorded under Control with values of 75.24 cm. The increase in plant height under higher treatments may be attributed to the balanced and continuous supply of essential nutrients which enhanced cell elongation, cell division and chlorophyll synthesis. Adequate nutrient availability might have accelerated physiological and metabolic activities leading to vigorous vegetative growth. Integrated nutrient application also improves soil physical condition and root proliferation, resulting in greater absorption of water and nutrients from soil (Sharma *et al.*, 2018).

The number of tillers hill^{-1} increased significantly due to different treatments. The highest number of tillers hill^{-1} was recorded under 150% NPK + Compost @ 5 t/ha + Crop Residue with values of 13.61 at harvest. The next best treatment was 150% NPK + Compost @ 5 t/ha which produced 13.22 tillers hill^{-1} at maturity stage. On the other hand, the lowest number of tillers hill^{-1} was observed under control with values of 10.08, in present study. The production of tillers is an important growth parameter directly associated with crop productivity. The increased number of tillers under superior treatments may be due to enhanced nutrient availability, particularly nitrogen, which promotes rapid vegetative growth and stimulates the formation of auxiliary buds. Balanced nutrient supply under integrated management practices might have improved root development and nutrient uptake, thereby increasing photosynthetic efficiency and dry matter accumulation (Ruan *et al.*, 2023).

The panicle length was significantly influenced by different treatments. Among all the treatments, 150% NPK + Compost @ 5 t/ha + Crop Residue recorded the maximum panicle length of 27.12 cm, which was significantly superior over the remaining treatments. This was followed by 150% NPK + Compost @ 5 t/ha and 100% NPK + Compost @ 5 t/ha + Crop Residue, with panicle lengths of 26.75 cm and 25.72 cm, respectively. The minimum panicle length of 15.38 cm was observed under control. The increase in panicle length under superior treatments may be attributed to balanced and adequate nutrient supply throughout the crop growth period (Ashiq *et al.*, 2021). Better nutrient availability enhanced vegetative growth, photosynthetic activity and translocation of assimilates towards reproductive parts. Nitrogen promotes vigorous plant growth and chlorophyll synthesis, while phosphorus encourages root development and flowering, ultimately contributing to improved panicle formation. Enhanced panicle length indicates better reproductive growth and greater sink capacity of the crop (Yadav *et al.,* 2025).

The results showed significant differences among treatments with respect to panicle weight. The highest panicle weight of 4.51 g was recorded under 150% NPK +Compost @ 5 t/ha + Crop Residue followed by 150% NPK + Compost @ 5 t/ha (4.48 g) and 100% NPK + Compost @ 5 t/ha + Crop Residue, (4.43 g). The lowest panicle weight of 4.16 g was observed under control. The increase in panicle weight under higher treatments may be due to improved nutrient uptake and efficient translocation of photosynthates from source to sink. Adequate nutrient supply enhances carbohydrate synthesis and accumulation in reproductive structures, leading to heavier panicles. Potassium plays an important role in enzyme activation and movement of assimilates, which improves grain filling and panicle development. Better physiological efficiency under integrated nutrient management practices might also have contributed to increased panicle weight (Verma *et al.,* 2025).

The number of grains per panicle was significantly affected by different treatments. The highest number of grains per panicle (132.41) was recorded under 150% NPK + Compost @ 5 t/ha+Crop Residue, followed by 150% NPK + Compost @ 5 t/ha with 129.75 grains per panicle and T_5 with 125.64 grains per panicle. The lowest number of grains per panicle (95.21) was observed under control. The increased number of grains per panicle under superior treatments may be attributed to improved reproductive efficiency and better translocation of assimilates towards developing grains. Balanced nutrition and enhanced photosynthetic activity may have promoted flowering, pollination and grain setting, resulting in a higher number of filled grains (Ruan *et al.,* 2023). Nitrogen supports protein synthesis and growth, phosphorus improves reproductive development and potassium facilitates carbohydrate movement and grain filling. The higher grain number under 150% NPK + Compost @ 5 t/ha + Crop Residue indicates efficient utilization of nutrients and better partitioning of assimilates towards economic yield (Yadav *et al.,* 2025).

Whereas, the test weight was not significantly affected by different treatments, as the treatment differences were statistically non-significant. However, numerically the maximum test weight of 16.24 g was recorded under 150 % NPK + Compost @ 5 t/ha + Crop Residue followed by 150% NPK + Compost @ 5 t/ha (16.18 g) and T_5 (16.11 g), whereas the minimum test weight of 14.87 g was observed under control. The slight variation in test weight among treatments may be due to improved grain filling and accumulation of carbohydrates under better nutrient supply. However, since test weight is mainly controlled by genetic characteristics of the variety, the influence of nutrient management practices was comparatively less pronounced (Islam *et al.,* 2022). The non-significant effect indicates that treatments mainly influenced grain number and panicle development rather than grain size and density (Mahajan *et al.,* 2021).

Table 1: Effect of integrated application of inorganic fertilizers and organic sources on growth and yield attributes of rice (*Oryza sativa* L.) during Kharif season of 2025.

Treatments	Plant height (cm)	Tillers / hill	Panicle length(cm)	Panicle weight(g)	Grain/ panicle	Test weight(g)
Control,	75.24	10.08	15.38	4.16	95.21	14.87
50% NPK+ Compost @ 5 t/ha	79.25	11.43	20.85	4.25	114.67	15.89
50% NPK+ Compost @5 t/ha + Crop Residue	81.06	11.76	22.55	4.34	117.26	15.97
100% NPK + Compost @ 5 t/ha	86.11	12.62	24.18	4.38	121.73	16.04
100% NPK + Compost @ 5 t/ha + Crop Residue	88.12	12.93	25.72	4.43	125.64	16.11
150% NPK + Compost @ 5 t/ha	90.28	13.22	26.75	4.48	129.75	16.18
150% NPK + Compost @ 5 t/ha + Crop Residue	93.09	13.61	27.12	4.51	132.41	16.24
C.D.	**2.146**	**0.673**	**1.304**	**0.220**	**5.828**	**NS**
SE(m)	**0.689**	**0.216**	**0.419**	**0.071**	**1.871**	**0.299**

(B) Yields:

The data pertaining to yield viz; grain, straw and biological yield and harvest index are presented in Table 2. The results revealed that grain yield was significantly influenced by different treatments. Among all treatments, 150% NPK + Compost @ 5 t/ha + Crop Residue recorded the highest grain yield of 45.64 q ha^{-1}, which was significantly superior over the remaining treatments. This was followed by 150% NPK + Compost @ 5 t/ha and T_5 which produced grain yields of 43.12 q ha^{-1} and 42.05 q ha^{-1}, respectively. In contrast, the lowest grain yield of 26.15 q ha^{-1} was recorded under control. The maximum straw yield of 85.25 q ha^{-1} was recorded under 150% NPK + Compost @ 5 t/ha + Crop Residue, followed by 150% NPK + Compost @ 5 t/ha (84.28 q ha^{-1}) and T_5 (83.42 q ha^{-1}). The minimum straw yield of 79.24 q ha^{-1} was observed under control. The biological yield was significantly influenced by different treatments. Treatment 150% NPK + Compost @ 5 t/ha + Crop Residue recorded the highest biological yield of 130.89 q ha^{-1}, followed by 150% NPK + Compost @ 5 t/ha with 127.40 q ha^{-1} and 100% NPK + Compost @ 5 t/ha + Crop Residue with 125.47 q ha^{-1}. The lowest biological yield of 105.39 q ha^{-1} was observed under control. The results revealed that harvest index was significantly affected by different treatments. The highest harvest index of 34.87% was recorded under 150% NPK + Compost @ 5 t/ha + Crop Residue, followed by 150% NPK + Compost @ 5 t/ha (33.85%) and T_5 (33.51%), whereas the lowest harvest index of 24.81% was observed under control. The increase in grain yield, straw yield, biological yield and harvest index under superior treatments may be attributed to balanced nutrient supply, improved growth attributes and enhanced photosynthetic efficiency. Better nutrient uptake and efficient translocation of assimilates promoted grain formation, dry matter accumulation and biomass production. Improved soil fertility, root growth and nutrient use efficiency further contributed to higher productivity and efficient conversion of total biomass into grain yield. Similar findings found Yadav *et al.*, 2025 and Verma *et al.*, 2025.

Table 2 : Effect of integrated application of inorganic fertilizers and organic sources on yields of rice (*Oryza sativa* L.) during Kharif season of 2025.

Treatments	Grain yield(q/ha)	Straw yield(q/ha)	Biological yield (q/ha)	Harvest Index (%)
Control	26.15	79.24	105.39	24.81
50% NPK + Compost @ 5 t/ha	32.46	81.74	114.2	28.42
50% NPK + Compost @ 5 t/ha + Crop Residue	36.54	81.99	118.53	30.83
100% NPK + Compost @ 5 t/ha	40.23	82.45	122.68	32.79
100% NPK + Compost @ 5 t/ha + Crop Residue	42.05	83.42	125.47	33.51
150% NPK + Compost @ 5 t/ha	43.12	84.28	127.4	33.85
150% NPK + Compost @ 5 t/ha + Crop Residue	45.64	85.25	130.89	34.87
C.D.	**1.986**	**3.239**	**6.329**	**1.036**
SE(m)	**0.637**	**1.040**	**2.031**	**0.333**

Conclusion

On the basis of results illustrated from the present investigation it can be concluded that growth and yield attributes viz., plant height, tillers per hill, panicle length, grain per panicle and test weight were noticed superior with 150% NPK + Compost @ 5 t/ha + crop residue resulted higher and better yields viz., grain, straw and biological yield and harvest index. Thus,

treatment of 150% NPK + Compost @ 5 t/ha + crop residue is viable option for growth and yield attributes to achieve yields under inceptisole order of soil.

References

Anonymous (2025). Food and Agriculture Organization and United States Department of Agriculture, report.

Ashiq, W., & Biswas, A. (2021). Biochar role in mitigation of greenhouse gas emissions from agricultural soils. In *Soil science: Fundamentals to recent advances* (pp. 261-278). Singapore: Springer Singapore.

Islam, S. M., Gaihre, Y. K., Islam, M. R., Khatun, A., & Islam, A. (2022). Integrated plant nutrient systems improve rice yields without affecting greenhouse gas emissions from lowland rice cultivation. *Sustainability*, **14**(18), 11338.

Mahajan, G. R., Manjunath, B. L., Morajkar, S., Desai, A., Das, B., and Paramesh, V. (2021). Long-Term effect of various organic and inorganic nutrient sources on rice yield and soil quality in west coast india using suitable indexing techniques. *Communications in Soil Science and Plant Analysis*, **52**(15), 1819 1833.

Paramesh, V., Kumar, P., Bhagat, T., Nath, A. J., Manohara, K. K., Das, B., ... & Prasad, P. V. (2023). Integrated nutrient management enhances yield, improves soil quality, and conserves energy under the lowland rice–rice cropping system. *Agronomy*, **13**(6), 1557.

Ruan, Y., Jin, Y., Liu, H., and Wang, Z. (2023). Effects of partial replacement of chemical fertilizer with organic sources on yield and grain quality of fragrant rice. *Agronomy*, **13**(2), 413. https://doi.org/10.3390/agronomy 13020413

Sande, T. J., Tindwa, H. J., Alovisi, A. M. T., Shitindi, M. J., & Semoka, J. M. (2024). Enhancing sustainable crop production through integrated nutrient management: a focus on vermicompost, bio-enriched rock phosphate, and inorganic fertilisers–a systematic review. *Frontiers in Agronomy*, **6**, 1422876.

Sharma, S. K., Yadav, D. S., and Verma, A. (2018). Effect of NPK and Zn on growth and yield of scented rice in Eastern Uttar Pradesh. *International Journal of Current Microbiology and Applied Sciences*, **7**(4), 1125–1132.

Verma, R., Kumar, R., Maveril, K., Panzade, P. P., Kumar, A., Kumar, A., & Solanki, P. (2025). Influence of Organic Manures and Chemical Fertilizers on the Yield and Yield-Attributing Characteristics of Rice. *Journal of Experimental Agriculture International*, **47**(12), 695-702.

Yadav, K. K., Kumar, A., & Kumar, R. (2025). Organic manure and biochar with inorganic fertilizer's effect on growth dynamics and yield performance of rice (*Oryza sativa*). *Indian Journal of Agronomy*, **70**(4), 400-408.