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RESEARCH ARTICLE

EFFECT OF ORGANIC AND INORGANIC FERTILIZER APPLICATION ON GROWTH, YIELD ATTRIBUTE AND PRODUCTIVITY OF RICE CROP

Anoop Kumar Maurya,[1]* Satendra Kumar[2], Yogesh Kumar[3], S. P. Singh[4], Adesh Singh[5] and Kamal Khilari[6]

[1-4]Department of Soil Science, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, 250110
[5]Department of Agronomy, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, 250110.
[6]Department of Plant Pathology, Sardar Vallabhbhai Patel University of Agriculture and Technology, Meerut, 250110.
Email: anoopkumar5399@gamil.com

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Abstract: A field experiment was conducted at Crop Research Centre of SVPUAT, Meerut during *kharif*2024. The study aimed to assess the effects of various combinations of organic manures and inorganic fertilizers on rice growth, yield and yield attributes. The treatments were evaluated, including T_1 (control), T_2 (100% Recommended dose of fertilizer), T_3 -75% RDF + 25% N, (Farm yard manure), T_4 75% RDF + 25% N, (Vermicompost),T_5 75% RDF + 25% N, (Poultry manure), T_6 50% RDF + 25% N (FYM)+25% N (VC) T_7 50% RDF + 25% N (FYM)+25% N (PM), T_8 50% RDF + 25% N (VC)+25% N (PM), and T_9 (25% of RDF + FYM+VC+PM). The effect of the different dosesof inorganic sourceswith various organic manureson yield attributes and yield. Application of T_9(25% RDF + FYM + VC + PM) significantly improved yield attributes such as panicle length, filled grains, test weight, and grain and straw yield. T_9 recorded the highest yield, showing a 9% increase over sole RDF application T_2.

Keywords: Farm yard manure, Organic manure, Poultry manure, Recommended dose of Fertilizer, Vermicompost

INTRODUCTION

The agricultural productivity of Western Uttar Pradesh, particularly in Inceptisols soils, faces significant challenges due to imbalanced fertilizer use, declining soil organic matterand poor nutrient-use efficiency. Excessive reliance on chemical fertilizers, coupled with inadequate knowledge of organic manure application and continuous nutrient mining through intensive cropping, has led to soil health degradation, nutrient deficiencies, and reduced crop sensitivity to fertilizers (Mallikarjun and Maity, 2017). Long-term studies indicate that neither sole application of inorganic fertilizers nor organic manures alone can ensure sustainable crop production or soil health stability. Instead, an organic and inorganic nutrients approach-combining organic amendments, microbial inoculants, and mineral fertilizers-has proven more effective in enhancing soil fertility, improving nutrient availability, and sustaining long-term productivity (Agegnehu and Amede, 2017).

In Western UP, Inceptisols are prone to nutrient leaching, low organic carbon, and poor cation exchange capacity, exacerbating soil fertility issues. It alone cannot address multifaceted nutrient imbalances without a holistic organic and inorganic nutrients strategy. Organic manures (e.g., farmyard manure, compost, green manure) play a critical role in boosting soil organic matter (SOM), enhancing microbial activity, and improving nutrient mineralization, thereby ensuring better nutrient synchrony for crops. However, optimal crop yields in these soils also require balanced chemical fertilization to meet immediate nutrient demands.

Given the suboptimal productivity of major crops (e.g., rice, wheat) in Western UP's Inceptisols, there is an urgent need to adopt organic and inorganic nutrients practices tailored to region-specific soil constraints. This study investigates the impact of organic and inorganic nutrients on soil nutrient dynamics and crop yield in acidic Inceptisols of Western UP, aiming to develop a sustainable soil fertility management framework for improved agricultural outcomes.

MATERIALS AND METHODS

The present entitled experiment conducted at CRC Farm, Sardar Vallabhbhai Patel University

*Corresponding Author

Agriculture and Technology, Meerut (Uttar Pradesh) during *Kharif* 2024.The experimental site means annual temperature 28.4° South and 28.0° North latitude, and between 77.0° and 78.0° longitude in the district of Meerut. It is also at an elevation of 237 meters above mean sea level (MSL) and at latitude 29° August' North and longitude 77°69' East.The experimental field soil was analyzed for various physico-chemical properties to establish baseline fertility status. The soil texture was classified as sandy loam, consisting of 61.6% sand, 20.0% silt, and 18.3% clay. Bulk density measured 1.39 g cm^{-3}, while particle density was 2.68 g cm^{-3}. The soil showed slightly alkaline pH (7.5) and low electrical conductivity (0.132 dS m^{-1}). Organic carbon content was found to be 0.21%. Nutrient analysis revealed available nitrogen at 123.55 kg ha^{-1}, phosphorus at 12.38 kg ha^{-1}, and potassium at 129.29 kg ha^{-1}. Additionally, the soil contained 10.36 kg ha^{-1} of available sulphur, while micronutrient levels showed 1.43 mg kg^{-1} of zinc. The experiments consisted of 9 treatments replicated thrice in a randomized block design.T_1 (control), T_2 (100% RDF), T_3 -75% RDF + 25% N, (FYM), T_4 75% RDF + 25% N, (VC),T_5 75% RDF + 25% N, (PM), T_6 50% RDF + 25% N (FYM)+25% N (VC) T_7 50% RDF + 25% N (FYM)+25% N (PM), T_8 50% RDF + 25% N (VC)+25% N (PM), and T_9(25% RDF + FYM,VC, PM). Urea, diammonium phosphate, and muriate of potash were used as inorganic sources to supply nitrogen (N), phosphorus (P), and potassium (K), respectively. Phosphate and potash fertilizers were applied as basal doses during field preparation, while nitrogen was applied in split into three applications—one-third at transplanting and the remaining at 21 and 42 days after transplanting (DAT). For organic sources, farmyard manure (FYM), vermicompost, and poultry manure were applied one week before transplanting and incorporated into the soil based on treatment requirements. Standard analytical procedures were employed to assess soil properties. Soil texture classification followed Bouyoucos (1962), while bulk and particle density were determined using core sampler (Badman, 1942) and pycnometer (Richards, 1954) techniques. Soil pH and EC were measured in a 1:2.5 soil-water suspension (Jackson, 1967). Organic carbon was estimated by Walkley and Black's (1947) oxidation method, and available nitrogen via alkaline permanganate (Subbiah & Asija, 1956). Phosphorus extraction followed Olsen's method (1954), and potassium was analyzed using flame photometry (Hanway & Heidal, 1952). Sulphurs content was determined by the turbidimetric method (Leon Chenin & Yien, 1951), while micronutrients (Zn,) were extracted using DTPA (Lindsay & Norvell, 1978). These methods ensured precise characterization of soil fertility, forming the basis for subsequent nutrient management interventions.

RESULTS AND DISCUSSIONS

The experimental findings highlight that integrated nutrient management (INM) combining different doses of inorganic fertilizers with organic sources (FYM, vermicompost, and poultry manure) significantly improves rice yield compared to sole application of chemical fertilizers or control treatments.

Table 1. Effect of different nutrients treatments on yield attributes of rice

Treatments		Yield attributes			
		Panicle length (cm)	**Filled grains $panicle^{-1}$**	**Effective tiller per m^{-2}**	**1000 grains weight (g)**
T_1	Control	19.19	110	139.69	17.08
T_2	RDF (N: P: K-120:60:40 kg ha^{-1})	24.85	130	172.45	24.00
T_3	75% RDF + 25% N, (FYM)	22.07	142	163.45	22.86
T_4	75% RDF + 25% N, (VC)	23.21	135	168.52	23.38
T_5	75% RDF + 25% N, (PM)	22.79	138	154.75	22.32
T_6	50% RDF + 25% N (FYM)+25% N (VC)	24.58	128	169.31	23.62
T_7	50% RDF + 25% N (FYM)+25% N (PM)	23.42	122	158.68	22.30
T_8	50% RDF + 25% N (VC)+25% N (PM)	20.64	132	156.68	20.74
T_9	**25% RDF + 25% N (FYM)+25% N (VC) +25% N (PM)**	**26.01**	**150**	**188.75**	**25.32**
SEm ±		**1.04**	**4.43**	**8.65**	**0.74**
CD at 5 %		**2.21**	**9.40**	**1.00**	**1.58**

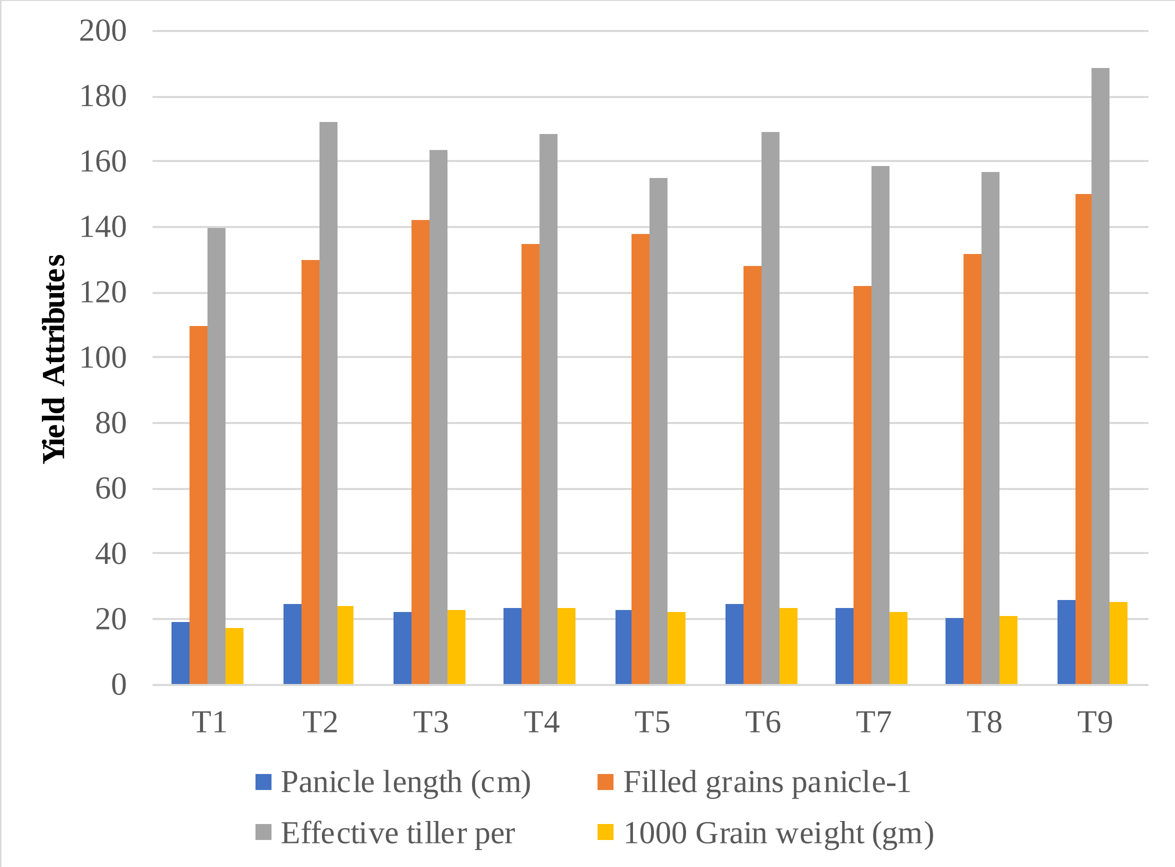

Fig 1: Effect of different nutrients treatments on at different stages Yield Attributes of rice.

The best-performing treatment, T9 (25% RDF + balanced organic inputs), exhibited the highest panicle length (26.01 cm), filled grains per panicle (150), effective tillers (188.75 m^{-2}), and 1000-grain weight (25.32 g). This aligns with previous studies indicating that combined organic and inorganic fertilization enhances nutrient use efficiency, soil health, and crop productivity (Das *et al*., 2000). The superior performance of T_9 suggests a synergistic effect, where organic amendments improve soil microbial activity and nutrient mineralization, complementing chemical fertilizers (Mader *et al*., 2002). Vermicompost, rich in microbial activity and humic substances, enhances phosphorus availability and root growth (Atiyeh *et al*., 2000), while FYM provides a steady supply of nitrogen and micronutrients (Yadav *et al*., 2013). In contrast, poultry manure may have a higher C:N ratio or ammonia content, leading to slower mineralization (Tewatia *et al*., 2017). This supports the argument that not all organic fertilizers are equally effective, and selection should be based on their decomposition rates and nutrient profiles.

Table 2: Effect of different nutrients treatments on grain, straw, biological yield and harvest index of rice

Treatments		Yield (q ha^{-1})			Harvest Index (%)
		Grain	Straw	Biological	
T_1	Control	25.83	37.73	77.24	31.84
T_2	RDF (N: P: K-120:60:40 kg ha^{-1})	45.78	69.84	109.54	45.72
T_3	75% RDF + 25% N, (FYM)	43.70	67.24	106.53	43.39
T_4	75% RDF + 25% N, (VC)	42.95	67.13	105.13	44.89
T_5	75% RDF + 25% N, (PM)	40.88	65.51	105.59	41.10
T_6	50% RDF + 25% N (FYM)+25% N (VC)	42.74	66.40	100.14	43.35

T_7	50% RDF + 25% N (FYM)+25% N (PM)	43.03	67.33	95.97	43.88
T_8	50% RDF + 25% N (VC)+25% N (PM)	41.99	66.50	102.93	43.21
T_9	25% RDF + 25% N (FYM)+25% N (VC) +25% N (PM)	49.81	74.99	110.10	48.04
SEm ±		**2.64**	**2.43**	**5.13**	**2.18**
CD at 5 %		**5.60**	**5.16**	**10.87**	**4.64**

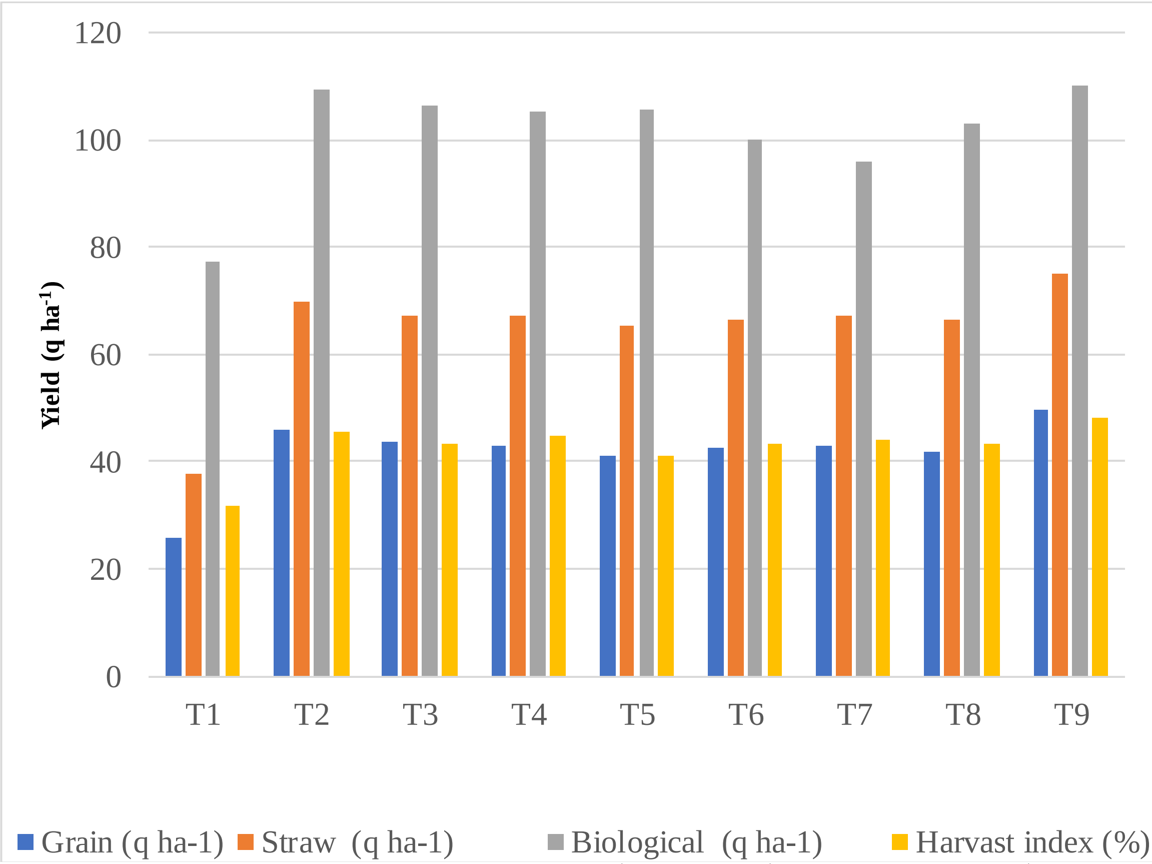

Fig 2: Effect of different nutrients treatments on grain (qha^{-1}), straw (qha^{-1}), biological yield (qha^{-1}), and harvest index (%) of rice.

The experimental results demonstrate that integrated nutrient management (INM) strategies significantly enhance rice productivity compared to conventional fertilization approaches. While the control treatment (T_1) showed poor performance (37.73 q ha^{-1} biological yield), the full RDF treatment (T_2) produced intermediate results (109.54 q ha^{-1}), and the 75% RDF treatments with single organic amendments (T_3-T_5) maintained comparable yields, suggesting partial substitution with organic inputs can sustain productivity. Notably, the integrated approach (T_9) combining 25% RDF with three organic sources (FYM, VC, PM) achieved superior performance (110.10 q ha^{-1} biological yield, 49.81 q ha^{-1} grain yield), supporting findings by Mader *et al*. (2002) that balanced organic-inorganic combinations enhance nutrient use efficiency and crop yields. These results highlight the potential of INM to reduce chemical fertilizer dependence while improving productivity, though further research is needed to optimize application rates and assess long-term soil health impacts across different agroecological conditions (Lal, 2015; Vanlauwe *et al*., 2010).

CONCLUSION

Results clearly indicate that the integrated application of 25% RDF (T_9) along with organic inputs such as FYM, vermicompost, and poultry manure significantly improves the overall performance of Basmati rice cultivation. This integrated nutrient management practice not only enhances rice productivity (49.81 q/ha, which is 9% higher than the full RDF) but also contributes to better soil health by increasing organic carbon content, improving nutrient availability, and reducing bulk density. In addition, higher uptake of essential nutrients such as N, P, K, and Zn highlights its efficiency in nutrient utilization compared to sole chemical fertilization. Furthermore, this approach ensures long-term soil fertility, minimizes environmental risks, and reduces dependency on synthetic fertilizers, making it a highly effective, eco-friendly, and sustainable strategy for rice production.

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