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Response of integrated nutrient management on growth and yield attributes of rice (*Oryza sativa* L.)

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Abstract
The experiment entitled "Response of Integrated nutrient management on growth and yield attributes of Rice (*Oryza sativa* L.)" for the two consecutive years, beginning from kharif season 2023 and 2024 at CRF, Department of Soil Science and Agricultural Chemistry, SHUATS, Prayagraj-211007, UP. The trial was laid down in RBD with sixteen treatments of rice which replicated thrice. The application plot size is 2x2m. Transplanting was done with spacing row to row and plant to plant 15x15 with two plants per hill at depth of 5 cm. the value of growth, yield and yield attributes *viz*., plant height (cm) (123.15), tillers (No.) (332.56m^{-2}), dry weight plant^{-1} (45.95 g), crop growth rate (26.32g/g/day), leaf area index (6.59 lai), rice leaf n content (45.38 spad value), net assimilation rate (3.89 g/day/m2), panicle plant^{-1} No. (15.82), filled grain panicle^{-1} No. (136.43), length of panicle (31.48cm), test weight (33.26g), grain yield q ha^{-1} (61.09), straw yield q ha^{-1} (96.05) & harvest index (38.88%) of rice were significantly higher in T_{14}RDF + V.C + Zn 100% SA.

Keywords: INM, zinc growth, yield and rice

Introduction
The leading cereal food crop in the world is Rice. It is cultivated in 114 countries, spanning an area of about 150 million hectares, which is nearly 11% of the world's agricultural land, resulting in an annual production of over 525 million tons**.** Yet, by the year 2025, a 40% surge in global rice demand is foreseen due to the rising population. Sahoo *et al*., (2019) [27]. It is grown during both the kharif and rabi seasons in India. In the kharif season, the area planted with rice increased from 38,919 thousand hectares in 2019 to 41,195.80 thousand hectares in 2023, experiencing some fluctuations in the interim. According to the MAFW, in India area in rice cultivation has increased from 43.8 million hectares in 2000-01 to 44.9 million hectares in 2020-21, while production improved from 93.8 to 118.9 million tonnes during the similar period. During the 2020-21 agricultural year, rice comprised 35.26 percent of the land area and 40.02 percent of the total food grain output in India Akancha *et al*., (2025) [1]. India is also a major exporter of rice exporting around 14.37 million tonnes of rice (2020-21), according to the APEDA. It has a good amount of protein (6–10%), carbohydrates (70–80%), minerals (1.22%), and vitamins (1.22%), and it is a good source of energy. (Vitamin E, thiamine, riboflavin, and niacin). Rice (*Oryza sativa* L.) is a member of the Poaceae family. One of the most significant cereal crops during the Kharif season is rice. It has a good amount of protein (6–10%), carbohydrates (70–80%), minerals (1.22%), and vitamins (1.22%), and it is a good source of energy. (Vitamin E, thiamine, riboflavin, and niacin) Kumar *et al.*, (2023) [13]. INM focuses on the effective and prudent utilization of all primary sources of plant nutrients in a cohesive manner. Consequently, the synergistic application of organic manure and inorganic fertilizers contributes to the stability of yields by rectifying minor insufficiencies in minor and micronutrients, thereby improving the efficiency of the nutrients applied and ensuring constructive soil physical environments (Gill and Walia, 2014; Singh, 2017) [10, 37]. Organic materials provide nutrients during the optimal absorption phase, in addition to supplying micronutrients, altering the physical properties of soil, and enhancing the effectiveness of applied nutrients (Pandey *et al.*, 2007) [20]. FYM serves as a primary source of organic fertilizer

for field crops, as it delivers all necessary plant nutrients and promotes microbial activity in the soil (Sutaliya and Singh, 2005) [41]. Vermicompost also plays a role in disease prevention in plants (Rao *et al.*, 2000) [25]. The nutrients found in vermicompost are readily accessible (Robinson *et al.*, 1990) [26]. The application of vermicompost has a beneficial impact on the yield attributes and overall yield of various crops (Vasanthi and Kumarswamy, 2000; Das *et al.*, 2002; Singh *et al.*, 2005) [43, 6, 35]. Furthermore, vermicompost contributes to the enhancement and preservation of topsoil fertility, while also increasing productivity by 40% (Dussere *et al.*, 1992) [7]. Zinc is a crucial micronutrient that is vital for the growth of plants, particularly rice cultivated in submerged conditions. Plants absorb zinc in the form of Zn2+; although it is classified as a micronutrient, it significantly contributes to the growth and metabolism of plants. Zinc serves as a crucial element and activator for various enzymes that play a role in metabolic processes. It is essential for the synthesis of proteins and the expression of genes in plants. (Cakmak, 2000) [4].

Materials and Methods

The experiment entitled "Response of Integrated nutrient management on growth and yield attributes of Rice (*Oryza sativa* L.)" for the two consecutive years, beginning from kharif season 2023 and 2024 at CRF, Department of Soil Science and Agricultural Chemistry, SHUATS, Prayagraj-211007, UP. The highest temperature recorded in this area can reach between 460°C and 480°C, while the lowest temperature varies from 40°C to 50°C. The relative humidity fluctuates between 20% and 94%. Annually, the average precipitation in this region is approximately 1100 mm. The experiment was laid down in RBD with sixteen treatments combination which replicated thrice. The INM treatments in the rice were included T_1:(Control), T_2:RDF @ 100%, T_3:RDF @ 100%+ @ 50% Zn SA, T_4:RDF @ 100%+ @ 100% Zn SA, T_5:RDF @ 50% + @ 0.5% Zn foliar application, T_6:RDF @ 100%+ @ 0.5% Zn foliar application, T_7:RDF @100% + @ FYM 100%, T_8: RDF @ 50% +@ 50% FYM + @ 50%Zn SA, T_9: RDF @ 100% + @ 100% FYM + @ 100% Zn SA, T_{10}: RDF @ 50% + @ 50% FYM + @ 0.5% Zn foliar application, T_{11}: RDF@100% +@100% FYM + @ 0.5% Zn foliar application, T_{12}: RDF @100% +@100% Vermicompost, T_{13}: RDF @50% + @50% Vermicompost + @ 50% Zn SA, T_{14}: RDF @100% + @100% Vermicompost + @ 100% Zn SA, T_{15}: RDF @ 50%+ @50% Vermicompost + @ 0.5% Zn foliar application and T_{16}: RDF @100% + @100% Vermicompost + @ 0.5% Zn foliar application. @ 25 kg ha^{-1} Zinc as soil application and 0.5% Zinc as a foliar application at different days after transplanting. The Rice variety SHIATS DHA^{-1} sowing on 20th June 2023 and 23 June 2024. The treatment plot size is 2x2m. Transplanting was done with spacing row to row 15 cm and plant to plant 15 cm with two plants per hill at depth of 5 cm. Transplanting was done on 23rd July 2023 and 27 July 2024. Observation on growth parameters at 30, 60 and 90 DAT and yield and yield attributes. The information collected regarding various characteristics underwent statistical analysis utilizing the analysis of variance (ANOVA) method as outlined by Gomez and Gomez.

Results and Discussion

The pooled data on growth parameter of rice as influenced by different INM are showed in table 1. The response of different integrated INM on plant height of rice was found to be significant in pooled mean analysis. The maximum plant height at 90 DAT (123.15) was recorded in treatment combination T_{14}RDF + V.C + Zn 100% SA. Where as the minimum plant height at 90 days after transplanting (81.06) was found in treatment T_1 Control. The increase in the height of rice plants can be linked to the application of FYM in conjunction with chemical fertilizers. Similar findings were documented by Asewar *et al.* (2000) [2] and Sudha and Chandini (2003) [39]. Nitrogen is widely acknowledged as a key factor in promoting vegetative growth. The enhanced availability of nitrogen from both organic and inorganic sources generally led to greater plant height during the periods of study. Organic manures serve as a slow-releasing nitrogen source and are beneficial during the later stages of crop development (Usman *et al.*, 2003; Kumar *et al.*, 2017) [42, 14]. The increase in plant height may be due to improved nourishment, which positively influences processes such as the rate of photosynthesis, assimilation, cell division, and overall vegetative growth. These findings align with the research conducted by Dutta and Chauhan (2010) [8] and Kumar *et al.* (2021) [15]. Zinc has been shown to play a crucial role in vegetative growth, particularly in low-temperature environments and rhizosphere conditions, with adequate zinc availability supporting the growth and development of young plants (Singh *et al.*, 2012) [33]. The response of different integrated nutrient management treatments on number of tillers (m-2) of rice was found to be significant. The maximum number of tillers (m-2) at 90 days after transplanting (332.56) was recorded in treatment combination T_{14}RDF + V.C + Zn 100% SA. Where as the minimum number of tillers (m-2) at 90 days after transplanting (92.39) was found in treatment T_1 Control. The observed effects may be attributed to the improved availability of both macro and micro nutrients. Comparable research findings regarding the impact of Integrated Nutrient Management (INM) on growth characteristics have been documented by Satyanarayana *et al.* (2002) [28], Sudha and Chandini (2003) 39[], Naing *et al.* (2010) [19], and Kumar *et al.* (2017) [14]. This can be explained by the notion that balanced nutrition increases the number of tillers. Dutta and Chauhan (2010) [8] and Singh *et al.* (2011) [38] have also reported similar outcomes. Additionally, the positive effects of FYM and vermicompost have been noted by Sharma and Sharma (2002) [31] and Kumar *et al.* (2021) [15]. Furthermore, the rising levels of zinc supplied to rice have been shown to enhance the total zinc content per plant at various growth stages, positively influencing tiller production (Impa *et al.*, 2013) [12]. The response of different INM treatments on dry weight (g per plant) of rice was found to be significant. The maximum dry weight (g per plant) at 90 days after transplanting (45.95) was recorded in treatment combination T_{14}RDF + V.C + Zn 100% SA. Whereas the minimum dry weight (g per plant) at 90 days after transplanting (17.77) was found in treatment T_1 Control. The gradual, consistent, and enhanced availability of nutrients through the combined application of FYM and inorganic fertilizers led to an increased accumulation of dry matter, promoting superior growth and development of the crop. The rise in dry matter production per hill may be attributed to the cumulative effects of enhanced growth characteristics, such as plant height and the number of tillers. Similar enhancements in dry matter production have been documented by Asewar *et al.* (2000) [2], Senthivelu *et al.* (2009) [29], and Kumar *et al.* (2017) [14]. A continuous and balanced nutrient supply from the early growth stages fosters vigorous plant growth, which likely contributes to the increased accumulation of dry matter (Pooniya and Shivay, 2011) [21]. The response of different INM treatments on crop growth rate (g/g/day) of rice was found to be significant. The maximum crop growth rate (26.32) between the interval 60-90 DAT was recorded in the treatment combination T_{14} RDF + V.C + Zn 100% SA. Whereas the minimum crop growth rate

(9.60) between the intervals 60-90 DAT was found in treatment T_1 Control. The application of INM must provide nutrients in a balanced and accessible form, which ultimately promotes an increase in growth rate. Similar findings were previously reported by Usman *et al.* (2003) [42] and Kumar *et al.* (2017) [14]. The response of different INM treatments on Leaf area index (LAI) of rice was found to be significant. The maximum leaf area index at 90 days after transplanting (6.59) was recorded in treatment combination T_{14}RDF + V.C + Zn 100% SA. Where as the minimum leaf area index at 90 days after transplanting (5.71) was found in treatment T_1 Control. The response of different integrated nutrient management treatments on Rice leaf N content (SPAD value) of rice was found to be significant. The maximum rice leaf N content (SPAD value) at 90 days after transplanting (45.38) was recorded in treatment combination T_{14}RDF + V.C + Zn 100% SA. Where as the minimum rice leaf N content (SPAD value) at 90 days after transplanting (29.14) was found in treatment T_1 Control. The positive change in dry matter accumulation can be attributed to the modification of NPK levels, which likely led to an increase in both the quantity and efficiency of chlorophyll. This enhancement may have adversely affected photosynthetic efficiency and facilitated the synthesis of additional nitrogenous compounds such as amino acids, proteins, alkaloids, and protoplasm, ultimately resulting in an increase in plant height and contributing to greater dry matter accumulation. These conclusions are well-supported by the findings of Pradhan (2019) [22], Chowdhury (2015) [5], Pradhan *et al.* (2022) [23], and Kumar *et al.* (2018) [17]. The response of different INM treatments on Net assimilation rate (g/day/m2) of rice was found to be significant in table 2. The maximum Net assimilation rate (g/day/m2) (3.89) between the interval 60-90 DAT was recorded in the treatment combination T_{14} RDF + V.C + Zn 100% SA. Whereas the minimum Net assimilation rate (g/day/m2) (1.26) between the intervals 60-90 DAT was found in treatment T_1 Control. The pooled data on yield and yield attributes of rice as influenced by different INM are presented in table 2. The number of panicle plant^{-1} at harvest showed significant differences among various treatment. The number of panicle plant^{-1} of rice was found to be maximum 15.82 was recorded in treatment T_{14}: RDF + V.C + Zn 100% SA and minimum number of panicle plant^{-1} 11.76 in treatment T_1 Control. The provision of balanced nutrients via organic and inorganic fertilizers (RDF), along with FYM and vermicompost, may have enhanced nutrient uptake, potentially leading to increased vegetative growth. The advantageous production of growth-promoting compounds within the plant system, attributed to improved nutrient availability, may have resulted in a greater number of panicles per square meter. These findings align with the research conducted by Kumar *et al.* (2021). [15] The number of filled grain panicle^{-1} at harvest showed significant differences among various treatment. The number of filled grain panicle^{-1} of rice was found to be maximum (136.43) was recorded in treatment T_{14}: RDF + V.C + Zn 100% SA and minimum number of filled grain panicle^{-1} (112.61) in treatment T_1 Control. The rise in the quantity of filled grains per panicle may be attributed to more vigorous and lush vegetative growth, which was supported by a consistent supply of adequate nutrients. This, in turn, facilitated improved partitioning of assimilates from the source to the sink, ultimately resulting in a greater number of filled grains per panicle (Budhar and Palaniappan, 1997) [3]. Given that the number of spikelets (sink) was higher in the plot that received a combination of organic and inorganic fertilizers, it is likely that the carbohydrates from the source were sufficient to meet the demands of such plots compared to the absolute control. The findings of Usman *et al.* (2003) [42], Sudhakar (2011) [40], and Kumar *et al.* (2017) [14] also corroborate these results in the context of rice cultivation. The balanced supply of nutrients through organic and inorganic fertilizers (RDF), along with FYM and vermicompost, enhanced nutrient uptake, which likely contributed to increased vegetative growth. The favorable synthesis of growth-promoting compounds within the plant system, due to improved nutrient availability, may have led to a higher number of grains per panicle. These results align with the findings of Shankar and Laware (2011) [30] and Kumar *et al.* (2021) [15]. The length of panicle (cm) at harvest showed significant differences among various treatment. The length of panicle (cm) of rice was found to be maximum (31.48) was recorded in treatment T_{14}: RDF + V.C + Zn 100% SA and minimum length of panicle (cm) (24.78) in treatment T_1 Control. Data in respect of test weight of rice as influenced by different treatment are presented in table 2. The result showed that the different treatments had significant influence on test weight in pooled mean analysis. The test weight (g) of rice was found to be maximum (33.26) was recorded in treatment T_{14}: RDF + V.C + Zn 100% SA and minimum test weight (g) (24.53) in treatment T_1 Control. Similar findings was also reported earlier by Gogoi (2008) and Kumar *et al.*, (2017) [14]. Data in respect of grain yield (q ha^{-1}) of rice as influenced by different treatment are presented in table 2. The result showed that the different treatments had significant influence on grain yield (q ha^{-1}) in pooled mean analysis. The grain yield (q ha^{-1}) of rice was found to be maximum (61.09) was recorded in treatment T_{14}: RDF + V.C + Zn 100% SA and minimum grain yield (q ha^{-1}) (28.48) in treatment T_1 Control in pooled mean analysis. The enhanced grain yield can also be attributed to the sufficient availability of NPK in the soil solution, which may lead to increased root development, consequently enhancing nutrient uptake. The higher yield resulting from the combined use of inorganic fertilizers and organic manures may be due to a sustained supply of nutrients and improved utilization of applied nutrients, facilitated by better microenvironmental conditions, particularly the activities of soil microorganisms involved in nutrient transformation and fixation. Satyanarayana *et al.* (2002) [28], Sudha and Chandini (2003) [39], Virdia and Mehta (2008) [44], Senthivelu *et al.* (2009) [29], Naing *et al.* (2010) [19], and Kumar *et al.* (2017) [14] have also reported similar findings regarding the increased grain yield associated with the integrated application of both organic and inorganic nutrient sources. Data in respect of straw yield (q ha^{-1}) of rice as influenced by different treatment are presented in table 2. The result showed that the different treatments had significant influence on straw yield (q ha^{-1}) in pooled mean analysis. The straw yield (q ha^{-1}) of rice was found to be maximum (96.05) was recorded in treatment T_{14}: RDF + V.C + Zn 100% SA and minimum (80.87) in treatment T_1 Control. The rise in straw yield can be attributed to the enhanced availability of nitrogen (N), while the reduction of N loss led to improved growth from the tillering phase to the reproductive stage, ultimately resulting in a greater straw yield. This pattern closely mirrored that of grain yield, which was influenced by an increase in plant height, the total number of tillers per hill, dry matter production, the number of panicles per square meter, and, consequently, straw yield. These results align with those reported by Satyanarayana *et al.* (2002) [28], Sudha and Chandini (2003) [39], Virdia and Mehta (2008) [44], Senthivelu *et al.* (2009) [29], as well as Naing *et al.* (2010) [19] and Kumar *et al.* (2017) [14]. The enhancement of soil properties may have contributed to improved growth parameters and yield characteristics. The productivity of the crop is determined by the vigor of vegetative growth and yield attributes, which together lead to increased grain and straw yield. The rise in yield may be linked to more effective translocation of photosynthates from source to sink, facilitated by higher uptake of NPK, which are crucial for rapid and efficient translocation. Similar findings have also been documented by Kumar *et al.* (2000) [16], Singh *et al.* (2000) [32], and Kumar *et al.* (2021) [15]. Data in respect of harvest index of rice as influenced by different treatment are presented in table 2. The result showed that the different treatments had significant influence on harvest index in pooled mean analysis. The harvest index of rice was found to be maximum (96.05) was recorded in treatment T_{14}: RDF + V.C + Zn 100% SA and minimum harvest index (80.87) in treatment T_1 Control in pooled mean analysis. The findings of the current study align with those reported by Radha Madhav *et al.* (1996) [24], Singh (2001) [34], Singh *et al.* (2002) [36], and Kumar *et al.* (2017) [14]. Comparable results were also reported by Kundu (2012) [18], Chowdhury (2015) [5], and Pradhan (2019) [22], who indicated that the incorporation of various sources of plant nutrients (such as FYM, vermicompost, and crop residues) plays a beneficial role in all yield attributes in relation to the yield of rice, whether cultivated as a sole crop or as part of a cropping sequence involving three or four crops. This may be attributed to the fact that partially substituting chemical fertilizers with organic manures has proven to be a more effective option. This combined approach typically enhances the physical condition of the soil while progressively supplying nutrients to the plants in a consistent manner, along with the added benefit of the rapid, abundant, and efficient nutrient delivery capacity of chemical fertilizers to the crops, ultimately leading to increased yields, as noted by Pradhan *et al.* (2022) [23] and Kumar *et al.* (2018) [17]. This could be because zinc fertilization has a significant impact on the grain yield of rice, with the highest grain yield observed following zinc application, as reported by Hatwar *et al.* (2003) [11] and Fageria *et al.* (2011) [9].

Table 1: Response of integrated nutrient management on growth, yield and yield attributes of rice (Pooled data 2023 and 2024)

Treatment No.	Pooled data (2023 and 2024)																	
	Plant height (cm)			Number of tillers (m-2)			Dry weight (g per plant)			CGR (g/g/day)			Leaf area index (LAI)			Rice leaf N content (SPAD value)		
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	0-30 DAT	30-60 DAT	60-90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT
T_1	30.40	60.32	81.06	98.20	115.93	92.39	5.28	11.28	17.77	7.82	8.90	9.60	2.26	5.86	5.71	34.19	30.51	29.14
T_2	43.12	78.35	107.93	212.90	289.85	278.65	9.02	19.81	31.82	13.36	15.99	17.79	3.48	6.79	6.32	46.69	38.91	37.98
T_3	44.61	81.12	109.44	228.02	312.69	307.87	9.42	21.83	37.44	13.96	18.39	23.13	3.53	6.81	6.48	49.65	42.01	41.10
T_4	40.90	74.40	101.42	195.00	262.28	256.22	8.10	17.70	27.69	12.01	14.21	14.81	3.29	6.24	5.95	44.34	34.90	34.17
T_5	36.99	73.60	95.57	182.97	246.18	234.86	8.39	16.61	21.86	12.43	12.18	7.77	3.30	6.27	6.06	42.63	32.76	32.24
T_6	40.64	72.11	98.09	217.62	304.09	287.83	8.80	20.32	34.20	13.02	17.08	20.55	3.49	6.80	6.40	48.72	40.63	40.01
T_7	41.63	67.63	100.39	193.24	260.54	249.77	8.82	19.16	24.92	13.07	15.31	8.54	3.41	6.52	6.10	44.28	33.97	33.40
T_8	46.70	83.20	112.08	233.26	320.09	312.14	9.68	22.97	38.27	14.34	19.69	22.67	3.57	6.89	6.53	49.92	43.28	42.18
T_9	47.27	84.44	116.46	238.58	327.69	320.20	9.29	23.11	39.42	13.76	20.48	24.16	3.60	6.91	6.54	50.08	44.00	43.29
T_{10}	35.89	76.30	98.77	209.29	285.34	272.89	8.45	18.56	29.79	12.52	14.98	16.64	3.47	6.76	6.28	46.03	38.13	36.79
T_{11}	33.38	68.69	98.06	198.92	266.46	258.75	8.47	17.19	27.55	12.54	12.93	15.34	3.44	6.65	6.19	45.60	35.77	34.93
T_{12}	34.77	76.61	101.78	222.42	307.89	302.36	9.11	20.36	35.35	13.50	16.65	22.22	3.50	6.78	6.47	48.99	40.90	39.92
T_{13}	49.65	87.97	120.50	243.60	332.45	328.02	9.52	26.42	43.30	14.11	25.03	25.01	3.62	6.94	6.56	50.78	45.31	43.81
T_{14}	51.05	90.22	123.15	248.97	338.54	332.56	10.43	28.19	45.95	15.45	25.30	26.32	3.63	6.95	6.59	51.07	46.80	45.38
T_{15}	38.04	69.20	104.67	202.81	274.11	267.12	8.66	17.39	29.12	12.83	12.93	17.38	3.45	6.73	6.26	45.75	36.75	35.94
T_{16}	38.91	68.40	105.77	186.54	253.29	240.69	8.44	16.30	23.40	12.49	11.41	10.52	3.42	6.60	6.16	44.05	33.34	32.06
F-Test	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
S.Ed. (±)	0.83	0.95	1.47	1.04	1.42	1.80	0.18	0.39	0.77	0.14	0.75	0.77	0.009	0.0117	0.015	0.35	0.41	0.33
CD at 0.5%	1.69	1.95	3.00	2.13	2.91	3.68	0.37	0.80	1.57	0.29	1.54	1.58	0.018	0.0240	0.032	0.71	0.83	0.68

Table 2: Response of integrated nutrient management on growth, yield and yield attributes of rice (Pooled data 2023 and 2024)

Treatment No.	Net assimilation rate (g/day/m^2)		Yield and yield attributes						
	30-60 DAT	60-90 DAT	Number of panicle/ per plant	Filled grain/ panicle (No.)	Length of panicle (cm)	Test weight (g)	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	Harvest index
T_1	2.35	1.26	11.76	112.61	24.78	24.53	28.48	80.87	26.05
T_2	3.23	2.72	14.36	126.28	28.81	28.76	40.58	85.06	32.30
T_3	3.68	3.48	14.97	128.97	30.33	30.04	41.53	85.99	32.57
T_4	3.09	2.43	13.65	122.91	27.05	27.91	43.57	86.91	33.39
T_5	2.64	1.66	13.20	118.97	25.95	25.69	41.39	85.77	32.45
T_6	3.44	3.11	14.49	126.68	29.30	28.97	43.34	86.22	33.45
T_7	3.19	1.36	13.56	121.62	26.71	27.43	45.63	88.53	34.01
T_8	3.90	3.38	15.22	130.91	30.93	30.51	51.47	91.32	36.05
T_9	4.04	3.60	15.53	132.79	31.04	30.89	57.62	94.29	37.93
T_{10}	3.04	2.56	14.14	124.60	28.44	28.27	51.31	90.83	36.10
T_{11}	2.66	2.39	13.90	123.15	27.19	27.96	55.45	93.72	37.17
T_{12}	3.36	3.36	14.74	127.77	29.91	29.64	50.16	89.30	35.97
T_{13}	4.91	3.71	15.71	134.23	31.34	32.49	53.53	92.35	36.70
T_{14}	5.15	3.89	15.82	136.43	31.48	33.26	61.09	96.05	38.88
T_{15}	2.64	2.68	13.98	123.75	27.73	28.17	52.25	91.87	36.25
T_{16}	2.41	1.65	13.44	121.67	26.67	27.31	58.58	94.93	38.16
F-Test	S	S	S	S	S	S	S	S	S
S.Ed. (±)	0.130	0.160	0.13	0.36	0.42	0.10	0.115	0.29	0.10
CD at 0.5%	0.265	0.327	0.26	0.73	0.87	0.20	0.234	0.60	0.21

Conclusion
The study concludes that the treatment T_{14}: RDF @100%+ @100% Vermicompost + @ 100% Zn SA, produced the highest growth and yield parameters of rice under Prayagraj agro-climatic condition.

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