www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(10): 1182-1186

www.thepharmajournal.com
Received: 19-07-2023
Accepted: 22-08-2023

Prashant Uraon
M.Sc. Scholar, Section of Agronomy, DKS College of Agriculture and Research Station, Bhatapara, IGKV Raipur, Chhattisgarh, India

Dr. Tej Lal Kashyap
Professor, Section of Agronomy, DKS College of Agriculture and Research Station, Bhatapara, IGKV Raipur, Chhattisgarh, India

Dr. Angad Singh Rajput
Associate Professor, Section of Agronomy, DKS College of Agriculture and Research Station, Bhatapara, IGKV Raipur, Chhattisgarh, India

Sanjay Kumar
M.Sc. Scholar, Section of Agronomy, DKS College of Agriculture and Research Station, Bhatapara, IGKV Raipur, Chhattisgarh, India

Satish Kumar Yadaw
M.Sc. Scholar, Section of Agronomy, DKS College of Agriculture and Research Station, Bhatapara, IGKV Raipur, Chhattisgarh, India

Corresponding Author:
Prashant Uraon
M.Sc. Scholar, Section of Agronomy, DKS College of Agriculture and Research Station, Bhatapara, IGKV Raipur, Chhattisgarh, India

Effect of integrated nutrient management and nitrobenzene on yield, yield attributes and nutrient uptake of rice (*Oryza sativa* L.) in Vertisols of Chhattisgarh

Prashant Uraon, Dr. Tej Lal Kashyap, Dr. Angad Singh Rajput and Sanjay Kumar and Satish Kumar Yadaw

Abstract
A field experiment was conducted at the Instructional Farm, Dau Kalyan Singh College of Agriculture and Research Station, Bhatapara (C.G.) during the *kharif* season of 2022. The experiment was laid out in Randomized Block Design with 8 treatments and 3 replications. The treatments consisted of recommended dose of fertilizer (RDF), vermicompost, and foliar application of nitrobenzene. The results showed that combining T_2 (100% RDF + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) significantly increased yield attributes like number of panicles hill-1, panicle length, number of grains panicle^{-1}, and test weight compared to control. Further, the integration of vermicompost along with RDF and nitrobenzene (T_6 (75% RDF + Vermicompost 1 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 and T_7 (50% RDF + Vermicompost 2 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1) also improved these parameters over control. Grain and straw yields, along with biological yield, were highest in T_2 which was at par with T_6 and T_7. The minimum yields were recorded in control. Harvest index did not vary significantly between treatments. Uptake of nitrogen, phosphorus and potassium in grain and straw increased in treatments where nitrobenzene was applied along with RDF (T_2) compared to T_1 (Control). The integration of vermicompost with RDF and nitrobenzene (T_6) also improved nutrient uptake over control. Overall, the combined application of recommended fertilizer dose along with nitrobenzene showed maximum improvement in rice yield attributes, yields and nutrient uptake. Addition of vermicompost further enhanced these parameters. The study demonstrates the feasibility of integrating nitrobenzene with inorganic and organic sources for improving productivity of rice.

Keywords: INM, RDF, nitrobenzene, vermicompost, nutrient, rice

Introduction
Rice (*Oryza sativa* L.) is the major food crop in the world. Nearly 40% of the world population consumes rice as the major staple food. Most of the people, who depend on rice as primary food, live in the less developed countries. Archeological evidence on rice in India dates back to 1500-1000 B.C. Since the dawn of civilization, rice has served humans as a life-giving cereal in the humid regions of Asia and to a lesser extent in West Africa (Dunna and Roy, 2013) [4].

Integrated nutrient management (INM) has an important role which improves efficiency of applied nutrient 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 (Dutta and Chauhan, 2010) [5].

Vermicompost is a microbiologically active organic nutrient-rich amendment that results from the encounters between microbial activities during organic matter breakdown. It is a stabilized, finely differentiated peat-like substance with a low C: N ratio, high porosity and high potential for water absorption, of which most nutrients are found in forms readily absorbed by plants (Domfnguez, 2004) [3].

Nitrobenzene is combination of nitrogen and plant growth regulators, extracted from seaweed. It is known to increase flowering in plant, prevent flower shedding, increase yield by 35-50%. Nitrobenzene (C6H5NO2) is used which is an organic compound, coming under aromatic nitro-group. It helps in increasing the flower forming substances like amino acids, enzymes, vitamins, hormones, etc. (Lone *et al.*, 2009) [10].

Materials and Methods

The experiment was carried out at the Instructional Farm, Dau Kalyan Singh College of Agriculture and Research Station, Bhatapara (C.G.) during the *kharif* season of 2022. The field had an even topography and good drainage system. The provide information about the field experiment conducted to evaluate integrated nutrient management strategies in rice during the 2022 *Kharif* season. The experiment was laid out in Randomized Block Design (RBD) with eight treatments and three replications. The plot size was 6 m × 4 m and the treatments are control (T_1), 100% RDF + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) (T_2), 75% RDF + Nitrobenzene 20% v/v@ 2.5 ml L-1 (30, 45 and 60 DAT) (T_3), Vermicompost 4 t ha^{-1} +Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) (T_4), Vermicompost 2 t ha^{-1} +Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) (T_5), 75% RDF + Vermicompost 1 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) (T_6), 50% RDF + Vermicompost 2 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) (T_7) and 25% RDF + Vermicompost 3 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) (T_8). The gross and net plot sizes were 24 m2 and 15.6 m2 respectively. The recommended dose of fertilizer was (100% RDF) 120:60:40 kg N: P: K ha^{-1} for rice field by urea, single super phosphate and muriate of potash respectively applied to all plots except control. 50% of nitrogen, 100% phosphorus and potash were applied during sowing of crop and remaining half dose of nitrogen was applied at 25-30 DAT and 40-45 DAT. The rice variety "IGKVR-1" (Rajeshwari) was transplanted at 20 × 10 cm spacing in 24 plots on 3rd August. The yield attributes assessed included number of panicles per hill, panicle length, and number of grains per panicle which were measured by counting and averaging from sampled hills and panicles in each plot. Test weight was determined by manually counting 1000 grains randomly sampled from the produce and weighing them. For measuring yields, grain yield was recorded from the produce in net plot area and expressed per hectare at 14% moisture. Straw yield was measured from sun dried above ground biomass in each net plot and expressed per hectare. Biological yield was calculated by weighing the total sun dried above ground plant parts in the net plots and converting to per hectare basis. The standardized procedures ensured accurate assessment of the yield attributes and grain, straw and biological yields for analyzing the effect of treatments.

Result and Discussion

Yield attributes

Number of panicles hill^{-1}

The data pertaining for number of panicles hill^{-1} have been presented in Table 1. Number of panicles hill^{-1} was significantly under those treatments where nitrobenzene sources used with RDF. Significantly maximum number of panicles (15.67 hill-1) was found in treatment T_2 (100% RDF + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) which was at par with T_6, T_7, T_8 and T_4 (Vermicompost 4 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) (15.19 hill-1), (14.34 hill-1), (13.80 hill-1) and (13.78 hill-1) respectively. Significantly minimum number of panicles (9.43 hill-1) was seen in treatment T_1 (Control). It may be due to increase in availability of nutrient by vermicompost and nitrobenzene, resulted better growth and yield attribute the similar results was also reported by Ganguly *et al.* (2019) [6].

Panicle length (cm)

The data pertaining for panicle length (cm) have been presented in Table 1. Number of panicles hill-1 was significantly under those treatments where nitrobenzene sources used with RDF. significantly maximum panicle length (24.13 cm) was found in T_2 (100% RDF + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) which was at par with T_6 T_7 and T_8 (25% RDF + Vermicompost 3 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) (24.07 cm), (22.90 cm) and (22.49 cm) respectivlty. Significantly minimum panicle length (18.69 cm) was seen in treatment T_1 (Control). Similar result was conformity with Kumar *et al.* (2019) [8].

Number of grains panicle^{-1}

The data pertaining for number of grains panicle^{-1} have been presented in Table 1. Number of grains panicle^{-1} was significantly influenced under those treatments where nitrobenzene sources used with RDF and vermicompost. Significantly maximum number of grain panicle (201.13 panicle^{-1}) was found in T_2 (100% RDF + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) which was at par with T_6 (75% RDF + Vermicompost 1 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) (185.67 panicle^{-1}) and T_7 (50% RDF + Vermicompost 2 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) (175.33 panicle^{-1}). Significantly minimum number of grain panicles (133.13 panicle^{-1}) was seen in treatment T_1 (Control). The variation found might be due to higher availably of nutrient and favourable condition for producing a greater number of grains panicle^{-1}. The similar results were also reported by Yadav *et al.* (2021) [13], Kumar *et al.* (2019) [8].

Test weight (g)

The data pertaining for Test weight (g) have been presented in Table 1. Test weight was significantly influenced under those treatments where nitrobenzene sources used with RDF and vermicompost. Significantly maximum test weight (28.67g) was found in T_2 (100% RDF + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) which was at par with T_6, T_7, T_8 and T_4 (Vermicompost 4 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT). Significantly minimum test weight (23.00g) was seen in treatment T_1 (Control). Similar results were reported by Kumar *et al.* (2014) [7] and Suseendran *et al.* (2020) [12].

Yield and harvest index

Grain yield (kg ha^{-1}): The data pertaining to effect of integrated nutrient management and nitrobenzene on grain yield (kg ha^{-1}) have been presented in Table 2. The significantly maximum grain yield (5572 kg ha^{-1}) was observed in treatment T_2 (100% RDF + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) which was at par with T_6 (75% RDF + Vermicompost 1 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) (5416 kg ha^{-1}) and T_7 (50% RDF + Vermicompost 2 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) (5089 kg ha^{-1}).

Significantly minimum grain yield (2748 kg ha^{-1}) was seen in treatment T_1 (Control). The significantly higher grain yield observed in treatment T_2 compared to the control treatment can be attributed to the combined effects of Nitrobenzene and recommended fertilizer dose (RDF). Nitrobenzene likely enhanced the physiological processes in the plants, promoting

better nutrient uptake, increased enzymatic activities, and improved plant growth. The presence of Nitrobenzene, along with RDF and Vermicompost in treatments T_6 and T_7, further contributed to the improved grain yield. These treatments provided a balanced nutrient supply, enhanced soil fertility, and stimulated plant growth, resulting in higher grain production. Similar results were also observed by Chowdhury *et al*. (2018) [2].

Straw yield (kg ha^{-1})

The data pertaining to effect of integrated nutrient management and nitrobenzene on straw yield (kg ha^{-1}) have been presented in Table 2. Significantly maximum of straw yield (7202 kg ha^{-1}) was observed in treatment T_2 (100% RDF + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) which was at par with T_6 (75% RDF + Vermicompost 1 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) (7017 kg ha^{-1}). Significantly minimum straw yield (3742 kg ha^{-1}) was seen in treatment T_1 (Control). These results also conformity with Begum *et al*. (2018) [1] and Chowdhury *et al*. (2018) [2].

Biological yield (kg ha^{-1})

The data pertaining to effect of integrated nutrient management and nitrobenzene on biological yield (kg ha^{-1}) have been presented in Table 2. Significantly maximum of biological yield (12774 kg ha^{-1}) was observed in treatment T_2 (100% RDF + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) which was at par with T_6 (75% RDF + Vermicompost 1 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) (12432 kg ha^{-1}). Significantly minimum biological yield (6990 kg ha^{-1}) was seen in treatment T_1 (Control). The increased straw and biological yields in these treatments indicate the overall improvement in crop productivity and biomass accumulation, further emphasizing the positive impact of Nitrobenzene in combination with RDF on rice yield. The combined application of Nitrobenzene with RDF and Vermicompost might have synergistic effects, providing optimal nutrition and promoting overall plant performance, leading to improved yields in rice cultivation. These outcomes are consistent with findings of Begum *et al*., (2018) [1], Manimaran *et al*. (2019) [11] and Suseendran *et al*. (2020) [12].

Harvest index (%)

Among the difference treatment showed non-significant variation to each other but the maximum harvest index (44.33%) was observed in treatment T_2 (100% RDF + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) which was followed by T_6 (75% RDF + Vermicompost 1 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) (44.23%) and T_7 (50% RDF + Vermicompost 2 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) (43.49%). The minimum harvest index (41.78%) was seen in treatment T_5 (Vermicompost 2 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT). Also, similar result was reported by Kumar *et al*. (2017) [7].

Nutrient uptake by crop

Nitrogen uptake

The data pertaining to effect of integrated nutrient management and nitrobenzene on nitrogen uptake (kg ha^{-1}) have been presented in Table 3. Significantly maximum nitrogen uptake in grain (65.95 kg ha^{-1}) and straw (42.62 kg ha^{-1}) were observed in treatment T_2 (100% RDF + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) which was at par with T_6 (75% RDF + Vermicompost 1 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT). Minimum nitrogen uptake of grain (28.50 kg ha^{-1}) straw (11.97 kg ha^{-1}) were seen in treatment T_1 (Control). The application of Nitrobenzene, along with Vermicompost, resulted in significantly higher nitrogen uptake in both the grain and straw of rice. Treatment T_2 with 100% RDF + Nitrobenzene, exhibited the highest nitrogen uptake in the grain, followed by treatment T_6. Similarly, in the straw, treatment T_2 had the highest nitrogen uptake, followed by treatment T_6. This indicates that the combined application of Nitrobenzene and Vermicompost enhanced the nitrogen uptake efficiency of the rice plants, leading to increased total nitrogen uptake in both grain and straw compared to the control treatment. The finding of present study is in accordance with those of Ganguly *et al*. (2019) [6].

Phosphorus uptake

The data pertaining to effect of integrated nutrient management and nitrobenzene on Phosphorus uptake (kg ha^{-1}) have been presented in Table 3. Significantly maximum phosphorus uptake in grain (18.51 kg ha^{-1}) and straw (8.13 kg ha^{-1}) were observed in treatment T_2 (100% RDF + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) which was at par with T_6 (75% RDF + Vermicompost 1 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT). Minimum phosphorus uptake of grain (6.18 kg ha^{-1}) and straw (3.82 kg ha^{-1}) were seen in treatment T_1 (Control). The application of Nitrobenzene, along with Vermicompost, resulted in significantly higher phosphorus uptake in both the grain and straw of rice. Treatment T_2 with 100% RDF + Nitrobenzene, exhibited the highest phosphorus content in the grain, followed by treatment T_6 and T_7. Similarly, in the straw, treatment T_2 had the highest phosphorus uptake, followed by treatment T_6 and T_7. This indicates that the combined application of Nitrobenzene and Vermicompost enhanced the phosphorus uptake and accumulation in the rice plants, leading to increased phosphorus uptake in both grain and straw compared to the control treatment. Overall, the application of RDF, Nitrobenzene and Vermicompost can improve phosphorus availability and uptake by rice plants, thereby enhancing their phosphorus uptake and nutrient quality. These outcomes are consistent with findings of Kumar *et al*. (2014) [7] and Begum *et al*. (2018) [1].

Potassium uptake

The data pertaining to effect of integrated nutrient management and nitrobenzene on potassium uptake (kg ha^{-1}) have been presented in Table 3. Significantly maximum potassium uptake in grain (24.24 kg ha^{-1}) and straw (106.98 kg ha^{-1}) were observed in treatment T_2 (100% RDF + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT). Minimum potassium uptake of grain (8.59 kg ha^{-1}) and straw (52.00 kg ha^{-1}) were seen in treatment T_1 (Control). The reason about the potassium uptake of rice are the application of RDF, Nitrobenzene and Vermicompost also resulted in significantly higher potassium uptake in both the grain and straw of rice compared to the control treatment. Treatment T_2 exhibited the highest potassium uptake in the grain, followed by treatment T_6, while in the straw, treatment T_2 had the

highest potassium uptake, followed by treatment T_6. Moreover, the total potassium uptake was also significantly higher in treatment T_2 and T_6 compared to the control treatment. Therefore, the combined application of RDF, Nitrobenzene and Vermicompost can not only enhance the potassium content but also increase the uptake of potassium in rice plants, thereby improving their nutrient quality and overall productivity. These outcomes are consistent with findings of Kumar *et al*. (2014) [7] and Begum *et al*. (2018) [1].

Table 1: Yield attributes of rice as influenced by integrated nutrient management and nitrobenzene

Treatment Details	Number of panicles hill^{-1}	Panicle length (cm)	Number of grains panicle^{-1}	Test weight (g)
T_1 - Control	9.43	18.69	133.13	23.00
T_2 - 100% RDF + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT)	15.67	24.13	201.13	28.67
T_3 - 75% RDF + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT)	12.74	21.43	155.93	25.10
T_4 - Vermicompost 4 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT)	13.78	21.58	159.13	25.75
T_5 - Vermicompost 2 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT)	11.73	20.73	144.73	24.30
T_6 - 75% RDF + Vermicompost 1 t ha- 1 + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT)	15.19	24.07	185.67	27.30
T_7 = 50% RDF + Vermicompost 2 t ha- 1 + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT)	14.34	22.90	175.33	26.85
T_8 - 25% RDF + Vermicompost 3 t ha- 1 + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT)	13.80	22.49	162.00	26.15
S.Em±	0.82	0.81	10.32	0.96
CD (0.05)	2.51	2.45	31.61	2.93

Table 2: Yield and harvest index of rice as influenced by integrated nutrient management and nitrobenzene

Treatment Details	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest Index (%)
T_1 - Control	2748	3742	6990	42.65
T_2 - 100% RDF + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT)	5572	7202	12774	44.23
T_3 - 75% RDF + Nitrobenzene 20% v/v@ 2.5 ml L-1 (30, 45 and 60 DAT)	4325	6122	10447	42.52
T_4 - Vermicompost 4 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT)	4557	6554	11111	42.06
T_5 - Vermicompost 2 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT)	4218	6108	10326	41.78
T_6 - 75% RDF + Vermicompost 1 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT)	5416	7017	12432	44.23
T_7 - 50% RDF + Vermicompost 2 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT)	5089	6704	11793	43.49
T_8 - 25% RDF + Vermicompost 3 t ha^{-1}+ Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT)	4810	6632	11442	42.26
S.Em±	231.35	195.10	358.04	1.68
CD (0.05)	708.54	597.51	1086.01	NS

Table 3: Nitrogen, phosphorus and potassium uptake of rice as influenced by integrated nutrient management and nitrobenzene

Treatment Details	Nitrogen uptake^{-1}		Phosphorus^{-1}		Potassium uptake^{-1}	
	Grain	Straw	Grain	Straw	Grain	Straw
T_1 - Control	28.50	11.97	6.18	3.82	8.59	52.00
T_2- 100% RDF + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT)	65.5	42.62	18.51	8.13	24.24	106.98
T_3 - 75% RDF + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT)	47.00	23.14	11.04	6.48	15.43	83.50
T_4 - Vermicompost 4 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT)	50.08	29.99	12.08	6.87	16.69	91.14
T_5 - Vermicompost 2 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT)	45.15	22.28	10.20	6.38	14.56	86.05
T_6 - 75% RDF + Vermicompost 1 tha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT)	62.20	40.09	16.64	7.69	22.69	104.26
T_7 - 50% RDF + Vermicompost 2tha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT)	57.42	34.73	14.20	7.33	20.25	93.65
T_8 - 25% RDF + Vermicompost 3 tha^{-1}+Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT)	53.47	32.74	13.04	7.11	18.25	96.14
S.Em±	3.01	1.74	1.05	0.25	1.67	5.24
CD (0.05)	9.13	5.30	3.19	0.77	5.08	15.92

Conclusion

The field experiment demonstrated that integrating chemical fertilizers with organic amendments like vermicompost along with plant bio-stimulants such as nitrobenzene can significantly improve productivity and nutrient use efficiency in rice cultivation. The combined application of recommended dose of fertilizer and nitrobenzene (T_2) 100% RDF + Nitrobenzene 20% v/v @ 2.5 ml L-1 (30, 45 and 60 DAT) showed maximum increase in yield attributes, grain and straw yields, and nutrient uptake compared to sole application of fertilizers T_1 (Control). Addition of vermicompost to RDF and nitrobenzene (T_6) 75% RDF + Vermicompost 1 t ha^{-1} +

Nitrobenzene 20% v/v @ 2.5 ml L-1) and (T_7) 50% RDF + Vermicompost 2 t ha^{-1} + Nitrobenzene 20% v/v @ 2.5 ml L-1 also resulted in improved parameters over control. Though T_2 gave the best results, T_6 and T_7 were statistically at par, indicating the synergistic benefits of organic and inorganic nutrient sources along with bio-stimulants. Overall, the study validated that integrated nutrient management involving judicious combination of chemical fertilizers, organic manures and bio-stimulants can sustainably enhance rice yields while ensuring optimal nutrient supply and maintaining soil health.

References

1. Begum Y, Patil RP, Meena MK, Amaregouda A, Mahanta S. Influence of different agrochemicals on morphological and yield traits of rice (*Oryza sativa* L.) grown under northern dry zone of Karnataka. Journal of Pharmacognosy and Phytochemistry. 2018;7(4):2958-2963.
2. Chowdhury B, Howlader MHK, Hossain MK, Sikder MC, Hasan MM. Effect of nitrobenzene on growth and yield of boro rice. Progressive Agriculture. 2018;29(4):304-312.
3. Domfnguez J. State of the Art and New Perspectives on Vermicomposting Research. Earthworm ecology. 2004;2(1):401-424.
4. Dunna V, Roy B. Breeding, Biotechnology and Seed Production of Field Crops. New India Publishing Agency. 2013;4(1):71-122.
5. Dutta M, Chauhan BS. Effect of nutrient management practice on the performance of upland rice in a newly developed terraced land. Indian Agriculture. 2010;54(1/2):13-21.
6. Ganguly B, Imayavaramban V, Murugan G. Effect of integrated nutrient management on rice yield parameter's and nutrient uptake. Journal of Pharmacognosy and Phytochemistry. 2019;8(3):3910-3912.
7. Kumar A, Meena RN, Yadav L, Gilotia YK. Effect of organic and inorganic sources of nutrient on yield, yield attributes and nutrient uptake of rice cv. PRH-10. The Bioscan. 2014;9(2):595-597.
8. Kumar NS, Suresh S, Paramasivan M. Performance of rice under integrated nutrient management in southern region of Tamil Nadu. Journal of Pharmacognosy and Phytochemistry. 2019;8(2):735-736.
9. Kumar R, Singh A, Yadav RB, Kumar A, Kumar S, Shahi UP, *et al*. Growth, development and yield response of rice (*Oryza sativa* L.) as influenced by efficient nitrogen management under subtropical climatic condition. Journal of Pharmacognosy and Phytochemistry. 2017;6(6):791-797.
10. Lone NA, Mir MR, Khan NA. Impact of exogenously applied Ethephon on physiological and yield attributes of two mustard cultivars under rainfed condition. Applied Biological Research. 2009;11:44-46.
11. Manimaran S, Martinco M, Kalyanasundram D, Baradhan G, Ravichandran S. Impact of various sources of nutrients and methods of application on yield and economics of rice. International Journal of Research and Analytical Reviews. 2019;6(1):951-954.
12. Suseendran K, Kalaiyarasan C, Jawahar S, Stalin P, Murugan G, Vinodkumar SR, *et al*. Response of rice to foliar application of plant growth regulator on growth and yield of rice. Plant Archives. 2020;20(1):1510-1514.
13. Yadav DK, Yadav S, Anshuman K, Rao A, Srivastava A, Dev A, *et al*. Studies on the effect of integrated nutrient management practices (INM) on yield and economics of aromatic rice (*Oryza sativa* L.) International Journal of Agricultural Science. 2021;12(1):101-105.