

Original Research Article

The Effect of Integrated Nutrient Management on growth, yield attributes and yield of transplanted rice under irrigated condition (*Oryza sativa* L.)

Comment [JRS1]: The Effect of Integrated Nutrient Management on growth and yield potential lowland rice (*Oryza sativa* L.) in suggest

ABSTRACT

The present investigation was carried out in *kharif* season 2022-23 at Agronomy Research Farm of Chandra Bhanu Gupta Krishi Snatakottar Mahavidyalaya, Bakshika Talab, Lucknow (U.P.). The 8 treatments comprised of T1-RDF (IF), T2-100% RDF + 25 kg ha⁻¹ ZnSO₄ (B), T3-100% RDF + 2 foliar spray of ZnSO₄, T4-RDF + 50 kg ha⁻¹ FeSO₄ (B), T5-100% RDF + ZnSO₄ 25 kg ha⁻¹ (B) + FeSO₄ @ 50 kg ha⁻¹ (B), T6-75% RDF (IF) + 25% RDN (FYM), T7-50% RDF (IF) + 50% RDN (FYM), T8-100% RDF through FYM were laid out in Randomized Block Design (RBD). The soil was silty-loam texture with slightly alkaline pH 8.1, organic carbon 0.70%, available nitrogen 270.00 kg ha⁻¹, available phosphorus 27.0 kg ha⁻¹, and available potash 262.0 kg ha⁻¹ during 2022-2023. The values of growth contributing characters viz., plant height (cm), number of tillers per m² (439.73), dry matter accumulation (g m⁻²) (829.62), at harvest and significantly highest (6.33) leaf area index (LAI) was recorded under 100% RDF + 2 foliar spray of ZnSO₄ and yield attributes and yield like number of effective tillers per m² (200.66), panicles weight (g) (4.51), length of panicle (cm) (28.33), number of grains per panicle⁻¹ (175.33), test weight (g) (29.10), grain yield (47.85), straw yield (q ha⁻¹) (64.75) of rice were significantly higher under T3-100% RDF + 2 foliar spray of ZnSO₄ compared to other treatment. The nitrogen content (%), and its uptake (kg ha⁻¹), and protein content (%), and its production (kg ha⁻¹) in grain and straw was significantly higher under T3-100% RDF + 2 foliar spray of ZnSO₄. The Fe and Zn content (mg kg⁻¹) and its uptake (kg ha⁻¹) in grain and straw was higher under T3-100% RDF + 2 foliar spray of ZnSO₄. Economics analysis viz gross return (123514), net return (84107) and benefit cost ratio (2.13) was recorded highest with T3-100% RDF + 2 foliar spray of ZnSO₄ while lowest with T8-100% RDF through FYM. Thus for obtaining better yield and profit apply T3-100% RDF + 2 foliar spray of ZnSO₄.

Keywords: Integrated nutrient management, Growth, Yield attributes, Yield, Transplanted rice.

1. INTRODUCTION

Rice (*Oryza sativa* L.) belongs to Poaceae (Gramineae) family with chromosome number 2n=24. It is one of the most important staple food crops in the world. Rice is a crop of wet tropical climate and also grown in humid regions of subtropics. Rice is a C₃ plant and self-pollinated crop. Rice is a major source of energy. Its main component is carbohydrate, which is composed of amylose & amylopectin. It constitutes 12% water, 75%-85% starch & only 7% protein with a full complement of amino acid with very low amount of

Phosphorus, Iron & some quantity of Calcium. Rice also provides more than 15 essential vitamins and minerals including, folic acid, B vitamins, potassium, selenium, fibre, iron and zinc. Rice is gluten-

free and highly digestible. Rice is an important grain option for those who suffer from celiac disease. Rice provides 35-60% of the dietary calories and 50 - 80% of the energy intake of the people in developing countries (Fageria et al., 2003). Rice (*Oryza sativa* L.) is the premier food crop of India and therefore, national food security system largely relies on the productivity of rice in different agro-

ecosystems. Among the rice growing countries, India stands first in area (36.95 mha) and second in production (120.6 mt) next only to China. India ranks first in rice area after China. India occupies the largest rice area of 45 million hectares and produced 111.76 million tonnes with productivity of 25.78 q ha⁻¹ (Anonymous, 2022). Uttar Pradesh is the largest rice growing state after West Bengal in

India, though the productivity is low. In Uttar Pradesh Rice is grown over an area of 5.68 million hectares with the production of 15.66 million tonnes and productivity of about 2.75 tonnes ha⁻¹. (Mishra and Kapur, 1992) Integrated nutrient

management (INM) is a prescription for developing a durable integrated plant nutrient system (IPNS). The INM is a soil fertility and productivity sustaining practice because it enhances the availability of both, applied and native soil nutrients during the growing season of the crop synchronizing the nutrient demand set by the plants both in time and space with supply of the nutrients from the labile soil and applied nutrient pools sustains and enhances

chemical, biological and physical soil health and arrests degradation of soil, water and environmental quality by promoting carbon sequestration, minimizing the avoidable leakage of the fertilizer nutrients to the water bodies and atmosphere. There is a vast scope for increasing nutrient supply through

use of organic manures viz. FYM, mustard oil cake, green manures. The fertilizer use should be promoted till a full proof low input technology for higher productivity is available. Under the present Indian context, the organic sources of nutrients should be considered as supplements to chemical fertilizers and not their substitutes.

2. METHODS AND MATERIALS

The field experiment was conducted during Kharif 2022-

23 at Shradhay Bhagwati Singh Agriculture Research Farm, Hajipur, Chandra Bhanu Gupta Krishi Sna takottar Mahavidyalaya, BKT, Lucknow University, Lucknow (U.P.). The experimental site was well levelled having good soil condition. Geographically, Experimental site falls under subtropical zone and is situated at 26.50°N North latitude, 80.52°E East longitudes with an altitude of 123 meters above mean sea level. Nestled on the bank of Gomti river, Lucknow is flanked by Barabanki district on the East, Unnao on the West, Raibareilly on the South and Sitapur and Hardoi districts on the North,

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respectively. The experimental site is situated about 20 kms away from Lucknow city Airforce road on Sitapur highway. The soil of experimental field was slightly alkaline in reaction (8.00 pH), low in organic carbon (0.70%) and available nitrogen (270 kg ha^{-1}), medium in phosphorous (27 kg ha^{-1}) and potassium (262 kg ha^{-1}).

The 8 treatments comprised of RDF (IF), 100% RDF + $25 \text{ Kg ha}^{-1} \text{ ZnSO}_4$ (B), 100% RDF + 2 foliar spray of ZnSO_4 , RDF + $50 \text{ kg ha}^{-1} \text{ FeSO}_4$ (B), 100% RDF + ZnSO_4 25 kg ha^{-1} (B) + FeSO_4 @ 50 kg ha^{-1} (B), 75% RDF (IF) + 25% RDN (FYM), 50% RDF (IF) + 50% RDF (IF) + 50% RDN (FYM), 100% RDF through FYM were in Randomized Block Design (RBD). The half dose of Nitrogen as per treatment was applied at the time of sowing and rest half does of nitrogen was applied in two splits at the time of first irrigation and second irrigation. Healthy and bold seed of rice variety NDR 2065 @ 40 kg ha^{-1} for transplanting were sown on 18 June 2022 in puddled soil. All improved packages of practices were followed to raise the crop. The data on plant height and tillers were recorded from the area already marked by tagged. Sample for dry matter accumulation was recorded by cutting of plants 25 cm row length. For leaf area index the sample taken for dry matter accumulation, was first used to take leaf area. All the leaves of two hills were separated and grouped into three categories viz. small, medium, large.

The number of leaves of each group was recorded and one representative leaf for each category was taken and their length and width was measured and multiplied by number of leaves of each category. The leaf area of all leaves was calculated. The samples were first sun dried and then kept in hot air oven $72^\circ\text{C} \pm 1^\circ\text{C}$ for 48 hours till the constant weight was achieved. Yield attributes were recorded from 10 panicles selected randomly from each plot. Grain and straw yields of rice were recorded at harvest the harvest index was calculated as grain yield divided by total biological yield and multiplied by hundred. The uptake of nutrients was calculated as nutrient content in grain and straw multiplied by respective yield. Economics of different treatments was worked out on the basis of prevailing market prices. The data so obtained on various parameters were analyzed as per standard statistical procedures. The content of N, P, and K in grain and straw was determined using standard laboratory procedures.

3. RESULTS AND DISCUSSION

3.1 Growth attributes:-

Plant height, number of tillers, leaf area index and dry matter accumulation of rice were affected significantly due to application of 100% RDF through Inorganic fertilizer + 2 foliar spray of ZnSO_4 due to different nutrient management practices (Table-1). The maximum plant height (99.18 cm), leaf area index (5.97), number of tillers (367.35 m^{-2}) and dry matter accumulation (1215.24 gm^{-2}) was recorded significantly with T3 - 100% RDF + 2 foliar spray of ZnSO_4 over rest of the treatments. Significant improvement in growth parameters with increasing the levels of nitrogen might be due to increased availability of nitrogen and its

Comment [JRS8]: It is better not to use abbreviations, because lay people find it difficult to understand the meaning of your research

Comment [JRS9]: Anova and DMRT/LSD because this research is experimental design with RCBD

uptake by plant increased the metabolic activity and formation of meristematic tissues which improved the cell elongation and cell division which in turn improved the plant height, number of leaves, leaf area/plant and dry matter accumulation of crop. The findings of present investigation are in close proximity of those observed by [Suvarna Latha and Sankara Rao \(2001\)](#), [Devi and Manimaran \(2012\)](#) and [Moe et al. \(2017\)](#).

Comment [JRS10]: use references from the last 10 years

Table no.1 Growth attributes of rice as affected by different integrated nutrient Management				
Treatments	Number of tillers/m ²	Plant height (cm)	Leaf area index	Dry matter accumulation (gm ⁻²)
T1-Recommended dose of fertilizer through inorganic fertilizer	407.00	96.68	5.55	745.77
T2-100% RDF + 25kg/ha ZnSO ₄ (Basal)	415.33	100.27	5.94	792.63
T3-100% RDF + 2 foliar spray of ZnSO ₄ (30 and 60 DAT)	439.73	104.97	6.33	829.62
T4-100% RDF + 50kg/ha FeSO ₄ (Basal)	411.73	98.96	5.87	781.38
T5-100% RDF + ZnSO ₄ @ 25kg/ha (B) + FeSO ₄ @ 50kg/ha (B)	418.33	100.88	5.96	803.90
T6-75% RDF (IF) + 25% RDN through (FYM)	410.66	97.87	5.82	780.29
T7-50% RDF (IF) + 50% RDN through (FYM)	435.37	102.26	6.22	819.63
T8-100% RDF through FYM	402.11	93.56	5.52	730.36
SE(m) ±	3.23	0.37	0.19	4.44
C.D. at 5%	9.90	1.17	0.58	13.60

Comment [JRS11]: please use anova analysis and multiple comparison DMRT/LSD

3.2 Yield attributes:-

Yield attributing characters like effective tiller/m², length of panicle (cm), no. of grain/panicle, grain weight/panicle (g), panicle weight (g) & 1000 grain weight (g) were affected significantly when crop fertilized with 100% RDF + 2 spray of ZnSO₄ observed significantly highest no of effective tillers (439.73), panicle length (104.97 cm), No. of grain/panicle (175.33), grain weight/panicle (3.46 g), panicle weight (4.51 g), and 1000 grain weight (29.10 g) over rest of the treatments. With the application of T3 (RDF + 2 foliar spray of ZnSO₄) No. of effective tillers was recorded higher which was found at par with the treatment (50% RDF-IF + 50% RDN – FYM (T6) but recorded significantly highest tiller over rest of the treatments. The crop sown with T3 (100% RDF through (IF) + 2 foliar spray of ZnSO₄) recorded the significantly higher panicle length (cm), panicle weight (g), numbers of grains panicle⁻¹, grains weight panicle⁻¹ which might be due to chemical fertilizers provide readily plant nutrient to crop. Similar responses were also recorded by [Krishnakumar et al. \(2005\)](#) and [Uma Shankar et al. \(2005\)](#). This might be due to improvement in nutrient supply system is more with organic manures, which

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improves the soil physical, chemical and biological properties. Yield is the combined result of all growth and management factors. It is well known fact that grain yield is the function of a greater number of effective tillers per unit area, number of grains per panicle and test weight.

Table no.2 Yield attributes of rice as influenced by integrated nutrient management

Comment [JRS13]: please use anova analysis and DMRT/LSD

Treatments	Effective Tillers/m ²	Panicle length (cm)	No. of Grains/panicle	Grain weight/panicle (g)	Panicle weight (g)	1000 grain weight (g)
T1- Recommended dose of fertilizer (RDF) through inorganic fertilizer	407.00	20.76	141.33	2.19	3.77	25.33
T2-100% RDF+25kg/ha ZnSO ₄ (Basal)	415.33	22.53	162.33	2.65	3.96	27.33
T3- 100% RDF+2 foliar spray of ZnSO ₄ (30&60 DAT)	439.73	28.33	175.33	3.46	4.51	29.10
T4-100% RDF+50kg/ha FeSO ₄ (Basal)	411.73	21.90	160.33	2.60	3.86	27.17
T5- 100% RDF+ZnSO ₄ 25kg/ha (B)+FeSO ₄ @50kg/ha (B)	418.33	25.23	164.33	2.72	4.04	28.33
T6-75% RDF (IF)+25% RDN (FYM)	410.66	21.07	157.66	2.45	3.81	26.33
T7-50% RDF (IF)+50% RDN (FYM)	435.37	26.83	167.00	2.79	4.27	28.68
100% RDF through FYM	402.11	19.11	126.00	2.17	3.70	22.15
S.E(m)+	2.01	0.27	1.78	0.20	0.41	2.00
C.D. at 5%	6.18	0.82	5.47	0.61	1.27	4.35

3.3 Yield studies:-

Crop received 100% RDF-IF+2 foliar spray of ZnSO₄ (T3) produced significantly highest grain yield (47.85 q/ha), straw yield (64.75q/ha) and total biological yield (112.6 q/ha) as compared to rest of the nutrient management practices. However, the differences between T3 (100% RDF+2 foliar spray of ZnSO₄) was statistically non-significant over 50% RDF+50% RDN (FYM). Application of 100% RDF+ZnSO₄ 25kg/ha + FeSO₄ 50 kg/ha produced higher grain yield of (42.15q/ha), straw yield (59.20q/ha) and total biological yield (101.35q/ha) which was on par with 100% RDF+25kg/ha ZnSO₄. As the yield is directly related to all the yield attributing characters which also showed increasing used with this type of nutrient management. T3 (100% RDF through (IF) + 2 foliar spray of ZnSO₄) recorded the significantly higher grain yield with 47.85qha⁻¹, straw yield with 64.75 q ha⁻¹ and biological yield with 112.6 q ha⁻¹. Similar responses were also recorded by [Dikshit and Khatik \(2002\)](#), [Uma Shankar et al. \(2005\)](#) and [Kumar et al. \(2008\)](#). It might also due to that the combination of chemical fertilizers and organic manures not only increase the rate of photosynthesis but also increase the translocation of source to sink which resulted in higher grain yield. However, the rate of releasing of nutrients from organic manures is slow in beginning. The effect of INM on harvest in

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dex was non-significant. The grain, straw, biological yield and harvest index was closely followed by treatment T7 (50% RDF (IF) + 50% RDN FYM). This result was closely justified with report of Siavoshi (2010), Yadav and Yadav (2015) and Thulasi et al. (2016).

Table no. 3 Yield of rice as influenced by different integrated nutrient management

Comment [JRS15]: add anova and DMRT/LSD

Treatments	Grain yield (q/ha)	Straw yield (q/ha)	Total biological yield (q/ha)	Harvest index (%)
T1- Recommended dose of fertilizer (RDF) through inorganic fertilizer	35.12	56.44	91.56	38.78
T2- 100% RDF + 25kg/ha ZnSO ₄ (Basal)	40.18	59.04	99.22	40.43
T3- 100% RDF + 2 foliar spray of ZnSO ₄ (30 & 60 DAT)	47.85	64.75	112.6	42.29
T4- 100% RDF + 50kg/ha FeSO ₄ (Basal)	39.21	58.58	97.79	40.09
T5- 100% RDF + ZnSO ₄ @ 25kg/ha (B) + FeSO ₄ @ 50kg/ha (Basal)	42.15	59.20	101.35	41.61
T6- 75% RDF (IF) + 25% RDN (FYM)	37.15	58.32	95.47	38.91
T7- 50% RDF (IF) + 50% RDN (FYM)	46.79	62.42	109.21	42.84
T8- 100% RDF through FYM	32.44	54.79	87.23	37.18
SE (m) ±	0.96	1.10	1.27	0.81
C.D. at 5%	2.94	3.37	3.90	2.50

3.4 Nutrient uptake

The nitrogen, phosphorus and potassium content (%) in grain and straw was non-significantly affected with the application of 100% RDF + 2 foliar spray of ZnSO₄ followed by 50% RDF (IF) + 50% RDN (FYM) and 100% RDF + ZnSO₄ @ 25kg/ha (B) + @ 50kg/ha (B).

Crop fertilized with 100% RDF through FYM produced lowest NPK content (%). Nitrogen, phosphorus and potassium uptake (kg/ha) by grain and straw was recorded highest with the treatment T3 (100% RDF + 2 foliar spray of ZnSO₄). In grain N, P, K uptake was found highest with the treatment T3 (100% RDF + 2 foliar spray of ZnSO₄). Which was being at par with the treatment T7 (50% RDF (IF) + 50% RDN (FYM)). N, P uptake by straw was non-significant, while K uptake was found significant and highest value was found significant and highest value was found with the treatment T3 (100% RDF + 2 foliar spray of ZnSO₄). However, minimum value was recorded with the application of 100% RDF through FYM (T8). Application of 100% RDF + 2 foliar spray of ZnSO₄ recorded maximum content of protein (8.80% and 3.00%) in grain and straw, respectively followed by 50% RDF through inorganic fertilizer + 50% RDN (FYM) and 100% RDF + ZnSO₄ @ 25kg/ha (B) + FeSO₄ @ 50kg/ha (B).

Protein production (q/ha)

¹) also exhibited similar trend as in case of protein % and being highest with 100% RDF + 2 foliar spray of Z

nSO₄ followed by 50% RDF through inorganic fertilizer + 50% RDN (FYM) and 100% RDF + ZnSO₄ @ 25 kg/ha (B) + FeSO₄ @ 50 kg/ha (B). Application of 100% RDF + 2 foliar spray of ZnSO₄ recorded maximum Fe content (mg/kg) in grain and straw (184 and 418) followed by Recommended dose of fertilizer through inorganic fertilizer and RDF + ZnSO₄ @ 25 kg/ha (B) + FeSO₄ @ 50 kg/ha (B). However, crop fertilized with 100% RDF through FYM produced lowest Fe content in grain and straw. Fe uptake in grain was recorded maximum with the application of 100% RDF + 2 foliar spray of ZnSO₄ and in straw was observed maximum with the application of 100% RDF + 2 foliar spray of ZnSO₄. Application of 100% RDF through FYM was recorded non-significantly affected Zn content (mg/kg) and uptake (kg/ha) in grain and straw followed by Recommended dose of fertilizer through inorganic fertilizer. Crop fertilized with 100% RDF through FYM produced lowest Zn content and uptake. Nutrient content (%) in grain and straw and its uptake as affected by various INM practices. The higher N, P and K content in grains and straw was found higher under treatment T₃ (100% RDF through (IF) + 2 foliar spray of ZnSO₄) followed by T₇ (100% RDF through (IF) + 25% RDN through FYM), the higher content (mg/kg) of N with T₃ might be due to higher availability of nutrients as compared to other treatment. Similar responses were observed by Kumar et al. (2007), Kumar et al. (2008) and Sultana et al. (2015).

The uptake of nitrogen, phosphorus and potassium in grain and straw in rice was recorded significantly higher with the treatment T₃ (100% RDF through (IF) + 2 foliar spray of ZnSO₄). This result is closely related with finding of Ghose et al. (2014) and the uptake of phosphorus and potassium was statistically at par with T₇ (50% RDF through (IF) + 50% RDN through FYM). The high uptake of nitrogen with T₃ was mainly due to higher grain and straw. These findings are in conformity with the findings of Kumar et al., (2008); and Shrivastava and Singh (2017). The protein content (%) is the function of nitrogen content in grain and multiplied by constant. Hence, higher protein content (%) and its production was found maximum under T₃ treatment because of higher grain and straw yield. The higher Fe and Zn content in grain and straw was found maximum when crop was fertilized with 100% RDF + 2 foliar spray of ZnSO₄, however, lowest content (mg/kg) was recorded with 100% RDF through FYM. This was because of lower grain and straw yield with their treatment. Contrary to this, the T₃ recorded the lowest content (mg/kg) might be due to higher grain and straw yield. The uptake of Zn and Fe was highest with T₃ and the lowest being with 100% RDF through FYM. This is because of high grain and straw yield with former treatments.

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Table no. 4 NPK content (%) and uptake (kg/ha) in grain and straw as affected by different integrated nutrient management

Treatments	NPK content (%)						NPK uptake (kg/ha)					
	Grain			Straw			Grain			Straw		
	N	P	K	N	P	K	N	P	K	N	P	K
T1-Recommended dose of fertilizer through	1.4	0.4	0.4	0.4	0.2	1.21	52.38	16.84	15.	26.	15.	71.
	1	2	1	2	5			80	52	23	11	

Comment [JRS18]: add anova and dmr/lsd

ughinorganic fertilizer													
T2-100%RDF+ 25kg/ha ZnSO4(Basal)	1.4 2	0.5 1	0.4 2	0.4 4	0.3 0	1.25	57.69	19.81	17. 27	27. 15	17. 71	73. 80	
T3-100%RDF+2FoliarsprayofZnSO4(30 DAT&60DAT)	1.5 1	0.5 5	0.4 6	0.4 8	0.3 2	1.27	66.99	22.45	19. 65	28. 71	18. 72	80. 93	
T4-100%RDF + 50 kg/haFeSO4(Basal)	1.4 1	0.4 4	0.4 2	0.4 3	0.2 8	1.24	55.67	18.26	16. 46	26. 94	16. 32	72. 63	
T5-100%RDF+ZnSO4@ 25kg/ha(B)+FeSO4@50kg/ha(B)	1.4 3	0.5 2	0.4 3	0.4 6	0.3 0	1.26	59.85	20.04	17. 70	27. 23	17. 49	74. 59	
T6-75%RDF(IF)+25% RDN through(FYM)	1.4 1	0.4 3	0.4 1	0.4 3	0.2 8	1.23	53.03	17.25	15. 97	26. 24	16. 4	71. 73	
T7-50%RDF(IF)+50% RDN through(FYM)	1.4 3	0.5 3	0.4 4	0.4 7	0.3 1	1.26	65.97	21.29	19. 61	27. 84	18. 71	76. 15	
T8-100%RDFthroughFYM	1.4 0	0.4 0	0.4 0	0.4 1	0.2 1	1.20	49.95	15.21	14. 92	26. 29	15. 29	69. 58	
SE(m)+	0.1 7	0.0 5	0.0 7	0.0 6	0.0 5	0.22	0.76	0.92	1.0 3	1.1 0	1.2 1	0.9 8	
C.D.at5%	NS	NS	NS	NS	NS	NS	2.34	2.82	3.1 6	NS	NS	3.0 3	

Tableno.5Proteincontent(%)ingrainandstrawanditsproduction(kgha⁻¹)asinfluencedby differentintegrated nutrient management.

Comment [JRS19]: add anova and dmrt/lsd

Treatments	Protein content(%)		Protein yield(kg/ha)	
	Grain	Straw	Grain	Straw
T1-Recommendeddoseoffertilizerthroughinorganicfertilizer	8.03	2.17	299.4 2	164.8 7
T2-100%RDF+ 25kg/haZnSO4(Basal)	8.12	2.87	328.2 7	169.4 4
T3-100%RDF+2FoliarsprayofZnSO4 (30DAT&60DAT)	8.80	3.00	382.8 0	179.3 3
T4-100%RDF+ 50 kg/ha FeSO4(Basal)	8.10	2.87	318.3 8	168.1 2
T5-100%RDF+ZnSO4@25kg/ha(B)+FeSO4@50kg/ha(B)	8.17	2.87	342.2 5	169.9 0
T6-75%RDF(IF)+25%RDNthrough(FYM)	8.06	2.87	303.0 8	165.9 0
T7-50%RDF(IF)+50%RDNthrough(FYM)	8.63	2.93	377.1 2	173.1 4
T8-100%RDFthroughFYM	8.00	2.68	285.4 7	163.8 7
SE(m)±	0.64	0.77	1.49	0.62
C.D.at5%	NS	NS	4.57	1.92

UNDER PEER REVIEW

Table no.6 Fe, Zn content and uptake in grain and straw as affected by different integrated nutrient management practices.

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Treatments	Fe content (mg/kg)		Fe uptake (kg/ha)		Zn content (mg/kg)		Zn uptake (kg/ha)	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
T1- Recommended dose of fertilizer (RDF) through inorganic fertilizer.	195	419	0.626	2.36	33.18	35.10	0.106	1.98
T2- 100% RDF + 25 kg/ha ZnSO ₄ (Basal)	191	416	0.767	2.45	30.00	35.00	0.120	0.206
T3- 100% RDF + 2 Foliar spray of ZnSO ₄ (30 DAT and 60 DAT)	184	418	0.880	2.71	29.50	32.80	0.141	2.12
T4- 100% RDF + 50 kg/ha FeSO ₄ (Basal)	190	422	0.744	2.47	30.07	33.10	0.117	1.93
T5- 100% RDF + ZnSO ₄ @ 25 kg/ha (B) + FeSO ₄ @ 50 kg/ha (B)	186	415	0.783	2.456	29.00	33.00	0.122	0.195
T6- 75% RDF (IF) + 25% RDN through (FYM)	205	426	0.761	2.484	35.00	40.00	0.130	0.233
T7- 50% RDF (IF) + 50% RDN through (FYM)	164	383	0.767	2.390	22.00	27.00	0.102	0.168
T8- 100% RDF through FYM	210	431	0.681	2.361	35.10	30.22	0.097	1.65
Sem ±	0.87	0.79	-	-	0.61	0.55	-	-
C.D. at 5%	2.68	2.42	-	-	1.87	1.70	-	-

3.5 Economics-

The data recorded on the cost of cultivation (Rs/ha), Gross return (Rs/ha), Net return (Rs/ha) and the Benefit: Cost ratio (Rs/Re invested) are presented in table. A perusal of the data indicated that the highest gross return (123514 Rs/ha) net income (Rs 84107) and benefit:cost ratio (2.13) was recorded with T3 which was followed by T4 and T5 for gross income and T2 for net income and benefit:

cost ratio. However, the lowest net return and BCR was recorded with T8. The highest profitability with T3 was mainly due to higher grain and straw yield and lower cost incurred. However, treatment combined with farm yard manure recorded lower profit as compared to inorganic treatment alone was mainly attributed due to low yield and higher cost incurred. The lowest net return (Rs 20218.6) and B:CR (0.29) was recorded with T8

Treatments	Cost of cultivation	Gross return (Rs/ha)	Net return (Rs/ha)	B:C ratio (Rs/Reinvested)
T1-Recommended dose of Fertilizer (RDF) through inorganic fertilizer.	38867	94220.8	55353.8	1.42
T2-100% RDF+25kg/ha ZnSO ₄ (Basal)	39367	105583.2	66216.2	1.68
T3-RDF+ 2 Foliar spray of ZnSO ₄ (30DAT&60DAT)	39407	123514	84107	2.13
T4-RDF+50kg/ha FeSO ₄ (Basal)	39617	103420.4	63803.4	1.61
T5-RDF+ZnSO ₄ @25kg/ha(B) + FeSO ₄ @50kg/ha (B)	47867	109666	61799	1.29
T6-75% RDF(IF)+25% RDN through (FYM)	54087	99114	45027	0.83
T7-50% RDF(IF)+50% RDN through (FYM)	69308	120419.6	51111.6	0.73
T8-100% RDF through (FYM)	67875	88093.6	20218.6	0.29

4. Conclusion:-

It can be concluded from the above results that rice crop should be fertilized with 100% RDF + 2 foliar spray of ZnSO₄ to obtain maximum yield and highest profit under irrigation condition of central plain zone of UP.

Comment [JRS21]: It would be good if the conclusion describes the essence of the research you conducted so that it can be conveyed easily to the reader

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Comment [JRS22]: use references from the last 10 years. 80% journal and 20% books and another.

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