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Evaluation of integrated nutrient management on growth and yield of transplanted rice (*Oryza sativa* L.) under irrigated condition

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Abstract
The field experiment conducted during the Kharif season of 2023 aimed to assess the "Evaluation of Integrated Nutrient Management on Growth, Yield, and Economics of Transplanted Rice (Oryza sativa L.) Under Irrigated Condition" at Rama university Mandhana Kanpur, Uttar Pradesh focused on the transplanted rice variety Sarjoo-52. This study evaluated eleven treatment combinations, each replicated three times. Treatments are Control (T_1), 100% RDF (T_2), 75% RDF + 25% FYM (T_3), 75% RDF + Azolla (T_4), 75% RDF + 25% Poultry manure (T_5), 50% RDF + 50% FYM (T_6), 50% RDF + Azolla (T_7), 50% RDF + 25% Poultry manure (T_8), 50% RDF + Azolla + 25% FYM (T_9), 50% RDF + Azolla + 25% Poulty manure (T_{10}) and 50% RDF + 25% FYM + 25% Poultry manure (T_{11}). The findings demonstrated the significant influence of integrated Nutrient Management (INM) on growth, yield, nutrient content and economic aspects of transplanted rice cultivation. Among the treatments, particularly the combinations involving 75% of the recommend dose of fertilizer (RDF) along with organic amendments like 25% poultry manure emerged as the most effective, yielding superior growth, yield quality and nutrient uptake followed by 100% RDF, 75% RDF + 25% FYM and 75% RDF with Azolla. These treatments performed to 100% RDF and combination with azolla or farmyard manure, indicating the effectiveness of integrated approaches over convectional fertilization methods. Furthermore, the economic analysis revealed that the combination of 75% RDF with 25% poultry manure not only resulted in the highest net returns but also exhibited the highest benefit cost ratio indicating its economic viability and superiority over other treatments in terms of profitability.

Keywords: Integrated nutrient management, growth, yield, transplanted rice, *Oryza sativa* L.

Introduction
Rice (*Oryza sativa* L.), a member of the Poaceae family, as a staple food crop, plays a critical role in feeding a significant portion of the global population. It is the major source of calories for 40 percent of the world population. With the world's population continuously increasing, the challenge of producing enough food becomes more pressing. It's significance as a staple food cannot be overstated, particularly in regions like India where it plays a crucial role in food security and sustenance. India boasts the largest area under rice cultivation, making it the second-largest producer worldwide. Production of rice rank second among the food grain and half of the world population receiving the highest (26.2%) calories intake from it in the developing countries of their dietary protein. The majority of people who eat rice as their primary dietary source live in developing countries. According to the ministry of agriculture second advance estimate, rice production in the Kharif season last crop year was anticipated to be 103.75 million tonnes, compared to the objective of 102.60 million tons (Anonymous, 2021) [1]. Its production and consumption statistics underscore its centrality to global diets. the expansion of cultivable land is limited, making it essential to maximize the productivity of existing agricultural areas. (Kumar *et al*., 2021) [23] suggested that imbalance usage of fertilizers is the main factor to cause low productivity and decline of soil fertility.

Integrated Nutrient Management (INM), which involves judicious use of fertilizers and organic manures, emerges as an important strategy for enhancing crop productivity as well as maintaining soil health. While inorganic fertilizers supply essential nutrients, their excessive use leads to challenges such as reduced productivity and environmental degradation. To address these concerns, INM emphasizes the synergistic use of nitrogen fertilizers along with bio-inoculants such as Azotobacter and Azospirillum as well as phosphorus-solubilizing bacteria (PSB). The mostly used microorganisms as biofertilizers are nitrogen fixers, growth promoting rhizobacteria (PGPRs) like azotobacter, azospirillum and phosphorus solubilizing bacteria (PSB) i.e., Pseudomonas sp. and Bacillus sp. endo and ectomycorrhizal fungi, cyanobacteria and other useful microscopic organisms (Yasin *et al*., 2012) [22].

Materials and Methods

The present experiment entitled, "Evaluation of Integrated Nutrient Management on Growth, Yield and economics of Transplanted Rice (*Oryza sativa* L.) under irrigated condition" at Rama university Mandhana Kanpur, Uttar Pradesh during kharif season of 2023. The experiment was conducted using standard procedure regarding treatments, replications and experimental designs etc. To achieve the objectives; The details of technical programmers are given in as follows: The experiment was carried out by using Randomized Block Design (RBD) with nine different treatments combinations and three replications.

The details of treatment and layout plan are discussed below in Table 1.

Table 1: Details of treatments

S. No.	Treatments Details	Treatment No.
1.	Control	T_1
2.	100% RDF	T_2
3.	75% RDF + 25% FYM	T_3
4.	75% RDF + Azolla	T_4
5.	75% RDF + 25% Poultry manure	T_5
6.	50% RDF + 50% FYM	T_6
7.	50% RDF + Azolla	T_7
8.	50% RDF + 25% Poultry manure	T_8
9.	50% RDF + Azolla + 25% FYM	T_9
10.	50% RDF + Azolla + 25% Poultry manure	T_{10}
11.	50% RDF + 25% FYM + 25% Poultry manure	T_{11}

Results and Discussion

The chapter titled "Evaluation of Integrated Nutrient Management on Growth, Yield and economics of Transplanted rice under irrigated condition (*Oryza sativa* L.) under irrigated condition" details a study conducted during the kharif season of 2022 at Rama university Mandhana Kanpur, Uttar Pradesh. The aim of this investigation was to assess the impact of integrated nutrient management practices on the growth and yield of transplanted rice under irrigated condition.

Growth attributes

Different growth attributes were recorded at successive stages of rice i.e. at 30, 60, 90 DAT and at harvest. The results and discussion on growth attributes are described here under as follows:-

Plant height

ThedatarevealedthataT$_3$0DAT T_2 (100% RDF) was recorded highest plant height which was at par with T_5 (75% RDF + 25% Poultry manure) and T_3 (75% RDF + 25% FYM). At 60 DAT T_2 (100% RDF) was recorded highest plant height which was at par with T_3 (75% RDF + 25% FYM), T_4 (75% RDF + Azolla), T_5 (75% RDF + 25% Poultry manure) and T_8 (50% RDF + 25% Poultry manure). T_2 (100% RDF) was obtained highest plant height at 90 DAT which was at par with T_3 (75% RDF + 25% FYM), T_4 (75% RDF + Azolla) and T_5 (75% RDF + 25%Poultrymanure). The findings of present investigation are in close proximity of those observed by Shankar *et al.* (2020) [24].

Number of tillers hill^{-1}

At 30 DAT there was less significant difference among the treatments. T_5 (75% RDF + 25% poultry manure) was showing highest number of tillers hill-1 which showed at par with T_2 (100% RDF) and T_3 (75% RDF + 25% FYM). At 60 and 90 DAT, T_5 (75% RDF + 25% Poultry manure) was observed as producing maximum no of tiller hill-1 which showed at par with T_2 (100% RDF). At harvest stage T_5 (75% RDF + 25% Poultrymanure) showed highest no of tiller hill-1 which was at par with T_2 (100% RDF) and T_3 (75% RDF + 25% FYM). Similar results were found by Amin *et al*. (2004) [3].

Dry matter accumulation (gm^{-2})

At 30 DAT, T_5 (75% RDF + 25% Poultry manure) showed significantly higher value which was at par with T_2 (100% RDF), T_3 (75% RDF + 25% FYM), T_4 (75% RDF + Azolla), and T_8 (50% RDF + 25% Poultry manure). At 60 DAT T_5 (75% RDF + 25% Poultry manure) was at par with T_2 (100% RDF), T_3 (75% RDF + 25% Poultry manure), T_4 (75% RDF + Azolla), T_8 (50% RDF + 25% FYM + 25% Poultry manure) and T_{11} (50% RDF + 25% FYM + 25% Poultry manure). At 90 DAT, T_5 (75% RDF + 25% Poultry manure) was at par with T_2 (100% RDF), T_3 (75% RDF + 25% Poultry manure), T_4 (75% RDF + Azolla), and T_8 (50% RDF + 25% Poultry manure) these results are in close conformity with the observations of Moe *et al*. (2017) [25].

Leaf area index

At 30 DAT T_2 (100% RDF) was at par with T_2 (100% RDF), T_3 (75% RDF + 25% FYM, T_4 (75% RDF + Azolla) and T_5 (75% RDF + 25% Poultry manure). At 60 DAT T_2 (100% RDF) was at par with T_3 (75% RDF + 25% FYM) and T_5 (75% RDF + 25% Poultry manure) At 90 DAT and at harvest T_2 (100% RDF) was at par with T_3 (75% RDF + 25% FYM), T_4 (75% RDF + Azolla) and T_5 (75% RDF + 25%Poultrymanure). Similar result was reported by Egbuchua and Enujeke (2013) [26].

Evaluation tillers hill-1

Critical observation of the data recorded on Evaluation tillers hill-1have been summarized in Table 2. T_5 (75% RDF + 25% Poultry manure) showed the maximum no of Evaluation tillers hill- 1i.e.,10.40whichwasat par with T_2 (RDF (100%) and T_4 (75% RDF + Azolla). Lowest value was by T_1 (Control). Similar findings were studied by Sharkar *et al*. (2016) [27].

Panicle length (cm)

Critical observation of the data recorded on Panicle length (cm) have been summarized in Table 2. T_5 (75% RDF + 25% Poultry manure) observed with highest panicle length, 25.76 which was at par with T_2 (100% RDF), T_3 (75% RDF + 25% FYM), and T_3 (75% RDF + 25% FYM).

Panicle weight (g)

Critical observation of the data recorded on Panicle weight (g) have been summarized in Table 2. Maximum panicle weight was 3.85 g, observed in T_5 (75% RDF + 25% Poultry manure)

which was at par with T_2 (100% RDF), T_3 (75% RDF + 25% FYM) and T_4 (75% RDF + Azolla).

No. of grains panicle-1

The data recorded on No. of grains panicle-1have been summarized in Table 2. The data showed that T_5 (75% RDF + 25% Poultry manure) showed maximumgrainspanicle-1whichwasatpar with T_2 (100% RDF) and T_3 (75% RDF + 25% FYM). Minimum value was showed by T_1 (Control). Similar finding was found by Hossaen *et al*. (2011) [28].

Grain weight panicle^{-1}

The data recorded on Grain weight panicle-1have been summarized in Table 2. Grain weight panicle-1 was found maximum in T_5 (75% RDF + 25% Poultry manure) which was at par with T_2 (100% RDF) and T_3 (75% RDF + 25% FYM).

Test weight (g)

The data recorded on Test weight (g) have been summarized in Table 2. There was no significant difference among the treatments. T_5 (75% RDF + 25% Poultry manure) showed the highest test weight. Similar findings were observed by Xia *et al*. (2011) [29].

Table 2: Evaluation of Integrated nutrient management on Plant height (cm.), No. of tillers (g hill-1), Dry Matter Accumulation (g m-2) and Leaf Area Index of at 30, 60, 90 DAT and Harvest transplanted rice under irrigated condition

Treatments	Plant height (cm.)				No. of tillers (g hill^{-1})			
	at 30 DAT	at 60 DAT	at 90 DAT	at Harvest	at 30 DAT	at 60 DAT	at 90 DAT	at Harvest
T_1 Control	37.47	71.24	83.85	86.45	6.10	9.54	11.09	9.95
T_2 100% RDF	44.91	85.38	104.69	107.95	10.20	15.55	18.08	16.21
$T_3$75% RDF + 25% FYM	43.15	82.04	97.71	100.74	9.80	14.82	17.24	15.46
T_4 75% RDF + Azolla	42.65	81.09	96.58	99.58	9.10	14.23	16.55	14.84
$T_5$75% RDF + 25% Poultry manure	43.73	83.14	101.02	104.16	10.30	16.10	18.73	16.79
T_6 50% RDF + 50% FYM	41.25	78.42	93.41	96.31	8.50	13.29	15.46	13.86
T_7 50% RDF + Azolla	40.98	77.91	92.80	95.68	8.10	12.66	14.73	13.21
T_8 50% RDF + 25% Poultry manure	42.05	79.95	95.22	98.18	8.90	13.92	16.18	14.51
T_9 50% RDF + Azolla + 25% FYM	39.09	74.32	88.52	91.27	8.10	12.16	14.15	12.68
T_{10} 50% RDF + Azolla + 25% Poultry manure	40.05	76.14	90.69	93.51	8.30	12.98	15.09	13.53
T_{11} 50% RDF + 25% FYM + 25%Poultry manure	41.68	79.24	94.38	97.31	8.90	13.63	15.85	14.21
SEm±	0.61	1.94	2.88	3.10	0.28	0.36	0.44	0.47
CD	1.79	5.72	8.50	9.16	0.81	1.07	1.29	1.39

Treatments	Dry Matter Accumulation (g m^{-2})				Leaf Area Index			
	at 30 DAT	at 60 DAT	at 90 DAT	at Harvest	at 30 DAT	at 60 DAT	at 90 DAT	at Harvest
T_1 Control	196.18	383.72	604.32	782.13	1.10	2.09	2.38	1.95
T_2 100% RDF	242.96	506.18	880.34	1314.18	1.88	4.11	4.67	3.83
$T_3$75% RDF + 25% FYM	239.74	499.47	868.66	1296.75	1.77	3.85	4.38	3.59
T_4 75% RDF + Azolla	236.96	493.68	858.60	1281.73	1.73	3.74	4.26	3.49
$T_5$75% RDF + 25% Poultry manure	249.52	519.84	904.09	1349.64	1.83	3.98	4.53	3.71
T_6 50% RDF + 50% FYM	229.18	477.48	830.41	1239.65	1.55	3.37	3.84	3.14
T_7 50% RDF + Azolla	227.68	474.35	824.98	1231.54	1.47	3.20	3.64	2.98
T_8 50% RDF + 25% Poultry manure	233.63	486.74	846.52	1263.69	1.66	3.61	4.11	3.37
T_9 50% RDF + Azolla + 25% FYM	217.18	452.47	786.93	1174.74	1.35	2.94	3.34	2.74
T_{10} 50% RDF + Azolla + 25% Poultry manure	40.05	76.14	90.69	93.51	8.30	12.98	15.09	13.53
T_{11} 50% RDF + 25% FYM + 25%Poultry manure	41.68	79.24	94.38	97.31	8.90	13.63	15.85	14.21
SEm±	0.61	1.94	2.88	3.10	0.28	0.36	0.44	0.47
CD	1.79	5.72	8.50	9.16	0.81	1.07	1.29	1.39

Yield

Grain yield (t ha^{-1})

Critical observation of the data recorded on grain yield (t ha^{-1}) have been summarized in Table 3 The highest grain yield of 5.65 t ha^{-1} was recorded with treatment T_5 (75% RDF + 25% Poultry manure) which was significant over all the treatments. The lowest grain yield 2.88 t ha^{-1} was recorded with treatment T_1 (control). Combined use of organic manure and inorganic fertilizer can increase the grain yield. Khursheed *et al*. (2013) [30] found a similar set of findings.

Straw yield (t ha^{-1})

The data recorded on straw yield (t ha^{-1}) have been presented in Table 3. The higher straw yield of 7.46tha- 1which was recorded with T_5 (75% RDF + 25% Poultry manure), which was significant over all the treatments and at par with T_2, T_3, T_4. The lowest straw yield of 4.21 t ha^{-1} was recorded with treatment T_1 (Control). Similar findings reported by Liza *et al*. (2014) [31]

Total Biological yield (t ha^{-1})

The data recoded on biological yield (t ha^{-1}) have been given in Table 3. The highest biological yield of 13.10 t ha^{-1} was recorded treatment with T_5 (100% RDF + 25% Poultry manure) which was significant over all the treatments and at par with T_2 (100% RDF). The lowest biological yield was recorded with treatment T_1 (Control) with 7.09 t ha^{-1}.

Harvest index (%)

Harvest index indicates the relationship between economic yield and biological yield. The data presented in Table 3. It is clearly revealed from the data there was variation in harvest index among the treatments but it could not reach to the level of significance so the treatments are non-significant with each others. The maximum harvest index was recorded with T_5 (75% RDF + 25% Poultry manure) and minimum under T_1 (control). Integrated nutrient management can increase the harvest index. Ali *et al*. (2018) [32] found the similar result.

Table 3: Evaluation of Integrated nutrient management on Grain yield, Straw yield, Biological yield and Harvest index of transplanted rice under irrigated condition

Treatments	Grain Yield (t ha^{-1})	Straw Yield (t ha^{-1})	Biological Yield (tha^{-1})	Harvest index (%)
T_1 Control	2.88	4.21	7.09	40.56
T_2 100% RDF	5.34	7.06	12.40	43.08
$T_3$75% RDF + 25% FYM	5.25	6.98	12.23	42.92
T_4 75% RDF + Azolla	5.14	6.91	12.06	42.66
$T_5$75% RDF + 25% Poultry manure	5.65	7.45	13.10	43.12
T_6 50% RDF + 50% FYM	4.63	6.41	11.05	41.94
T_7 50% RDF + Azolla	4.49	6.27	10.76	41.76
T_8 50% RDF + 25% Poultry manure	4.96	6.70	11.67	42.54
T_9 50% RDF + Azolla + 25% FYM	4.04	5.71	9.74	41.43
T_{10} 50% RDF + Azolla + 25% Poultry manure	4.21	5.89	10.10	41.69
T_{11} 50% RDF + 25% FYM + 25%Poultry manure	4.86	6.65	11.51	42.24
SEm±	0.10	0.26	0.24	0.66
CD (P=0.05)	0.30	0.76	0.71	NS

Nutrient uptake

Nitrogen content and Nitrogen uptake

Nitrogen content in grain (%)

The data regarding nitrogen content in grain have been presented in Table 4 revealed that application of treatment T_2 (100% RDF) showed the maximum value but there was no significant differences among treatments. Minimum value was observed in T_1 (Control). Integrated use of fertilizer and organic manures can increase the nitrogen content in grain. Similar finding was observed by Bamugade (2007) [5].

Nitrogen content in straw (%)

The data regarding nitrogen content in grain have been presented in Table 4 revealed that application of treatment T_5 (75% RDF + 25% Poultry manure) showed the maximum value and it was at par with T_2, T_3, T_4, T_8 and T_{11}. Lowest value was seen by T_1 (Control). imilar results have the conformity with the results of Bari *et al*. 2013) [6].

Nitrogen uptake in grain (kgha^{-1})

The data relevant to nitrogen uptake in grain have been presented in Table 4 revealed that application of treatment T_5 (75% RDF + 25% Poultry manure) showed the highest value among all the treatments. T_1 (Control) showed the lowest value i.e., 32.67 kg ha^{-1}.

Nitrogen uptake in straw (kgha^{-1})

The data related to nitrogen uptake in grain have been presented in Table 4 revealed that application of treatment T_5 (75% RDF + 25% Poultrymanure) was significantly superior to all the treatments. Lowest value was observed by treatment T_1 (Control).

Total nitrogen uptake (kg ha^{-1})

The data recorded on total nitrogen uptake in rice have been presented in Table 4. Highest total nitrogen uptake was by treatment T_5 (75% RDF + 25% poultry manure) and lowest by T_1 (Control).T_5showed 100.36 kg ha^{-1}and T_1showed 48.64 kg ha^{-1}. These results corroborate with the findings of Kumar *et al*. (2006) [9].

Table 4: Evaluation of Integrated nutrient management on Nitrogen content and Nitrogen uptake by transplanted rice under irrigated condition

Treatments	Nitrogen content (%)		Nitrogen uptake (kgha^{-1})		
	Grain	Straw	Grain	Straw	Total
T_1 Control	1.136	0.379	32.67	15.97	48.64
T_2 100% RDF	1.216	0.429	64.93	30.27	95.20
$T_3$75% RDF + 25% FYM	1.191	0.427	62.53	29.81	92.34
T_4 75% RDF + Azolla	1.189	0.421	61.15	29.10	90.25
$T_5$75% RDF + 25% Poultry manure	1.202	0.436	67.88	32.48	100.36
T_6 50% RDF + 50% FYM	1.176	0.407	54.50	26.11	80.60
T_7 50% RDF + Azolla	1.164	0.403	52.31	25.26	77.57
T_8 50% RDF + 25% Poultry manure	1.185	0.415	58.80	27.82	86.62
T_9 50% RDF + Azolla + 25% FYM	1.157	0.392	46.70	22.37	69.07
T_{10} 50% RDF + Azolla + 25% Poultry manure	1.148	0.398	48.35	23.45	71.80
T_{11} 50% RDF + 25% FYM + 25% Poultry manure	1.178	0.412	57.27	27.39	84.66
SEm±	0.024	0.008	1.00	0.69	1.73
CD (P=0.05)	NS	0.025	2.94	2.03	5.09

Phosphorus content and Phosphorus uptake

Phosphorus content in grain (%)

The data regarding phosphorus content in grain have been presented in Table 5 revealed that application of treatment T_5 (75% RDF + 25% Poultry manure) showed the maximum value with 0.225 but there was no significant differences among treatments. Minimum value was observed in T_1 (Control) with 0.195. Organic manure and inorganic fertilizer can increase phosphorus content in grain Similar result was observed by Kumar *et al*. (2008) [10].

Phosphorus content in straw(%)

The data regarding phosphorus content in grain have been presented in Table 5 revealed that both the application of treatment T_5 (75% RDF + 25% Poultry manure) showed the maximum value and it was at par with T_2, T_3, and T_4. Lowest value was observed by T_1 (Control).

Phosphorus uptake in grain (kgha^{-1})

The data relevant to phosphorus uptake in grain have been presented in Table 5 revealed that application of treatment T_5 (75% RDF + 25% Poultry manure) showed the highest value 12.71 kg ha^{-1} among all the treatments and it showed at par with $T_2$and T_3. T_1 (Control) showed the lowest value i.e., 5.61 kg ha^{-1}.

Phosphorus uptake in straw (kgha^{-1})

The data related to Phosphorus uptake in grain have been presented in Table 5 revealed that application of treatment T_5 (75% RDF + 25% Poultry manure) was significantly superior to all the treatments and was at par with T_2, and T_3. Lowest value was obtained by treatment T_1 (Control).

Total phosphorus uptake (kgha^{-1})

The data recorded on total phosphorus uptake in rice have been presented in Table 5. Highest total phosphorus uptake was by treatment T_5 (75% RDF + 25% poultry manure) and lowest by T_1 (Control). T_5 showed at par with $T_2$and T_3. T_5 observed with value 21.05 and T_1 by 9.40. Similar results observed by Sabina Ahmed *et al*. (2014) [33].

Table 5: Evaluation of Integrated nutrient management on Phosphorus content and Phosphorus uptake by transplanted rice under irrigated condition

Treatments	Phosphorus content (%)		Phosphorus uptake (kg ha^{-1})		
	Grain	Straw	Grain	Straw	Total
T_1 Control	0.195	0.090	5.61	3.79	9.40
T_2 100% RDF	0.223	0.109	11.91	7.69	19.60
$T_3$75% RDF + 25% FYM	0.219	0.108	11.50	7.54	19.04
T_4 75% RDF + Azolla	0.217	0.107	11.16	7.40	18.56
$T_5$75% RDF + 25% Poultry manure	0.225	0.112	12.71	8.34	21.05
T_6 50% RDF + 50% FYM	0.207	0.102	9.59	6.54	16.13
T_7 50% RDF + Azolla	0.207	0.101	9.30	6.33	15.63
T_8 50% RDF + 25% Poultry manure	0.214	0.104	10.62	6.97	17.59
T_9 50% RDF + Azolla + 25% FYM	0.205	0.098	8.27	5.59	13.87
T_{10} 50% RDF + Azolla + 25% Poultry manure	0.201	0.095	8.47	5.60	14.06
T_{11} 50% RDF + 25% FYM + 25%Poultry manure	0.210	0.104	10.21	6.91	17.12
SEm±	0.006	0.002	0.42	0.29	0.68
CD (P=0.05)	NS	0.006	1.23	0.84	2.01

Potassium content and Potassium uptake

Potassium content in grain(%)

The data regarding Potassium content in grain have been presented in Table 6 revealed that application of treatment T_5 (75% RDF + 25% Poultry manure) showed the maximum value with 0.356% which was at par with T_2,T_3,T_4,T_8 and T_{11}.. Minimum value was observed in T_1 (Control) with 0.327%.

Potassium content in straw (%)

The data regarding Potassium content in grain have been presented in Table 6 revealed that both the application of treatment T_5 (75% RDF + 25% Poultry manure) showed the maximum value i.e., 1.462% and it was at par with T_2, T_3, T_4, $T_8$and T_{11}. Lowest value of 1.286% was seen by T_1 (Control).

Potassium uptake in grain (kg ha^{-1})

The data relevant to Potassium uptake in grain have been presented in Table 6 revealed that application of treatment T_5 (75% RDF + 25% Poultry manure) showed the significantly superior most value 20.10 kg ha^{-1} among all the treatments. T_1 (Control) showed the lowest value i.e., 9.40 kg ha^{-1}.

Potassium uptake in straw (kg ha^{-1})

The data related to Potassium uptake in grain have been presented in Table 6 revealed that application of treatment T_5 (75% RDF + 25% Poultry manure) was significantly maximum to all the treatments with value 108.91 kg ha^{-1} and it was at par with T_3. Lowest value was obtained by treatment T_1 (Control) i.e., 54.20 kgha^{-1}.

Total Potassium uptake (kg ha^{-1})

The data recorded on total potassium uptake in rice have been presented in Table 6. Highest total Potassium uptake was by treatment T_5 (75% RDF + 25% poultry manure) and lowest by T_1 (Control). The value of $T_5$was 129.01 which observed at par with T_2, $T_3$and T_4. Combined Evaluation of organic and inorganic source can increase the potassium uptake by crop. Similar finding was observed by Yadav *et al*. (2010) [21].

Table 6: Evaluation of Integrated nutrient management on Potassium content and Potassium uptake by transplanted rice under irrigated condition

Treatments	Potassium Content (%)		Potassium Uptake (kg ha^{-1})		
	Grain	Straw	Grain	Straw	Total
T_1 Control	0.327	1.286	9.40	54.20	63.60
T_2 100% RDF	0.352	1.441	18.80	101.67	120.46
T_3 75% RDF + 25% FYM	0.349	1.435	18.32	100.19	118.51
T_4 75% RDF + Azolla	0.348	1.428	17.90	98.70	116.60
$T_5$75% RDF + 25% Poultry manure	0.356	1.462	20.10	108.91	129.01
T_6 50% RDF + 50% FYM	0.341	1.401	15.80	89.86	105.66
T_7 50% RDF + Azolla	0.340	1.401	15.28	87.82	103.10
T_8 50% RDF + 25% Poultry manure	0.345	1.414	17.12	94.78	111.90
T_9 50% RDF + Azolla + 25% FYM	0.336	1.380	13.56	78.75	92.31
T_{10} 50% RDF + Azolla + 25% Poultry manure	0.337	1.398	14.19	82.36	96.55
T_{11} 50% RDF + 25% FYM + 25% Poultry manure	0.344	1.414	16.73	94.00	110.73
SEm ±	0.004	0.018	0.44	3.85	4.36
CD (P=0.05)	0.013	0.054	1.28	11.34	12.88

Soil properties after harvesting

Soil pH

The data pertaining to pH of soil after harvesting of rice are presented in Table 7 reveals that the soil pH was higher in T_1 (control) i.e., 8.39. The lowest value was found with T_9 (50% RDF + Azolla + 25% FYM). INM practices had less significant differences on soil PH. Organic manure can decrease the soil pH. Similar result discussed by Kumar *et al*. (2012) [34]

Soil EC (dsm^{-1})

The data relevant to EC of soil after harvesting of rice are presented in Table 7 reveals that soil EC was highest under treatment T_1 (Control) which was highest among overall treatments and lowest EC was found under T_9 (50% RDF + Azolla + 25% FYM). Combined use of organic manure and inorganic fertilizer can decrease the soil EC. Similar result observed by Tiwari *et al*. (2011) [19]

Organic carbon (%)

The data regarding to soil organic carbon after the harvesting of rice presented in Table 7. It is observed that organic carbon was highest under treatment T_9 (50% RDF + Azolla + 25% FYM) and lowest under treatment T_1 (Control). Organic manure can lead to increase the carbon content of soil. Similar results were given by Kumar *et al*. (2008) [10], Vipin *et al*. (2011) [19].

Soil bulk density (gcm-3)

The data related to soil bulk density (g cm-3) of soil after the harvesting of the crop are presented in Table 7. It is resulted that T_8 (50% RDF + 25%Poultry manure) showed minimum bulk density and T_1 (Control) showed maximum bulk density. Organic matter could enhance soil resistance to compaction through several mechanisms and provided a higher porosity and lower soil bulk density. Similar finding was reported by Papini *et al*. (2011) [11].

Table 7: Evaluation of Integrated nutrient management on soil pH, electrical conductivity, organic carbon and bulk density of soil after the harvesting of transplanted rice under irrigated condition

Treatments	PH (1:2.5)	EC (dsm^{-1})	Organic carbon (%)	Bulk density (gm cm-3)
T_1 Control	8.39	0.35	0.30	1.45
T_2 100% RDF	8.24	0.34	0.31	1.44
T_3 75% RDF + 25% FYM	8.14	0.33	0.33	1.41
T_4 75% RDF + Azolla	8.09	0.31	0.36	1.41
T_5 75% RDF + 25% Poultry manure	8.19	0.34	0.32	1.42
T_6 50% RDF + 50% FYM	8.04	0.29	0.38	1.39
T_7 50% RDF + Azolla	7.99	0.29	0.40	1.38
T_8 50% RDF + 25% Poultry manure	8.13	0.33	0.34	1.37
T_9 50% RDF + Azolla + 25% FYM	7.87	0.27	0.42	1.38
T_{10} 50% RDF + Azolla + 25% Poultry manure	7.94	0.28	0.41	0.41
T_{11} 50% RDF + 25% FYM + 25% Poultry manure	8.12	0.33	0.34	1.40
SEm ±	0.06	0.01	0.01	0.02
CD (P=0.05)	0.18	0.03	0.04	0.05

Available Nitrogen, Phosphors and Potassium in soil

Available Nitrogen (kgha^{-1})

The data pertaining to available Nitrogen of soil after harvesting of rice are presented in Table 8. The higher available nitrogen in soilwas 178.44 kgha^{-1} which was found in treatment T_4 (75% RDF + Azolla) which was at par with T_2 (100% RDF) and T_5 (75% RDF + 25% Poultry manure). The lowest value was recorded with T_1 (control) having value 145.36 kg ha^{-1}. Inoculation of green Azolla can enhance the microbial activities and helps to increase the nutrient availability of soil. Roy *et al*. (2016) [35] observed similar findings.

Available Phosphorus (kgha^{-1})

The data relevant to available Phosphorus of soil after harvesting of rice are presented in Table 8. The higher available phosphorus in soil was recorded with treatment T_5 (75% RDF + 25% Poultry manure) i.e., 18.68 kg ha^{-1} which was at par with T_2 (100% RDF) and T_3 (75% RDF + 25% FYM). However, the lowest available phosphorus was recorded under the treatment T_1 (control). Integrated nutrient management technique resulted in a positive influx of nutrients by increasing available Phosphorus in soil. Similar findings were observed by Walia *et al*. (2010) [20] [20], Tilahun *et al*. (2013) [18].

Available Potassium (kg ha^{-1})

The data related to available Potassium of soil after harvesting of rice are presented in Table 8. There were significant differences among the treatments. T_5 (75% RDF + 25% Poultry manure) gave the highest result among all the treatments. Combined use of both organic and inorganic fertilizer can increase availability of Potassium in the soil. Similar result was reported by Kumar *et al*. (2012) [34].

Table 8: Evaluation of Integrated nutrient management on available Nitrogen, Phosphors and Potassium in soil after harvesting of transplanted rice under irrigated condition

Treatments	Available Nitrogen (kg ha^{-1})	Available Phosphorus (kg ha^{-1})	Available Potassium (kg ha^{-1})
T_1 Control	145.56	13.34	246.26
T_2 100% RDF	172.84	18.39	270.54
$T_3$75% RDF + 25% FYM	174.44	18.25	268.38
T_4 75% RDF + Azolla	178.59	17.87	262.82
$T_5$75% RDF + 25% Poultry manure	172.84	18.68	274.76
T_6 50% RDF + 50% FYM	160.80	16.82	247.39
T_7 50% RDF + Azolla	157.50	16.47	242.31
T_8 50% RDF + 25% Poultry manure	168.37	17.61	259.04
T_9 50% RDF + Azolla + 25% FYM	154.31	16.14	237.41
T_{10} 50% RDF + Azolla + 25% Poultry manure	155.34	16.25	238.99
T_{11} 50% RDF + 25% FYM + 25%Poultry manure	164.41	17.20	252.95
SEm ±	2.36	0.50	3.05
CD (P=0.05)	6.96	1.48	8.99

Conclusions

Among the various treatments conclusions are drawn based on Growth, yield and quality of transplanted rice were observed maximum with the application of 75% RDF with 25% Poultry manure that showed significant higher result. It can also be concluded that the treatment of 100% RDF resulted in the maximum height and leaf area index of rice plants across all growth stages: 30, 60, and 90 days after transplanting (DAT), as well as at harvest. 100% RDF had a significant positive impact on the height of the rice plants throughout their growth cycle.75% RDF with 25% Poultry manure recorded highest nutrient uptake as compared to other treatments.

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