International Journal of Advanced Biochemistry Research

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; 8(10): 255-261
www.biochemjournal.com
Received: 07-07-2024
Accepted: 11-08-2024

Parmanand Verma
Department of Soil Science, IGKV, Raipur, Chhattisgarh, India

Dr. Rakesh BanwasiSenior
Scientist, Department of Soil Science, IGKV, Raipur, Chhattisgarh, India

Dr. LK Srivastava
Professor and Head, Department of Soil Science, IGKV, Raipur, Chhattisgarh, India

Dr. Gaurav Jatav
Scientist, Department of Soil Science, IGKV, Raipur, Chhattisgarh, India

Nainsi Naya
Ph.D. Scholar, Department of Soil Science, IGKV, Raipur, Chhattisgarh, India

Corresponding Author:
Parmanand Verma
Department of Soil Science, IGKV, Raipur, Chhattisgarh, India

Impact of poultry litter on yield and economic feasibility of rice under rice-wheat cropping system in a *Vertisol*

Parmanand Verma, Dr. Rakesh Banwasi, Dr. LK Srivastava, Dr. Gaurav Jatav and Nainsi Naya

DOI: https://doi.org/10.33545/26174693.2024.v8.i10d.2443

Abstract
An investigation to assess the Impact of Poultry Litter on yield and economic feasibility of rice under rice-wheat cropping system was carried out during the *kharif* seasons of 2022 and 2023 at College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.). The experiment was laid down in Randomized Block Design (RBD) with twelve treatments which replicated thrice. The treatments were included T1- Control (No NPK, No organics), T2-100% RDF @ 120:60:40 kg/ha N, P_2O_5, and K_2O), T3- Poultry Litter @ 2 t/ha+ NPK adjusted as 100% RDF through Chemical fertilizer, T4- Poultry Litter @ 4 t/ha+ NPK adjusted, T5, T6 and T7 were comprises sole application of PL @ 4, 6 and 8 t/ha, respectively., T8 and T9 were 50 and 100% Phosphorous through PL + NPK adjusted and T10, T11 and T12 were combinations of PL and FYM @ 1, 2 and 3 t/ha each respectively, with NPK adjusted. NPK adjusted means balanced dose of NPK adjusted to meet 100% RDF (@ 120 kg N, 60 kg P_2O_5, and 40 kg K_2O per hectare) through the chemical fertilizer.
The results revealed that various growth and yield attributing parameters in rice (plant height, number of tillers per plant, effective tillers per hill, panicle length and panicle weight) were significantly influenced by applied poultry litter. The highest grain yield of rice (59.12 q/ha) was recorded with 100% RDF. The grain and straw yield of rice was also significantly affected by application of PL and FYM with adjusted nutrient dose through chemical fertilizer. The grain yield of rice was also recorded maximum with application of PL @ 1t/ha +FYM @ 1t/ha + NPK adj (57.08 q/ha), PL @ 2t/ha + NPK adj. (56.03 q/ha) and PL @ 2 t/ha +FYM @ 2 t/ha + NPK adj. (55.44 q/ha) which were found statistically at par with the highest yielded treatment of 100% RDF (T2) and identified as best treatment combinations. The study of economic feasibility of poultry litter under rice-wheat cropping system showed that in the rice, the highest B:C ratio (2.83) was estimated in 100 % RDF (T2). Treatments T10 (PL @ 1 t ha^{-1} + FYM @ 1 t ha^{-1} + NPK adjusted) T3 (PL @ 2 t ha^{-1} + NPK adjusted) and T11 (PL @ 2 t ha^{-1} + FYM @ 2 t ha^{-1} + NPK adjusted) also showed best and comparable B:C ratio 2.83, 2.81 and 2.78 respectively.

Keywords: Rice, poultry litter, FYM, growth, yield, economics

Introduction
Modern Indian agriculture is increasingly focusing on organic manures over inorganic fertilizers. Organic manures like FYM, poultry litters, biogas-slurry, and vermicompost are rich in growth hormones and enzymes, enhancing soil fertility and productivity. They also improve the efficiency of inorganic fertilizers (Singh and Biswas, 2000) [12].
Poultry litter, a byproduct of poultry farming, is an effective organic manure containing essential nutrients like nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, zinc, copper, and manganese (Almaz, M.G. 2017) [2]. It includes bedding material, litter, and feathers from various poultry types.
The total poultry population in India is 851.81 million in 2019, increased by 16.8% over the previous Census of 2012. The highest poultry producing state is Tamil Nadu (120.8 million) followed by Andhrapradesh with 107.9 million population (Ministry of Fisheries, Animal Husbandry & Dairying, 2019) [3]. Total poultry population of Chhattisgarh was 18.712 million (Animal census 20th, 2019). It is estimated that one tonne of poultry litter is generated annually through the excreta of 40 to 50 birds when the birds are reared in the deep litter

system. According to an estimation a total of 21.27 and 0.467 million-ton poultry waste produce per year in India and Chhattisgarh respectively.

Materials and Methods

A field experiment was carried out to investigate the "Impact of Poultry Litter on yield and economic feasibility of rice under rice-wheat cropping system" in a Vertisol of Chhattisgarh. The experiment was conducted during the *kharif* seasons of 2022 and 2023 at College of Agriculture, IGKV, Raipur (C.G.)., which is situated in central part of Chhattisgarh.

The experiment was laid down in Randomized Block Design (RBD) with twelve treatments (Table-01) which replicated thrice. The treatments were included T_1- Control (No NPK, No organics), T_2-100% RDF @ 120:60:40 kg/ha N, P_2O_5, and K_2O), T_3- Poultry Litter @ 2 t/ha+ NPK adjusted as 100% RDF through Chemical fertilizer, T_4- Poultry Litter @ 4 t/ha+ NPK adjusted, T_5, T_6 and T_7 were comprises sole application of PL @ 4, 6 and 8 t/ha, respectively., T_8 and T_9 were 50 and 100% Phosphorous through PL + NPK adjusted and T_{10}, T_{11} and T_{12} were combinations of PL and FYM @ 1, 2 and 3 t/ha each respectively, with NPK adjusted. NPK adjusted means balanced dose of NPK adjusted to meet 100% RDF (@ 120 kg N, 60 kg P_2O_5, and 40 kg K_2O per hectare) through the chemical fertilizer. The initial characters and nutrient content in poultry litter and FYM are given in the table-02.

Observations were recorded time to time as per the objectives of the studies. Plant height was measured during different growth stages i.e. 30 DAT, 60 DAT, 90 DAT and at the harvest. Ten hills from each plot were randomly selected and total number of tillers per hill were counted. Numbers of effective tillers per square meter were counted from the center of each plot. Panicle length and panicle weight were recorded from ten randomly selected panicles of rice. Grain and straw yields of rice were recorded in kg per plot and converted in to quintal per hectare. Test weight was recorded from randomly collected 1000 grains which were taken from the cleaned grain produce of each treatment. Cost of cultivation and gross return (Rs ha^{-1}) for each treatment were calculated by converting the harvest into monetary terms of the prevailing market rate during the studies. The benefit: cost ratio was calculated by gross return and total cost of cultivation.

Table 1: Treatment details

Treat No.	Treatment details for rice
T_1	Control (No fertilizer, no poultry litter)
T_2	100 % RDF @ 120:60:40 kg ha^{-1} N, P_2O_5, K_2O
T_3	Poultry Litter @ 2t ha^{-1} + NPK adjusted with chemical fertilizer as per RDF
T_4	Poultry Litter @ 4 t ha^{-1} + NPK adjusted with chemical fertilizer as per RDF
T_5	Poultry Litter @ 4 t ha^{-1}
T_6	Poultry Litter @ 6 t ha^{-1}
T_7	Poultry Litter @ 8 t ha^{-1}
T_8	50% P though Poultry Litter + NPK adjusted with chemical fertilizer as per RDF
T_9	100% P though Poultry Litter + NK adjusted with chemical fertilizer as per RDF
T_{10}	Poultry Litter @ 1t ha^{-1} +FYM @1t ha^{-1} + NPK adjusted with chemical fertilizer as per RDF
T_{11}	Poultry Litter @ 2t ha^{-1} +FYM @2t ha^{-1} + NPK adjusted with chemical fertilizer as per RDF
T_{12}	Poultry Litter @ 3t ha^{-1} +FYM @3t ha^{-1} + NPK adjusted with chemical fertilizer as per RDF

Table 2: Nutrient content in Poultry litter and FYM

Parameters	Poultry litter 2022	Poultry litter 2023	FYM 2022	FYM 2023
pH (1:5)	7.48	7.51	7.13	7.17
EC (ds m^{-1})	0.54	0.55	0.31	0.32
N content (%)	2.08	2.12	0.43	0.45
P content (%)	1.09	1.13	0.25	0.27
K content (%)	0.65	0.68	0.83	0.86
C:N ratio	31.51	28.34	17.12	18.66

Results and Discussion

Plant height

Plant height of rice at 30, 60, and 90 days after transplanting (DAT) and at the harvest indicates that the highest plant height was observed with 100% RDF, while the lowest height was recorded in the control treatment (table 3). In kharif 2022, the 100% RDF treatment resulted maximum plant heights of 58.07 cm, 88.87 cm, 121.34 cm, and 123.27 cm at 30, 60, 90 DAT, and the harvest, respectively. The combination of PL with FYM and adjusted NPK ratios often resulted in comparable or improved heights, suggesting a synergistic effect between organic and inorganic fertilizers. Similar trends were also observed in kharif 2023. The results showed the positive effect of readily available nitrogen fertilizer on vegetative growth of rice.

No. of tillers per hill

The data of number of total tillers per hill of rice at 30, 60, and 90 days after transplanting (DAT) and at harvest (table 4). shows that the highest tillers were observed with the application of 100% RDF, while the lowest were recorded in the control. The data of 2022, there were no significant differences in tiller counts at 30 DAT among the treatments, but by 60 DAT, 90 DAT, and harvest, the 100% RDF treatment had the highest tiller numbers, ranging from 6.95 to 7.03 tillers per hill. Treatments with poultry litter (PL) at 2 and 4 t/ha combined with adjusted NPK ratios (T_3, T_4) showed generally positive impacts compared to the control. Combining PL with farmyard manure (FYM) and adjusted NPK ratios (T_{10}, T_{11}, T_{12}) resulted in comparable or slightly improved tiller counts over PL alone. In 2023, similar trends

were observed with the 100% RDF treatment showing the highest tiller counts, ranging from 5.30 to 7.49 tillers per hill. The combined use of PL, FYM, and adjusted NPK ratios consistently showed a synergistic effect, significantly increasing tiller counts over sole PL or control treatments. Organic sources offer more balanced nutrition to the plants, especially micro nutrients which has caused better affectivity of tiller in plants grown with poultry manure and vermicompost (Miller, 2007). Similar results also reported by Anvesh *et al.* (2023) [4], Alam *et al*. (2021) [1], and Usman *et al*. (2003) [13].

Effective tillers per hill

At the final stage of the crop, the total number of tillers recorded at harvest represented the actual number of effective tillers per hill (table 5). In 2022, the highest number of effective tillers per hill (7.03) was recorded with 100% RDF and was found statistically at par with the combination of poultry litter (PL) and farmyard manure (FYM) with adjusted chemical fertilizers (T_{10} and T_{11}). In 2023, 100% RDF treatment (T_2) was observed statistically higher effective tillers among all the treatments. The mean data of two year also showed the similar trends which indicating the strong stimulatory effect of inorganic and integrated nutrient management.

Similar result of higher number of effective tillers in combined application of inorganic with poultry manure also reported by Hasanuzzaman *et al.* (2010) [9]. He also stated that excess application of inorganic fertilizers is not necessary to produce effective tillers if we can supplement it from organic manures.

Length of panicle of rice (cm)

The length of panicles of rice crops were ranged 19.62 - 23.11 cm in 2022 and 18.30 -20.86 cm in 2023 (Table 6). In 2022, the longest panicles were recorded under the 100% RDF treatment (23.11 cm), which was statistically at par with application PL @ 2 t/ha + NPK adj. (T_3), PL @ 1 t/ha + FYM @ 1 t/ha + NPK adj. (T_{10}), and PL @ 2 t/ha + FYM @ 2 t/ha + NPK adj. (T_{11}). In 2023, the highest panicle length (20.86 cm) with 100% RDF was followed similar trend as previous season. Mean data from the two years showed panicle lengths ranging from 18.96 cm (control) to 21.98 cm (100% RDF) also confirming the observed trends. Increase in panicle length in response to combined use of organic and inorganic fertilizers is might be due to more availability of macro as well as micro nutrients. Arif, M. (2014) [5] similarly concluded that the combine application of poultry manure or FYM with 50% RDF significantly increased panicle length over alone application of poultry manure and found at par with 100% RDF. Similar results were also reported by Babu *et al*. (2001) [7] and Awan *et al*. (2011) [6].

Weight of panicle

Weight of rice panicles were ranged 3.69 - 5.24 g in 2022 and 3.36 - 5.10 g in 2023 (Table 6). In the year 2022, the highest panicle weight was recorded in the 100% RDF treatment (5.24 g), which was at par with treatments combining poultry litter and farmyard manure (@ 1, 2, and 3 t/ha each) with adjusted NPK through inorganic fertilizers. In 2023, the significantly highest panicle weight 5.10g was recorded in the 100% RDF, among all the treatments. The mean panicle weight of two years ranged from 3.43 g (control) to 5.17 g (100% RDF), showing similar trends and results as those observed in 2022. Higher weight of panicles in 100% RDF and combination of poultry litter with inorganic fertilizers may be due to the higher length of panicles in the above treatments (Table 6) and also due to high amount of macro and micronutrient availability in integrated treatments.

Test weight of rice (1000 grains)

The data on the test weight of rice grain (Table 6) showed non-significant differences among the treatments. In 2022, the test weight was ranged 30.44 - 30.03 grams. And in 2023, the test weight was ranged 29.80- 30.20 grams. Results also showed slightly declined test weight in single applications of organic manures and in control treatments, which may be due to essential nutrient deficiencies in these treatments. The mean data of two years also showed consistent trends, reinforcing the non-significant effect of various treatments on test weight of rice. The results indicate that test weight was primarily influenced by the genetic potential of the rice variety. Test weight is mostly genetically fixed factor by the individual variety and not much influenced by nutrient levels. No significant difference due to different levels of NPK on test weight of rice was also reported by Srinivas *et al*. (2017) [16] and Rahman *et al*. (2007) [13].

Grain yields of rice crop

In 2022, rice grain yields showed significant variation across different fertilization treatments. The highest yield of 59.63 q ha^{-1} was achieved with 100% RDF (T_2), which was statistically at par with application PL @ 1t/ha + FYM @ 1t/ha + NPK adj. (57.54 q ha^{-1}), PL @ 2 t/ha + FYM @ 2 t/ha + NPK adj. (55.93 q/ha) and PL @ 2 t/ha + NPK adj. (55.87 q/ha). Lowest yield (27.03 q/ha) was recorded in control

Similar trends were also observed in 2023 and mean of two year data of grain yields. The highest mean grain yield was recorded in 100% RDF (59.12q/ha) and found at par with PL @ 1t/ha + FYM @ 1t/ha + NPK adj. (57.08 q/ha), PL @ 2t/ha + NPK adj. (56.03 q/ha) and PL @ 2t/ha + FYM @ 2t/ha + NPK adj. (55.44 q/ha). Lowest mean grain yield (26.60 q/ha) was recorded in control (table 8). The result showed that combined application of poultry litter and farmyard manure with adjusted NPK ratios were performed well and highlighting the impact of integrated nutrient management on yield outcomes. Across both years, the integration of poultry litter and farmyard manure with inorganic fertilizers consistently outperformed over the sole applications of organic.

Integrated approach not only enhanced grain yields but also maintained a balanced nutrient supply critical for sustained crop health and productivity. These findings align with research emphasizing the synergistic benefits of combining organic and chemical fertilizers to achieve higher and more stable rice yields over time. Rahman *et al.* (2018) also revealed the positive results of integrated application of poultry manure (PM) and chemical fertilizers on yield of rice and reported that application of poultry manure @ 2 t ha^{-1} with adjusted IPNS based chemical fertilizer were statistically higher over the 100% soil test based chemical fertilization. Similar result were also reported by other researchers Laxminarayana (2006) [11], Hossaen *et al.* (2011) [11] and Chaudhary *et al*. (2014) [8].

Straw yields of rice crop

In 2022, the highest straw yield of 68.87 q/ha was achieved with the application of 100% RDF (T_2), which significantly outperformed all other treatments including T_3 to T_{12} and the control (T_1) that received no fertilizers (31.88 q/ha). Among the treatments involving poultry litter (PL), PL @ 2 t/ha + NPK adj. (T_3) yielded 62.18 q/ha, while PL @ 4 t/ha + NPK adj. (T_4) resulted in 57.84 q/ha. Sole applications of PL (T_5, T_6, T_7) showed dose-dependent increases in straw yield, with PL @ 8 t/ha (T_7) producing the highest yield of 50.87 q/ha. (table 8)

The effect of phosphorus application through poultry litter showed that T_8 (50% P through PL) produced a straw yield of 59.42 q/ha, which was significantly higher than T_9 (100% P through PL, 52.17 q/ha). Combined applications of poultry litter and FYM with adjusted NPK ratios (T_{10}, T_{11}, T_{12}) recorded straw yields ranging from 57.52 to 61.55 q/ha, demonstrating their effectiveness compared to the control.

In 2023, similar trends were observed in straw yield compared to 2022. Once again, 100% RDF (T_2) yielded the highest straw yield of 66.92 q/ha, followed closely by PL @ 2 t/ha + NPK adj. (T_3) and 50% P through PL (T_8) which were at par with each other. T_3 recorded a straw yield of 63.59 q/ha, while T_8 produced 62.22 q/ha.

Sole applications of poultry litter (T_5, T_6, T_7) showed increasing straw yields with higher doses, with T_7 (PL @ 8 t/ha) and T_6 (PL @ 6 t/ha) yielding 50.57 q/ha and 46.99 q/ha respectively, both significantly higher than T_5 (PL @ 4 t/ha). Similar to 2022, T_8 (50% P through PL) outperformed T_9 (100% P through PL) in terms of straw yield.

The mean straw yield over both years ranged from 30.99 to 67.90 q/ha. Treatments involving 100% RDF consistently provided the highest straw yields by meeting the plant's nutritional requirements through inorganic fertilizers. This aligns with previous studies highlighting the efficacy of balanced nutrient management in maximizing rice straw production.

Overall, integrating organic amendments like poultry litter and farmyard manure with adjusted NPK fertilization strategies showed significant potential in enhancing rice straw yield compared to sole applications or no fertilization, emphasizing the importance of nutrient balance in crop management practices. Similar result was also found by Rahman *et al*. (2018), Laxminarayana (2006) [11], Hossaen *et al.* (2011) and Chaudhary *et al*. (2014) [8].

Economic feasibility of poultry litter with organic and inorganic fertilizer of rice

The benefit-cost ratio (B:C ratio) analysis for rice cultivation using poultry litter and organic manure over the years 2022 and 2023 highlights several key findings (Table 9). Data of net return showed that, among all the treatments, 100% RDF and PL @ 2 t ha^{-1} + NPK adjusted (T_3) were found best with the highest mean net returns of ₹ 80623.78 and ₹ 77079.37 per ha, respectively. Among all the treatments, the highest benefit: cost ratio 2.83 was estimated in 100% RDF. Treatments of application of PL @ 1 t ha^{-1} + FYM @ 1 t ha^{-1} + NPK adjusted, PL @ 2 t ha^{-1} + NPK adjusted and PL @ 2 t ha^{-1} + FYM @ 2 t ha^{-1} + NPK adjusted were also showed best and comparable B:C ratio 2.83, 2.81 and 2.78, respectively.

Table 3: Effect of poultry litter with organic and inorganic fertilizers on plant height of rice (cm)

Treatment Details		Plant height 2022				Plant height 2023			
		30 DAT	60 DAT	90 DAT	At harvest	30 DAT	60 DAT	90 DAT	At harvest
T_1	Control (0:0:0)	44.87f	66.85e	93.79f	95.72e	31.29f	46.49g	91.48g	93.28g
T_2	100% RDF (120:60:40)	58.07a	88.87a	121.34a	123.27a	44.69a	81.11a	118.80a	120.60a
T_3	PL @ 2t/ha (poultry litter) + NPK adj.	54.97b	84.74abc	117.69b	118.62b	40.28bcd	76.69abc	114.02bc	115.82bc
T_4	PL @ 4t/ha + NPK adj.	54.17bc	85.88ab	113.60b	115.53b	36.47de	73.82c	113.29bc	114.09bc
T_5	PL @ 4t/ha	47.13e	68.11e	93.45f	95.38e	31.59f	54.30f	95.01f	96.81g
T_6	PL @ 6t/ha	49.07de	70.99de	96.71ef	98.64e	35.9e	58.04ef	98.87f	100.67f
T_7	PL @ 8t/ha	53.23b	77.60cd	102.75de	104.68d	41.44abc	74.72bc	105.42e	107.22e
T_8	50% P though PL + NPK adj.	53.03b	87.47a	114.05b	115.98b	38.43cde	73.79c	114.14bc	115.64bc
T_9	100% P though PL + NK adj.	50.60d	80.14bc	108cd	110.02c	40.82bc	64.77de	107.47de	109.27de
T_{10}	PL @ 1t/ha +FYM @1t/ha + NPK adj.	54.37b	87.45a	119.01ab	121.94ab	39.02cde	79.99ab	115.68ab	117.48ab
T_{11}	PL @ 2t/ha +FYM @2t/ha + NPK adj.	53.20bc	90.06a	112.08bc	116.01bc	42.44abc	71.13cd	112.98bc	114.78bc
T_{12}	PL @ 3t/ha +FYM @3t/ha + NPK adj.	52.60bcd	88.86a	113.05bc	114.98b	43.54ab	73.85c	110.72cd	112.52cd
	S.Em (±)	0.74	2.32	1.44	1.43	1.19	1.74	1.17	1.16
	C.D. (P= 0.05)	2.19	6.82	4.21	4.20	3.50	5.10	3.43	3.42

Table 4: Effect of poultry litter with organic and inorganic fertilizers on total no. of tillers per hill of rice (Nos.)

Treatment details		Total no. of tillers per hill during 2022 (Nos.)				Total no. of tillers per hill during 2023 (Nos.)			
		30 DAT	60 DAT	90 DAT	At Harvest	30 DAT	60 DAT	90 DAT	At Harvest
T_1	Control (0:0:0)	3.13	3.75h	4.00h	3.88h	3.73d	4.05g	4.10f	3.99f
T_2	100% RDF (120:60:40)	4.63	6.95a	7.15a	7.03a	5.30a	6.90a	7.60a	7.49a
T_3	PL @ 2t/ha (poultry litter) + NPK adj.	4.17	5.65cd	6.95cde	6.63cde	4.77bc	5.87cde	6.40bc	6.69bc
T_4	PL @ 4t/ha + NPK adj.	3.93	5.07def	5.40ef	5.28ef	4.03d	5.45def	5.72de	5.61de
T_5	PL @ 4t/ha	3.23	3.87h	4.20h	4.08h	3.77d	4.18g	4.43f	4.32f
T_6	PL @ 6t/ha	4.10	4.90ef	5.17fg	5.05gh	4.57c	5.37ef	5.57e	5.46e
T_7	PL @ 8t/ha	3.63	4.97gh	5.58gh	5.17fg	4.70bc	5.45f	5.67e	5.63e
T_8	50% P though PL + NPK adj.	4.07	6.20bc	6.37bcd	6.25bcd	4.87bc	6.10bc	6.77bc	6.36bc
T_9	100% P though PL + NK adj.	3.93	4.70fg	5.17fg	5.10fg	4.47c	5.03f	5.43e	5.32e
T_{10}	PL @ 1t/ha +FYM @1t/ha + NPK adj.	4.23	6.65ab	6.92ab	6.80ab	5.03ab	6.42ab	6.93b	6.82b
T_{11}	PL @ 2t/ha +FYM @2t/ha + NPK adj.	3.80	6.40abc	6.80abc	6.48abc	4.87ab	6.28bc	6.57bc	6.46bc
T_{12}	PL @ 3t/ha +FYM @3t/ha + NPK adj.	3.90	5.50cde	5.77def	5.65def	4.63bc	6.18bcd	6.23cd	6.12cd
	S.Em (±)	0.32	0.24	0.23	0.23	0.14	0.18	0.19	0.18
	C.D. (P=0.05)	NS	0.70	0.69	0.68	0.41	0.54	0.55	0.54

Table 5: Effect of poultry litter with organic and inorganic fertilizers on effective tillers per hill at harvest of rice (Nos.)

Treatment details		Effective tillers per hills (Nos.)		
		2022	2023	Mean
T_1	Control (0:0:0)	3.88h	3.99f	3.94h
T_2	100% RDF (120:60:40)	7.03a	7.49a	7.26a
T_3	PL @ 2t/ha (poultry litter) + NPK adj.	6.63cde	6.69bc	6.66bc
T_4	PL @ 4t/ha + NPK adj.	5.28ef	5.61de	5.45e
T_5	PL @ 4t/ha	4.08h	4.32f	4.20gh
T_6	PL @ 6t/ha	5.05gh	5.46e	5.26ef
T_7	PL @ 8t/ha	5.17fg	5.63e	5.40e
T_8	50% P though PL + NPK adj.	6.25bcd	6.36bc	6.31c
T_9	100% P though PL + NK adj.	5.10fg	5.32e	5.19ef
T_{10}	PL @ 1t/ha +FYM @1t/ha + NPK adj.	6.80ab	6.82b	6.81b
T_{11}	PL @ 2t/ha +FYM @2t/ha + NPK adj.	6.48abc	6.46bc	6.47bc
T_{12}	PL @ 3t/ha +FYM @3t/ha + NPK adj.	5.65def	6.12cd	5.89d
	S.Em (±)	0.23	0.18	0.07
	C.D. (P=0.05)	0.68	0.54	0.41

Table 6: Effect of poultry litter with organic and inorganic fertilizers on panicle length, panicle weight and Test weight of rice.

Treatment details		Panicle Length (cm)			Panicle Weight (gm)			Test weight (gm)		
		2022	2022	Mean	2022	2022	Mean	2022	2023	Mean
T_1	Control (0:0:0)	19.62f	18.30e	18.96f	3.49g	3.36h	3.43f	30.03	29.80	29.92
T_2	100% RDF (120:60:40)	23.11a	20.86a	21.98a	5.24a	5.10a	5.17a	30.44	30.20	30.32
T_3	PL @ 2t/ha (poultry litter) + NPK adj.	22.22abc	20.46ab	21.23ab	4.87abc	4.84b	4.86ab	30.35	30.11	30.23
T_4	PL @ 4t/ha + NPK adj.	21.97bc	20.05bc	21.01bcd	4.32cde	4.30f	4.31d	30.28	30.04	30.16
T_5	PL @ 4t/ha	19.95ef	19.27d	19.61e	3.56fg	3.53gh	4.05f	30.08	29.85	29.96
T_6	PL @ 6t/ha	20.50def	19.35d	19.92e	3.84efg	3.76g	3.80ef	30.09	29.86	29.98
T_7	PL @ 8t/ha	21.66bcd	19.99bc	20.82cd	4.11defg	3.89g	4.00e	30.13	29.90	30.02
T_8	50% P though PL + NPK adj.	22.08bc	20.14bc	21.11bc	4.75abc	4.63cd	4.69bc	30.15	29.92	30.04
T_9	100% P though PL + NK adj.	21.22cde	19.94c	20.58d	4.54bcd	4.51d	4.52cd	30.09	29.86	29.97
T_{10}	PL @ 1t/ha +FYM @1t/ha + NPK adj.	23.09a	20.53a	21.81ab	4.98ab	4.84b	4.91ab	30.25	30.01	30.13
T_{11}	PL @ 2t/ha +FYM @2t/ha + NPK adj.	22.13abc	20.25abc	21.19abc	4.83ab	4.73bc	4.76bc	30.23	30.00	30.12
T_{12}	PL @ 3t/ha +FYM @3t/ha + NPK adj.	22.07bc	20.03bc	21.05bc	4.45bcd	4.60cd	4.52cd	30.11	29.88	29.99
	S.Em (±)	0.42	0.10	0.22	0.20	0.05	0.05	0.08	0.08	0.04
	C.D. (P=0.05)	1.23	0.28	0.64	0.59	0.59	0.15	0.24	0.22	0.12

Table 7: Effect of poultry litter with organic and inorganic fertilizers on grain, straw yield and total yield of rice (q/ha).

Treatment details		Grain yield (qha^{-1})			Straw yield (qha^{-1})			Total yield (qha^{-1})		
		2022	2023	Mean	2022	2023	Mean	2022	2023	Mean
T_1	Control (0:0:0)	27.03g	26.17f	26.60h	31.88f	30.09g	30.99h	58.91g	56.26f	57.58g
T_2	100% RDF (120:60:40)	59.63a	58.61a	59.12a	68.87a	66.92a	67.90a	128.50a	125.53a	127.02a
T_3	PL @ 2t/ha (poultry litter) + NPK adj.	55.87ab	56.19ab	56.03abc	62.18b	63.59ab	62.89b	118.06b	119.79ab	118.92b
T_4	PL @ 4t/ha + NPK adj.	48.55cd	49.64c	49.09de	57.84bc	58.86bcd	58.35bcd	106.39cd	108.50c	107.44c
T_5	PL @ 4t/ha	38.05f	37.78e	37.92g	41.37e	39.75f	40.56g	79.42f	77.52e	78.47f
T_6	PL @ 6t/ha	42.42ef	43.58d	43.00f	45.61e	46.99e	46.30f	88.03ef	90.57d	89.30e
T_7	PL @ 8t/ha	46.72de	47.14cd	46.93ef	50.87d	50.57e	50.72e	97.59de	97.71d	97.65d
T_8	50% P though PL + NPK adj.	55.08ab	55.53ab	55.30bc	59.42b	62.22abc	60.82bcd	114.50bc	117.75ab	116.13b
T_9	100% P though PL + NK adj.	47.65d	46.74cd	47.20ef	52.17cd	51.12e	51.65e	99.82d	97.87d	98.84d
T_{10}	PL @ 1t/ha +FYM @1t/ha + NPK adj.	57.54ab	56.61ab	57.08ab	61.55b	61.25bcd	61.40bc	119.09b	117.86ab	118.48b
T_{11}	PL @ 2t/ha +FYM @2t/ha + NPK adj.	55.93ab	54.94ab	55.44abc	57.52bc	57.39cd	57.45cd	113.44bc	112.33bc	112.89bc
T_{12}	PL @ 3t/ha +FYM @3t/ha + NPK adj.	52.42bc	51.31bc	51.86cd	57.64bc	56.08d	56.86de	110.06bc	107.39c	108.72c
	S.Em (±)	1.60	1.68	1.29	1.74	1.63	1.42	3.08	3.09	2.51
	C.D. (P=0.05)	4.69	4.93	3.79	5.11	4.79	4.17	9.05	9.07	7.37

Table 8: Benefit cost ratio for the cultivation of rice with poultry litter and organic manure (₹ earned / ₹ spent)

Treatment details		Cost of cultivation (₹ ha^{-1})	Gross return (₹ ha^{-1})			Net return (Profit) (₹ ha^{-1})			Benefit cost ratio (₹ earned/ ₹ spent)		
			2022	2023	Mean	2022	2023	Mean	2022	2023	Mean
T_1	Control (0:0:0)	36240.00	55136.67	57121.83	56129.25	18896.67	20881.83	19889.25	1.52	1.58	1.55
T_2	100% RDF (120:60:40)	44173.41	121646.33	127948.06	124797.19	77472.92	83774.64	80623.78	2.75	2.90	2.83
T_3	PL @ 2t/ha (poultry litter) + NPK adj.	42046.53	113979.33	122672.47	118325.90	70182.88	78876.02	74529.45	2.71	2.92	2.81
T_4	PL @ 4t/ha + NPK adj.	43115.58	99036.33	108361.69	103699.01	55616.84	64942.20	60279.52	2.30	2.51	2.41
T_5	PL @ 4t/ha	42640.00	77627.67	82468.89	80048.28	36587.67	41428.89	39008.28	1.82	1.93	1.88
T_6	PL @ 6t/ha	45840.00	86530.00	95142.42	90836.21	43090.00	51702.42	47396.21	1.89	2.08	1.98
T_7	PL @ 8t/ha	49040.00	95313.33	102904.19	99108.76	49473.33	57064.19	53268.76	1.94	2.10	2.02
T_8	50% P though PL + NPK adj.	42483.06	112364.33	121217.14	116790.74	68720.36	77573.17	73146.76	2.64	2.85	2.75
T_9	100% P though PL + NK adj.	40798.65	97200.33	102043.12	99621.73	54079.90	58922.69	56501.30	2.38	2.50	2.44
T_{10}	PL @ 1t/ha +FYM @1t/ha + NPK adj.	42609.68	117379.33	123582.06	120480.69	73353.86	79556.59	76455.23	2.75	2.90	2.83
T_{11}	PL @ 2t/ha +FYM @2t/ha + NPK adj.	42049.81	114092.67	119943.72	117018.19	70215.14	76066.20	73140.67	2.71	2.85	2.78
T_{12}	PL @ 3t/ha +FYM @3t/ha + NPK adj.	44179.31	106930.00	112000.03	109465.01	63002.88	68072.91	65537.89	2.42	2.54	2.48

Conclusion

It may be concluded from the study that different combinations of poultry litter and FYM (@ 1, or 2 t/ha of each) with adjusted NPK through chemical fertilizers and application of poultry litter @ 2 t/ha with adjusted NPK through chemical fertilizers are identified as another best option to meet out the recommended dose of nutrients in rice crop which found at par with 100% RDF and also saved the chemical fertilizers.

References

1. Alam MA, Rahman MM, Khan MAR, Shiragi MHK, Islam M, Morshed M. Modulation of yield and yield attributes of transplanted aman rice through organic and inorganic fertilization in terrace soil. Eur J Agric Food Sci. 2021;3(5):97-105.
2. Almaz MG, Halim RA, Martini MY, Samsuri AW. Integrated application of poultry manure and chemical fertiliser on soil chemical properties and nutrient uptake of maize and soybean. Malays J Soil Sci. 2017;21:13-28.
3. Department of Animal Husbandry & Dairying. Animal census 20th report. Govt of India; c2019.
4. Anvesh V, Mehera B, Kumar P. Effect of Varieties and Organic Manure on Growth and Yield of Rice (*Oryza sativa* L.). Int J Plant Soil Sci. 2023;35(17):640-643.
5. Arif M, Tasneem M, Bashir F, Yaseen G, Iqbal RM. Effect of integrated use of organic manures and inorganic fertilizers on yield and yield components of rice. J Agric Res. 2014;52(2):197-206.
6. Awan TH, Ali RI, Manzoor Z, Ahmad M, Akhtar M. Effect of different nitrogen levels and row spacing on the performance of newly evolved medium grain rice variety, KSK-133. J Anim Plant Sci. 2011;21:231-4.
7. Babu S, Marimuthu R, Manivanna V, Kumer SR. Effect of organic and inorganic manures on growth and yield of rice. Agric Sci Dig. 2001;21:232-4.
8. Chaudhary SK, Singh SP, Singh Y. Influence of integrated use of fertilizers and manures on SRI grown rice (*Oryza sativa*) and their residual effect on succeeding wheat (*Triticum aestivum*) in calcareous soil. Indian J Agron. 2014;59(4):527-33.
9. Hasanuzzaman M, Ahamed KU, Rahmatullah M, Akhter N, Nahar K, Rahman ML. Plant growth characters and productivity of wetland rice (*Oryza sativa* L.) as affected by application of different manures. Emirates J Food Agric. 2010;46-58.
10. Hossaen MA, Shamsuddoha ATM, Paul AK, Bhuiyan MSI, Zobaer ASM. Efficacy of different organic manures and inorganic fertilizer on the yield and yield attributes of boro rice. The Agriculturists. 2011;9(1-2):117-25.
11. Laxminarayana K. Effect of integrated use of inorganic and organic manures on soil properties, yield and nutrient uptake of rice in Ultisols of Mizoram. J Indian Soc Soil Sci. 2006;54(1):120-123.
12. Ministry of Agriculture and Farmers Welfare. Report of final production of foodgrains for 2021-22.
13. Rahman MH, Khatun MM, Mamun MAA, Islam MZ, Islam MR. Effect of number of seedlings per hill and nitrogen level on growth and yield of BRRI dhan 32. J Soil Nature. 2007;1(2):1-7.
14. Rahman F, Hossain ATMS, Islam MR. Integrated effects of poultry litter and chemical fertilizer on yield, nutrient balance and economics of wetland rice culture. Bangladesh Rice J. 2018;22(2):71-7.
15. Singh GB, Biswas PP. Balanced and integrated nutrient management for sustainable crop production. Indian J Fertilizers. 2000;45(5):55-60.
16. Srinivas M. Response of rice (*Oryza sativa* L.) to different nutrient levels under machine planted conditions. In: 5th International Conference on Agriculture, Ecology and Biological Engineering, Pattaya (Thailand); 2017. p. 1-5.
17. Ronanki S, Rani PL, Rajireddy D, Sreenivas G. Impact of plant densities and nitrogen levels on grain yield and yield attributes of transplanted rice (*Oryza sativa* L.). Int J Agric Innov Res. 2014;2(6):2319-23.

18. Usman M, Ullah E, Warriach EA, Farooq M, Liaqat A. Effect of organic and inorganic manures on growth and yield of rice variety Basmati-2000. Int J Agric Biol. 2003;5(4):481-483.