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Effect of integrated nutrient management on yield, yield attributes and quality characteristics of rice (*Oryza sativa* L.) crop

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Abstract
An experiment entitled "Studies on integrated nutrient management for sustainable production, nutrients uptake and soil health in rice (*Oryza sativa* L.) crop" was conducted at Crop Research Farm Nawabganj, College of Agriculture, Chandra Shekhar Azad University of Agriculture & Technology Kanpur (U.P.) in *Kharif* season for two years (2014 and 2015). The experiment was conducted in Randomized Block Design (RBD) with four replications and nine treatments combination. The yield and yield attributes maximum grain (49.27 qha^{-1}) and straw (64.08 qha^{-1}) yield recorded with the combined application of 75% NPK (RDF)+5t FYM+PSB+S_{40}+Zn_5+Mn_8 kg ha^{-1} and minimum 21.74 qha^{-1} grain, 32.68 qha^{-1} straw under control treatment. However yield of grain at T_3 and T_8 were significantly *at par*. The quality parameters viz., Head Rice Recovery (HRR), hulling per cent, L:B ratio, starch, amylase and protein contents in grain were recorded higher with above mentioned INM practice than control and other INM practices.

Keywords: INM, RBD, FYM, PSB, rice, yield attributes and quality characteristics

Introduction
Rice (*Oryza sativa* L.) belongs to family Poaceae. It is one of the most important cereal crops of *kharif* season and is the most important staple food crop in the world. Rice is a monocotyledonous angiosperm. Rice is the staple food for more than 70% of the population and source of livelihood for 120-150 million rural house holders. Rice is the seed of the grass species *Oryza sativa* (Asian rice) or *Oryza glaberrima* (African rice). As a cereal grain, it is the most widely consumed staple food for a large part of the world's human population, especially in Asia. It is the back bone of Indian agriculture. Rice is one of the richest starch food consumed by about half of the world population and is the rich source of energy and contains reasonable amount of protein (6-10%), carbohydrate (70-80%), mineral (1.2-2.0%) and vitamin (Riboflavin, Thiamine Niacin and Vitamin E).India alone produces nearly one fourth (22%) of the total rice in the world. Production of rice ranks second among the food grain, and half of the word population receive the highest (26.2%) calories intake from it (FAO, 2009) [140], in the developing countries 20% of their dietary protein. Globally, it ranks 1st in respect of area (431.94 Lakh ha) and second in production (110.15 million tones) and productivity (2550 $kgha^{-1}$) (Annual Report 2016-17). Rice is the bulk of food security of the global population. In 21st century, there will be need of about 250 million tones of food grains to feed the rapidly increasing population. To meet challenge, intensive cropping patterns were adopted which resulted in decline nutrient status of soil. There is indication of stagnation in food grains, even decline in the production of rice crop; this may be due to decline in organic matter, over mining of nutrient reserves, indiscriminate and imbalanced use of chemical fertilizer and continuous mono cropping. To meet the demand of increasing population and maintain self-sufficiency the present production level needs to be increased up to 14 million tones by 2025 which can be achieved only increasing in the coming decade (Subbaih, 2006) [22]; this has to be done against the back drop of declining natural sources such as land, labour, water and other inputs and alarming change in environmental condition.
Among major nutrients, nitrogen is one of the most important nutrients particularly in our country because most of Indian soils are deficient in nitrogen and organic matter (OM) content. The interaction of chemical fertilizers with the soil is considered less favorable to the

soil environmental in comparison to organic sources of crop nutrient. Organic manures like farm yard manure (FYM) and green manure (GM) in association with chemical fertilizers would play an important role in crop nutrition and maintenance of soil fertility and health. Phosphorus is an essential element required for energy storage and transfer within the plant. Phosphorus is a major component in ATP, the molecule that provides "energy" to the plant for such processes as photosynthesis, protein synthesis, nutrient translocation, nutrient uptake and respiration. Potassium (K) is an essential plant nutrient that improves root growth and plant vigor, helps prevent lodging and enhances crop resistance to pests and diseases.

Materials and Methods

The field experiment was conducted at Nawabganj Research Farm, College of Agriculture, Chandra Shekhar Azad University of Agriculture & Technology Kanpur (U.P.) in *Kharif* season for two consecutive years (2014 and 2015) in irrigated condition. The weather conditions prevailed during the course of investigation in respect of temperature (Maximum and Minimum), rainfall, wind velocity, relative humidity sunshine hours and evaporation rate, were recorded from weather observatory situated at Chandra Shekhar Azad University of Agriculture & Technology Kanpur (U.P.) India, Meteorological data were computed as per phonological stage. Nine treatments *viz*.,T_1:Control,T_2:75% NPK (RDF),T_3:100% NPK (RDF),T_4:75% NPK (RDF)+FYM @ 5 t ha $^{-1}$,T_5:75% NPK (RDF)+PSB,T_6:75% NPK (RDF)+S_{40} kg ha^{-1},T_7:75% NPK (RDF)+Zn_5 kg $ha^{-1,}$ T_8:75% NPK (RDF)+S_{40} kg ha^{-1}+Zn_5 kg ha^{-1}+Mn_8 kg ha^{-1} and T_9:75% NPK (RDF)+FYM @ 5 t ha^{-1}+PSB+S_{40} kg ha^{-1}+Zn_5 kg ha^{-1}+Mn_8 kg ha^{-1} were comprised in randomized Block Design (RBD) and replicated four. The rice variety Pant-12 was used during the present investigation. The nursery was raised for producing robust, healthy rice seedling in 21 days time suitable for transplanting in the field. The already treated pre-sprouted rice seeds were used. The 1-3 seedlings per hill was transplanting manually by using index figure and thumbs at 20 cm × 10 cm spacing in plots of 5m x4m. Just before sowing N, P, K, S, Zn and Mn were applied @ 120kg, 60 kg, 60 kg, 40kg, 5kg and 8kg of each by the urea, DAP, MOP, ZnO and MnO, respectively in all treatments. The FYM was incorporated in soil two weeks before transplanting. Weeding was done manually at 30 and 65 days after transplanting and irrigation was done as and required. The harvest of the crop was on 125 days after transplanting. The soil of experimental field was loamy in texture having pH (*1:2.5*) 8.20, EC (*1:2.5*) (dSm^{-1} *at* 25^0C) 0.42 and OC (%) 0.42.The soil was low in available N (213 $kgha^{-1}$), medium in available P (13.45 $kgha^{-1}$),available K (140 $kgha^{-1}$), available S (11.68 $kgha^{-1}$), available Zinc (0.47 *ppm*) and available Manganese (2.35 *ppm*).Soil sample from all four replications (0-15 cm) were taken before starting the experiment and from each treatment. The soil sample was analyzed for pH pH (*1:2.5*) Glass electrode pH meter (Jackson, 1973) [12], EC (*1:2.5*) (dSm^{-1} *at* 25^0C) Conductivity meter (Jackson, 1973) [12], Organic Carbon (*%*) (Walkley& Black's rapid titration method and Walkley and Black, 1934) [25], Available Nitrogen ($kg\ ha^{-1}$) Alkaline permanganate method (Subbiah and Asija, 1956), Available Phosphorus ($kg\ ha^{-1}$) Olsen's method (Olsen *et al*., 1954) [14], Available Potassium ($kg\ ha^{-1}$) Flame photometer (Jackson, 1973) [12], Available Sulphure ($kg\ ha^{-1}$) Turbidimetric method (Chesnin and Yien,1950) [5], Available Zinc and Manganese (*ppm*) DTPA extraction (AAS).

Results and Discussion

Yield of rice

The pooled data related to grain of rice presented in Table 1. It is clearly indicated that grain yield varied from 21.74 to 49.27 qha^{-1} under different treatments. The highest grain of rice 49.27 qha^{-1} was recorded under T_9 and lowest 21.74 qha^{-1} at control (T_1). However yield of grain at T_3 and T_8 were significantly *at par*. The effective utilization of different sources of nutrients the grain yield increased 2.3 times more in comparison to control in no fertilizer.It is revealed the data presented (Table 1.) showed that pooled straw yield of rice ranged from 32.68qha^{-1} to 64.08qha^{-1}. Likewise, grain yield, the highest straw yield of 64.08 qha^{-1} recorded under treatment T_9 followed by 62.60 qha^{-1} under treatment T_3 and lowest 32.68 qha^{-1} under control (T_1). All the treatment combination gave significantly higher straw yield than control treatment. Rice grains and straw yield highest recorded with the application of 75% NPK (RDF) with 5t FYM+PSB +S_{40}+ Zn_5+ Mn_8 kg ha^{-1} and minimum under control treatment grain yield recorded 21.74 to 49.27 qha^{-1} and straw yield varied 32.68 to 64.08 q ha^{-1}. The highest grain yield recorded at T_9 was found about 126.7 per cent higher than control i.e. no fertilizer application. Likewise, grain, maximum straw yield was computed about 96.08 per cent over control. The results indicated that integrated use of FYM, PSB, Sulphur, Zinc and Manganese with 75% recommended NPK were affective in increasing the grain and straw yield. Babu *et al.* (2000) [3] conducted a field experiment to study the effect of 100:50:50 NPK ha^{-1}, 10t FYM ha^{-1}, 5T FYM + 50 kg N ha^{-1} or 3 t ha^{-1} poultry manure on rice and reported that grain yield were highest with 5t FYM + 50kg N ha^{-1}. Sengar *et al.* (2000) noted that the application of fertilizer with organic significantly increased the yield of rive over control. The increased grain and straw yield might be due to balanced supply of macro and micro nutrients. Addition of FYM besides its nutritional role might be improving the physico-chemical property especially the soil moisture, aggregations, soil aeration and increased microbial activity. The yield grain and straw under different treatments are attributed to growth and yield attributes which also behaved in similar manner. Those results may be supported by Dubey and Verma (1959) [9], Khan *et al.* (2007) [15], Yadav *et al.* (2009) [26], Vijay Bahadur *et al* (2014) [24] and Sharma *et al.* (2015) [20].

Table 1: Effect of INM on Grain and Straw Yield of rice crop

S. No.	Treatments	Grain Yield (qha^{-1})			Straw Yield (qha^{-1})		
		2014	2015	Pooled	2014	2015	Pooled
1	Control	21.50	21.99	21.74	32.34	33.02	32.68
2	75% NPK (RDF)	38.39	40.24	39.31	55.33	56.96	56.14
3	100% NPK (RDF)	44.87	46.38	45.62	61.64	63.57	62.60
4	75% NPK (RDF)+FYM @ 5 t ha $^{-1}$	43.25	45.19	44.20	59.43	61.16	60.29
5	75% NPK (RDF)+PSB	40.25	41.40	40.82	56.49	58.17	57.33
6	75% NPK (RDF)+S_{40} kg ha^{-1}	41.45	43.10	42.27	57.06	58.90	57.98

7	75% NPK (RDF)+Zn_5 kg ha^{-1}	42.55	44.50	43.52	58.27	59.97	59.12
8	75% NPK (RDF)+S_{40} kg ha^{-1}+Zn_5 kg ha^{-1}+Mn_8 kg ha^{-1}	44.55	46.00	45.27	60.58	62.37	61.47
9	75% NPK (RDF)+FYM @ 5 t ha^{-1}+PSB+S_{40} kg ha^{-1}+Zn_5 kg ha^{-1}+Mn_8 kg ha^{-1}	48.65	49.90	49.27	63.37	64.80	64.08
	CD at 5%	3.29	3.50	2.18	3.95	5.00	3.00

Yield attributes of rice

The data of plant height was recorded at maturity of the crop. Pooled values under different treatment (Table 2). Plant height varied from 83.9cm to 110.3cm. The highest plant height was recorded 110.3cm under T_9 i.e. 75% NPK (RDF)+FYM 5 t ha^{-1}+PSB+S_{40}+Zn_5+Mn_8 kg ha^{-1} and lowest 83.9 cm under control. Application of 75% NPK (RDF) gave significantly higher plant height than control increasing trend was observed in all fertilizers treatments up to T_9. Similar trend was recorded in individual year i.e. 2014 and 2015 and all treatments showed significantly difference among them. It might be due to increase in availability of nutrients with integrated use of FYM, bio fertiliser with inorganic fertilizers. Increase plant height of rice due to organic and inorganic have also been reported by Singh *et al.* (2002) [21] and Yadav *et al.* (2009) [26]. Similar results reported by Khan *et al* (2007) [15].

In the present study the number of tillers ranged from 10.45 to 6.01 (Table 2). All the treatment significantly higher to control. Application of 75% NPK+FYM 5t+PSB+S_{40}+Zn_5 +Mn_8 (T_9) gane highest value followed by 100% NPK (T_3) and lowest under control. It might be humbled to increased availability and uptake of nutrient. Similar results have been reported by Das and Yadav (2009) [7]. The best treatment almost 73.9 per cent higher than control. Jagdish and Yadav (2008) [14] reported that conjugative use of inorganic, organic and bio-fertilizer significantly improved number of effective tillers m^{-2}. Krishna *et al.* (2008) [16] reported that the application of 75:75:87.5 NPK $kgha^{-1}$+ 10t FYM ha^{-1} resulted significantly higher number of tillers per plant (26.22).

Table 2: Effect of INM on plant height and No. of $tillers^{-1}$

S.No.	Treatments	Plant height (cm)			No. Tillers $hill^{-1}$		
		2014	2015	Pooled	2014	2015	Pooled
1	Control	83.17	84.57	83.87	5.85	6.18	6.01
2	75% NPK (RDF)	93.19	95.88	94.35	8.64	9.12	8.88
3	100% NPK (RDF)	107.21	110.32	108.76	9.90	10.45	10.17
4	75% NPK (RDF)+FYM @ 5 t ha^{-1}	104.21	107.22	105.71	9.54	10.07	9.80
5	75% NPK (RDF)+PSB	97.19	100.01	98.55	8.73	9.22	8.97
6	75% NPK (RDF)+S_{40} kg ha^{-1}	100.20	103.10	101.65	9.18	9.69	9.43
7	75% NPK (RDF)+Zn_5 kg ha^{-1}	102.20	105.16	103.65	9.36	9.88	9.62
8	75% NPK (RDF)+S_{40} kg ha^{-1}+Zn_5 kg ha^{-1}+Mn_8 kg ha^{-1}	106.21	109.29	107.75	9.63	10.17	9.90
9	75% NPK (RDF)+FYM @ 5 t ha^{-1}+PSB+S_{40} kg ha^{-1}+Zn_5 kg ha^{-1}+Mn_8 kg ha^{-1}	108.22	112.35	110.28	10.17	10.74	10.45
	CD at 5%	7.54	9.29	2.81	1.28	1.44	0.91

Number of panicle $hill^{-1}$ were recorded in 2014 and 2015 and pooled of two years data were presented in Table 3. It is revealed that higher number of panicle $hill^{-1}$ (8.58) was recorded under treatment T_9 (75% NPK+FYM 5t ha^{-1}+PSB+S_{40}+Zn_5+Mn_8) kg ha^{-1} followed under treatment T_3i.e. 100% NPK (RDF) and lowest 5.36 was recorded under control treatment. All the treatment combinations gave significantly super result in comparison to control. Application of inorganic fertilizer with FYM, PSB, Sulphur, Zinc and manganese gave superior response. Jagdish and Yadav (2008) [14] studied the effect of different nutrient sources on the growth and nutrient uptake of hybrid rice and found that conjugative use if inorganic and bio-fertilizer significantly improve the panicle number of hybrid rice than inorganic fertilizer alone.

The pooled data number of grains $panicle^{-1}$ ranged between 51.46 to 95.73 (Table 3). Highest number 95.73 was recorded in treatment T_9 (75% NPK (RDF)+ FYM@ 5t ha^{-1}+PSB+S_{40}+Zn_5+Mn_8) kg ha^{-1} followed by 100% NPK (RDF) treatment T_3 (92.40) and lowest 51.46 under control treatment. The treatment combination T_3(100% NPK) is closely followed to treatment T_9 (75% NPK+FYM @ 5 t ha^{-1}+PSB+S_{40}+Zn_5+Mn_8) kg ha^{-1}.All the fertilizer application treatments gave significantly more number of grains per panicle in comparison to control treatment. It is revealed that test weight varies from 22.62 to 25.05 gram under different treatments (Table 3). Highest grain test weight 25.12gm was recorded under treatment T_9 (75% NPK+FYM@ 5t ha^{-1}+PSB+S_{40}+Zn_5+Mn_8) $_{kg}$ ha^{-1} followed by 24.99 under 100% NPK (RDF) i.e.T_3 and lowest 22.62gm under control treatment. The treatment wise variation is very less in first and second years in term of test weight. All the treatment combination gave significantly superior result in comparison to control treatment. Number of grain per panicle and test weight ranged between 51.46 to 95.73 and 22.62 to 25.05 gram significantly influenced by inorganic and organic fertilizers. Geeta Devi *et al.* (2000) [11] reported that increasing rate of N application increase number of grains per panicle and maximum test weight was recorded with 150 kg N ha^{-1} application. Barik *et al.* (2006) [4] reported that the application of 50% of recommended NPK (30:15:15) along with FYM 10 ton ha^{-1} produced significantly higher number of filled grains per panicle in comparison to 100% of recommended NPK fertilizer (60:30:30).The results are in agreement with Darde and Bankar (2009) [6].

Table 3: Effect of INM on No. of panicle $hill^{-1}$, No.of grains $panicle^{-1}$ and Test weight (g)

S. No.	Treatments	No. of panicle $hill^{-1}$			No.of grains $panicle^{-1}$			Test weight(g)		
		2014	2015	Pooled	2014	2015	Pooled	2014	2015	Pooled
1	Control	5.23	5.49	5.36	51.00	51.92	51.46	22.57	22.68	22.62
2	75% NPK (RDF)	7.24	7.62	7.43	77.35	78.00	77.67	24.46	24.58	24.52
3	100% NPK (RDF)	8.15	8.59	8.37	91.85	92.95	92.40	24.93	25.05	24.99
4	75% NPK (RDF)+FYM @ 5 t ha^{-1}	7.89	8.31	8.10	87.92	88.45	88.18	24.73	24.86	24.79

5	75% NPK (RDF)+PSB	7.31	8.69	8.00	80.92	91.85	86.38	24.57	24.69	24.63
6	75% NPK (RDF)+S_{40} kg ha^{-1}	7.63	8.03	7.83	85.12	86.25	85.68	24.63	24.74	24.68
7	75% NPK (RDF)+Zn_5 kg ha^{-1}	7.76	8.18	7.97	86.50	87.00	86.75	24.67	24.80	24.73
8	75% NPK (RDF)+S_{40} kg ha^{-1}+Zn_5 kg ha^{-1}+Mn_8 kg ha^{-1}	7.96	8.38	8.17	89.00	89.82	89.41	24.78	24.90	24.84
9	75% NPK (RDF)+FYM @ 5 t ha^{-1}+PSB+S_{40} kg ha^{-1}+Zn_5 kg ha^{-1}+Mn_8 kg ha^{-1}	8.36	8.80	8.58	95.11	96.35	95.73	25.10	25.15	25.12
	CD at 5%	0.99	0.42	0.75	5.65	6.28	0.91	1.28	1.21	0.84

Quality characteristics of rice crop

The pooled value of head rice recovery (HRR) varied from 60.56% to 68.21% (Table 4). Maximum 68.21% HRR recorded under T_9 (75%NPK+5t FYM+PSB+S_{40}+Zn_5+Mn_8) $kgha^{-1}$ followed by 66.30% under T_8 (75% NPK+S_{40}+Zn_5+Mn_8) $kgha^{-1}$ and lowest 60.56% at control. However, the values of HRR per cent at T_3 and T_8 were significantly *at par*. Maximum head rice recovery and hulling percent recorded with the application of 75% NPK (RDF) with 5t FYM+PSB+S_{40}+ Zn_5+Mn_8 kg ha^{-1} and minimum under control treatment. All the fertilizer application treatment gave significantly superior results than control treatment.

Data presented in Table 4 showed that application of fertilizers with or without organic, bio-fertilizer, secondary and micronutrient gave significantly superior response in comparison to control treatment regarding kernel length per breadth and L:B ratio. Kernel length ranged between 5.15 to 6.10mm, kernel breadth between 1.75 to 1.88 mm and L:B ratio 2.98 to 3.24. Maximum beneficiary effect recorded with the application of 75% NPK (RDF) with 5t FYM+PSB+Sulphur+Zinc+Manganese with control treatment. Jadhav *et al.* (2003) [13] reported that N at 20 kg ha^{-1} showed highest kernel length, kernel length and cooked kernel length. Adhikari *et al.* (2005) [1] evaluated the effect of FYM and BGA in combination with NPK on aromatic rice cultivar (Basmati 307 and Pusa Sungandha) and observed the either alone application of N or through integrated management result a significant improvement in kernel length and kernel breadth.

Table 4: Effect of INM on Head Rice Recovery (HRR) of rice grain and L:B ratio

S. No.	Treatments	Head Rice Recovery (HRR)			L:B ratio		
		2014	2015	Pooled	2014	2015	Pooled
1	Control	60.08	61.05	60.56	2.97	3.00	2.98
2	75% NPK (RDF)	63.08	64.00	63.50	3.02	3.05	3.03
3	100% NPK (RDF)	65.07	65.09	65.08	3.21	3.20	3.20
4	75% NPK (RDF)+FYM @ 5 t ha^{-1}	64.50	65.55	65.02	3.25	3.17	3.21
5	75% NPK (RDF)+PSB	61.34	62.33	61.83	3.10	3.07	3.08
6	75% NPK (RDF)+S_{40} kg ha^{-1}	61.98	62.97	62.47	3.08	3.08	3.08
7	75% NPK (RDF)+Zn_5 kg ha^{-1}	63.24	64.26	63.75	3.19	3.21	3.20
8	75% NPK (RDF)+S_{40} kg ha^{-1}+Zn_5 kg ha^{-1}+Mn_8 kg ha^{-1}	65.77	66.83	66.30	3.19	3.15	3.17
9	75% NPK (RDF)+FYM @ 5 t ha^{-1}+PSB+S_{40} kg ha^{-1}+Zn_5 kg ha^{-1}+Mn_8 kg ha^{-1}	67.67	68.76	68.21	3.25	3.24	3.24
	CD at 5%	1.63	2.06	1.24	0.13	0.14	0.09

It is revealed from the data presented in Table 5 showed beneficiary effect of inorganic and organic fertilizer with sulphur, zinc and manganese application gave significantly superior response regarding quality parameter starch, amylase and protein percentage in rice. Starch ranged 68.72 to 74.76%, amylase 19.99 to 25.30% and protein ranged 6.31 to 8.24% as influenced by different nutrient management. Maximum values were recorded with the application of 75% NPK (RDF) with 5t FYM+PSB+Sulphur+Zinc+Manganese application and minimum under control treatment. Poongothai (1994) [18] reported that application of 50Kg P_2O_5 as DAP gave the highest grain crude protein content of 10.83%. Rao *et al*. (1996) [19] observed that higher levels of N increased the amylose content of the long slender varieties by 3.0-9.9%. According to Dixit and Gupta (2000) [8] also reported the quality of rice grain improved might by due to more availability of nutrients (Macro and Micro) balanced fertilizer to the plants with addition of organic macro over the chemical fertilizers only. Improved in quality parameter of rice due to combined application of organic sources of nutrients along with inorganic fertilizers. Jadhav *et al*. (2003) [13] reported that 120 kg N ha^{-1} showed highest amylase content than other N application rates. Adhikari *et al*. (2005) [1] reported either alone application of N or through integrated management resulted significant improvement in protein content of rice. observed that protein yield were significantly more under higher nitrogen level (120 kg ha^{-1}) than lower level (60kg ha^{-1}). Dwivedi *et al.* (2006) [9] reported that application of phosphorus and potassium (80kg ha^{-1}) were found better good quality protein of hybrid rice. Trivedi *et al.* (2015) [23] revealed that maximum starch content in rice grain observed with the application of 100% NPK, 40kg sulphur and 5 kg Zn while lowest in control. In case of amylase content, the highest value was recorded in control and lowest with 100% NPK+S_{40}+Zn_5 combination.

Table 5: Effect of INM on Starch, Amylase and Protein%

S. No.	Treatments	Starch%			Amylase%			Protein%		
		2014	2015	Pooled	2014	2015	Pooled	2014	2015	Pooled
1	Control	65.89	66.86	66.37	19.94	20.04	19.99	6.25	6.37	6.31
2	75% NPK (RDF)	68.34	69.36	68.72	20.99	21.10	21.04	7.37	7.50	7.43
3	100% NPK (RDF)	73.52	74.60	74.06	24.05	24.17	24.11	7.94	8.19	8.06
4	75% NPK (RDF)+FYM @ 5 t ha^{-1}	70.75	71.79	71.27	22.66	22.77	22.71	7.87	8.01	7.94
5	75% NPK (RDF)+PSB	67.28	68.27	67.77	20.22	20.32	20.27	7.50	7.62	7.56
6	75% NPK (RDF)+S_{40} kg ha^{-1}	67.97	68.97	68.47	21.27	21.37	21.32	7.75	7.94	7.84

7	75% NPK (RDF)+Zn_5 kg ha^{-1}	69.36	70.38	69.87	22.52	22.64	22.58	7.93	8.00	7.96
8	75% NPK (RDF)+S_{40} kg ha^{-1}+Zn_5 kg ha^{-1}+Mn_8 kg ha^{-1}	72.13	73.20	72.66	23.57	23.69	23.63	7.87	8.12	7.99
9	75% NPK (RDF)+FYM @ 5 t ha^{-1}+PSB+S_{40} kg ha^{-1}+Zn_5 kg ha^{-1}+Mn_8 kg ha^{-1}	74.22	75.31	74.76	25.24	25.36	25.30	8.18	8.31	8.24
	CD at 5%	1.05	1.18	0.75	1.23	1.22	0.82	0.23	0.30	0.18

Conclusion

The integrated nutrients management (INM) practice of 75% NPK (RDF) with FYM 5 t ha^{-1},PSB, S_{40} Kg ha^{-1},Zn_5 Kg ha^{-1} and Mn_8 was significantly superior in respect to yield and yield attributing in comparison to control and other treatments either alone or in combination. The quality parameters viz., Head Rice Recovery (HRR), L:B ratio, starch, amylase and protein contents in grain were recorded higher with above mentioned INM practice than control and other INM practices.

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