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Performance of rice under IPNS- STCR based nutrients management strategy

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Abstract
A STCR based field experiment on rice commenced in *kharif* 2017 at the Research Farm of Department of Soil Science and Agricultural Chemistry, JNKVV, Jabalpur with Integrated Plant Nutrition System (IPNS) approaches for assessing its impact on yield attributes and yield of rice in Vertisol. The field experiment layout was laid in four replications and six treatments *viz*., T_1: Control, T_2: GRD, T_3: T.Y. 50 q ha^{-1}, T_4: T.Y. q ha^{-1}, T_5: T.Y. 50 q with 5 t FYM ha^{-1} and T_6: T.Y. 60 q with 5 t FYM in Randomized Block Design. The result revealed that growth, yield attributing characters and yield were significantly influenced by different treatments of nutrients application with and without FYM. Maximum plant height, number of tillers $plant^{-1}$, number of panicles and number of seed per panicle were obtained highest under T_6 having 158:107:69 kg N, P_2O_5 and K_2O + 5 t FYM ha^{-1}, while minimum with control. Yield of rice was significantly influenced by different treatments and highest grain (5678 kg ha^{-1}) and straw (7563 kg ha^{-1}) yields were recorded under T_6 having highest levels of NPK integrated with FYM. N, P and K content in shoot and roots of rice were observed in $T_{6,}$ where minimum with control. Therefore, application of FYM with STCR based fertilizers increased the productivity of rice significantly under Vertisol of Madhya Pradesh.

Keywords: FYM, IPNS, STCR, rice, yield

Introduction
Rice (*Oryza sativa* L.) is the staple food for more than half of the world population and it provides 21% and 15% per capita of dietary energy and protein, respectively (Maclean *et al.* 2002). Rice is one of the most important cereal food crops of India in terms of area, production and consumer preference. India is also the second largest producer and consumer of rice in the world. In India, rice accounts for more than 40% of food-grain production, providing direct employment to 70% people in rural areas. Our national food security hinges on the growth and stability of rice production. Rice is grown in 44.6 million ha under 4 major ecosystems: irrigated, rainfed lowland, rainfed upland and flood prone. More than half of rice area (55%) is rainfed and distribution-wise 80% of rainfed rice area is in eastern India, making its cultivation vulnerable to vagaries of monsoon. At present, lowland rice occupies about 39% of the total cropped area of Asom (Adhya *et al.* 2008) [1]. Integrated nutrient management is one of the most important components of the production technology to sustain soil fertility and crop productivity. The combined use of organic and inorganic sources of plant nutrients not only pushed the production and profitability of field crops but also helped in maintaining the fertility status of the soil (Chandrasoorian *et al*. 1994) [4]. The advantage of combined use of organic and inorganic sources of nutrients as integrated nutrient management has been proved superior to the use of each component separately (Palaniappan and Annadurai 2007) [9]. Though, the fertilizers have played a prominent role in increasing the productivity of crops in the country, but continuous imbalanced use of fertilizers caused deterioration of soil health. Organic manures improve soil physical, chemical and biological properties and thus enhance crop productivity *vis-à-vis* maintain soil health. In addition to this, the organic manures help in improving the use efficiency of inorganic fertilizers (Singh and Biswas 2000) [11]. The supply of essential micronutrients through organic manures also improved plant metabolic activities especially in the early vigorous growth of plant (Anburani and Manivannan 2002) [2]. So, soil test based (STCR) field experiments are crucially important for understanding demand of nutrient and crop management practices and provide one of the few means for evaluating sustainable agricultural management systems and better prediction of the sustainable future. Therefore, this study was conducted with an objective to find out the impact of farm yard

manure and STCR based fertilizer on yield of rice in vertisol.

Materials and Methods

The study was conducted at the JNKVV research field, Department of Soil Science and Agricultural Chemistry, AICRP on STCR, Jabalpur (M.P.), situated in the South-Eastern part of the Madhya Pradesh at 23^0 13' North latitude, 79^0 57' East longitudes and at an elevation of 393 meter above mean sea level. Experiment was conducted in a randomised block design with six treatments and four replicates (plot size 5 m × 5 m, with 1 m buffer zone between treatments). The initial soil properties of experimental soil are shown in table2. The different treatments were as T1: absolute control; $T_{2:}$ General recommended dose (120:60:40 kg N, P_2O_5 and K_2O ha^{-1}), $T_{3:}$ Targeted yield 50 q ha^{-1} (115:72:48 kg N, P_2O_5 and K_2O ha^{-1}), T_4: Targeted yield 60 q ha^{-1} (157:108:70 kg N, P_2O_5 and K_2O ha^{-1}), $T_{5:}$ Targeted yield 50 q + 5 t FYM ha^{-1} (115:72:48 kg N, P_2O_5 and K_2O ha^{-1}) and T_6: Targeted yield 60 q + 5 t FYM ha^{-1} (157:108:70 kg N, P_2O_5 and K_2O ha^{-1}) and the manurial schedule shown in table 1. The variety Kranti rice was directly sown on the second week of July. Crops were harvested at maturity and grain and straw yields were recorded and analysed statistically.

Fertilizer Adjustment Equations

Rice

FN = 4.25 T - 0.45 SN

FP_2O_5 = 3.55 T - 4.09 SP

FK_2O = 2.10 T - 0.18 SK

Whereas,

FN - Fertilizer nitrogen (kg ha^{-1}), FP_2O_5 - Fertilizer phosphorus (kg ha^{-1}), FK_2O- Fertilizer potassium (kg ha^{-1}), T- Desired yield target (q ha^{-1}), SN- Available soil nitrogen (kg ha^{-1}), SP- Available soil phosphorus (kg ha^{-1}), SK- Available soil potassium (kg ha^{-1})

Table 1: Manurial schedule for rice

Treatments	Nutrients applied (kg ha^{-1})			FYM (t ha^{-1})
	N	P_2O_5	K_2O	
T_1: Control	0	0	0	0
T_2: GRD	120	60	40	0
T_3: T.Y. 50 q ha^{-1}	115	72	48	0
T_4: T.Y. 60 q ha^{-1}	158	107	69	0
T_5: T.Y. 50 q + FYM* 5 t ha^{-1}	115	72	48	5
T_6: T.Y. 60 q + FYM* 5 t ha^{-1}	158	107	69	5

*Composition of FYM: N: 0.55, P: 0.53 and K: 0.67%

Table 2: Initial properties of experimental soil

Particulars	Method employed	
	0-15 cm	Method
Soil pH (pH 1:2.5 at 25 ^{0}C)	7.51	Glass electrode pH meter (Jakson, 1973)
Electrical Conductivity (dS m^{-1} at 25 ^{0}C)	0.297	Electrical conductivity meter (Jakson, 1973)
Organic Carbon (g kg^{-1})	5.39	Potassium dichromate rapid titration method (Walkley and Black, 1934)
Available Nitrogen (kg ha^{-1})	215.83	Alkaline permanganate method (Subbiah and Asija, 1956)
Available Phosphorus (kg ha^{-1})	21.67	0.5 M $NaHCO_3$ method (Watanabe and Olsen's, 1965)
Available Potassium (kg ha^{-1})	319.25	Neutral normal ammonium acetate method (Hanway and Heidel, 1952)

Result and Discussion

Plant height

Plant height at different growth stages as affected by different levels of fertilizers with and without FYM at different stages of crop growth (40, 80 DAS and at harvest) are presented in Table 3. The plant height increased gradually with the advancement in crop growth up to 80 DAS. At early growth stage (40 DAS) the significantly maximum plant height (38.13 cm) was recorded in treatment T_6 (158:107:69 kg N: P_2O_5: K_2O + 5 t FYM ha^{-1}) which were statistically at par with $T_{3,}$ T_4 and T_5. Whereas, minimum plant height was recorded (34.51 cm) in treatment T_1 (control). While the rate of increase was maximum between 40 to 80 DAS under all the treatment. Data further revealed that there was marked significant difference in plant height at various treatments at all the stages. The maximum plant height (*viz.*, 75.22 and 74.78 cm at 80 DAS and at harvest, respectively) were recorded in treatment T_6 where highest NPK levels integrated with FYM (158:107:69 kg N: P_2O_5: K_2O + 5 t FYM ha^{-1}). The minimum values of plant height (*viz.*, 52.88 and 51.43 cm at 80 DAS and at harvest, respectively) were recorded under without fertilizers and manure application (control) at all the crop growth stages. At 80 DAS, the maximum plant height (75.22 cm) was recorded in T_6 which was statistically significant over control (T_1), GRD (T_2) and T_3 where as; T_4, T_5 were significantly at par with T_6. At harvest, the plant height slightly decreases but also at harvest stage T_6 (T.Y.6 t ha^{-1} + 5 t ha^{-1} FYM) were recorded with maximum significant plant height (74.78) which was at par with T_4 and T_5. The progressive increase in plant height might be due to the fact that the demand of NPK levels with FYM have been sufficient for the formation of chlorophyll and nucleic acids which are responsible for growth and development. The findings are in accordance with the results reported Khidrapure *et al.* (2015) [7] and Mahmud *et al.* (2016) [8].

Table 3: Effect of different treatments on plant height

Treatments	Plant height		
	40 DAS	80 DAS	At harvest
T_1: Control	34.51	52.88	51.43
T_2: GRD	36.17	64.76	63.79
T_3: T.Y. 50 q ha^{-1}	36.73	67.41	66.63
T_4: T.Y. 60 q ha^{-1}	37.41	71.45	70.87
T_5: T.Y. 50 q + 5 t FYM ha^{-1}	37.49	69.82	69.15
T_6: T.Y. 60 q ha^{-1} + 5 t FYM ha^{-1}	38.13	75.22	74.78
CD *(p = 0.05)*	**3.53**	**6.11**	**5.95**

Number of tillers plant^{-1}

The analysis of data (Table 4) on number of tillers plant^{-1} showed significant variation at all growth stages. It is evident from the data that number of tillers plant^{-1} were increased with increasing levels of NPK with FYM. At early growth stages (40 DAS), the treatment T6 (158:107:69 kg N: P_2O_5: K_2O + 5 t FYM ha^{-1}) brought significantly maximum number of tillers plant^{-1} (4.31) over control.) Which were statistically at par with T_5. Whereas, minimum number of tillers plant^{-1} were recorded (1.97) in treatment T_1 (control). At 80 DAS the significantly maximum number of tillers plant^{-1} (8.21) were recorded in treatment T_6 (158:107:69 kg N: P_2O_5: K_2O +5 t ha^{-1}FYM) which were statistically at par with T_4 and T_5. However, the minimum number of tillers plant^{-1} (4.39) were recorded in treatment T_1 (control).At harvest, the number of tillers hill^{-1} slightly decrease but also at harvest stage T_6 (T.Y.6 t ha^{-1} + 5 t ha^{-1} FYM) were recorded with maximum significant number of tillers plant^{-1} (8.17) which was at par with T_4 followed by T_5 whereas, the minimum number of tillers plant^{-1} (4.17) were recorded in treatment T_1, followed by T_2 (6.68), respectively. The increase in number of tillers with NPK and FYM can be attributed to soil conditions with more availability and uptake of nutrients, water and growth promoting substances to promote more tillers. Similar findings have been also reported by Srivastava *et al.* (2013) [13].

Table 4: Effect of different treatments on number of tillers plant^{-1}

Treatments	Number of tillers plant^{-1}		
	40 DAS	80 DAS	At harvest
T_1: Control	2.41	4.39	4.17
T_2: GRD	3.47	6.81	6.68
T_3: T.Y. 50 q ha^{-1}	3.83	7.43	7.31
T_4: T.Y. 60 q ha^{-1}	4.15	7.95	7.89
T_5: T.Y. 50 q + 5 t FYM ha^{-1}	3.99	7.73	7.65
T_6: T.Y. 60 q ha^{-1} + 5 t FYM ha^{-1}	4.31	8.21	8.17
CD (p = 0.05)	0.35	0.67	0.63

Panicle length (cm)

It is clear from the data that panicle length was influenced significantly due to different treatments (table 5). Significantly increased with maximum panicle length (21.48 cm) was recorded under the treatment T_6 (158:107:69 kg N:P_2O_5:K_2O + 5 t FYM ha^{-1}), which was statistically at par with T_2, T_3, T_4 and T_5, whereas minimum panicle length (18.27 cm) was observed under control. Singh and Verma (2001) [12] found similar results.

Panicles weight plant^{-1} (g)

The analysis of the data revealed that panicles weight plant^{-1} under varying treatments differed significantly among themselves (table 5). Data clearly showed that significantly more panicles weight plant^{-1} (19.82 g) was observed under treatment T_6 compare with control, while minimum (16.46 g) in without applied fertilizers.

Number of grains panicle^{-1}

Application of higher doses of NPK nutrients with FYM (T_6) was obtained significantly higher number of grains panicle^{-1} (108.23), which was statistically at par with T_3, T_4 and T_5. However, the minimum number of grains panicle^{-1} (71.47) was associated with control, followed by GRD (85.93), respectively.

Weight of grains panicle^{-1} (g)

The analysis of the data revealed that weight of grains panicle^{-1} differed significantly due to varying treatments. The data clearly showed that significantly maximum weight of grains panicle^{-1} (2.68 g) was observed under treatment T_6. Which was being statistically at par with T_2, T_3, T_4 and T_5, while the minimum weight of grains panicle^{-1} (1.55 g) in without applied fertilizers (control).

Number of filled grains panicle^{-1}

Addition of higher level of inorganic nutrients containing 158:107:69 kg N:P_2O_5:K_2O along with 5 t FYM ha^{-1} was recorded significantly maximum number of filled grains panicle^{-1} (100.23), which was statistically at par with T_4 and T_5. However, the minimum number of filled grains panicle^{-1} (56.38) was recorded under control.

Balasubramanian and Wahab (2012) [3] observed that growth and yield attributes of rice crop *viz.* productive tillers hill^{-1}, DMP at harvest, filled grains panicle^{-1}, 1000 grain weight, were favourably influenced with the combined use of inorganic fertilizers and organic manures.

Table 5: Effect of different treatments on yield attributes

Treatments	Panicle length (cm)	Panicle weight plant^{-1} (g)	Number of grains panicle^{-1}	Weight of grains panicle^{-1} (g)	Number of filled grains panicle^{-1}
T_1: Control	18.27	16.31	71.47	1.55	56.37
T_2: GRD	19.33	18.65	85.93	2.03	73.15
T_3: T.Y. 50 q ha^{-1}	20.29	19.13	96.35	2.27	84.76
T_4: T.Y. 60 q ha^{-1}	21.15	19.53	103.61	2.51	93.21
T_5: T.Y. 50 q + 5 t FYM ha^{-1}	20.66	19.45	101.39	2.46	90.76
T_6: T.Y. 60 q ha^{-1} + 5 t FYM ha^{-1}	21.48	19.82	108.23	2.68	100.23
CD (p=0.05)	2.36	2.24	12.19	0.31	11.47

Grain yield

An examination of the data revealed that each increment of NPK levels caused significant variation in grain yield of rice. Higher targeted yield of T_6 (60 q + 5 t FYM ha^{-1}) could not be achieved and deviated by ± 4.58% negatively, whereas the targeted yield of T_5 (50 q + 5 t FYM ha^{-1}) was obtained comfortably. The grain yield target was achieved only in treatment T_5 which was significantly increased over control. Maximum grain yield of 5678 kg ha^{-1} was recorded in T_6 with application of 158:107:69 kg N:P_2O_5:K_2O + 5 t FYM ha^{-1}, which was statistically significant with other treatments except T_4 and T_5, whereas minimum grain yield of 2763 kg ha^{-1} was found under control.

Straw yield

The effect of treatments on straw yield also followed the similar trend as that of grain yield. The higher yield of straw (7563 kg ha^{-1}) was obtained with higher level of inorganic fertilizers along with FYM (T_6), which was significantly superior to T_1 (control), T_2 (GRD) and T_3, respectively. However, this treatment was statistically at par with T_4 and T_5. The minimum straw yield of 4331 kg ha^{-1} was obtained in T_1 (control).

Test weight: Significantly maximum test weight of grains (24.33 g) was registered under treatment T_6 (158:107:69 kg N: P_2O_5: K_2O + 5 t FYM ha^{-1}) over control there was no application of fertilizers and manure, whereas, minimum test weight of grains (20.75 g) in control, followed by GRD (22.91 g), respectively.

The improvement in yield and yield traits under higher level nutrients might be due to higher absorption of nutrients responsible for increased photosynthetic accumulation and high biomass production and finally resulting in increament of yield and yield component. Similar findings were reported earlier by Sharma and Subehia (2014) [10].

Harvest Index (%)

Data pertained that the T_6 have highest harvest index (42.88%), which is significant with control but it was non significant with T_2 (GRD) and other treatments. The minimum harvest index (38.95%) obtained in T_1 (control).

Table 6: Effect of different treatments on yield of rice

Treatments	Yield (kg ha^{-1})		Test weight (g)	Harvest Index (%)
	Grain	Straw		
T_1: Control	2763	4331	20.75	38.95
T_2: GRD	4127	5815	22.91	41.51
T_3: T.Y. 50 q ha^{-1}	4655	6439	23.69	41.96
T_4: T.Y. 60 q ha^{-1}	5239	7067	24.11	42.57
T_5: T.Y. 50 q + 5 t FYM ha^{-1}	5091	6935	23.95	42.33
T_6: T.Y. 60 q + 5 t FYM ha^{-1}	5678	7563	24.33	42.88
CD (p=0.05)	682	973	2.98	NS

Conclusion

Application of FYM and fertilizers based on STCR approach would help to provide the appropriate amount of nutrients for the crop. It not only helps to enhance crop yield but sustains soil health also. It is concluded that significantly superior performance of rice in terms of growth, yield attributes, grain and straw yields of rice were obtained under a higher level of NPK integrated with FYM (158:107:69 kg N, P_2O_5 and K_2O + 5 t FYM ha^{-1}) as compared to other treatments. If the nutrient availability in soil and requirement for a targeted yield is known, balance fertilizers can apply to the soil.

References

1. Adhya TK, Singh ON, Swain P, Ghosh A. Rice in Eastern India: Causes of low productivity and available options. Journal of Rice Research. 2008;2:1-5.
2. Anburani A, Manivannan K. Effect of integrated nutrient management on growth in brinjal. South Indian Horticulture. 2002;50:377-86.
3. Balasubramanian A, Wahab K. Integrated nutrient management in rice for Cauvery Deltaic zone of Tamil Nadu, India. Plant Archives. 2012;12(1):95-97.
4. Chandrasoorian S, Palaniappan SP, Martin GJ. Studies on soil fertility changes in a rice based cropping system. (In) XIII National Symposium on Integrated Nutrient Management for Efficient Crop Production, TNAU. 1994, 22-5.
5. Hanway JJ, Heidel H. Soil Analysis Methods, as used in Iowa State. College Soil Testing Laboratory, Iowa, Agriculture. 1952;57:1-31.
6. Jackson M. Soil Chemical Analysis. Prentice Hall of India Pvt. Ltd., New Delhi, 1973.
7. Khidrapure G, Uppar DS, Maruti K, Tejagouda MB, Shankrayya. Effect of integrated nutrient management on plant Growth and seed yield in hybrid maize (Arjun). An International Journal of Life Science. 2015;10(1):369-371.
8. Mahmud AJ, Shamsuddoha ATM, Nazmul Haque MD. Effect of Organic and Inorganic Fertilizer on the Growth and Yield of Rice (*Oryza sativa* L.). Nature and Science 2016;14(2).
9. Palaniappan SP, Annadurai K. Organic Farming: Theory and Practices, Scientific Publishers, Jodhpur. 2007, pp. 169.
10. Sharma U, Subehia SK. Effect of long-term integrated nutrient management on rice (*Oryza sativa)* - wheat (*Triticum aestivum*) productivity and soil properties in north-western Himalaya. Journal of the Indian Society of Soil Science. 2014;62(3):248-254.
11. Singh GB, Biswas PP. Balanced and integrated nutrient management for sustainable crop production. Indian Journal of Fertilizers. 2000;45:55-60.
12. Singh RP, Verma TS. Dynamics of nitrogen fractions with long term addition of Lanatana camera biomass in rice-wheat cropping sequences. Journal of the Indian Society of Soil Science. 2001;49:407-412.
13. Srivastava VK, Bohra JS, Singh JK. Effect of integration of NPK levels and organic sources on growth, yield and economics of rice. Adv. Res. J Crop Improv. 2013;4(2):113-117.
14. Subbiah BV, Asija GL. A rapid method for the estimation of nitrogen in soils. Current Science. 1956;25:259-260.
15. Walkley A, Black CA. An examination to different method for determination soil organic matter and proposal for modification of the chromic acid titration method. Soil Science. 1934;37:29-38.
16. Watanabe FS, Olsen SR. Test of an ascorbic acid method for determining phosphorus in water and $NaHCO_3$ extracts from soil. Soil Science Society of America Proceedings. 1965;29:677-678.