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Optimizing Crop Productivity and Profitability through Integrated Nutrient Management in low land Rice

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ABSTRACT: The most rational approach for maintaining long-term soil fertility and productivity is the integrated nutrient supply system. To optimise the yield of rice under different inorganic and organic combinations of nutrients that also leave positive effects on soil health, a field experiment was conducted at the Regional Sugarcane and Rice Research Station, Rudrur, during kharif season of 2021 to assess the effect of different nutrient management practices on yield and yield parameters of rice. The experiment was laid out in randomized block design, with three replication and seven treatments. The results revealed among the different nutrient combinations tested, the nutrient supplied based on STCR equation in addition to 5t FYM blended with microbial consortium (T7) recorded significantly more productive tillers (28.0), number of grains panicle^{-1} (262.0) and test weight (15.1 gr) when compared to control (no fertilizer). However, it was on par with T4 and T6 with respect to the productive tillers, T3, T4 & T6 with respect to no. of grains panicle^{-1} and T2, T3, T4 & T6 in terms of test weight. Further T7 treatment was recorded highest grain yield of 5418 kg ha^{-1}. However, it was comparable with T4 and significantly superior over rest of the treatments. This trend was also reflected in terms of net returns. The highest B:C ratio was recorded with T7 treatment. However, it comparable with T3, T4, T5 & T6 and significantly more over T1 & T2. The integrated use of NPK fertilizer along with FYM + Microbial consortium based on STCR approach not only gave higher rice yield but also improve and sustain the soil fertility. The observation of the data revels that the performance of STCR with 5t FYM + MC for the yield target 75q ha^{-1} (T7) and RDF+10 t FYM, in general was better over rest of the treatments in increasing yield parameters, yield and economics of rice.

Keywords: Rice, Integrated nutrient management, Azospirillum, STCR, FYM, Yield.

INTRODUCTION

Rice (*Oryza sativa* L.) is the most important and widely grown food grain in the world. It is accredited as a 'global grain' because of its elementary role as a staple food all around. Rice is the most important and staple food crop for more than two third of population of India. Monitoring the rice market is a critical task considering more than half of the global population consumes rice daily. The primary regions for rice production worldwide are South and East Asia. China and India are considered as the main producers of paddy rice worldwide. Rice cultivated in India about 457.69 area (Lakh hectare.), production is 124.37 (Million Tonnes) and productivity is 2717 kg ha^{-1} (Indiastat, 2020). To meet the food demand of the increasing population, the production and productivity of crops are to be concentrated. The only use of synthetic or organic nutrient inputs for plants cannot met this demand; rather, a mixture of both is more practical, cost-effective and feasible for the farmers, end-users, and soil environment (Selim, 2020; Khan *et al*., 2009).

Nutrient management is one of the pivotal factors for realizing sustainable yield from any production practices. Integrated nutrient management system plays a key role in harmonizing the soil fertility and plant nutrient supply to an optimum level through the judicious and efficient use of chemical fertilizers, green manure, Farm Yard Manures and biofertilizers resulting to an ecofriendly and economically sustainable for this problem. The use of green manure, FYM or biofertilizer not only helps in supplementing requirement but also improves soil physical, chemical and biological properties (Yadav *et al*., 2009).

Inclusion of green manure, farmyard manure (FYM) and biofertilizers, such as Azospirillum, Rhizobium and PSB help in augmenting crop requirements and ameliorating the physicochemical and biological properties of soil in the cropping system (Yaduvanshi *et al*., 2013; Maitra *et al*., 2018). Biofertilizers are economical, eco-friendly, and provide nutrients to the crop for a prolonged period. Farmyard manure and green manure act as soil conditioners by providing a amiable environment for the growth of the soil microbes. Organic sources, apart from improving intrinsic properties of soil, help in enhancing the use efficiency of applied fertilizers. Integrating chemical fertilizers with organic manures offer an environmentally safe, economically sound, socially reasonable, and ecologically sustainable production system (Midya *et al*., 2021; Sahu *et al*., 2015). Amongst the essential elements, nitrogen has a prominent role in the growth and metabolic processes in rice, consequently contributing to more than 50% of the yield increment, even under usual growing conditions. Application of fertilizers based on Soil test crop response not only enhance crop yield, when the STCR along with Integrated nutrient management can also take about balance between degenerative and soothing activities in the soil ecosystem. The present study was conducted to assess the effect of soil test based integrated fertilization on productivity and profitability on rice.

MATERIALS AND METHODS

A field experiment was conducted at the Regional Sugarcane and Rice Research Station, Rudrur, PJTSAU, Telangana, India in 2021, situated at an altitude of 286.3 m above mean sea level at 18° 49′41″ N latitude and 78°56′45″ E longitude. The experimental site is in the Northern Telangana Agro-climatic zone of Telangana state, India and experiences a semiarid climate. The experiment was laid out in randomized block design with three replication and treatments comprised of inorganic and organic sources of nutrients, i.e., T1-control (No fertilizer), T2 – Recommended dose of fertilizer (100% RDF - 102:35:30 of NPK kg ha^{-1}), T3-farmer practice (156:45.5:39 NPK kg ha^{-1}), T4- RDF + 10 t ha^{-1} FYM, T5- RDF + 5t ha^{-1} Green manure, T6-RDF + Microbial consortium (MC), T7- STCR dose + 5t FYM + MC with yield target 75q ha^{-1} (198:93:166 NPK Kg ha^{-1}). The FYM was incorporated into the soil before transplanting. The full dose of P and K and nitrogen as per treatments was applied in three splits i.e., at the basal, top dressed 25 days after transplanting and before flowering along with K fertilizer. The size of the individual plot was 8 x 9 m. The experimental field was black soil and Initial nutrient status of experimental soil is low available nitrogen (211 kg N ha^{-1}) (Kjeldal method), available phosphorus (63 kg P_2O_5 ha^{-1}) (Olesen's method) and available potassium (207 kg K_2O ha^{-1}) (Flame photometric method), respectively. The soil was found to be slightly saline (pH 8.0) with normal electric conductivity (0.0218 dSm^{-1}) and soil organic carbon is 0.53%. Chemical sources of nutrients are Urea, single super phosphate and muriate of potash. Farm yard manure, Azospirillum and (Phosporus solubilizing bacteria) PSB as organic and biofertilizer sources were used in different combinations to make above mentioned treatments. Dahincha (*Sesbania aculeata*) grown as green manure and incorporated at 50% flowering (45 DAS). The size of individual plot was 8 × 9 m. Rice variety is RNR 15048, which 25 days old seedlings were uprooted from the nursery bed and transplanted in the main field with a spacing of 20 × 15 cm at the depth of 2-3 cm with 2-3 seedlings per hill without damaging the seedlings. The seedlings were transplanted in September, 2021 and harvested in December, 2021. Rainfall received during the crop growth period from September to December is 462.30 mm. The data were analysed statistically by applying the technique of analysis of variance for randomized block design and significance was tested by F-test. The critical difference for treatment means tested for their significance was calculated at the 5% level of probability.

RESULTS AND DISCUSSION

Effect of INM practices on yield parameters and yield

Number of Productive tillers: The data pertaining to number of productive tillers presented in Table 1. The nutrient supplied based on STCR equation in addition to 5t FYM blended with microbial consortium (T7) recorded significantly more productive tillers (28.0) over control and other remaining treatments, but it is statistically on par with RDF + 10 t FYM (T4) and RDF + Microbial consortium (T6) and the similar results are reported by Sahu *et al*. (2015). Nayak *et al*. (2007) also reported that the significant increase in number of effective tillers per hill due to application of chemical fertilizer with organic manure.

No. of grains panicle^{-1}: The data pertaining to No. of grains panicle^{-1} presented in Table 1 more number of grains panicle^{-1} (262) reported in STCR equation in addition to 5t FYM blended with microbial consortium (T7) over control and other treatments, however, it is on par with RDF+10 t FYM (T4) and RDF+ Microbial consortium (T6). The similar findings was suggested by Sahu *et al*. (2015). Mohanty *et al*. (2013) also found that application of chemical fertilizer, FYM and Biofertilizer produced significantly higher number of tillers and significantly highest number of grains panicle^{-1} as compared to 100% recommended dose of fertilizer and control.

1000 Grain weight: Data regarding 1000 Grain weight was presented in table 1. The test weight (1000-grain weight) of rice varied from 11 to 15 g. Heighest 1000 grain weight (15g) was recorded in STCR dose + 5t FYM+MC (T7) and RDF+10 t FYM (T4) followed by Farmer practice (T3), however T7 on par with T2, T3 &

T6. Bahadur *et al*. (2013) reported the same results. Yang *et al*. (2004) stated that test weight was increased by the application of chemical fertilizer along with organic manure.

Grain yield: T7 treatment was recorded highest grain yield of 5418 kg ha^{-1}, it is 49.4%, 34 %, 26 and, 20.4% higher than T1, T2, T3, T5 and T6 respectively. However, it was comparable with T4 (5015 kg ha^{-1}) and significantly superior over rest of the treatments. Lower grain yield recorded in control (no fertilizer). Similar results were obtained by Bahadur *et al*. (2013) due to the integrated application of NPK fertilizers and FYM, which enhance the nutrient availability throughout the growing season.

Furthermore, results showed that grain yield from the treatment receive from (T6) RDF + Microbial consortium (4311 kg ha^{-1}) and (T5) RDF + 5t Green manure (4009 kg ha^{-1}) were at par with each other. Combined application of organic manures and fertilizers under STCR approach also helps in improvement of nutrient use efficiency, P solubilization, K availability, enhancing soil properties and ultimately maintaining soil quality Mahmood *et al*. (2017). The results are in line with Sellamuthu *et al.* (2015) as opined that STCR approach helps in balanced nutrient availability by efficient utilization of nutrients from soil, fertilizer sources and synergistic effect of the conjugated use of organic as well as inorganic sources.

Economics: Different nutrient management practices have significantly influence on Economics and data pertaining to economics presented in Table 2. The benefit cost ratio of the treatments was calculated by using the input cost and output value. The highest gross returns (99,426 Rs ha^{-1}) obtained from the nutrient supplied based on STCR equation in addition to 5t FYM blended with microbial consortium (T7) and it was statistically on par with (T4) RDF+10 t FYM. Lower gross return obtained from control (T1). Higher net returns (44,444) and B:C (1.8) ratio realized from (T7) STCR dose + 5t FYM +MC, however, it comparable with T3, T4, T5 & T6 and significantly more over T1& T2. According to Dey (2015) the treatment of targeted yield found the most economic treatment as compared to general recommendation.

Table 1: Yield attributes and yield of rice influenced under different nutrient management practices.

Treatments	No. of Productive tillers per hill	No. of grains panicle^{-1}	1000 Grain weight (gr)	Yield (kgha^{-1})
T1: Control (no fertilizer)	18	197	11	2738
T2: Current rec. dose (100 % RDF)- 102:35:30	21	202	13	3523
T3: Farmer practice- 156:45.5:39	22	233	14	3485
T4: RDF+10 t FYM	24	247	15	5015
T5: RDF+5t Green manure	23	219	13	4009
T6: RDF+ Microbial consortium	24	243	13	4311
T7: STCR dose + 5t FYM+MC (198:93:166 Kg ha^{-1})	28	262	15	5418
SE.m	1	13	1	329
CV	10	10	10	14.0
CD	4	39	2	1015

Table 2: Gross returns, Net returns and B:C of rice under different nutrient management practices.

Treatments	Gross returns (Rs ha^{-1})	Net returns (Rs ha^{-1})	B:C ratio
T1: Control (no fertilizer)	50,237	11,078	1.3
T2: Current rec. dose (100 % RDF)-102:35:30	64,653	20,825	1.4
T3: Farmer practice156:45.5:39	63,956	21,673	1.5
T4: RDF+10 t FYM	92,032	41,711	1.8
T5: RDF+5t Green manure	73,571	29,350	1.7
T6: RDF+ Microbial consortium	79,101	33,181	1.7
T7: STCR dose + 5t FYM+MC (198:93:166 Kg ha^{-1})	99,426	44,444	1.8
SE.m	6,045	6,313	0.1
CV	14.0	38	10.0
CD	18,832	19,669	0.3

CONCLUSIONS

The outcomes of this study indicated that the application of fertilizers based on soil test value (STCR approach) along with organic manures significantly improved the growth, yield attributes and yield compared to chemical fertilizers alone of lowland rice. The observation of the data revels that the performance of STCR dose with 5t FYM + MC for the yield target 75q ha^{-1} (T7) and RDF + 10 t FYM, in general was better over rest of the

treatments in increasing yield parameters, yield and economics of rice.

FUTURE SCOPE

Need to study on long term effect of INM applications in rice-rice cropping system and STCR equations should be developed for different types of soils.

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Conflict of Interest. None.

REFERENCES

Bahadur, L., Tiwari, D. D., Mishra, J. and Gupta, B. R. (2013). Evaluation of integrated nutrient management options in rice (*Oryza sativa*)–wheat (*Triticum aestivum*) cropping system in reclaimed sodic land. *Indian Journal of Agronomy*, *58*(2), 137-145.

Dey, P. (2015). Targeted yield approach of fertilizer recommendation for sustaining crop yield and maintaining soil health. *JNKVV Research Journal*, *49*(3), 338-346.

Khan, A., Jan, M. T., Marwat, K. B. and Arif, M. (2009). Organic and inorganic nitrogen treatments effects on plant and yield attributes of maize in a different tillage systems. *Pak. J. Bot.*, *41*(1), 99-108.

Mahmood, F., Khan, I., Ashraf, U., Shahzad, T., Hussain, S., Shahid, M., ... & Ullah, S. (2017). Effects of organic and inorganic manures on maize and their residual impact on soil physico-chemical properties. *Journal of soil science and plant nutrition*, *17*(1), 22-32.

Maitra, S., Zaman, A., Mandal, T. K. and Palai, J. B. (2018). Green manures in agriculture: A review. *Journal of Pharmacognosy and Phytochemistry*, *7*(5), 1319-1327.

Midya, A., Saren, B. K., Dey, J. K., Maitra, S., Praharaj, S., Gaikwad, D.J., Gaber, A., Alhomrani, M. and Hossain, A. (2021). Crop establishment methods and integrated nutrient management improve: Part ii. nutrient uptake and use efficiency and soil health in rice (*Oryza sativa* L.) field in the lower indo-gangetic plain, India. *Agronomy*, *11*(9), 1894.

Mohanty, M., Nanda, S. S. and Barik, A. K. (2013). Effect of integrated nutrient management on growth, yield, nutrient uptake and economics of wet season rice (*Oryza sativa*) in Odisha. *Indian Journal of Agricultural Sciences*, *83*(6), 599-604.

Nayak, D. R., Babu, Y. J. and Adhya, T. K. (2007). Long-term application of compost influences microbial biomass and enzyme activities in a tropical Aeric Endoaquept planted to rice under flooded condition. *Soil Biology and Biochemistry*, *39*(8), 1897-1906.

Sahu, Y. K., Chaubey, A. K., Mishra, V. N., Rajput, A. S. and Bajpai, R. K. (2015). Effect of integrated nutrient management on growth and yield of rice (*Oryza sativa* L.) in Inceptisols. *Plant Archives*, *15*(2), 983-986.

Selim, M. M. (2020). Introduction to the integrated nutrient management strategies and their contribution to yield and soil properties. *International Journal of Agronomy*, *2020*.

Sellamuthu, K. M., Santhi, R., Maragatham, S. and Dey, P. (2015). Validation of soil test and yield target-based fertilizer prescription model for wheat on Inceptisol. *Research on Crops*, *16*(1), 53-58.

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Yadav, D. S., Kumar, V. and Yadav, V. (2009). Effect of organic farming on productivity, soil health and economics of rice (*Oryza sativa*)–wheat (*Triticum aestivum*) system. *Indian Journal of Agronomy*, *54*(3), 267-271.

Yaduvanshi, N. P. S., Sharma, D. R. and Swarup, A. (2013). Impact of integrated nutrient management on soil properties and yield of rice and wheat in a long-term experiment on a reclaimed sodic soil. *Journal of the Indian Society of Soil Science*, *61*(3), 188-194.

Yang, C. M., Yang, L., Yang, Y. and Ouyang Z. (2004). Rice root growth and nutrient uptake as influenced by organic manure in continuously and alternately flooded paddy soils. *Agricultural Water Management*, *70*(1), 67-81.

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