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Integrated nutrient management in rice

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Abstract
An experiment entitled "Effect of integrated nutrient management (INM) on rice (*Oryza sativa* L.) was conducted at Regional Research Technology Transfer Station, G. Udayagiri Kandhamal, Odisha during July-November months of 2020-21. The experiment consisted of twelve treatments, was laid out in Randomized Block Design with three Replications. The grain and straw yields of the rice crop were noted, including panicle length (cm) and plant height. that grain yield due to various treatments ranges from 25.0-33.3q ha^{-1}. lowest yield was 25.0 q ha^{-1} observed in control where no nitrogen applied. Highest yield was recorded 33.3q ha^{-1} due to 100% Nitrogen dose. The yield was increased by only 15% over control due to addition of 50% N dose of 28.9q ha^{-1}. Use of Azospirillum, Dhanicha, glyricidia leaf and *Lantana camera* significantly increased the yield by 8.0, 9.6, 14.8 and 6.8% respectively over control. However, addition of 50% N with the above treatment resulted in 17.6, 22.0, 24.8 and 16.0% increase over control respectively. Out of various green manures, glyricidia leaf was found more efficient by increasing the yield by 14.8% over control which is comparable to the application of 50% N in inorganic form. So far as application of full recommended dose of N is concerned it resulted highest yield of 33.3 q ha^{-1} which is followed by the yield of 31.2q ha^{-1} of 50% N through glyricidia leaf + 50% N s inorganic form.

Keywords: Rice, INM, yield, organic, inorganic

Introduction

Rice (*Oryza sativa* L.) is one of the most important staple food grain crops in the world. It belongs to family Poaceae (Gramineae). It is a high calories food which contains 75% starch, 6-7% protein, 2-2.5% fat, 0.8% cellulose and 5-9% ash. Gobally rice (*Oryza sativa* L.) is one most important staple cereal after wheat and maize in India, the total cultivated area under rice (43.8 M ha), production (163.7 mt) and productivity of 2.78 t ha^{1} (Agriculture Statistics at a Glance, 2018). Rice (*Oryza sativa* L.) is an important cereal crop and staple food for about half of the population on the world (Pathak *et al.*, 2020) [17]. In India rice is cultivated in an area of 43.79 million ha with production of 116.42 million tonnes and productivity of 2659 kg ha^{-1} (Anonymous, 2019) [2]. In Odisha, rice is the most important crop and cultivated in about 41 lakh ha (Mangaraj *et al.*, 2021) [12]. Average rice productivity in Odisha (1972 kg ha^{-1}) is quite low as compared to national average (Anonymous, 2019) [2]. Nutrient management is one of the important factors for higher rice production. Though the use of nitrogenous fertilizers per unit area for rice production is high, but the fertilizer use efficiency is generally low. Integrated nutrient management system plays a vital role in balancing the soil fertility and plant nutrient supply by judicious and efficient use of chemical fertilizers along with others. Integration of nutrients from organic and inorganic sources which can help in obtaining good crop yields as well as the sustainable production system (Ullah *et al.*, 2019; Shankar *et al.*, 2020) [25, 20]. The HYV rice generally required more amount of nutrients with organic and inorganic which improve s Odisha oil fertility (Imade *et al.*, 2017; Pattanayak *et al.*, 2022) [7, 18]. In Asia, more than two billion people are getting 60-70% of their energy requirement from rice and its derived products (Tomar *et al.*, 2 Odisha 018). In India it is cultivated in an area of 43.66 million hectares with a production of 118.87 million tonnes and productivity 2722 kg ha^{-1}. In Odisha like other states of India, rice is cultivated as main staple crop. Improper management of nutrients has led with excess nutrients to nutritional imbalances in the soil, although other nutrients have been decreased (Maurya *et al.*, 2019) [13]. The Integrated Nutrient Management (INM) is extremely essential in rice production (Upadhyay *et al.*, 2011) [26].

Manures like FYM, vermicompost, poultry manure and green manure can be substituted with the inorganic fertilizers for balanced and continuous supplement of nutrients for the crop (Pandit *et al*., 2020) [16]. Nitrogen is one of the critical inputs in the irrigated ecosystem which limits rice productivity. The processing of 15 to 20 kg of grain requires around 1 kg of nitrogen, but the efficiency of nitrogen usage in India is very poor (Zhang *et al*., 2012) [27]. Rice is the major nutrient draining crop, there will be huge deficit in the soil nutrients in rice. To overcome the problem and maintain soil fertility, there is need for integration of nutrients from organic and inorganic sources which can help in obtaining good crop yields as well as the production sustainability (Shankar *et al*., 2020) [20]. The increasing cost of chemical input, pollution, soil health and sustainability of the production system had generated interest in the integrated nutrient management. The integrated nutrient supply system is the most logical concept for managing long-term soil fertility and productivity (Ramesh *et al*., 2009) [21]. Green manuring has twin benefits of soil quality and fertility enhancement while meeting a part of nutrient needs of crop. Use of organic manures, green manures, crop residues along with inorganic fertilizers not only reduces the demand of inorganic fertilizers but also increases the efficiency of applied nutrients due to their favorable effect on physical, chemical and biological properties of soil (Pandey *et al.*, 2010) [15], as organic manure provide a good substrates for the growth of microorganism and maintain a favorable nutrient supply to crop and achieve sustainable crop production. (Ram *et al.*, 2020) [20] revealed that yield improvements with INM were due to instantaneous and rapid supply of nutrient through chemical fertilizers and steady supply through mineralization of FYM for prolonged period. It also had effect on residual phosphorus and potassium in soil. FYM is rich nutrient and contains 0.5% nitrogen, 0.2% phosphorus and 0.5% potassium. Inorganic fertilizer is not be enough to maintain the present levels of crop productivity of high yielding varieties. Green manuring is the process of turning of green plant into the soil either by raising them in same field or plant growth elsewhere at the green stage before flowering and incorporate into the soil. It is a good management practice in agriculture production, because it can improve soil fertility and quality (Lee *et al.*, 2010) [11] and also supply N, a primary limiting nutrient for crops.

Materials and Methods

Experiment on INM in Rice was conducted at RRTTS, G. Udayagiri (OUAT), Kandhamal, Odisha during July-November of 2020-21 as details mentioned below.

T_1-control
T_2-50% N
T_3-100% N
T_4-Azospirillum@ 5kg ha^{-1}
T_5-50% N through Dhanicha
T_6-50% N through Glyricidia leaf
T_7-50% N through *Lantana camera*
T_8-T_2 + T_4
T_9- T_2 + T_5
T_{10}- T_2 +T_6
T_{11}-T_2+T_7
T_{12}-T_2+ PSM

N.B.-P and K was applied common for all treatments
Design-RBD, replication -3, location-RRTTS, G. Udayagiri, plot size-5mx3m Fertilizer dose-60:30:30
Season -*kharif*, variety- Khandagiri, Month-July- November

The experiment was conducted in medium land site. The soil is sandy loam in texture, p H -5.39, low in available P_2 O $_5$, Organic carbon-5.4g/kg and available K_2 O is 160 kg ha^{-1} the micronutrient content of the experimental site were 1.04, 15.25,4.12 and 3.25 ppm in respect of B, Fe, Zn and Cu content respectively.

Result and Discussion

The grain yield and other yield attributing characters of rice recorded in different treatments are presented below in Table 1. it is observed from the Table 1 that grain yield due to various treatments ranges from 25.0to 33.3q ha^{-1}. Lowest yield was 25.0 q ha^{-1} observed in control where no nitrogen applied. Highest yield was recorded 33.3q ha^{-1} due to 100% Nitrogen dose. The yield was increased by only 15% over control due to addition of 50% N dose of 28.9q ha^{-1}. Use of Azospirillum, Dhanicha, glyricidia leaf and *Lantana camera* significantly increased the yield by 8.0, 9.6, 14.8 and 6.8% respectively over control. However, addition of 50% N with the above treatment resulted in 17.6, 22.0, 24.8 and 16.0% increase over control respectively.

Out of various green manures, glyricidia leaf was found more efficient by increasing the yield by 14.8% over control which is comparable to the application of 50% N in inorganic form.

So far as application of full recommended dose of N is concerned it resulted highest yield of 33.3 q ha^{-1} which is followed by the yield od 31.2q ha^{-1} of 50% N through glyricidia leaf + 50% N s inorganic form.

Table 1: Yield and yield attributing parameter of rice *cv.* Khandagiri

Treatments	Mean plant height (cm)	Mean effective tillering/hill	Mean panicle length (cm)	Mean yield (q ha^{-1})	% increase over control	Mean straw yield (q ha^{-1})
T_1	62.7	7.1	17.1	25.0	-	27.5
T_2	68.6	7.9	17.8	28.9	15.6	34.7
T_3	64.7	8.5	17.6	33.3	33.2	34.3
T_4	65.1	7.2	17.7	27.0	8.0	29.7
T_5	63.9	7.9	17.4	27.4	9.6	30.6
T_6	66.8	8.3	18.4	28.7	14.8	34.4
T_7	66.4	7.5	18.5	26.7	6.8	28.8
T_8	64.9	8.4	18.2	29.4	17.6	32.3
T_9	64.3	8.7	17.8	30.5	22.0	34.2
T_{10}	63.3	8.9	18.8	31.2	24.8	37.4
T_{11}	66.4	8.7	18.7	29.0	16.0	31.9
T_{12}	65.5	8.8	17.9	29.8	19.2	33.9
C.D.(0.05)				1.78		3.89

The yield increase was in the order of glyricidia leaf (31.2q ha^{-1}.)., Dhanicha (30.5q ha^{-1}), *Lantana camara* (29.0q ha^{-1}) with addition of 50% N. This might be attributed due to the fact that higher doses of nutrients resulted in higher availability of nutrients in the soil for plant nourishment and further, organic source which slow release and continuous availability of nutrients enhanced cell division, elongation as well as various metabolic processes which ultimately increased the plant height. The results have got close conformity with the findings of Krishna *et al.*, (2008) [10], Dutt and Chauhan (2010) [6] and Murthy (2012) [14]. Integration of 25 or 50% Organic nutrients as (FYM/GM) with 50 or 75% inorganic release slow and continuous nutrients to the plant, and improved soil environment for better root penetration leading to better absorption of moisture and nutrients and produced better plant height and growth. These findings are in close agreement with those of Aruna and Mohhamad (2005) [3] and Barik *et al*., (2006) [4]. Bellakki *et al.*, (1998) [5] reported the superior performance of organic N as FYM /GM might be owing to reduced loss of N by fixation of NH4 + ion with humus present in FYM and increased availability of N to crop which ultimately increased the plant height. Tillering is the product of the expansion of auxiliary buds which is closely associated with the nutritional conditions of the culm because a tiller receives carbohydrate and nutrient from the culm during its early growth period which improved by the application of nitrogen (Tisdale and Nelson, 1975). Dry matter accumulation and Crop growth rate Dry matter production progressively increased up to harvest and the increase was remarkable from flowering to harvest because after heading and flowering, the increase in the weight of the ear become very marked (Ishizuka,1971) [8].

Conclusion

Integrated nutrient management practices showed positive and favorable effect on improving almost all the growth characters, rice. Lowest yield was 25.0 q ha^{-1} observed in control where no nitrogen applied. Highest yield was recorded 33.3q ha^{-1} due to 100% Nitrogen dose. The yield was increased by only 15% over control due to addition of 50% N dose of 28.9q ha^{-1}. Use of Azospirillum, Dhanicha, glyricidia leaf and *Lantana camera* significantly increased the yield by 8.0, 9.6, 14.8 and 6.8% respectively over control. However, addition of 50% N with the above treatment resulted in 17.6, 22.0, 24.8 and 16.0% increase over control respectively.

Future Scope of Research

More research in farmers field and bio-chemical studies are to be taken in future study of research.

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