Original Article

Impact Of Inorganic Nitrogenous Fertilizers And Farmyard Manure Combination On Nitrogen Content By Grain, Straw At Harvest And Protein Content Of Grain In Ppm

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Abstract

A pot culture experiment entitled **"Impact of inorganic nitrogenous fertilizers and farmyard manurecombination on nitrogen content by grain, straw at harvest and protein content of grain in ppm"** was conducted at the Institute of Agricultural Sciences farm, Sikha 'O' Anusandhan (Deemed to be University), Bhubaneswar Odisha. on sandy loam soil during Kharif 2018-2019. Eight treatments made up the experiment: T1- (Control), T2 - 50% RDF, T3-50% RDF + FYM @ 5 t ha^{-1}, T4- 75% RDF, T5-75% RDF + FYM 5t ha^{-1}, T6- 100% RDF (NPK 80:40:40), T7-100% RDF + FYM 5t ha^{-1}, T8-150% RDF. Three replications of the experiment were set up using a Randomized Block Design. The findings showed that the treatment that received 100% RDF + FYM @ 5t ha^{-1} recorded the highest and most significant values for growth parameters, such as plant height, number of tillers per hill, effective tillers per hill, and yield attributes, such as number of panicles per hill, panicle length, and the number of filled grains 1000 seed weight (test weight). In addition, larger increases in the aforementioned parameters were seen when FYM (5t ha^{-1}) was combined with lower amounts of RDF(50 and 75% RDF), as opposed to the application of inorganic fertilizers alone at the corresponding levels. The trend in grain and straw yields was similar to that of the growth parameters, and at higher concentrations of nitrogen in the inorganic form (150% RDF), the values of all of the parameters, including grain and straw yield, were significantly lower than in the treatment where 100% RDF + FYM 5t ha^{-1} was used. The application of 100% RDF + FYM 5t ha^{-1} increased the number of nutrients (N, P, and K) in grain and straw compared to 100 and 150% RDF. With the combined application of 100% RDF as an inorganic source and 5 t ha^{-1} FYM as an organic source, improvements in physicochemical parameters such as organic carbon, bulk density, porosity, and accessible macronutrients (N, P,K) were seen. Based on the results of the investigation, it can be said that inorganic nitrogen applied to sandy loam soils in Odisha at 100% RDF level along with FYM 5 t ha^{-1} improved physical conditions and the availability of macronutrients. Higher levels of RDF (150%) produced yields that were significantly lower than those produced by the combination of inorganic and FYM and yields that were nearly equal to those produced with the recommended dose of nitrogen (100% RDF) only in mineral form.

Keywords: Inorganic nitrogen, FYM, Grain, Straw, Yield

1. Introduction

Intensive rice production and future rice demands will require knowledge-intensive strategies for the efficient use of all inputs, including fertilizer nutrients (Dobermann and Fairhurst 2000). Rice is unique among cereal crops because its root system is adapted to largely anaerobic soil conditions. The aquatic environment also alters the availability of several essential nutrients, and affects nutrient uptake and use efficiency and fertilization practices. Katyal et al., 2001 reported the importance of integrated nutrient management with continuous application of chemical fertilizers to virgin soil, soil organic matter (SOC) remained stable for 10 years, while in manure and fertilizer (integrated nutrient management) practices, it was stable for 25 years. This indicated that the combined use of organic and inorganic fertilizers played an important role in stabilizing and maintaining SOC in cropping systems and ensuring sustainability. Organic manure has been recorded to enhance efficiency and reduce the requirement for chemical fertilizers. Partial nitrogen substitution through organic manure recorded significant superiority in yield over farmers' practices (Singh and Gangwar, 2000). The use of organic manures in conjunction with or as an alternative to chemical fertilizer is receiving attention. Khan et al., 2006 reported a series of experiments that were conducted in different agro-climatic situations by various scientists for integrated nutrient management by using the different sources of organic manures, green manures, and chemical fertilizers and their combinations to study the effect on the productivity of rice under rain-fed lowland and varying irrigation regimes. Excessive use of chemical fertilizers isthe major cause of nutrient imbalance in soil (Meena et al., 2003).

2. Materials and Methods

The Institute of Agricultural Sciences farm, Siksha 'O' Anusandhan (Deemed to be University), Bhubaneswar, Odisha, conducted a pot culture experiment to investigate the "Impact of inorganic nitrogenous fertilizers and farmyard manure combination on nitrogen content by grain, straw at harvest, and protein content of grain in ppm" during Kharif 2018-2019. The materials utilized, the methods used to collect soil and plant samples, the analytical procedures employed, and the statistical approaches used are all covered in this article. During the 2018–2019 growing season, the pot culture experiment was carried out at Research Farm, Campus-4, Institute of Agricultural Science, Siksha 'O' Anusandhan University, Bhubaneswar, Odisha. The experimental site is 50.6 meters above mean sea level and is situated at 20.2588°N latitude and 85.7920°E longitude. Maximum temperatures at the test location range from 31.5 to 28.5 degrees Celsius, while minimum temperatures range from 18.7 to 13.0 degrees Celsius. In addition, 3.7 mm of rain fell on average at the test location. Between 48 and 38 percent of the relative humidity was present. Composite surface (0–15 cm) soil samples were collected from the Campus-4 agricultural field for the marijuana culture experiment. The soil is sandy loam-textured and falls within the Alfisol classification. For the experiment, 12 kg clay pots were filled with 10 kg of soil, eight treatments, and three replications. They were then air-dried, placed through a 2 mm screen, and kept in polythene bags for a preliminary analytical study of their physicochemical characteristics.

3. Results and Discussion

Following accepted practices, the physical and chemical characteristics of the soil used in pots were analyzed. The soil had a pH of 5.65, was electrically conductive (0.58 dSm-1), was non-saline, and had a sandy loam texture (Clay 9%, Silt 21%, and Sand 70%). The particle density of the soil was 2.64 g/cc, whereas the bulk density was 1.58 g/cc. The soil had a moisture content of 26%. The department of soil science, Institute Of Agricultural Sciences, Siksha 'O' Anushandhan University, Bhubaneswar, undertook a pot culture experiment. At a pH of 5.65, the soil sample exhibited an acidic reaction. Exchange of Cations 5.8 mol (P+) kg-1 of capacity may be found in the soil. The soil exhibited low amounts of accessible nitrogen (245 kg/ha) and organic carbon (58 g/kg), but medium levels of phosphorus (13.2 kg/ha) and potassium (156 kg/ha). The results of the experiment's numerous parameters were statistically examined using a computer and the MSTAT method for randomized block design (RBD) with the critical difference (CD) at 5% and standard error of means, as advised by Cochran and Cox 1977. The current research findings were described using the justification, qualities, and supporting scientific study findings.

3.1. N Content in rice Grain, Straw and Protein Content of Grain

The nitrogen content of the rice grain varied between 9.42 to 43.56 ppm in different fertilizer treatments (Table 1.). The N content in all three levels of RDF (50, 75, and 100% RDF) alone recorded a significantly higher amount of nitrogen than the control and higher levels of RDF also gave a significantly higher amount of nitrogen than their corresponding lower levels. When combined with 50, 75, and 100% RDF-treated plots, FYM 5t ha^{-1} considerably increased the N content of the plots' respective RDF levels. Due to greater grain production, 100% RDF application with FYM 5t ha^{-1} (T7) produced rice grain with the greatest N content(43.56 ppm). This value was substantially higher than that of other treatments. 75% RDF and FYM 5t ha^{-1} treatments for rice grain had nitrogen contents that were on par with 100% RDF treatments (80: 40: 40 Kg N, P_2O_5, and K_2O). N availability and better translocation of available N ultimately resulted in more grain yield and higher N concentration in grains. Higher N content in grain under organic treatments as compared to recommended fertilizer may be due to the slow release and steady supply of nitrogen from FYM. Similar results were reported by Singh (2011) and Sharma (2015) while studying the organic and integrated management in the basmati-wheat sequence. The highest nitrogen content in rice straw was recorded in T_7 (33.04 ppm) which received 100% RDF along with 5 t ha^{-1}FYM followed by T_8 (27.43 ppm) with 150% RDF. The treatment T_7 recorded significantly higher nitrogen content over all treatments. The trends in straw nitrogen content were different than grain nitrogen content. Application of 50% RDF + 5 t ha^{-1} FYM (T_3) and 75% RDF + 5 t ha^{-1} FYM(T_5) was at par with T_4(75% RDF) and T_6 (100% RDF) with respect to nitrogen content respectively. Similar results have been reported by Rani and Sukumari (2013), Yadav et al., (2005), and Walia (2007) in rice crops.

Protein content was increased significantly due to the application of general RDF(100%RDF + FYM 5t ha^{-1}) closely followed by 150% RDF through chemical fertilizer. The increase in protein content of rice grain due to more quantity of nitrogen content ingrain improved metabolic activities in the plant (Subbiah and Kumarswamy, 2000) and the variation in protein content was observed because of nitrogen content associated with its levels of supply as well as plant potential to absorb and utilize. Application of 75% RDF through chemical fertilizer + 5 t ha^{-1} FYM recorded significantly higher protein content than 75% RDF applied alone and significantly lower than 100%RDF. Similar results were reported by Singh et al., (2006) and Kulkarni (2012). Thus, it can be concluded that the application of 75% and the 100%recommended dose of nitrogen (RDN) through chemical fertilizer + 5t ha^{-1} FYM could improve growth, achieving higher productivity. The main effects of FYM and nitrogen significantly influenced protein concentration in the rice grain. The highest protein concentration in the grains was obtained in response to the combined application of the highest rates of RDF with the combined application of FYM 5t ha^{-1}.

(Fig- 1- Experimental Site)

T-1-Impact of inorganic nitrogenous fertilizers and farmyard manure combination onnitrogen content by grain, straw at harvest, and protein content of grain in ppm

Treatment	Grain (ppm)	Straw (ppm)	Protein (ppm/pot)
T1 - Control	9.42	7.55	58.87
T2 - 50% RDF	20.27	9.91	126.68
T3 -50% RDF + FYM 5t/ha^{-1}	24.56	14.72	153.50
T4 -75% RDF	27.21	17.36	170.08
T5 -75% RDF + FYM 5t/ha^{-1}	32.85	21.18	205.29
T6 -100% RDF	35.32	24.44	220.79
T7-100% RDF FYM 5t/ha^{-1}	43.56	33.04	272.24
T8 -150% RDF	36.85	27.43	230.31
SEm±	0.60	1.18	3.74
CD (P=0.05)	1.81	3.59	11.33

4. Conclusion

According to the study's findings, rice growth and production are improved by applying organic manures (FYM) and inorganic fertilizers together. Rice grain production was enhanced by using FYM 5t ha^{-1} in conjunction with 100% RDF. Increased nutrient availability and content led to more fertile tillers, grains per panicle, panicles per hill, filled grains per panicle, 1000 grain weight, biological yield, grain yield, and harvest index, all of which contributed to the higher yield obtained with integrated use of FYM and inorganic fertilizers.

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6. References

1. Dobermann A. and Frairhurst T H. 2000. Rice: Nutrient Disorders and Nutrient Management. 1st Edn., PPIC and IRRI, Philippines, Singapore,, Pages: 191
2. Katyal JC, Rao NH, and Reddy MN. 2001. Critical aspects of organic matter managementin the tropics: the example of India. Nutr. Cycling Agroecosyst,61, 77–88
3. Kulkarni MV. 2012. Effect of INM on physicochemical properties of soil under transplanted and drilled Rice (Oryza Sativa L.) in South Gujarat conditions. M.sc. (Agri.) A thesis submitted to Navsari Agricultural University, Navsari.
4. Meena SL, Surendra S, Shivay YS and Singh S. 2003. Response of hybrid rice (Oryza sativa L.) to nitrogen and potassium application in sandy clay loam soils. Indian J. Agric. Sci.**73**: 8-11
5. Rani S and Sukumari P. 2013. Root growth, nutrient uptake, and yield of medicinal rice Njavara under different establishment techniques and nutrient sources. American J of Plant Sci **4:**1568-1573
6. Sharma VK, Pandey RN and Sharma BM.2015. Studies on the long-term impact of STCR-based integrated fertilizer use on pearl millet (PennisetumglaucumL.)- Wheat (Triticum aestivumL) cropping system in a semi-arid condition of India. Journal of Environmental Biology, **36**: 241-247
7. Singh G, Singh OP, Singh RG, Mehta RK, Kumar V, and Singh RP. 2006. Effect of integrated nutrient management on yield and nutrient uptake of rice-wheat cropping system inlow lands of eastern Uttar Pradesh. Indian Journal of Agronomy, **51**(2): 85-88

8. Singh P, Gangwar B. 2000. Nitrogen substitution through FYM in maize-wheat cropping sequence under irrigated conditions Proc. of International Conference on managing natural resources for sustainable agricultural production in the 21st century, New Delhi 3 881-882
9. Singh RN, Singh S, Prasad SS, Singh VK and Kumar P. 2011.Effect of integrated nitrogen management on soil fertility nutrient uptake and yield of rice Leo cropping system on the soil of Jharkhand.JISS.Vol.**59** (2): 158-163
10. Subbiah, S. and Kumaraswamy, K. (2000). Effect of different manure fertilizer schedules on the yield and quality of rice and on soil fertility. Fertilizer News.**45**(10)**:** 61-62 & 65-67
11. Walia MK. 2007. Long-term effect of integrated nutrient management on rice (Oryza sativa L.) productivity and soil health in rice-wheat system. M.Sc. Thesis, Punjab Agricultural University, Ludhiana.
12. Yadav MP, Aslam M, and Kushwaha SP. 2005. Effect of integrated nutrient management on a rice-wheat cropping system in a central plain zone of Uttar Pradesh. Indi-an J. Agron. **50**: 89-93