Effect of integrated nutrient management on yield and economics of rice

Abstract

Two successive field experiments were conducted during kharif 2022 and 2023 at the Crop Research Centre of Chandra Shekhar Azad University of Agriculture and technology Kanpur, Uttar Pradesh. The experiment consisted of fourteen different treatments in randomized block design replicated thrice. Soil of the experimental field was sandy loam in texture and slightly alkaline in reaction. Result found that on the pool data basis higher grain yield (42.45q/ha) and was recorded with the treatment (T_8) consisting application of application of 75% NPK+FYM+Consortia+Nano zinc. During both the years higher straw yield 69.23 qha^{-1} and 67.00 qha^{-1} was recorded and on the pool data basis maximum straw yield obtained in T_8 which is followed by T_{14}. This treatment also resulted in comparatively higher (Benefit: Cost ratio) B:C ratio during both the years.

Keywords: Economics, Nano zinc, Consortia, FYM, B: C ratio, yield

Introduction:

Rice (*Oryza sativa L.)* is the staple food to feed over half of the world's population. Use of inorganic fertilizers has several negative impacts on soil fertility. Presently; use of organic sources is slowly mushrooming up over the globe due to its scientifically proven beneficial effects. In India, rice is grown in about 47.05 million hectares with a production level of 135.54 million tones and the productivity is about 2781 kg/ha .There is an ample scope to increase the productivity of rice. To increase the productivity of rice, it is important to maintain the fertility and organic matter status of soil.Integratedfertilizer and organic manure nutrient management is one of the viable options for preserving soil quality with regard to crop productivity (Bajpai *et al.,* 2006). Organic manures serve as the carbon and energy source for proliferation of microorganisms which may alter the activities of different enzymes. Incorporation of organic manures in the soil affects chemical and biological environment but also affects the nutrient availability to crop plants and microorganisms. A promising approach is to develop effective fertilization strategies that can encourage agricultural sustainability by promoting soil microbial

biomass and operation by integrating organic modifications with reduced chemical fertilizer (Mandal *et al.*, 2007). The quality parameters of scented rice are improved by biofertilizers alone or in combination with organic manure (Dixit & Gupta, 2000; Quyen & Sharma, 2003). To supplement part of the nitrogen requirement with ecological and economic significance, blue green algae (BGA) and Azospirillum can be successfully used in wetland rice.

Farm yard manure (FYM) is the most commonly used organic manure in most countries of the world. Farm Yard Manure application leads to improves soil structure, nutrient exchange, and maintains soil health thus very useful for INM or organic farming. FYM is a heterogeneous composted organic material consisting of dung, crop residue, and household sweeping in various stages of decomposition. It also had effect on residual phosphorus and potassium in soil. Introduction 3 FYM is rich in nutrients and contains 0.5% Nitrogen, 0.2% Phosphorus and 0.5% Potassium. Application of FYM improves soil fertility and soil physical properties like soil structure, aeration, water holding capacity etc.Generally, the enzyme activities in the soil are closely related to the organic matter content and strongly influenced by the hydrothermal regimes. Enzyme catalyzes all biochemical reactions and are an integral part of nutrient cycling in soil and these are sensitive indicators of soil ecological stress or other environmental changes. The main microbial enzymes involved in the mineralization of soil organic matter are cellulases, dehydrogenases, acid and alkaline phosphatase activity, proteases; nitrogen fertilization is the most important management strategy for the improvement of agricultural crops.

Materials and Methods

Two successive field experiments were conducted during kharif 2022 and 2023 at the Crop Research Centre of Chandra Shekhar Azad University of Agriculture and technology Kanpur, Uttar Pradesh. The experiment consisted of fourteen different treatments in randomized block design replicated thrice. Soil of the experimental field was sandy loam in texture and slightly alkaline in reaction. The experiment consisted fourteenth (14) treatments of INM based like that's Control (T_1) , 100% N P K (T_2),75% NPK + FYM @ 5 ton/ha (T_3), 75% NPK + NPK Consortia(T_4), 75% NPK + FYM @ 5 ton /ha + Consortia(T_5), 75% NPK + FYM @ 5 ton/ha + Nanozinc(T_6), 75% NPK + Consortia + Nano zinc(T_7), 75% NPK + FYM @ 5 ton/ha + Consortia+ Nano zinc (T_8), 50% NPK + FYM @ 5 ton/ha(T_9),50% NPK + Consortia(T_{10}),50% NPK +FYM @ 5 ton/ha + Consortia(T_{11}), 50% NPK + FYM @ 5 ton/ha + Nano zinc(T_{12}), 50% NPK+ Consortia + nano zinc(T_{13}), 50% NPK + FYM @ 5 ton/ha + Consortia + Nano zinc(T_{14})

were applied in randomized block design with three replications. Recommended dose of P and K was used in all the treatments with exception control. Rice variety (Pusa Basmati-1509) was transplanted in plant geometry on 16 July during 2022 and 2023. Recommended dose of fertilizer i.e.120kg N and 60 kg P and 40 kg / ha was applied through Urea, DAP and MOP with the FYM Consortia and Nano zinc. Whole of nitrogen, phosphorus and potassium and FYM was applied at planting while rootof paddy nurserydipped in Consortia and transplanted in field. Nano zinc spray at 30,60 DAT. After threshing each plot individually, the grains were cleaned, and their weight was recorded in kg/plot. This yield was then converted to a per-hectare basis. The observations collected during the study were organized into tables and analyzed statistically to reach valid conclusions.

Observation recorded

Grain yield (q ha^{-1})

After cleaning and drying the grains, the grain yield was recorded in kg per plot. The moisture percentage in 100 g samples drawn from each treatment was determined with the help of moisture meter and grain yield per plot was adjusted to 14 per cent moisture. The yield of net plot, thus converted into q ha^{-1}.

Straw yield (q ha^{-1})

The straw yield of each net plot will be worked out by deducting the grain yield from the biological yield of each plot. Finally, the straw yield will be computed on hectare basis and expressed in q ha^{-1}.

Economics of treatments

The cost of cultivation was calculated by taking into account the cost of seed, fertilizer, herbicide and the hiring charges of labour and machines for land preparation, irrigation, fertilizer application, plant protection, harvesting and threshing and the time required per hectare to complete an individual field operation. Cost of irrigation was calculated by multiplying time (h) required to irrigate a particular plot, consumption of diesel by the pump (1 h^{-1}) and cost of diesel. Gross income is the minimum support price offered by the Government of India for rice. Net income was calculated as the difference between gross income and total cost.

Result and Discussion

Grain yield

The data presented in Table-1 indicate that all treatments significantly increased grain yield compared to the control. The highest grain yields, 43.53 q ha^{-1} in the first year and 44.20 q ha^{-1} in the second year, were recorded with treatment T8 (75% NPK + Consortia + FYM @ 5 tons/ha + Nano Zinc). The control plot (T_1) produced the lowest yields, with 18.29 q ha^{-1} in the first year and 20.66 q ha^{-1} in the second year. On a pooled data basis, the maximum grain yield was 43.6 q ha^{-1}, followed by 41.85 q ha^{-1} in T14 (50% NPK + Consortia + FYM @ 5 tons/ha + Nano Zinc), with the lowest yield of 19.79 q ha^{-1} recorded in the control with application of FYM,Consortia, and Nano zinc obtained 52% more yield as compared to only NPK application. Similar findings were reported by **Sangeeta *et al.* (2020) and Sravan *et al.* (2020)**

Straw yield

The data in Table 1 show that straw yield was significantly affected by nutrient applications in both years of the study. In the first year, straw yield ranged from 41.84 to 73.41 q ha^{-1}, while in the second year it varied from 44.15 to 79.11 q ha^{-1}. The highest straw yield was recorded in T_8 (75% NPK + Consortia + FYM @ 5 tons/ha + Nano Zinc), with 73.41 q ha^{-1} in the first year and 79.11 q ha^{-1} in the second year, followed by T_{14} (50% NPK + Consortia + FYM @ 5 tons/ha + Nano Zinc). The control plot produced the lowest straw yields, 41.84 q ha^{-1} in 2022 and 44.15 q ha^{-1} in 2023. Based on pooled data, the maximum straw yield was 76.26 q ha^{-1} in T_8, while the minimum was 43.00 q ha^{-1} in the control.Similar findings were reported by **Shahni*et al.* (2019)and Ruan *et al.*, (2023)**

Economics

The economic analysis of any experimental research is an important expect for getting the most beneficial treatment combination from soil health and farmer s point of view. It is very obviously that a treatment with more chemical fertilizers may obtain a highest net return with minimum cost of cultivation in comparison to a treatment which includes organic sources but from soil health point of view its recommendation cannot be made. The maximum cost of cultivation incurred under T_{14}, and T_8(Rs.50416.00/-) and (Rs.51560 .00/-) during 2022 and 2023, Highest gross return in cured with the application of 75% NPK + FYM @ 5 ton/ha + Consortia+ Nano zincNet return was maximum under T_8in2022 and 2023. Although T_{14} notgavemore return than during 2022 and 2023but both are more beneficial from soil health point of view because it include FYM organic source Consortia biofertilizer and also application of Nano Zinc which improve the physical, chemical and biological properties. B:C ratio was found maximum under

T_8 (3.42) on the pooled data basis because of comparatively lower cost of cultivation and minimum is T_1(1.45) and (1.67) during 2022-2023.Similar findings were reported by **Imade*et al.*** **(2017) and Sharma *et al.* (2017)**

Conclusion

To achieve maximum yield of rice grain and straw yield during Kharif season, an integrated nutrient management system of application of 75% NPK + FYM @ 5 ton/ha + Consortia+ Nano zincseems better one since grain and straw yield in these treatment was maximum and also maximum b:c ratio found which is more profitable compare to other.

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Treatment Symbol	Treatment Combination	Grain yield (q/ha)			Straw yield (q/ha)		
		2021-22	2022-23	Pooled	2021-22	2022-23	Pooled
T_1	Control (Absolute)	18.92	20.66	19.79	41.84	44.15	43.00
T_2	100% NPK	23.64	26.60	25.12	49.55	53.81	51.68
T_3	75% NPK + FYM @ 5 ton/ha	27.31	30.74	29.02	54.24	58.92	56.58
T_4	75% NPK + NPK Consortia	28.46	32.04	30.25	55.37	60.14	57.76
T_5	75% NPK + FYM @ 5 ton /ha + Consortia	32.44	36.55	34.49	59.90	65.08	62.49
T_6	75% NPK + FYM @ 5 ton/ha + Nano zinc	33.76	38.05	35.90	61.10	66.37	63.74
T_7	75% NPK + Consortia + Nano zinc	35.68	40.46	38.07	62.59	68.38	65.49
T_8	75% NPK + FYM @ 5 ton/ha + Consortia + Nano zinc	40.13	45.12	46.13	71.41	77.11	74.26
T_9	50% NPK + FYM @ 5 ton/ha	24.49	27.55	26.02	50.71	55.08	52.90
T_{10}	50% NPK + Consortia	25.95	29.20	27.58	52.63	57.16	54.89
T_{11}	50% NPK + FYM @ 5 ton/ha + Consortia	29.67	33.42	31.55	56.57	61.45	59.01
T_{12}	50% NPK + FYM @ 5 ton/ha + Nano zinc	31.35	35.32	33.33	58.56	63.61	61.08
T_{13}	50% NPK + Consortia + nano zinc	34.90	39.34	37.12	62.45	67.84	65.15
T_{14}	50% NPK + FYM @ 5 ton/ha + Consortia + Nano zinc	38.34	43.36	39.85	67.66	73.48	70.57
	SEM(+/-)	**1.12**	**1.30**	**0.86**	**1.30**	**1.40**	**0.96**
	C.D.at 5% of level	**3.25**	**3.77**	**2.43**	**3.79**	**4.08**	**2.72**

Table-1: Effect of integrated nutrient management on yield of rice

S. No	Treatment Symbol	Treatment Combination	Total cost of cultivation (₹)	Gross Return (₹ /ha)	Net Return (₹ /ha)	B:C

Table-2: Effect of integrated nutrient management on economics of rice

1	**T_1**	**Control (Absolute)**	34312	87760	53448	1.56
2	**T_2**	**100% NPK**	39883	126320	86437	2.17
3	**T_3**	**75% NPK + FYM @ 5 ton/ha**	45982	144370	98388	2.14
4	**T_4**	**75% NPK + NPK Consortia**	38916	149880	110964	2.85
5	**T_5**	**75% NPK + FYM @ 5 ton /ha + Consortia**	46416	169205	122789	2.65
6	**T_6**	**75% NPK + FYM @ 5 ton/ha + Nano zinc**	49982	175470	125488	2.51
7	**T_7**	**75% NPK + Consortia + Nano zinc**	42916	185025	142109	3.31
8	**T_8**	**75% NPK + FYM @ 5 ton/ha + Consortia + Nano zinc**	50416	222650	172234	3.42
9	**T_9**	**50% NPK + FYM @ 5 ton/ha**	44606	130530	85924	1.93
10	**T_{10}**	**50% NPK + Consortia**	37540	137765	100225	2.67
11	**T_{11}**	**50% NPK + FYM @ 5 ton/ha + Consortia**	45040	155705	110665	2.46
12	**T_{12}**	**50% NPK + FYM @ 5 ton/ha + Nano zinc**	48606	163860	115254	2.37
13	**T_{13}**	**50% NPK + Consortia + nano zinc**	41540	181055	139515	3.36
14	**T_{14}**	**50% NPK + FYM @ 5 ton/ha + Consortia + Nano zinc**	51540	202685	151145	2.93