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Effect of Integrated Use of Fertilizers, Farm Yard Manure, Green Manure and Zinc on Rice (*Oryza sativa* L.) Productivity and Soil Fertility

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Abstract

The present investigation was conducted at the technology farmer field of district Shravasti during Kharif seasons 2021 and 2022. The Six treatment viz., control (T_1), 100% RDF (T_2), 50% RDF+Geen Manure (T_3), 100% RDF +Zn (T_4), FYM+Green Manure (T_5), FYM+Green Manure +Zn (T_6) were replicated in randomized block design in Rice crop variety Rajendra Bhagwati. The data recorded revealed that 100% RDF +Zn increased Number of panicles hill^{-1}, test weight, grain and straw yield. The treatment combination FYM+ Green Manure+Zn was found most effective improving yield and yield attributes. The maximum reduction of pH and maximum availability of O.C, N, P, K, S and zinc in soil was also recorded higher under FYM+Green Manure+Zn. The nutrients status of soil was improved at higher level of nitrogen and the effect was more noticeable when nitrogen was applied by organic manure.

Keywords: Grain, straw yield and soil properties

1. Introduction

Rice is one of the important cereal food crops for more than half of the world's population The global requirement of rice by 2050 AD would be 800 million tones, which is 26% higher than the present level of production. In India it is grown over an area 43.95 million hectare with a production of 130.29 million tons in 2021–22 (Anonymous, 2022). The ever increasing population of the country is forcing the planners to produce more and more with ever shrinking natural resources. Continuous use of high analysis fertilizers accelerated the mining of micro and secondary nutrients which brought down the productivity. The production of rice is adversely affected by regular application of high dose of inorganic fertilizers. It leads to degradation of soil day by day and the yield of rice are severely affected. The combined use of fertilizer and organic manure increases the productivity of crops with significant residual effect in soil. In addition to saving of available nutrients, integrated nutrient management also improved the soil organic carbon and nutrient status of the soil. The application of organic and inorganic fertilizer in proper proportion enhances the crop growth, maintains the organic carbon level in soil and productivity of crop also improves.. The combined use of organic manures and inorganic fertilizers helps in maintaining yield stability through correction of marginal deficiencies of secondary and micronutrients, enhancing efficiency of applied nutrients and providing favorable soil physical conditions (Gill and Walia, 2014) and (Kumar *et al*., 2014). Therefore, integrated nutrient management in which both organic manures and inorganic fertilizers are used simultaneously is the most effective method to maintain a healthy and sustainable productive soil.

2. Materials and Methods

The present investigation was conducted at technology Farmer field of district Shravasti during Kharif seasons 2021 and 2022 to explore the possibility of substituting fertilizer with FYM, Green manure (Dhaincha) and Zn is an integrated manner for the crop. The treatment consisting of chemical fertilizer with different combination of organics (FYM, Green manure and Zn) viz. control (T_1), 100% RDF (T_2), 50% RDF+Green Manure (T_3), 100% RDF+Zn (T_4), FYM+Green Manure (T_5), FYM+ Green Manure+Zn (T_6) were comprised in Randomized Block replicated as thrice. The experimental field soil was sandy loam with pH- 7.80 EC-0.98 dSm^{-1}, organic carbon- 25%, available nitrogen- 58.04 kg ha^{-1}, phosphorus- 14.15 kg ha^{-1}, potassium- 210.30 kg ha^{-1}, sulphur- 9.80 kg ha^{-1} and zinc- 23 mg kg^{-1}. The farm yard manure and Green manure was applied before fifteen days of transplanting and

zinc sulphate was applied in the last plough. Whereas half dose of nitrogen, phosphorus, potash and zinc were applied as basal application in the form of urea, diammonium phosphate, muriate of potash and zinc sulphate, respectively. Remaining doses of nitrogen was applied in two equally at tillering and panicle initiation stages. The seedling was transplanted with spacing of 20×10 cm^2. All the cultural practices were followed to raise a good crop. The grain and straw yield were recorded at maturity. The soil samples were collected before and after harvest of the crop and analyzed for chemical properties by following standard methods (Jackson, 1973). The experimental data were statistically analyzed using by MSTA for further observations and finding.

3. Results and Discussion

3.1. Plant growth and yield

Tremendous impact of fertility level on yield and yield attributes were observed Table 1. Maximum increment in plant height (101.14 and 123.50 cm) was recorded with the application of higher fertility level T_4: 100% RDF +Zn which was at par with T_3: 100% RDF. The highest grain and straw yield (60.95 and 74.34 q ha^{-1}) wererecorded with the application of 100% RDF+ Zn through inorganic fertilizer which was followed by 100% RDF T_2 (58.33 grain and 61.10 straw q ha^{-1}). Highest yield was obtained with recommended dose of chemical fertilizer as compared to added level of N in organic farm (Lal et al., 2013). The increased in grain and straw yield supplied the nutrient combination with organic, green manure and zinc Datta *et al.* (2008). Application of FYM+ Green Manure +Zn N-Organic manure and FYM significantly increased the productivity in rice (Bora et al*.,* 2008. The favorable effect of integrated nutrient management through inorganic fertilizer and organic manure on higher grain and straw yield was also reported by Kumar et al. (2014). Green manuring with N fixing tree leaves left marked residual effect and, therefore, improved productivity (Barik et al*.,* 2006). This may be due to the fact that slowly released nutrient through green manuring and applied inorganic fertilizer N helped in producing more grain yield of rice (Table 2).

Table 1: Effect of application of chemical fertilizer, FYM and green manure on physical parameters of rice cv. Rajendra Bhagwati

Treatment	No. of panicles $hill^{-1}$		Test weight (g)		Grain yield (q ha^{-1})		Straw yield (q ha^{-1})	
	2021	2022	2021	2022	2021	2022	2021	2022
T_1 (Control)	6.26	5.31	22.14	22.50	20.12	23.01	37.87	38.41
T_2 (100% RDF)	17.10	17.16	25.10	25.19	58.20	58.28	62.28	62.36
T_3 (50% RDF+Geen Manure)	12.17	13.17	24.14	24.81	54.01	55.41	58.10	58.97
T_4 (100% RDF+Zn)	17.58	17.99	25.20	25.67	59.10	60.01	70.47	71.10
T_5 (FYM+Green Manure)	13.44	14.79	24.30	24.98	55.01	56.32	70.11	73.52
T_6 (FYM+ Green Manure+Zn)	15.05	15.91	24.79	25.08	56.20	57.01	69.21	74.32
SEm±	0.72	0.57	1.01	1.08	1.39	1.11	1.92	1.11
CD (*p*=0.05)	2.12	1.68	3.03	3.24	4.08	3.27	5.63	3.27

3.2. Soil properties

Integration of organic sources with inorganic fertilizer was found more effective as compared to single application in

Table 2: Effect of application of chemical fertilizer, FYM and green manure on economics of cultivation of rice cv. Rajendra Bhagwati

Treatment	Harvest Index (%)		Cost of Cultivation (₹ ha^{-1})		Grass Income (₹ ha^{-1})		Benefit:cost ratio	
	2021	2022	2021	2022	2021	2022	2021	2022
T_1 (Control)	34.70	37.46	17873	18056	45251	46034	2.53	2.55
T_2 (100% RDF)	48.31	48.31	27985	28258	108141	109109	3.90	3.83
T_3 (50% RDF+Geen Manure)	48.18	48.44	22733	23157	97278	99231	4.28	4.29
T_4 (100% RDF+Zn)	45.61	45.77	29761	30207	114573	116703	3.85	3.86
T_5 (FYM+Green Manure)	43.97	43.38	21521	22121	77202	79938	3.59	3.61
T_6 (FYM+Green Manure+Zn)	44.81	43.41	24285	25310	104856	107082	4.32	4.23
SEm±	-	-	-	-			-	-
CD (*p*=0.05)	-	-	-	-	-	-	-	-

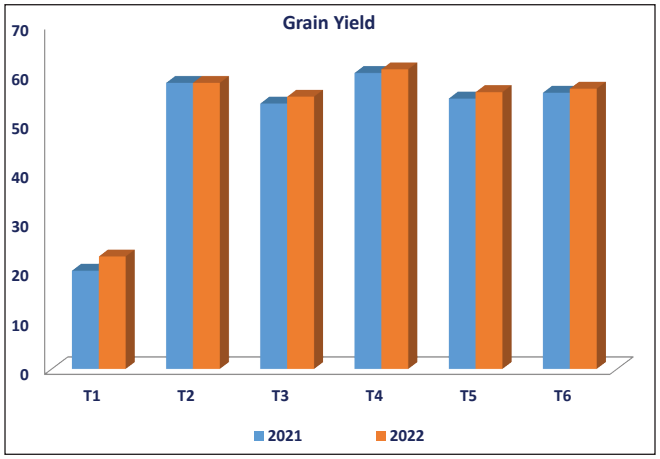

Figure 1: Grain Yield (q ha^{-1})

improving the physical status and fertility of soil. The buildup of neutral soil pH and EC were recorded under inorganic fertilizer treatment (T_2) whereas, maximum reduction in pH was observed with the application of T_6. However, differences in pH and EC were found non-significant. The higher availability of N, P, K, S and Zn in soil after harvest was recorded under modules as compared to inorganic fertilizer application treatments Table 3. Whereas, maximum availability of N, P, K, S and Zn were estimated under the treatment T_6 which was closely followed by T_3 and T_4. Jackson (1973). Better crop growth was observed with FYM, green manure and Zinc treated plots which might be due to the improvement of physical and chemical properties of the soil. These results closely correlate with the findings of Balu et al. (2014) and Prasad and Singhania (1989). On the basis of

Table 3: Effect of application of chemical fertilizer, FYM and green manure on soil pH, EC, O.C. and N, P and K availability

Treatment	pH		EC (dS m^{-1})		O.C (g kg^{-1})		N (kg ha^{-1})		P (kg ha^{-1})	
	2021	2022	2021	2022	2021	2022	2021	2022	2021	2022
T_1 (Control)	7.80	7.79	0.99	1.01	2.60	2.65	58.05	60.75	15.15	15.60
T_2 (100% RDF)	7.82	7.83	0.98	1.04	2.99	3.01	63.52	64.18	18.71	19.20
T_3 (50% RDF+Geen Manure)	7.75	7.74	0.87	0.93	3.60	3.69	81.01	85.5	19.62	21.30
T_4 (100% RDF+Zn)	7.79	7.82	1.01	1.04	3.41	3.48	76.50	81.25	22.21	25.15
T_5 (FYM+Green Manure)	7.75	7.74	0.97	0.94	3.82	3.93	85.53	94.5	22.50	26.50
T_6 (FYM+Green Manure+Zn)	7.75	7.73	0.97	0.93	3.94	4.05	87.75	90.00	20.22	24.25
SEm±	0.48	1.19	0.50	0.86	0.61	1.18	.62	1.28	1.01	1.02
CD (p=0.05)	1.41	3.49	1.46	2.56	1.89	3.46	1.82	3.77	2.97	3.01

Table 4: Effect of application of ghemical fertilizer, FYM and green manure on availability of K and Zn in soil

Treatment	K (kg ha^{-1})		Sulphur (kg ha^{-1})		Zn (ppm)	
	2021	2022	2021	2022	2021	2022
T_1	208.81	209.20	9.87	9.93	0.23	0.22
T_2	212.30	213.11	12.10	12.52	0.25	0.24
T_3	225.22	227.14	12.80	13.05	0.30	0.31
T_4	227.91	230.51	13.20	13.52	0.28	0.30
T_5	235.18	239.20	13.85	14.05	0.22	0.25
T_6	228.14	231.56	14.01	14.41	0.31	0.35
SEm±	0.62	0.83	0.52	.44	1.69	1.01
CD (p=0.05)	1.824	2.434	1.54	1.28	4.98	2.96

present investigation, it could be concluded that the T_6 found most effective in increasing the growth, yield and quality of rice and also helped in maintaining soil health for sustainable rice production.

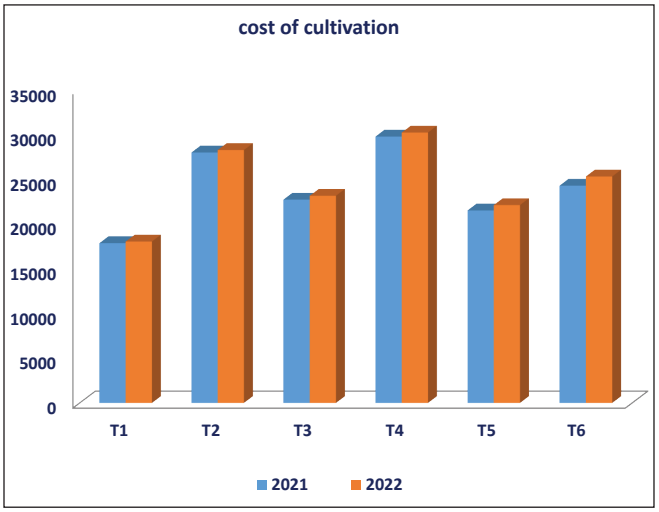

Figure 2: Cost of cultivation (₹ ha^{-1})

4. Conclusion

This study was conducted to understand the role of green manure, FYM and Zn in the morpho-physiology characters and yield of rice as well as how the application of these FYM and

GM can help to manage soil fertility issues. Soil fertility status was significantly increased with the application of organic and inorganic combination in treatment T6. This amendment results was showing better yield and soil properties in treatment T6 and suggested that FYM+GM+Zn Fund most effective in increasing the growth, yield and quality of rice and also helped in maintaining soil health for sustainable rice production.

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