Plant Archives Vol. 15 No. 2, 2015 pp. 983-986 *ISSN 0972-5210*

EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON GROWTH AND YIELD OF RICE (*ORIZA SATIVA* L.) IN INCEPTISOL

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Abstract

The present investigation was carried out to study the effect of integrated nutrient management on growth and yield of rice (*Oriza sativa* L.) in Inceptisol on the research farm of College of Agriculture and Research Station, Janjgir-Champa, an out campus of IGKV, Raipur (C.G.), India; during *kharif* season of 2014. The experiment was conducted in randomized block design with three replications comprising ten treatments. Results revealed that the treatment STCR dose with 5 t FYM for YT 50 q ha^{-1} ($\mathbf{T_{10}}$) was found to be significantly superior not only over control ($\mathbf{T_1}$) but also over rest of the treatments in increasing the plant height, dry matter, total and effective tillers of rice except 100% GRD + 5 t FYM ha^{-1} ($\mathbf{T_5}$) which was statistically similar to $\mathbf{T_{10}}$ in case of dry matter, total and effective tillers of rice. STCR dose with 5 t FYM for YT 50 q ha^{-1} ($\mathbf{T_{10}}$) registered significantly higher values of panicle length and total filled grains $panicle^{-1}$ over control. As regards to grain and straw yield of rice, significantly higher value was noted in treatment STCR dose with 5 t FYM for YT 50 q ha^{-1} ($\mathbf{T_{10}}$) as compared to rest of the treatments, however it was statistically similar to treatments 100% GRD (100:60:40) ($\mathbf{T_4}$), 100% GRD+ 5 t FYM ha^{-1} ($\mathbf{T_5}$) and 100% GRD + 10 kg BGA ha^{-1} ($\mathbf{T_7}$). Integrated use of organic manures along with optimum doses of chemical fertilizers increased the growth parameters and yield of rice.

Key words : INM, growth parameters, yield, rice, FYM, Inceptisol.

Introduction

Rice is the most important and staple food crop for more than two third of population of India. The slogan "RICE IS LIFE" is most appropriate for India as this crop plays vital role in our national food security and a mean of live hood for millions of rural households. India is the second largest rice producing country in the world after China. Although, rice planted area in India is 40 per cent higher than in China, Indian rice production is 30 percent below Chinese production because of lower yields. Indian rice yields are well below the world average (2.9 t ha^{-1}), implying there is a great potential for increasing production. Under limited nutrient supply the possibility of taking successful production of rice crop is feasible only through careful implementation of scientific agro-techniques. In Chhattisgarh plains, cultivation of rice is possible with judicious utilization of nutrient sources with respect to different inputs management. Among several constraints of production, nutrient management plays a key role in realizing sustainable yield from any given cultivation practices. Integrated nutrient management system play a vital role in balancing the soil fertility and plant nutrient supply to an optimum level through the judicious and efficient use of chemical fertilizers, green manure, FYM and biofertilizers leading to an ecofriendly approach and economically viable solution 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). Integrated nutrient management of fertilizers and organic manures, therefore, is one of the viable options for sustaining soil health *vis-à-vis* crop productivity (Bajpai *et al*., 2006). Continuous integrated use of organic manures with chemical fertilizers would be quite promising in assessing the sustainability of a cropping system *vis-à-vis* monitoring the soil properties. The present investigation was, therefore, undertaken to study the effect of integrated nutrient management on growth and yield of rice (*Oriza sativa* L.) in Inceptisol.

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Materials and Methods

A field experiment was conducted on Inceptisol during *kharif* season of 2014 to study the effect of integrated nutrient management on growth and yield of rice (*Oriza sativa* L.) in Inceptisol. The experiment was conducted at the Research Farm, College of Agriculture and Research Station, Janjgir-Champa, IGKV, Raipur (C.G.), India; located at north Mahanadi and the centre of Chhattisgarh and lies between 21°06' to 22°04' North latitude and 82°03' to 83°02' East longitude with an altitude of 294.4 meters above the mean sea level. The unit plot size was 8 m × 3.4 m. The total number of plots was 30. The spaces between plot to plot and replication to replication were 0.6 m and 1 m, respectively. Rice cultivar MTU-1010 was taken as test crop. It is a semi dwarf variety which is a cross of Krishnaveni and IR-64. The crop matures in about 115-125 days. The field was prepared by ploughing and cross ploughing with the cultivator. The field was puddled by tractor drawn puddler in presence of standing water and was leveled by planker. The 21 days old seedlings was planted. The planting was done at a spacing of 20 × 10 cm. Nutrients (Chemical fertilizers and Organic manures) were applied as per the treatments. Recommended doses of P and K were applied in the form of single superphosphate (SSP) and muriate of potash (MOP) as basal. Urea was applied in 3 equal splits *i.e.* 1/3rd basal, 1/3rd at tillering and 1/3rd at panicle initiation stages of the rice crop. The required quantity of basal doses of FYM were applied one month in advance of transplanting. Blue green algae dry flakes were applied after seven days of transplanting in standing water @ 10 kg ha^{-1} as per the treatments. There were 10 treatments of nutrient management *i.e.* $\mathbf{T_1}$ - Control, $\mathbf{T_2}$- FYM 5 t ha^{-1}, $\mathbf{T_3}$- BGA 10 kg ha^{-1}, $\mathbf{T_4}$- 100% GRD (100:60:40), $\mathbf{T_5}$- 100% GRD + 5 t FYM ha^{-1}, $\mathbf{T_6}$- 75% GRD + 5 t FYM ha^{-1}, $\mathbf{T_7}$- 100% GRD + 10 kg BGA ha^{-1}, $\mathbf{T_8}$- 75% GRD + 10 kg BGA ha^{-1}, $\mathbf{T_9}$- FYM 5 t ha^{-1} + 10kg BGA ha^{-1} and $\mathbf{T_{10}}$- STCR dose with 5 t FYM for YT 50 q ha^{-1} (125:50:46). The experiment was laid out with three replications in a randomized block design. Initial soil samples were collected and analyzed for nutrient status by adopting standard procedures. The data on initial soil analysis revealed that the soil was sandy loam in texture, pH 6.96 with non-saline conductivity (0.26 dS m^{-1}). The organic carbon content was 0.27% and the available N content was low 202 kg ha^{-1}, available P was very low 5.3 kg ha^{-1} and K content was medium 267 kg ha^{-1}. Growth parameters *i.e.* plant height, total and effective tillers, panicle length, total filled grains, test weight of rice from randomly selected ten plants was recorded at harvesting stage and five plants randomly selected for dry matter production and the dry weights were taken after oven drying at 60 °C for 48 hours at 30, 60 DAT and at harvest. The grain and straw yields of rice were recorded at the time of harvest and the data were statistically analyzed.

Results and Discussion

Plant height

The plant height (cm) at harvesting of rice as influenced by integrated nutrient management ranged from 67.2 to 100.5 cm (table 1). Treatment STCR dose with 5 t FYM for YT 50 q ha^{-1} ($\mathbf{T_{10}}$) was found to be significantly superior not only over control ($\mathbf{T_1}$) but also over rest of the treatments in increasing the plant height. Application of treatment FYM 5 t ha^{-1} ($\mathbf{T_2}$), BGA 10 kg ha^{-1} ($\mathbf{T_3}$) and FYM 5 t ha^{-1} + 10 kg BGA ha^{-1} ($\mathbf{T_9}$) significantly increased plant height of rice over control at 5 % level of significance. Application of chemical fertilizer and FYM gave taller plants height at harvest as compared to other treatment combinations (Mohanty *et al*., 2013).

Dry matter accumulation

Data related to dry matter accumulation (g hill^{-1}) at 30 DAT, 60 DAT and at harvest stages of rice ranged from 0.56 to 2.23, 1.02 to 7.26 and 5.12 to 20.70 g hill^{-1}, respectively (table 1). In general, dry matter accumulation showed increasing trend upto harvesting. Treatment STCR dose with 5 t FYM for YT 50 q ha^{-1} ($\mathbf{T_{10}}$) was found significantly higher not only over control, but also over rest of the treatments, but it was statically at par with 100% GRD + 5 t FYM ha-^{1} ($\mathbf{T_5}$) at 30 DAT, 60 DAT and at harvest stages of rice.

Total and effective tillers

Data pertaining to number of total and effective tillers hill^{-1} at harvesting of rice ranged from 3.4 to 9.4 tillers hill^{-1} and 2.6 to 7.7 tillers hill^{-1}, respectively (table 1). Treatment STCR dose with 5 t FYM for YT 50 q ha^{-1} ($\mathbf{T_{10}}$) was observed significantly higher not only over control but also over rest of the treatments in increasing the number of total and effective tillers in rice, but it was statically at par to 100% GRD + 5 t FYM ha^{-1} ($\mathbf{T_5}$). Nayak *et al.* (2007) also noted significant increase in number of effective tillers hill^{-1} due to application of chemical fertilizer with organic manure.

Panicle length and number of total filled grains

Data pertaining to panicle length (cm) and number of total filled grains panicle^{-1} at harvesting of rice ranged from 17.9 to 23.2 cm and 54.9 to 114.3 grains panicle^{-1}, respectively (table 1). Treatment STCR dose with 5 t FYM for YT 50 q ha^{-1} ($\mathbf{T_{10}}$) registered significantly higher

Table 1: Effect of integrated nutrient management on growth and yield attributes of rice

Integrated nutrient management	Plant height at harvest (cm)	Dry matter accumulation $hill^{-1}$ (g)			Total tillers $hill^{-1}$ (No.)	Effective tillers $hill^{-1}$ (No.)	Panicle length (cm)	Total filled grain $panicle^{-1}$ (No.)	Test weight (g)
		30 DAT	60 DAT	At harvest					
T_1- Control	67.2	0.56	1.02	5.12	3.4	2.6	17.9	54.6	25.75
T_2- FYM 5 t ha^{-1}	74.2	0.81	1.93	7.58	5.0	3.9	19.4	65.5	25.86
T_3- BGA 10 kg ha^{-1}	73.2	0.79	1.58	5.86	4.2	3.2	17.9	60.4	25.77
T_4- 100% GRD (100:60:40)	90.0	2.00	6.61	19.06	7.8	6.5	21.9	92.3	26.30
T_5- 100% GRD + 5 t FYM ha^{-1}	91.5	2.14	6.94	20.30	9.0	7.3	22.3	104.7	26.39
T_6- 75% GRD + 5 t FYM ha^{-1}	87.4	1.83	6.22	18.43	7.2	5.8	21.3	90.3	26.28
T_7- 100% GRD + 10 kg BGA ha^{-1}	90.2	2.02	6.73	19.71	8.4	6.2	22.2	103.0	26.34
T_8- 75% GRD + 10 kg BGA ha^{-1}	84.7	1.80	6.10	18.03	6.7	5.2	20.6	79.0	26.24
T_9- FYM 5 t ha^{-1} + 10 kg BGA ha^{-1}	76.9	1.24	2.51	8.26	5.4	3.6	19.8	68.9	25.87
T_{10}- STCR dose with 5 t FYM for YT 50 q ha^{-1}	100.5	2.23	7.26	20.70	9.4	7.7	23.2	114.3	26.48
SEm±	1.69	0.05	0.12	0.21	0.18	0.25	0.94	5.35	0.28
CD (P=0.05)	5.01	0.15	0.37	0.62	0.55	0.76	2.79	15.88	NS

GRD: General recommended dose of fertilizers, FYM: Farmyard manure, BGA: Blue green algae, STCR: Soil test crop response, YT: Yield target.

panicle length over control, but it was statistically similar with treatment 100% GRD (100:60:40) (**T_4**), 100% GRD + 5 t FYM ha^{-1} (**T_5**), 75% GRD + 5 t FYM ha^{-1} (**T_6**), 100% GRD + 10 kg BGA ha^{-1} (**T_7**) and 75% GRD + 10 kg BGA ha^{-1} (**T_8**). In case of number of total filled grains $panicle^{-1}$ treatment STCR dose with 5 t FYM for YT 50 q ha^{-1} (**T_{10}**) recorded significantly higher value as compared to rest of the treatment, however it was statistically similar to treatments 100% GRD + 5 t FYM ha^{-1} (**T_5**) and 100% GRD + 10 kg BGA ha^{-1} (**T_7**). Application of neither FYM 5 t ha^{-1} (**T_2**) nor BGA 10 kg ha^{-1} (**T_3**) and FYM 5 t ha^{-1} + 10 kg BGA ha^{-1} (**T_9**) did not give significant impact on panicle length (cm) and number of total filled grains $panicle^{-1}$ (No.) in rice over control (**T_1**) at 5% level of significance. 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.

Test weight

The size and boldness of rice seed measured as 1000-grain weight as influenced by different INM treatments have been presented in table 1. The test weight (1000-grain weight) of rice varied from 25.75 to 26.48 g. All the treatments failed to give significant impact on test weight of rice. The maximum value of test weight was recorded with STCR dose with 5 t FYM for YT 50 q ha^{-1} (**T_{10}**), which was statistically similar to control. Yang *et al.* (2004) recorded that 1000-grain weight was increased by the application of chemical fertilizer along with organic manure.

Grain and straw yield

The grain and straw yield of rice as influenced by integrated nutrient management. The grain and straw yield of rice ranged from 7.79 to 45.93 and 9.97 to 54.95 kg ha^{-1}, respectively (table 2). Significantly highest grain (45.93 kg ha^{-1}) and straw (54.95 kg ha^{-1}) yield of rice, was recorded in treatment STCR dose with 5 t FYM for YT 50 q ha^{-1} (**T_{10}**) as compare to rest of the treatments, however it was statistically similar to treatments100% GRD + 5 t FYM ha^{-1} (**T_5**), 100% GRD + 10 kg BGA ha^{-1} (**T_7**) and 100% GRD (100:60:40) (**T_4**).

Table 2 : Effect of integrated nutrient management on grain and straw yield (q ha^{-1}) of rice.

Treatments	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})
T_1- Control	7.79	9.97
T_2- FYM 5 t ha^{-1}	13.43	16.85
T_3- BGA 10 kg ha^{-1}	10.13	13.05
T_4- 100% GRD (100:60:40)	42.60	50.68
T_5- 100% GRD + 5 t FYM ha^{-1}	44.76	53.38
T_6- 75% GRD + 5 t FYM ha^{-1}	40.46	48.32
T_7- 100% GRD + 10 kg BGA ha^{-1}	43.06	51.25
T_8- 75% GRD + 10 kg BGA ha^{-1}	38.77	46.62
T_9- FYM 5 t ha^{-1} + 10 kg BGA ha^{-1}	15.84	19.08
T_{10}- STCR dose with 5 t FYM for YT 50 q ha^{-1}	45.93	54.95
SEm±	1.33	1.74
CD (P = 0.05)	3.96	5.16

Application of BGA alone (T_3) could not cause significant increase in yield of grain and straw over control (T_1), while FYM individually (T_2) and in combination with BGA treatment FYM 5 t ha^{-1} + 10 kg BGA ha^{-1} (T_9) significantly increased grain and straw yield of rice over control (T_1) at 5% level of significance. The integrated use of fertilizers with organic manures *viz*., FYM and BGA might have added huge quantity of organic matter in soil that increased grain and straw yield (Chaudhary and Thakur, 2007). Further, the addition of organic matter also maintains regular supply of macro and micronutrients in soil resulting in higher yields. These results are in conformity with the finding of Gupta *et al.* (2006).

Conclusion

Overall, the results obtained from this study indicate that application of organic manure along with chemical fertilizers increased growth and yield of rice compared to application of chemical fertilizers alone. A critical observation of the data reveals that the performance of STCR dose with 5 t FYM for yield target of 50 q ha^{-1} (T_{10}) and 100% GRD+ 5 t FYM ha^{-1} (T_5), in general, was better over other treatments in increasing plant height, total and effective tillers, panicle length, total filled grains, test weight, dry matter production and yield of rice.

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