

YIELD ADVANTAGE OF OPTIMAL, SUB OPTIMAL AND INTEGRATED NUTRIENT MANAGEMENT ON YIELD POTENTIAL AND ECONOMICS OF RICE (*ORYZA SATIVA*) IN RICE-WHEAT (*TRITICUM AESTIVUM*) CROPPING SYSTEM

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Abstract : The present investigation was carried out at IGKV., Raipur (C.G.) during *kharif* season of 2010. The soil of experimental field was 'Inceptisols' locally known as *Matasi*. The experiment was laid out in randomized block design with 3 replications. The results revealed that T₁₀ consisting of 50% RDF + 50% N through green manuring recorded the highest growth and yield attributing characters and recorded maximum net return (Rs. 46,117 ha⁻¹) and NPK content in soil under investigation. Application of 100% RDF (80:60:40 kg NPK ha⁻¹) also proved superior over other integrated nutrient management systems consisting of farmyard manure and rice residues for yield (55.19 qha⁻¹), net return (Rs.44,962 ha⁻¹) and B:C ratio (2.52). Sub-optimal doses of nutrients failed to provide considerable yield advantage and nutrients build-up in soil as compared to optimal level or integrated nutrient management options.

Keywords : Economics, Integrated nutrient management, Nutrient uptake, Rice-wheat cropping system, Yield potential.

INTRODUCTION

Rice-wheat is the super most cropping system adopted in Indian sub continent spreading over 13.5 mha. In Chhattisgarh rice is the predominant crop grown in approximately 3.50 mha, which is around 77 % of the net cultivated area. The state is considered as "rice bowl" and the livelihood of almost 83% of rural population is depending only on rice cultivation. Although, during favorable monsoon years, the state relishes good production of an ever time record of 6.0 mt and 1.7 t.ha⁻¹ productivity in the year 2010-11; the long-term productivity of rice in the state is remained below (1.3 t.ha⁻¹) to the national average. The main reasons for low productivity even in irrigated areas are application of inadequate and unbalanced quantity of fertilizers to this nutrient exhaustive crop, which not only resulted in low yield (Sharma and Sharma. 2002) but also consequently declined the soil organic carbon and soil health.

In Chhattisgarh, the status of soil nitrogen is very low and addition of organic matter to the soil is not very much practiced and rice crop is completely depends upon soil and applied nutrient. Therefore to sustain as well as to increase the productivity of the crop, replenishment of nutrients drawn out from the soil system by the crop harvest becomes imperative. Incorporation of organic sources *viz.* green manures, FYM and recycling of crop residues along with NPK fertilizers in an integrated (nutrient) manner is effective in alleviating the nutrient deficiency in soil and enhances the yield potential as well. Moreover, such integration ameliorates the properties of the soil further for sustaining the productivity and profitability in a long-term basis. Hence, it is necessary to judiciously manage the inflow of

organic sources of nutrients and their interaction with fertilizers in soil system.

MATERIAL AND METHOD

Grain and straw yield (q ha⁻¹)

The crop from each net plot was harvested separately. The grains were separated from straw by threshing. The weight of grains was recorded and expressed in q ha⁻¹ and the straw weight was worked out by subtracting the weight of grains from the bundle weight of the produce and expressed in qha⁻¹.

Harvest index (%)

The harvest index was calculated by dividing the grain yield with biological yield (grain + straw yield) and multiplied by 100.

$$HI (\%) = \frac{\text{Grain yield}}{\text{Biological yield}} \times 100$$

Economics

Cost of production for all treatments was worked out on the basis of the prevailing input and market price of the produce. The net return ha⁻¹ was calculated by deducting the cost of production ha⁻¹ from the gross return ha⁻¹. Ultimately, net return per rupees (cost: benefit ratio) invested was calculated treatment wise to assess the economic impact of the treatments by dividing the net return ha⁻¹ by the cost of production.

RESULT AND DISCUSSION

Grain yield

The data presented in Table 1 clearly revealed that the yield of rice increased with increasing the levels

of nitrogen from 50 to 100 % of RDF. Treatment T₁₀ consisting of 50% RDF + 50% N as received from green manuring registered significantly highest grain yield of rice (56.19 q ha⁻¹) which was significantly superior to the sub optimal doses of 50 % of RDF (T₂ and T₃), farmers' practice (T₁₂) and the control treatment (T₁). Paikray *et al.* (2001) also obtained significantly higher rice yield with *Sesbania* green manure. Higher yield attributes *i.e.* number of effective tillers m⁻², grains panicle⁻¹ panicle length (cm) and panicle weight (g) in 100% RDF and/or integrated nutrient treatments led to differential yield of the various treatments (Kumari *et al.* (2010). The rice grain yield of other integrated nutrient treatments using GM or FYM or RR was also similar amongst them and was found to be significantly higher over farmer's practice with respect to rice yield. Integration of organic manure with inorganic fertilizer either with FYM at 50% N level (T₆) or with GM at 25% N level (T₁₁) or with rice residues of 50% N under T₈ and 25% N under T₉ respectively produced grain yield comparable to that of 100% chemical fertilizer treatment (T₅). Superiority of combined application of urea and FYM over recommended fertilizer application was also reported by Choudhary and Thakur (2007). Even, the inorganic fertilizers treatment (50% dose of fertilizer under T₃) performed significantly to that of farmer's practice might be due to the residual effects of 100% NPK dose in wheat in same treatment during previous *rabi* season. While, the lowest yield of rice (13.63 q ha⁻¹) was recorded with no manures and fertilizers *i.e.* control. These findings indicated that integrated use of chemical fertilizers with FYM or GM or RR facilitates to curtail the use of expensive chemical fertilizers upto 50% and is a better alternative to use of full dose of recommended fertilizers (Gupta *et al.*, 2006, Gill *et al.*, 2008).

Straw yield

The Table 1 showed that the straw yield also followed almost same trend as of grain yield and the maximum straw yield (76.63 and 77.11 q ha⁻¹) was recorded in T₁₀ and T₁₁ consisting of 50% or 75%

RDF + 50% or 25% N as received from green manuring respectively. This was significantly superior over T₁, T₂, T₃, T₄, T₈, T₉ and T₁₂ and at par with T₅, T₆, and T₇. However, unlike to grain yield, application of rice residue as a source of N did not show its effect on straw yield and failed to produce as good as straw to that of GM and FYM. Pandey *et al.* (2007) also found higher straw yield with the application of FYM in conjunction with fertilizer NPK as compared to those where it was not supplemented.

Harvest index

Although, the highest harvest index (43.31) was calculated in sub-optimal dose of N (50% of recommended) in T₃ but it was remained at par with all the optimal doses of nutrients either applied in integrated manner or given as 100% from NPK fertilizer because proportionate increase in grain and straw yield under all these treatments remained same. Furthermore, all the optimal doses showed significantly higher values of harvest index over control and farmers' practice (Table 1).

Economics

It is revealed from the data presented in Table 2 that the cost of cultivation of rice varied from Rs. 17,733 to Rs. 18,205 ha⁻¹ owing to the use of different sources of optimal/integrated nutrient management. Among all the treatments, highest net return (Rs. 46,117 ha⁻¹) and benefit: cost ratio (2.60) was obtained with 50% of RDF + 50% N through GM. Comparatively higher cost incurred for supplementing N through FYM/RR is another reason for less remuneration from capital invested in the later treatments. On the other hand, the results also showed that the comparable total net return (Rs. 44,962 ha⁻¹) and benefit: cost ratio (2.52) was achieved with 100% of RDF. Sub-optimal doses of nutrients failed to register as good as amount of net return to that of integrated/100% RDF treatments. Lowest net return was recorded under control. These results are in agreement with the findings of Gupta *et al.* (2006).

Table 1. Effect of different nutrient management on No. of tillers, grain yield, straw yield and harvest index of rice

Treatments		Grain yield (q ha ⁻¹)	Straw yield (q ha ⁻¹)	HI
T ₁	No fertilizer, no manure (control)	13.63	22.73	37.52
T ₂	50% RDF	34.79	49.97	40.55
T ₃	50% RDF	39.63	51.95	43.31
T ₄	75% RDF	42.58	61.17	41.04
T ₅	100% RDF	55.19	76.50	41.90
T ₆	50% RDF+50% N (FYM)	55.10	76.75	41.79
T ₇	75% RDF+25% N (FYM)	53.42	74.06	41.89
T ₈	50% RDF+50% N (RS)	54.29	72.36	42.87

T ₉	75% RDF+25% N (RS)	53.54	71.44	42.83
T ₁₀	50% RDF+50% N (GM)	56.19	76.63	42.25
T ₁₁	75% RDF+25% N (GM)	54.50	77.11	41.40
T ₁₂	Farmers' practice 50:30:20 NPK kg ha ⁻¹	30.27	49.04	38.15
SEm±		2.24	1.29	1.66
CD 5%		6.58	3.79	4.88

Table 2. Economics of rice as influenced by different nutrient management treatments

Treatments		Cost of cultivation (Rs ha ⁻¹)	Gross Return (Rs ha ⁻¹)	Net return (Rs ha ⁻¹)	Benefit: cost ratio
T ₁	No fertilizer, no manure (control)	15,270	15,898	628	0.04
T ₂	50% RDF	16,573	39,789	23,216	1.40
T ₃	50% RDF	16,573	44,820	28,247	1.70
T ₄	75% RDF	17,225	48,700	31,475	1.83
T ₅	100% RDF	17,876	62,837	44,962	2.52
T ₆	50% RDF+50% N (FYM)	18,173	62,779	44,606	2.45
T ₇	75% RDF+25% N (FYM)	18,025	60,823	42,798	2.37
T ₈	50% RDF+50% N (RS)	17,943	61,528	43,585	2.43
T ₉	75% RDF+25% N (RS)	17,910	60,686	42,776	2.39
T ₁₀	50% RDF+50% N (GM)	17,733	63,850	46,117	2.60
T ₁₁	75% RDF+25% N (GM)	18,205	62,211	44,006	2.42
T ₁₂	Farmers' practice 50:30:20 NPK kg ha ⁻¹	16,694	35,175	18,481	1.11
SEm±		-	-	2,210	-
CD 5%		-	-	6,481	-

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