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Effect Of Integrated Nutrient Management On Growth, Yield And Quality Of Rice

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ABSTRACT
Field experiment was conducted during kharif season of 2012 and 2013 at Instructional Farm, Navsari Agricultural University, Navsari (Gujarat) to study the effect of organic manures in combination with inorganic fertilizers on transplanted rice under rice–green gram cropping sequence under south Gujarat condition. The experiment was laid out in randomized block design with five treatments replicated four times. Pooled data of two years revealed that the application of general RDF (RDF:100-30-00 kg N-P-K/ha + FYM @ 10 t/ha) recorded significantly higher growth attributes viz., plant height, total number of tillers per hill, leaf area index, dry matter accumulation per hill over control. Significantly higher yield attributes viz., number of panicles per m², number of filled grains per panicle, panicle length, test weight, seed and straw yields per hill and seed and straw yields per hectare as well as quality parameters, protein content and protein yield recorded under general RDF (RDF:100-30-00 kg N-P-K/ha + FYM @ 10 t/ha) over control. However, B:C ratio (1.39) was highest with the application of 75% Recommended dose of nitrogen (RDN) Recommended dose of nitrogen (RDN) through chemical fertilizer + 25% Recommended dose of nitrogen (RDN) through biocompost because of lower cost of cultivation. Harvest index did not influence significantly.
Key words: *Mineral Nutrition, Rice*

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INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important cereal crops. In country like India, rice is the most important food crop, Globally, India ranks first in rice area and second in rice production after China. Within the country, rice occupies one-quarter of the total cropped area that contributes about 40 to 43% of total food grain production and continues to play a vital role in the national food. Area under rice cultivation in India was 42.75 million hectares, production of 105.24 million tonnes with productivity of 2462 kg per hectare. Area under rice cultivation in Gujarat was 7.01 lakh hectares, production of 15.41 lakh tonnes with productivity of 2198 kg per hectare (Anon., 2013).

Continuous cultivation of rice for longer periods and often under poor soil and crop management practices, resulted in the loss of soil fertility as indicated by the emergence of multi-nutrient deficiencies (Fujisaka *et al.* 1994, Singh and Singh 1995, Dwivedi *et al*. 2001) and the deterioration of soil physical properties (Tripathi, 1992). This decline in soil quality results in a decrease in factor productivity and overall crop productivity (Yadav, 1998). Olk and Cassman (1995) proposed that the relatively low response to nitrogen (N) fertilizers in continuously flooded rice systems was associated with sequestration of N as recalcitrant N compounds that have slow mineralization rates. These N complexes are formed as a result of slow and incomplete decomposition of retained rice crop residues. Intensive agriculture involving exhaustive high yielding varieties of rice has led to heavy withdrawal of nutrients from the soil, imbalanced and discriminate use of chemical fertilizers has resulted in deterioration of soil health (John *et al.* 2001).

Organic materials were practically the only external source of nutrients to crops before introduction of inorganic fertilizers. The various implications of commercial fertilizer particularly in decreasing the soil fertility and productivity and the ever increasing cost of chemical fertilizers compels one to think of the use of organic manures (Bhardwaj and Gaur, 1985). Sustainability in crop yield and soil health could be achieved by applying mineral fertilizers along with organic manures. The present investigation was therefore, undertaken to find the effect of integrated nutrient management on transplanted rice under rice-green gram cropping sequence.

MATERIAL AND METHODS

An experiment was conducted during *kharif* season of 2012 and 2013 on transplanted rice under rice-green gram cropping sequence at Instructional Farm, Navsari Agricultural University, Navsari (Gujarat). The soil of the experimental site was clayey in texture belonging to *Inceptisols*. As regards chemical composition, it was low in organic carbon (0.45%) and available nitrogen (220.80 kg/ha), medium in available phosphorus (40.60 kg/ha) and high in available potassium (321.12 kg/ha). The soil was slightly alkaline in reaction (pH 8.0). The experiment comprised of five treatments of integrated nutrient management *viz*., T_1 - general RDF (RDF:100-30-00 kg N-P-K/ha + FYM @ 10 t/ha), T_2 - 75% Recommended dose of nitrogen (RDN) through chemical fertilizer + 25% RDN through biocompost, T_3 - 75% RDN through chemical fertilizer + 25% RDN through vermicompost, T_4 - 75% RDN through chemical fertilizer + 25% RDN through FYM and T_5 – control. The experiment was laid in randomized block design with four replications and crop was transplanted at 20 x 15 cm spacing on 12th and 22nd of July during 2012 and 2013, respectively. The fertilizers were applied as per treatments through ammonium sulphate and single super phosphate for nitrogen and phosphorus, respectively. The 40% dose of nitrogen and full dose of phosphorus were applied at the time of transplanting, 40% dose of nitrogen at maximum tillering stage and remaining 20% dose of nitrogen at panicle initiation stage. All the calculated quantity of organic manures was applied before 15 days of transplanting. Recommended seed rate was used and plant protection measures were applied as and when necessary. Total rainfall received during crop growth period i.e. *kharif* season of 2012 and 2013 was 1256 mm and 2443 mm in 60 and 79 rainy days, respectively as against normal rainfall of 1500 mm.

RESULTS AND DISCUSSION

Pooled mean of two years data (Table 1) indicated that plant height, total number of tillers per hill, leaf area index and dry matter accumulation per hill at harvest differed significantly with the application of various nutrients.

Application of general RDF (RDF + FYM @ 10 t/ha) (T_1) recorded significantly highest plant height and leaf area index at harvest over all other treatments and the same was found to be at par with 75% RDN through chemical fertilizer + 25% RDN through vermicompost (T_3) in respect of total number of tillers per hill and dry matter accumulation per hill. The increase in growth attributes with the combine application of organics and inorganics due to increased availability of nitrogen through different N management practices. Organic manures are slow releasing N source found beneficial during subsequent stages of crop, which might have resulted in increasing the total dry matter. Similar results were reported by Asewar *et al.* (2000), Sudha and Chandini (2003) and Usman *et al.* (2003).

Yield attributes *viz.,* number of panicles per m^2, number of filled grains per panicle, panicle length, test weight, seed and straw yields per hill influenced significantly due to different treatments (Table 1).

Significantly higher number of panicles per m^2, panicle length, grain and straw yields per hill were recorded with the application of general RDF (T_1) followed by 75% RDN through chemical fertilizer + 25% RDN through vermicompost (T_3). Similarly, general RDF (T_1) recorded significantly higher number of panicles per m^2 and test weight but remained at par with 75% RDN through chemical fertilizer + 25% RDN through vermicompost (T_3). Similar findings were reported by Satyanarayana *et al.* (2002), Sudha and Chandini (2003), Usman *et al.* (2003), Senthivelu and Prabha (2007) and Naing *et al.* (2010). Increase in growth attributes due to increased uptake of nitrogen, photosynthesis and translocation of photosynthates towards reproductive parts, which might have increased number of panicles per m^2, panicle length, number of filled grains per panicle, test weight and finally grain and straw yields per hill.

The integrated nutrient management exhibited great impact on grain and straw yields of rice (Table 2). Rice crop produced maximum grain yield (53.35 q/ha) and straw yield (77.10 q/ha) in general RDF treatment followed by 75% RDN through chemical fertilizer + 25% RDN through vermicompost. This might be due to the fact that farm yard manure besides supplying additional amount of nutrients, also brought an improvement towards physical properties of soil and thereby, improving nutrient and water holding capacity of soil (Bharadwaj and Gaur, 1985). The increased grain and straw yields can also be ascribed to the effect of adequate availability of NPK in soil solution, may cause increase in root growth, thereby increasing uptake of nutrients. Higher yield due to combined application of inorganic fertilizers and organic manures might have attributed to sustained nutrient supply and also as a result of better utilization of applied nutrients through improved micro-environmental conditions, especially the activities of soil micro-organisms involved in nutrient transformation and fixation. Similar results were opined by Satyanarayana *et al.,* 2002, Sudha and Chandini, 2003, Virdia and Mehta, 2008, Senthivelu *et al.*, 2009 as well as Naing *et al.*, 2010. The effect of integration of inorganics and organics on harvest index was non-significant indicating proportionate partitioning with increasing and decreasing supply of nitrogen (Singh, 2001 and Singh *et al.,* 2002).

Protein content and protein yield (Table 2) were increased significantly due to application of general RDF (RDF + FYM @ 10 t/ha) closely followed by 75% RDN through chemical fertilizer + 25% RDN through vermicompost. The increase in protein content of rice grain due to more quantity of nitrogen content in grain, improved metabolic activities in the plant (Subbiah and Kumarswamy, 2000) and the variation in protein yield was observed because of nitrogen uptake associated with its levels of supply as well as plant potential to absorb and utilize. Similar results were reported earlier by Gaud (2004).

Application of 75% RDN through chemical fertilizer + 25% RDN through biocompost (Table 2) recorded maximum net return and benefit cost ratio. It might be due to the less cost of biocompost ultimately low cost of cultivation. Similar results were reported by Singh *et al.* (2006) and Kulkarni (2012).

Thus, it can be concluded that the application of 75% Recommended dose of nitrogen (RDN) through chemical fertilizer + 25% RDN through biocompost is better preposition to improve growth, achieving higher productivity with better quality and economic return of transplanted rice under south Gujarat condition.

Table 1: Growth and yield attributes of *kharif* transplanted rice at harvest as influenced by different treatments (pooled mean of two years)

Treatment	Plant height (cm)	Total tillers/hill	Leaf area index	Dry matter accumulation/hill (g)	Panicles/m^2	Filled grains/panicle	Panicle length (cm)	Test weight (g)	Grain yield/hill (g)	Straw yield/hill (g)
T_1 : General RDF (RDF:100-30-00 kg N-P-K/ha + FYM @ 10 t/ha)	109.96	9.97	4.94	51.95	266.75	88.44	23.00	30.33	17.16	24.06
T_2 : 75 % RDN through chemical fertilizer + 25 % RDN through biocompost	100.11	8.64	4.28	44.36	237.52	79.79	21.63	28.80	14.91	20.48
T_3 : 75 % RDN through chemical fertilizer + 25 % RDN through vermicompost	101.20	9.21	4.53	48.61	241.73	87.08	21.90	29.73	15.43	21.25
T_4 : 75 % RDN through chemical fertilizer + 25 % RDN through FYM	100.21	8.09	4.08	42.33	236.29	76.02	21.19	28.44	14.18	20.09
T_5 : Control	88.70	6.59	3.27	29.12	205.63	57.61	19.71	27.02	9.17	15.06
SE m±	2.11	0.27	0.11	1.71	6.43	1.70	0.29	0.30	0.48	0.70
C.D. at 5 %	6.17	0.80	0.32	5.00	18.76	4.97	0.84	0.87	1.39	2.05
C.V. %	5.97	9.10	7.33	11.20	7.65	6.19	3.80	2.90	9.53	9.85

Note: RDN- Recommended dose of nitrogen

Table 2. Grain and straw yields, harvest index, protein content and protein yield of *kharif* transplanted rice influenced by different treatments (pooled mean of two years)

Treatment	Grain yield (q/ha)	Straw yield (q/ha)	Harvest index (%)	Protein content (%)	Protein yield (q/ha)	B:C ratio
T_1 : General RDF (RDF:100-30-00 kg N-P-K/ha + FYM @ 10 t/ha)	53.35	77.10	40.68	7.87	4.50	1.31
T_2 : 75 % RDN through chemical fertilizer + 25 % RDN through biocompost	46.09	66.20	40.92	7.60	3.68	1.39
T_3 : 75 % RDN through chemical fertilizer + 25 % RDN through vermicompost	47.89	66.72	41.48	7.79	3.79	1.25
T_4 : 75 % RDN through chemical fertilizer + 25 % RDN through FYM	44.15	65.68	39.71	7.41	3.27	1.24
T_5 : Control	28.66	45.11	38.52	6.78	2.15	0.96
SE m±	1.56	2.34	1.32	0.12	0.14	-
C.D. at 5 %	4.54	6.83	NS	0.35	0.41	-
C.V. %	9.99	10.31	9.28	4.54	11.46	-

Note: RDN- Recommended dose of nitrogen

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