# INTEGRATED NUTRIENT MANAGEMENT IN TRANSPLANTED RICE

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## *ABSTRACT*

***An experiment was conducted at the Instructional Farm, Navsari Agricultural University, Navsari (Gujarat) during kharif season of 2012 and 2013 on transplanted rice in randomized block design with five treatments replicated four times. The treatment imparted to rice crop were integrated nutrient management viz., $T_1$ - General RDF (RDF:100-30-00 kg N-P-K/ha + FYM @ 10 t/ha), $T_2$ - 75% 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 (No fertilizer). On the basis of pooled mean, the results indicated that application of general RDF (RDF + FYM @ 10 t/ha) recorded significantly highest grain and straw yields of rice as well as total NPK uptake by rice (grain and straw) followed by application of 75% RDN through chemical fertilizer + 25% RDN through vermicompost. However, maximum net returns and benefit ratio were noted with the application of 75% RDN through chemical fertilizer + 25% RDN through biocompost followed by general RDF (RDF + FYM @ 10 t/ha).***

***KEY WORDS: Economics, INM, NPK uptake, transplanted rice***

## INTRODUCTION

Rice (*Oryza sativa* L.) is one of the most important cereal crops. In country like India, rice is the most important food crop, it is not only an integral part of daily diet, but also it is an integral part of spiritual religious ceremonies and holy festivals. 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, contributes about 40 to 43 per cent of total food grain production and continues to play a vital role in the national food and livelihood security system. Area under rice cultivation in India was 42.75 million hectares with a production of 105.24 million tonnes and roductivity of 2462 kg/ha. Area under rice cultivation in Gujarat was 7.01 lakh hectares, production of 15.41 lakh tonnes with productivity of 2198 kg per hectare (Anonymous, 2013).

Continuous cultivation of rice for longer periods and often under poor soil and crop management practices, results in the loss of soil fertility as indicated by the emergence of multi-nutrient deficiencies (Dwivedi *et al.*, 2001) and deterioration of soil physical properties (Tripathi, 1992). 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.

## MATERIALS AND METHODS

An experiment was conducted during *kharif* season of 2012 and 2013 on transplanted rice at Instructional Farm, Navsari Agricultural University, Navsari (Gujarat). The soil of the experimental site was clayey in texture belongs to *Inceptisols*. With regards to 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% 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 (No fertilizer). The experiment was laid in randomized block design with four replications and rice seedling transplanted at 20 x 15 cm spacing on 12$^{th}$ and 22$^{nd}$ 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.

All the data pertaining to yield were recorded from net plot. At harvest, N concentration in rice grain and straw by modified Kjeldahl method; P concentration by vanadomolybdophosphoric acid yellow colour method using spectrophotometer; and K concentration by flame photometry method (Prasad *et al.*, 2006) were determined. The data recorded were statistically analyzed using MSTATC Software. The purpose of analysis of variance was to determine the significant effect of treatments on rice. LSD test at 5 per cent probability level was applied when analysis of variance showed significant effect for treatments (Steel and Torrie, 1980). The net realization was calculated by deducting the total cost of cultivation from the gross realization for each treatment. The benefit cost ratio (BCR) was calculated on the basis of the formula given below:

BCR = Net realization ( ₹ /ha) / Cost of cultivation ( ₹ /ha)

## RESULTS AND DISCUSSION

### *Grain yield*

The results showed that all the treatments yielded significantly higher grain yield over control during both the years of experimentation and also in pooled analysis (Table 1). Treatment ($T_1$) general RDF (RDF:100-30-00 kg N-P-K/ha + FYM @ 10 t/ha) recorded significantly higher grain yield over rest of the treatments during 2012 (62.87 q/ha), 2013 (43.82 q/ha) and in pooled data (53.35 q/ha). The treatment ($T_3$) i.e. application of 75% RDN through chemical fertilizer + 25% RDN through vermicompost was the second best treatment with respect to grain yield during 2012 (55.01 q/ha), 2013 (40.76 q/ha) and in pooled data (47.89 q/ha). The values of grain yield recorded in control ($T_5$) were 35.73, 21.58 and 28.66 q/ha during first year, second year and in pooled analysis, respectively. On the basis of pooled data, the per cent increase in grain yield of rice with treatment $T_1$, $T_3$, $T_2$ and $T_4$ was 86.15, 67.10, 60.82 and 54.10 per cent, respectively over control treatment $T_5$. This might be due 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 (Bhardwaj and Gaur, 1985). The increased grain yield 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 sustain 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. Senthivelu *et al.* (2009) and Naing *et al.* (2010) also opined the similar results for increased grain yield.

### *Straw yield*

The results showed that all the treatments yielded significantly higher straw yield over control during both the years of experimentation and also in pooled analysis (Table 1). Significantly highest straw yield (75.43, 78.77 and 77.10 q/ha) was recorded with the application of general RDF (RDF:100-30-00 kg N-P-K/ha + FYM @ 10 t/ha) ($T_1$) than other treatments followed by 75% RDN through chemical fertilizer + 25% RDN through vermicompost ($T_3$) (66.13, 67.31 and 66.72 q/ha) during 2012, 2013 and pooled analysis, respectively. The increase in straw yield was due to increased availability of N and minimizing N loss resulted in better growth right from tillering to reproductive stage which in turn, produced higher straw production. These findings are in agreement with those obtained by Senthivelu *et al.* (2009) and Naing *et al.* (2010).

### *NPK uptake*

It is evident from the Table 1 that uptake of N, P and K by rice crop increased significantly with integration of inorganic fertilizer and organic manures over control, however maximum N, P and K uptake was observed with the application of general RDF (RDF:100-30-00 kg N-P-K/ha + FYM @ 10 t/ha) followed by 75% RDN through chemical fertilizer + 25% RDN through vermicompost ($T_3$). This might be due to in general; the trend of nutrient uptake was very well resembled with dry matter accumulation and per hectare yield data of various treatments. The enhanced uptake of these nutrients in the corresponding treatments could be due to the increased and sustained

availability of nutrients through organic and inorganic fertilizers. The increased uptake by rice might be due to improvement in soil physical, chemical and biological health through application of organic and inorganic fertilizers under integrated nutrient management. Similar results were reported by Senthivelu *et al.* (2009) and Paul *et al*. (2013).

***Economics***

Economics is the major consideration of the farmers while taking decision regarding the adoption of new technology. Hence, the gross realization, net realization and benefit cost ratio were computed for different treatments. Application of 75% RDN through chemical fertilizer + 25% RDN through biocompost (Table 2) recorded maximum net return (₹ 17316/ha) and benefit cost ratio (1.39). 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).

## CONCLUSION

Form the forgoing discussion, it can be concluded that applying 75% RDN through chemical fertilizer + 25% RDN through biocompost was found beneficial by securing higher and economical profitable grain and straw yields of rice.

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**Table 1: Grain and straw yield and total NPK uptake of *kharif* transplanted rice as influenced by different treatments**

| Treatments | | Grain Yield (q/ha) | | | Straw Yield (q/ha) | | | Nitrogen Uptake (kg/ha) | Phosphorus Uptake (kg/ha) | Potassium Uptake (kg/ha) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 2012 | 2013 | Pooled | 2012 | 2013 | Pooled | Pooled | Pooled | Pooled |
| $T_1$ | General RDF (RDF:100-30-00 kg NPK/ha + FYM @ 10 t/ha) | 62.87 | 43.82 | 53.35 (86.15)* | 75.43 | 78.77 | 77.10 | 123.46 | 22.39 | 132.35 |
| $T_2$ | 75 % RDN through chemical fertilizer + 25 % RDN through biocompost | 54.71 | 37.46 | 46.09 (60.82) | 65.89 | 66.52 | 66.20 | 102.32 | 18.35 | 110.08 |
| $T_3$ | 75 % RDN through chemical fertilizer + 25 % RDN through vermicompost | 55.01 | 40.76 | 47.89 (67.10) | 66.13 | 67.31 | 66.72 | 107.45 | 19.40 | 113.86 |
| $T_4$ | 75 % RDN through chemical fertilizer + 25 % RDN through FYM | 53.52 | 34.77 | 44.15 (54.10) | 64.83 | 66.53 | 65.68 | 97.38 | 17.24 | 106.77 |
| $T_5$ | Control (No fertilizer) | 35.73 | 21.58 | 28.66 | 44.89 | 45.33 | 45.11 | 61.15 | 10.78 | 68.83 |
| | SE m± | 2.508 | 1.839 | 1.555 | 3.006 | 3.584 | 2.339 | 2.871 | 0.581 | 4.089 |
| | C.D. at 5 % | 7.73 | 5.67 | 4.54 | 9.26 | 11.04 | 6.83 | 8.38 | 1.70 | 11.94 |
| | C.V. % | 9.58 | 10.31 | 9.99 | 9.48 | 11.05 | 10.31 | 8.26 | 9.32 | 10.87 |

***Figures in parentheses are percentage enhancement over control***

**Table 2: Economics of *kharif* transplanted rice as influenced by different treatments (Average of 2012 and 2013)**

| Treatments | | Gross Monetary Returns (₹/ha) | Net Monetary Returns (₹/ha) | B:C Ratio |
|---|---|---|---|---|
| $T_1$ | General RDF (RDF:100-30-00 kg N-P-K/ha + FYM @ 10 t/ha) | 70892 | 16734 | 1.31 |
| $T_2$ | 75 % RDN through chemical fertilizer + 25 % RDN through biocompost | 61237 | 17316 | 1.39 |
| $T_3$ | 75 % RDN through chemical fertilizer + 25 % RDN through vermicompost | 63590 | 12563 | 1.25 |
| $T_4$ | 75 % RDN through chemical fertilizer + 25 % RDN through FYM | 58703 | 11480 | 1.24 |
| $T_5$ | Control (No fertilizer) | 38158 | -1720 | 0.96 |

***Selling price- Rice grain – 13 ₹/kg, Rice straw – 2 ₹/kg, Cost of input - Ammonium sulphate – 7.94 ₹/kg, SSP – 7.40 ₹/kg, FYM - 1 ₹/kg, Biocompost - 0.50 ₹/kg, Vermicompost - 4 ₹/kg***

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