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# Effect of Various Sources of Nutrition on Plant Growth, Yield and Quality of Rice (*Oryza sativa* L.) cv MTU 7029

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**Abstract** A field experiment was carried out during rainy season of 2014 to study the effect of different organic sources of nutrition on growth, yield and quality of rice (*Oryza sativa* L.) cv MTU 7029. Application of organic sources of nutrition remarkably increased growth, yield and quality of rice than alone. 100% RDF + vermicompost @ t $ha^{-1}$ +*Trichoderma* compost @ 7.5 kg $ha^{-1}$ significantly increased the growth parameters such as plant height, no of tillers $hill^{-1}$, leaf area index, dry matter accumulation $hill^{-1}$ and also the same trends were recorded the significantly higher yield, yield attributes and quality parameters viz. protein content, protein yield, hulling (%) and milling (%) than other treatments and this was followed by 100% RDF + vermicompost @ 5 t $ha^{-1}$ + *Trichoderma* compost @ 5 kg $ha^{-1}$.

**Keywords** Rice, Nutrition, Growth, Yield, Quality.

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## Introduction

Rice commends recognition as a supreme commodity to mankind, because rice is truly life, a culture, a tradition and a means of livelihood to millions. It is an important staple food providing 66 to 70% body calorie intake of the consumers. The United Nations General Assembly, in a resolution declared the year of 2004 as the International Year of Rice, which has tremendous significance to food security. It very eloquently upheld the need to heighten awareness of the role of rice in alleviating poverty and malnutrition [1]. Total geographical area under rice in India is 43.73 million hectares with annual production of 106.19 million tones with productivity 2.46 tons per ha in 2013-2014 crop year [2], hence a significant portion of the world's agricultural research has been focused on rice. This lead to development of modern rice varieties and their improved technologies that have greatly increased the global rice production. It occupies an important place in the economy of India. Rice crop is the biggest user of fresh water. Rice as a submersed crop is a prime target for water conservation because it is the most widely grown of all crops under irrigation. Rapidly depleting water resources threaten the sustainability of the irrigated rice and hence the food security and livelihood of rice producers and consumers [3]. Rice being water requirement crop, there is a need to search for alternate methods to reduce water requirement without reduction in the yield [4]. System of rice intensification (SRI) is another emerging water saving technology, with many fold increase in crop yield [5]. The optimum seedlings per hill ensure the plants to grow in their both aerial and underground parts through efficient utilization of solar radiation, water and nutrients [6].

The excessive use of chemicals in agriculture causes water pollution and human health hazards. After years of high yields, rice soils are depleted of nutrients. Therefore the application system of rice intensification technology would be necessary for sustainable rice production in the future. It is, therefore necessary to determine the optimum density of plant population per unit area for obtaining maximum yield. Wider spacing had linearly increasing effect on the performance of individual plants, the plants grown with wider spacing had more solar radiation to absorb for better photosynthetic process and hence performed better as individual [7]. The chemical fertilizers are considered as essential part of modern farming and their use in different countries has increased considerably day-by-day. Their application directly or indirectly causes series of changes in physical, chemical and biological properties of soil [8]. Chemical fertilizers contain very high amount of nutrients and these are the quick source of nutrient supply. However, use of chemical fertilizers alone had led to deterioration in soil health and reduction in fertilizer-use efficiency. In contrast, organic manure are nearly complete source of most of the nutrients and become available for crop uptake gradually but would be available for longer duration due to slow decomposition and gradual release of the nutrients into the labile pool [9]. Therefore, an integrated approach with the use of organic and inorganic inputs that nourishes the soil in many ways and supplies all the essential nutrients to the crops in sufficient amounts and make the nutrients readily available during entire crop growth is required. Energy crisis, higher fertilizer cost, sustainability in agri-production system and ecological stability are the important issues which renewed the interest of farmers and research workers to opt for non-chemical sources of plant nutrients like biofertilizers, azolla, farmyard manure, green manure, vermicompost, poultry manure. Awareness about soil health and crop quality has increased the attention of people towards organic farming [10].

Balanced use of nutrients through organic sources like farmyard manure, vermicompost, green manuring, neem cake and bio-fertilizers are prerequisites to sustain soil fertility, to produce maximum crop yield with optimum input level [11, 12]. To restore desirable grain quality and maintain sustainable production, integrated nutrient management provides immense opportunity. Keeping this in view, the present investigation was carried out to study the effect of various organic sources of nutrition on growth, yield and quality of rice (*Oryza sativa* L.) cv MTU 7029 in Inceptisol of Varanasi region of Uttar Pradesh.

## Materials and Methods

A field experiment was conducted during rainy seasons of 2013 at the Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, located at 25°47´ N latitude, 83°03´ E longitudes and at altitude of 128.93 MSL from indo-gangatic region of eastern UP. The soil of experimental site was sandy clay loam, neutral in reaction (pH 7.5), low in organic carbon (0.34%), available nitrogen (198.45 kg/ha), medium in available phosphorus (23.64 kg/ha) and available potassium (206.4 kg/ha). The experiment was laid out in randomized block design having 12 treatments viz. Control ($T_1$), 100% RDF ($T_2$), $T_2$ + FYM @ 5 t ha$^{-1}$ ($T_3$), $T_2$ + Vermicompost @ 5 t ha$^{-1}$ ($T_4$, $T_2$ + Press mud @ 5 t ha$^{-1}$ ($T_5$), $T_3$ + *Trichoderma* compost @ 2.5 kg ha$^{-1}$ ($T_6$), $T_3$ + *Trichoderma* compost @ 5.0 kg ha$^{-1}$ ($T_7$), $T_3$ + *Trichoderma* compost @ 7.5 kg ha$^{-1}$ ($T_8$), $T_4$ + *Trichoderma* compost @ 2.5 kg ha$^{-1}$($T_9$), $T_4$ + *Trichoderma* compost @ 5.0 kg ha$^{-1}$ ($T_{10}$), $T_4$ + *Trichoderma* compost @ 7.5 kg ha$^{-1}$ ($T_{11}$), $T_5$ + *Trichoderma* compost @ 2.5 kg ha$^{-1}$ ($T_{12}$), $T_5$ + *Trichoderma* compost @ 5.0 kg ha$^{-1}$ ($T_{13}$), $T_5$ + *Trichoderma* compost @ 7.5 kg ha$^{-1}$ ($T_{14}$) and replicated thrice. Recommended fertilizer 120 : 60 : 60 kg/ha of N, $P_2O_5$ and $K_2O$ respectively as per recommendation were applied through urea, DAP and muriate of potash as per treatments. Half dose of nitrogen and full dose of phosphorus and potassium

**Table 1.** Effect of different organic sources of nutrient on growth parameters of rice. $T_1$–Control, $T_2$–100% RDF, $T_3$–$T_2$ + FYM @ 5 t ha$^{-1}$, $T_4$–$T_2$ Vermicompost @ 5 t ha$^{-1}$, $T_5$–$T_2$ + Press mud @ 5 t ha$^{-1}$, $T_6$–$T_3$+*Trichoderma* compost @ 2.5 kg ha$^{-1}$, $T_7$–$T_3$ + *Trichoderma* compost @ 5.0 kg ha$^{-1}$, $T_8$–$T_3$ + *Trichoderma* compost @ 7.5 kg ha$^{-1}$, $T_9$–$T_4$ + *Trichoderma* compost @ 2.5 kg ha$^{-1}$, $T_{10}$–$T_4$ + *Trichoderma* compost @ 5.0 kg ha$^{-1}$, $T_{11}$–$T_4$ + *Trichoderma* compost @ 7.5 kg ha$^{-1}$, $T_{12}$–$T_5$ + *Trichoderma* compost @ 2.5 kg ha$^{-1}$, $T_{13}$–$T_5$ + *Trichoderma* compost @ 5.0 kg ha$^{-1}$, $T_{14}$–$T_5$+ *Trichoderma* compost @ 7.5 kg ha$^{-1}$.

| Treat-ments | Plant height (cm) | LAI | No of tillers hill$^{-1}$ | Dry matter accumu-lation hill$^{-1}$ |
|---|---|---|---|---|
| $T_1$ | 90.33 | 3.59 | 10.00 | 60.00 |
| $T_2$ | 91.70 | 3.67 | 10.40 | 61.50 |
| $T_3$ | 93.00 | 3.74 | 11.40 | 63.24 |
| $T_4$ | 94.03 | 3.85 | 12.00 | 63.70 |
| $T_5$ | 92.00 | 3.71 | 11.00 | 62.85 |
| $T_6$ | 97.10 | 4.27 | 14.80 | 66.00 |
| $T_7$ | 99.08 | 4.34 | 15.20 | 67.40 |
| $T_8$ | 100.97 | 4.39 | 16.00 | 68.25 |
| $T_9$ | 102.00 | 4.44 | 16.50 | 69.00 |
| $T_{10}$ | 103.00 | 4.49 | 17.20 | 70.00 |
| $T_{11}$ | 105.35 | 4.90 | 18.00 | 72.00 |
| $T_{12}$ | 94.50 | 3.97 | 12.50 | 64.67 |
| $T_{13}$ | 95.43 | 4.10 | 13.00 | 65.21 |
| $T_{14}$ | 96.68 | 4.18 | 13.80 | 65.60 |
| SEm± | 0.40 | 0.18 | 0.37 | 1.33 |
| CD ($p$ = 0.05) | 1.17 | 0.53 | 1.07 | 3.88 |

were applied basally. Remaining half N dose was applied in two equal splits once at tillering and rest panicle initiation stages. However vermicompost, *Trichoderma* compost, FYM and press mud was applied at the time of transplanting. Seedlings of 25 days of MTU 7029 rice were transplanted, keeping 2–3 seedling/hill at 20×10 cm spacing on 30 June in 2014 under puddle conditions. The crop was harvested at the mid of November. The other agronomic practices were followed as per standard recommendations.

### Experimental design, data collection and analysis

The observations recorded during the course of investigation were tabulated and analyzed statistically to draw a valid conclusion. The data were analyzed as per the standard procedure for analysis of variance (ANOVA) as described by Gomez and Gomez [13]. The significance of treatments was tested by $F$ test (Variance ratio). Standard error of mean (SEm±) was computed in all cases. The differences in the treatment mean were tested by using critical difference (CD) or least significant difference (LSD) at 5% level of probability.

## Results and Discussion

### Growth parameters

The significant variation in plant height due to different organic sources of nutrition at all stages of growth (Table 1). Among the organic sources of nutrition, significantly higher plant height (105.35 cm) was recorded with $T_{11}$ (100% RDF + vermicompost @ 5 t ha$^{-1}$ + *Trichoderma* compost @ 7.5 kg ha$^{-1}$) than rest of treatments at all the stage of the observations. The significantly higher tillers hill$^{-1}$ (18.0), LAI (4.90) and dry matter accumulation hill$^{-1}$ (72.0) was recorded under $T_{11}$ (100% RDF + vermicompost @ 5 t ha$^{-1}$ + *Trichoderma* compost @ 7.5 kg ha$^{-1}$) as compared to rest of the treatment.

The mineralization during the decomposition of organic manures (FYM and green manure) due to integrated use of inorganic fertilizers might have enhanced nitrogen availability in the rhizosphere resulting in increased nitrogen uptake by the crop which in turn promoted the increase in plant height in the above treatments. Further, synchronized availability of essential plant nutrients to the crop for a longer period with use of organic manures along with has increased plant height as the crop growth advanced [14]. Similar findings of higher dry matter accumulation with application of FYM, green manuring and bio-fertilizers was reported by Jagdish et al. [15] and Anchal et al. [16].

### Yield and quality parameters

Significantly higher grain yield (54 q/ha), straw yield (70 q/ha), protein content (8.38%), protein yield (4.44 q/ha), hulling (71.23%) and milling (64.30%) were recorded under 100% RDF + Vermicompost @ 5 t ha$^{-1}$ +*Trichoderma* compost @ 7.5 kg ha$^{-1}$. Integration of bioorganic sources might have increased the N con-

**Table 2.** Effect of different organic sources of nutrition on yield, yield attributes and quality parameters of rice.

| Treatments | Grain yield (q $ha^{-1}$) | Straw yield (q $ha^{-1}$) | Harvest index (%) | Protein content (%) | Protein yield (q $ha^{-1}$) | Hulling (%) | Milling (%) |
|---|---|---|---|---|---|---|---|
| $T_1$ | 39.00 | 58.00 | 40.21 | 6.19 | 2.42 | 63.11 | 58.46 |
| $T_2$ | 40.00 | 59.90 | 40.04 | 6.38 | 2.55 | 63.56 | 59.36 |
| $T_3$ | 41.30 | 61.00 | 40.38 | 6.69 | 2.75 | 64.59 | 60.10 |
| $T_4$ | 42.00 | 61.60 | 40.54 | 6.81 | 2.83 | 65.01 | 60.32 |
| $T_5$ | 40.83 | 60.45 | 40.31 | 6.56 | 2.68 | 64.10 | 59.63 |
| $T_6$ | 46.17 | 65.30 | 41.42 | 7.50 | 3.40 | 68.43 | 61.66 |
| $T_7$ | 48.20 | 66.00 | 42.26 | 7.63 | 3.49 | 68.80 | 62.33 |
| $T_8$ | 49.00 | 67.67 | 42.00 | 7.88 | 3.73 | 69.10 | 62.45 |
| $T_9$ | 51.85 | 68.20 | 43.24 | 8.00 | 3.95 | 69.28 | 62.51 |
| $T_{10}$ | 52.90 | 69.33 | 43.28 | 8.25 | 4.21 | 70.12 | 63.10 |
| $T_{11}$ | 54.00 | 70.00 | 43.56 | 8.38 | 4.44 | 71.23 | 64.30 |
| $T_{12}$ | 43.33 | 62.50 | 40.90 | 7.00 | 2.98 | 65.28 | 61.06 |
| $T_{13}$ | 44.12 | 63.13 | 41.13 | 7.13 | 3.14 | 66.54 | 61.10 |
| $T_{14}$ | 45.07 | 64.00 | 41.33 | 7.31 | 3.26 | 67.25 | 61.30 |
| SEm± | 0.56 | 1.12 | 0.55 | 0.286 | 0.221 | 1.146 | 1.116 |
| CD ($p$ = 0.05) | 1.63 | 3.27 | NS | 0.834 | 0.643 | 3.366 | 3.275 |

tent of the plants which ultimately influenced the protein yield favorably and these findings have been closely confirmed by Gandhi and Sivakumar [17] and Sangeetha et al. [18]. Application of higher dose of organic nitrogen either through vermicompost or FYM brought out significant improvement on the quality parameters of rice viz. hulling, milling and head rice recovery.

Application of organic nitrogen also influenced protein content and protein yield due to increase in the concentration of N in grains, which might have modified the proportion of grain constituents. Minimum grain yield (3.9 t/ha), straw yield (5.8 t/ha) and protein content (7.30%) were recorded under control. The maximum grain straw yield was due to marked improvement in dry matter accumulation, yield attributes and greater nutrient content and their uptake by rice crop. These findings are in direct conformity with Singh et al. [19]. Nutrients available from decomposing FYM to the rice crop during the reproductive stage were utilized for grain formation and grain filling leading to higher no of grains per panicle. This was supported by Mirza et al. [20].

## Conclusion

It may be concluded that 100% RDF + Vermicompost @ 5 t $ha^{-1}$ + *Trichoderma* compost @ 7.5 kg $ha^{-1}$ were recorded maximum value of all growth components, grain and straw yield as well as quality parameters. However the minimum values were examined under control plot.

## References


1. Barah BC, Pandey S (2005) Rainfed rice production systems in Eastern India: An on farm diagnosis and policy alternatives. Ind J Agric Econ 60 : 110—136.
2. Annual report (2014) Dep Agric and Coop, Min Agric, GOI.
3. Tuong TP, Bouman BAM, Mortimer M (2005) More rice, less water integrated approaches for increasing water productivity in irrigated rice-based systems in Asia. Pl Prod Sci 8 : 231—241.
4. Krishna A, Biradarpatil NK, Channappagoudar BB (2008) Influence of system of rice intensification (SRI) cultivation on seed yield and quality, Karnataka. J Agric Sci 21 : 369—372.
5. Laulanie H (1993) Le systeme de rigiculture intensive malagache. Tropicultura (Brussels). 11 : 104—114.
6. Miah MNH, Talukdar S, Sarker MAR, Ansari TH (2004) Effect of number of seedling per hill and urea super granules on growth and yield of rice cv BINA Dhan 4. J Biol Sci 4 : 122—129.
7. Baloch AW, Soomro AM, Javed MA, Ahmed M, Bughio HR, Bughio MS, Mastoi NN (2002) Optimum plant density for high yield in rice (*Oryza sativa* L.). Asian J Pl Sci 1 : 25—27.
8. Divya J, Belagali SL (2012) Effect of chemical fertilizers on physico-chemical characteristics of agricultural soil samples of Nanjangud taluk, Mysore district, Karnataka, India. The Ecoscan 6 : 181—187.

9. Das A, Patel DP, Munda GC, Ramkrushna GI, Kumar M, Ngachan SV (2014) Improving productivity, water and energy- use efficiency in lowland rice (*Oryza sativa*) through appropriate establishment methods and nutrient management practices in the mid altitudes of north east India. Experim Agric 50 : 353—375.
10. Sharma M, Pandey CS, Mahapatra BS (2008) Effect of biofertilizers on yield and nutrient uptake by rice and wheat in rice wheat cropping system under organic mode of cultivation. J Ecofriendly Agric 3 : 19—23.
11. Dahiphale AV, Giri DG, Thakre GV, Gin MD (2003) Effect of integrated nutrient management on yield and yield contributing parameters of the scented rice, Ann Pl Physiol 17 : 24—26.
12. Yadav OM, Dahiphale RV, Godhawale GV (2007) Effect of integrated management on productivity of rice under upland ecosystem. Int J Trop Agri 25 : 201—207.
13. Gomez KA, Gomez AA (1984) Statistical procedures for agricultural research. J Wiley and Sons, New York.
14. Harish H, Deshpande, Devasenapathy P (2011) Effect of different organic sources of nutrients and green manure on growth and yield parameters of rice (*Oryza sativa*) grown under low land condition. Crop Res 41 : 1—5.
15. Jagdish Kumar, Yadav MP, Prasad K (2010) Production potential of hybrid rice (*Oryza sativa*) as influenced by integrated nutrient management. Crop Res 39 : 20—23.
16. Anchal Dass S, Sudhishri, Lenka NK (2009) Integrated nutrient management for upland rice in eastern ghats of Orissa. Oryza 46 : 220—226.
17. Gandhi, Sivakumar K (2010) Impact of vermicompost carrier based bio inoculants on the growth, yield and quality of rice (*Oryza sativa* L.) cv NLR 145. The Ecoscan 4 : 83—88.
18. Sangeetha SP, Balakrishnan A, Bhuvaneswari J (2010) Influence of organic nutrient sources on quality of rice. Madras Agric J 97 : 230—233.
19. Singh MK, Thakur R, Verma UN, Upasani RR, Pal SK (2000) Effect of planting time and nitrogen on production potential of basmati rice (*Oryza sativa*) cultivars in Bihar plateau. Ind J Agron 45 : 300—303.
20. Mirza BB, Zia MS, Szambathovan N, Zauju A (2005) Rehabilitation of soils through environmental friendly technologies: Role of sesbania and farmyard manure. Agric Trop Et Subtrop 38 : 12—16.