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# Effect of enriched FYM and fertilizer levels on yield and yield components in aerobic rice (*Oryza sativa* L.)

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**Abstract:** A Field experiment to assess the effect of enriched farm yard manure (FYM) and fertilizer levels on growth and yield components of aerobic rice was carried out at university of Agricultural and Horticultural Sciences, Shivamogga during *kharif*, 2013 The experiment was laid out in factorial RCBD design with three fertilizer levels *viz.,* 125:62.5:62.5, 100: 50: 50 and 75:37.5:37.5 kg NPK ha$^{-1}$ with four methods of application *viz.,* separate application of manure and fertilizer, spot application of manure and fertilizer, broadcasting of enriched manure and spot application of enriched manure, The results showed that application of 125:62.5:62.5 kg NPK ha$^{-1}$ recorded higher grain yield (53.54 q ha$^{-1}$) and filled grains (111.86). Significantly higher 1000 grain weight (23.37 g) was recorded with application of 100:50:50 kg NPK ha$^{-1}$ which was on par with the level 75:37.5:37. 5 kg NPK ha$^{-1}$ (22.78 g). Among the methods of application, spot application of enriched manure recorded significantly higher 1000 grain weight (24.24 g) and grain yield (54.03 q ha$^{-1}$) due to timely available of nutrients. Interaction of spot application of enriched manure with 125:62.5:62.5 kg NPK ha$^{-1}$ has registered higher grain yield (60.58 q ha$^{-1}$) and filled grains panicle$^{-1}$ (128.75). While, higher 1000 grain weight (25.80 g) was recorded in spot application of enriched manure with 100:50:50 NPK kg ha$^{-1}$.

**Key words:** Aerobic rice; Enriched farm yard manure

## Introduction

Rice has shaped the cultures, diets and economies of thousands of millions of people. Rice (*Oryza sativa* L.) is being cultivated in more than hundred countries and undoubtedly a dominant staple food of world. But 91 per cent of the world's rice is grown and consumed in Asia (Dobermann and Witt, 2003). The food security in Asia is challenged by increasing food demand and is threatened by declining water availability with growing population, increased urbanization and environmental degradation. Projections indicated that most of the Asian countries will have a severe water problem by 2025, however a "physical water scarcity" is expected in Asia for more than 2 million hectares of irrigated dry-season rice and 13 million hectares of irrigated wet-season rice (Tuong and Bouman, 2003). Moreover, lack of rainfall is a major production constraint in rainfed areas, which led to the development of alternative methods of cultivation *i.e.,* alternate wetting and drying (AWD), saturated soil culture (SSC) and aerobic rice. Rice is normally mesophytic plant but forcibly it can grown as hydrophytic crop. Aerobic rice is the latest technology that reduces water inputs by growing rice as any other irrigated upland crop (Joshi Rohit *et al,* 2009).

In organic farming, nitrogen is supplied through organic amendments in the form of manures. The incorporated use of organic sources of nutrients not only supply essential nutrients but also has some positive interaction with chemical fertilizers to increase their efficiency and thereby to improve the soil structure (Elfstrand *et al.,* 2007). The use efficiency of applied fertilizer nitrogen in rice crop is very low (30-50%). Efficiency of applied fertilizer nitrogen is low, ranges from 20-25 per cent in submerged soils. The percolation is more in flooded soils than aerobic conditions. So the highly mobile nitrate ion is easily lost through leaching. When a dry soil is wetted, initially rapid mineralization of soil organic matter occurs, releasing relatively significant amounts of available nitrogen. But this available nitrogen can later be immobilized and rendered unavailable for crop absorption (Hooper, 1982). Hence, effective nitrogen management such as rate and synchronized N application with the crop requirement in real time plays an important role in increasing response to added fertilizers and thereby, improving the grain yield of rice varieties including hybrids. Among the factors governing nitrogen use efficiency, rate, time and method of application of nitrogen plays an important role. Use of enriched FYM is one of the methods to improve nutrient use efficiency. Further, fertilizer placement is an integral part of efficient crop management. Correct placement often improves the efficiency by which plants can take up nutrients and consequently encourages maximum yields of intensively managed agronomic crops. Correct fertilizer placement is critical for maximum crop yields particularly under reduced tillage operations.

## Materials and Methods

The field experiment was conducted at University of Agricultural and Horticultural Sciences, Shivamogga, India during *kharif,* 2013, which is situated at 13° 58' North latitude and 75° 34' East latitude with an altitude of 650 meters above mean sea level,. It comes under Agro-climatic Region-4 and Zone-VII (Southern Transitional Zone) of Karnataka. The soil of the experimental site was red sandy loam. The soil of the experimental site was neutral in reaction (pH 6.4) and normal in electrical conductivity (0.02 dS $m^{-1}$) with bulk density of 1.25 Mg $m^{-3}$ and low in organic carbon (4.2 g $kg^{-1}$). The soil was low in available nitrogen (241 kg $ha^{-1}$), high in phosphorus (87 kg $ha^{-1}$) and medium in potassium (131.72 kg $ha^{-1}$). The experiment was laid out in factorial RCBD design replicated thrice with three fertilizer level *viz.,* 125:62.5:62.5, 100: 50: 50 and 75:37.5:37.5 kg NPK $ha^{-1}$ with four methods of application *viz.,* separate application of manure and fertilizer, spot application of manure and fertilizer, broadcasting of enriched manure and spot application of enriched manure. The treatment combinations are $T_{1=}$ 125:62.5:6 2.5 kg NPK $ha^{-1}$ and manure applied separately, $T_2$=125:62.5:62.5 levels of fertilizer and manures by spot application. $T_3$=125:62.5:62.5 level of fertilizer with enriched manure by broad-casting. $T_4$=125:62.5:62.5 level of fertilizer by enriched manure and by spot application $T_5$=100:50:50 levels of fertilizer and manure applied separately. $T_6$=100:50:50 levels of fertilizer and manure by spot application $T_7$=100:50:50 level of fertilizer by enriched manure by broad casting $T_8$=100:50:50 level of fertilizer by enriched manure and by spot application $T_9$=75:37.5:37.5 levels of fertilizer and manure applied separately $T_{10}$=75:37.5:37.5 levels of fertilizer and manure by spot application $T_{11}$=75:37.5:37.5 levels of fertilizer by enriched manure and broad casting $T_{12}$=75:37.5:37.5 levels of fertilizer with enriched manure and by spot application. Seeds were sown with spacing of 25 X 25 cm @t one seed per hill.

The field was irrigated immediately after sowing. To avoid movement of fertilizer from one plot to another, each plot was irrigated separately and independently. Then subsequent irrigation was given to the crop at 5-6 days interval depending on weather condition to keep the soil moist. The crop was irrigated following alternate wetting and drying cycles. However, from flowering to grain filling stage, irrigation was given once in three to four days interval in order to maintain higher moisture in soil. Irrigation was withheld 10 days before the crop maturity. The soil was loosened with the help of hand hoe at 30, 45, 60 and 75 DAS. This enables easy penetration and development of good root system there by to induce more number of tillers. Londax power (Bensulfuron methyl 0.6% + Pretilachlor 6 % GR) @ 10 kg ha-1 was applied as pre-emergence herbicide at two DAS. Optimum plant population was maintained by thinning excess seedling leaving one seedling per hill. Hand weeding was done at 25 DAS. Healthy crop stand was ensured by adopting need based plant protection and recommended package of practices. Five plants were selected at random and tagged. These plants were used for recording plant height, tillers, leaf area and leaf area index. Leaf area was measured using leaf area meter and LAI was calculated as ratio of leaf area per plant to area occupied by the plant. Yield attributes like number of productive tillers $hill^{-1}$, panicle length, panicle weight, grains $panicle^{-1}$, 1000 grain weight, grain an, straw yields were recorded. The data pertaining to the experiment were subjected to statistical analysis suggested by Gomez and Gomez (1984) and results were compared.

**Preparation of enriched FYM:** Full dose of recommended FYM has been taken and allowed to enrich with the following fertilizer levels which include 125:62.5:62.5, 100:50:50 and 75:37.5:37.5 kg NPK $ha^{-1}$. As per the above fertilizer levels in each level nitrogen is taken as 50% of the mentioned levels. Phosphorus and potassium were taken as full dose with recommended FYM and kept for enrichment for a period of 3 days with good moisture maintenance under dark condition. Fifty per cent of nitrogen fertilizer and full dose of phosphorus and potassium were applied at the time of sowing and the remaining 50 per cent of N was top dressed at 45 days after sowing (DAS) and micronutrients were applied as per package (12.5 kg iron sulphate and 12.5 kg zinc sulphate per hectare).

For the observations like dry weight of the plants, leaf area etc, the plants from the outside the net plot were uprooted and brought to laboratory for measurement.

## Results and Discussion

**Yield components :** Number of panicles significantly influenced the grain yield. Significantly higher number of panicles $plant^{-1}$ (33.47) was recorded wit fertilizer level of 125:62.5:62.5 kg NPK $ha^{-1}$ (Table 1). The number of panicles is decided mainly during the early period just after transplanting stage. More panicles $plant^{-1}$ at harvest might be due to better availability of nutrients and reduced mortality of tillers which in turn resulted in higher uptake of nutrients. Adequate quantity of macronutrients and moisture during panicle differentiation stage might have helped to obtain higher number of grains $panicle^{-1}$ and better availability of moisture and aeration of roots, which might have helped to retain more number of panicles $plant^{-1}$ at harvest. These results are in conformity with findings of Ravi and Srivasthava (1997).

Use of higher dose of N might have helped in inducing good vegetative growth and thus produced higher number of panicles leading to higher yield (Dhurandher and Tripathi, 1999). The increased number of grains $panicle^{-1}$ (126.03) was noticed with fertilizer level of 125:62.5:62.5 kg NPK $ha^{-1}$. It might due to higher nutrient uptake, higher leaf area and dry matter production. These in turn might have favoured the development of large sink. The results of the present investigation are in conformation with the findings of Ahmed *et al.* (1990). Significantly higher panicle length was observed with the fertilizer level $A_1$ *i.e.* 125:62.5:62.5 kg NPK $ha^{-1}$ (20.40 cm) due to higher availability of nutrients, . While, fertilizer level $A_2$ *i.e.* 100:50:50 kg NPK $ha^{-1}$ recorded higher panicle weight (3.34 g) 1000 seeds weight (23.37g). This may be due to higher translocation of starch to panicle by higher nutrient uptake supported by higher leaf area. Higher fertilizer level lead to more chaffiness due to poor distribution photosynthets to increased number of seeds per panicle with reduced seed size Similar observation was made by Maragatham *et al.* (2010).

Panicle length, panicle weight and test weight (22.15 cm, 3.48g and 24.24) (Table 2) were significantly higher with spot application of enriched manure which was on par with broadcasting of enriched manure. It might due to reduced loss of nutrients in enriched FYM applied plots. Supply of nitrogen is one of element to control the panicle structure, Organic materials, acting as slow release source of N, are expected to more closely match N supply and rice N demand and this could reduce N losses (Backer *et al.,* 1994). It is very likely that N-losses due to volatilization, leaching or denitrificaiton will be reduced due to mixing of N fertilizer with organic compost resulting in greater N. These results are in line with the earlier findings of Jagathjothi and his co workers (2008).

**Table-1:** Yield and yield components as influenced by fertilizer level and methods of manure application in aerobic rice

| Treatments | Number of panicles plan 1 | Number of grains panicle 1 | Grain yield (q hs 1) | Straw yield (q hs 1) | Filled grain weight panicle1 | Chaffygrains panicle-1 | Chaffiness (%) |
|---|---|---|---|---|---|---|---|
| Fertilizer lavels (A) | | | | | | | |
| A1 | 33.47 | 126.03 | 53.54 | 61.52 | 111.86 | 14.17 | 11.40 |
| A2 | 27.35 | 121.16 | 51.44 | 57.42 | 108.90 | 12.26 | 10.16 |
| A3 | 25.7 | 100.35 | 44.4 | 53.3 | 87.51 | 12.83 | 12.74 |
| S.Em± | 0.28 | 3.92 | 1.12 | 2.92 | 4.14 | 0.52 | 0.65 |
| C.D. at 5% | 0.83 | 11.49 | 3.28 | 8.57 | 12.15 | 1.52 | 1.91 |
| Method of application (B) | | | | | | | |
| B1 | 25.96 | 109.2 | 45.73 | 56.04 | 94.80 | 14.40 | 13.26 |
| B2 | 27.04 | 114.18 | 48.54 | 58.01 | 100.12 | 14.06 | 12.34 |
| B3 | 30.15 | 116.64 | 50.87 | 56.31 | 104.06 | 12.58 | 10.76 |
| B4 | 32.21 | 123.37 | 54.03 | 59.29 | 112.05 | 11.32 | 9.38 |
| S.Em± | 0.33 | 4.52 | 1.29 | 3.37 | 4.78 | 0.60 | 0.75 |
| C.D. at 5% | 0.96 | 13.27 | 3.78 | NS | 14.02 | 1.75 | 2.21 |
| Interaction (A X B) | | | | | | | |
| $A_1B_1$ | 28.12 | 115.55 | 47.94 | 63.64 | 100.00 | 15.55 | 13.48 |
| $A_1B_2$ | 29.29 | 120.57 | 51.1 | 60.9 | 105.54 | 15.02 | 12.48 |
| $A_1B_3$ | 36.03 | 127.38 | 54.55 | 57.67 | 113.13 | 14.25 | 11.18 |
| $A_1B_4$ | 40.44 | 140.62 | 60.58 | 63.88 | 128.75 | 11.87 | 8.47 |
| $A_2B_1$ | 25.27 | 118.04 | 48.19 | 54.83 | 104.01 | 14.03 | 11.90 |
| $A_2B_2$ | 26.48 | 119.59 | 50.82 | 58.98 | 105.44 | 14.15 | 11.83 |
| $A_2B_3$ | 28.29 | 121.33 | 52.94 | 58.9 | 110.47 | 10.86 | 8.95 |
| $A_2B_4$ | 29.35 | 125.69 | 53.83 | 56.98 | 115.68 | 10.01 | 7.97 |
| $A_3B_1$ | 24.5 | 94 | 41.07 | 49.67 | 80.38 | 13.62 | 14.39 |
| $A_3B_2$ | 25.36 | 102.38 | 43.72 | 54.17 | 89.37 | 13.01 | 12.71 |
| $A_3B_3$ | 26.11 | 101.2 | 45.13 | 52.35 | 88.58 | 12.62 | 12.16 |
| $A_3B_4$ | 26.83 | 103.8 | 47.68 | 57.02 | 91.73 | 12.07 | 11.70 |
| S.Em± | 0.19 | 2.61 | 0.75 | 1.95 | 2.76 | 0.35 | 0.43 |
| C.D. at 5% | 0.55 | 7.66 | 2.19 | NS | 8.10 | 1.01 | 1.27 |

Higher the number of panicles plant$^{-1}$ normally leads to higher grains per panicle. Spot application of enriched manure with 125:62.5:62.5 kg NPK ha$^{-1}$ has recorded significantly higher filled grains (112.05) (Table 2) due to higher nutrient uptake. This is in conformity with the findings of Sharma and Mittra (1990). In this investigation, significantly higher test weight was recorded with spot application of manure with fertilizer level 75:37.5:37.5 kg NPK ha$^{-1}$ (24.58 g),. This might be due to higher content of starch in the flag leaf at grain filling stage (Mathsushima, 1966). The grain yield of a crop is the integrated results of a number of physiological processes. The average paddy yields under puddle conditions in Shivamogga district is varies from 30 to 40 quintals ha$^{-1}$. The results of the present study showed that fertilizer levels significantly influenced the yield attributes in rice. Application of 125:62.5:62.5 kg NPK ha$^{-1}$ recorded significantly higher grain yield (53.54 q ha$^{-1}$) over others.. This increase in grain yield is due to the higher yield parameters like number panicles plant$^{-1}$, number of grains panicle$^{-1}$ and higher filled grains per panicle. The results of this present investigation are in conformation with the findings of Ahmed *et al.* (1990). Use of higher dose of N might have helped in inducing good vegetative growth and thus produced higher number of panicles leading to higher yield (Dhurandher and Tripathi, 1999). Increase in filled grains panicie$^{-1}$ under increased nitrogen levels might be due to N induced enhancement in photosynthetic activity and thus resulted in the translocation of photosynthates and amino acids from the leaves and culms to the grain. It is in accordance with findings of Krishnakumar (1986) and Dhyani and Mishra (1994). Lower sterility per cent was noticed under increased levels of nitrogen. It can also be attributed to the increment in vegetative growth by higher N supply, which might have resulted in higher yield and yield components of rice. This is in harmony with findings of Krishnakumar (1986) and Dhurandhar and Tripathi (1999). Thousand-grain weight was higher in the highest level of nitrogen. This might be due to the enhanced photosynthetic activity and translocation of photosynthates and amino acids form the leaves and culms to grain under higher N levels (Dhyani and Mishra, 1994).

In this study enriched manure has recorded more yields compared to without enrichment treatments and spot application of enriched manure has recorded significantly higher grain yield (54.03 q ha$^{-1}$) (Table 1). These findings were in line with the results of a field experiment conducted to evaluate the influence of compost fertilizer mixed with chemical fertilizer on growth and yield of wheat and rice (Aslam *et al.,* 1998). They reported significant improvements in growth and yield. Similarly, Singh and Singh *et al.* (1999) reported the effect of compost plus nitrogen on grain yield, straw yield and total biomass of wheat, which were highest with compost plus nitrogen.

Significantly less unfilled grains panicle$^{-1}$(10.01) and chaffiness (7.97%) (Table 1) was recorded with spot application of enriched manure along with fertilizer level 100:50:50 NPK kg ha$^{-1}$ might be due higher the nutrient uptake during flowering period resulted in more number of spikelets panicle$^{-1}$, but it lead to increased unfilled grains panicle$^{-1}$ (Mathsushima 1966). Ammonium ions are the principal form of nitrogen available to paddy and as such are toxic to many metabolic systems. Rice must maintain an adequate supply of carbohydrates (presumably keto acids) to ensure prompt conversion to amino acids. It is possible that spikelet degeneration could be due to excess free ammonia in the spikelets rather than the lack of carbohydrates in the whole plant as suggested by Murata (1969) (a negative correlation between carbohydrate content and spikelet degeneration).The lower sterility per cent was noticed under increased levels of nitrogen. It can also be attributed to the increment in vegetative growth by higher N supply, which might have resulted in higher yield and yield components of rice. This is in harmony with findings of Krishnakumar (1986) and Dhurandhar and Tripathi (1999). Thousand-grain weight was higher in the highest level of nitrogen. This might be due to the enhanced photosynthetic activity and translocation of photosynthates and amino acids form the leaves and culms to grain under higher N levels (Dhyani and Mishra, 1994).

More number of filled grains (112.05), less chaffy grains panicle$^{-1}$ (11.32) and less chaffiness (9.38%) (Table 1) was observed in spot application of enriched manure than other methods. This may be due to less leaching loss of nutrients and more starch stored in flag leaf and more availability of photosynthates for better grain filling as a consequence of increased green leaves plant$^{-1}$, higher leaf area and higher dry matter (Siddaram *et al.,* 2010). Increase in filled grain and thousand grain weight due to N induced enhancement in photosynthetic activity and greater translocation of photosynthates and amino acids from the leaves and culms to the grain. The present findings are in accordance with the findings of Belder *et al.* (2005) and Dhyani and Mishra (1994). From the present investigation, it can be inferred that the spot application of 125: 62.5:62.5 kg NPK ha$^{-1}$ through enriched FYM resulted in higher rice yield of q ha$^{-1}$than conventional method. This helps in efficient use of nutrients.

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