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# Effect of micronutrients mixture on nutrient status in post harvest soil and yield of aerobic rice

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**Abstract**
A field experiment was conducted in college of Agriculture, V. C. Farm, Mandya during *Kharif* 2017 to evaluate the effect of micronutrients mixture on performance of aerobic rice. Treatments include micronutrients mixture combinations like foliar application (MMF @ 0.5 and 1.0%) and soil application (MMS @ 12.5 kg ha$^{-1}$) and their combination of both soil and foliar applications were checked in this experiment. The results revealed that maximum grain and straw yield was recorded with soil application of MMS @ 12.5 kg ha$^{-1}$+ MMF @ 1% along with RDF and FYM ($T_8$) and the same treatment recorded the maximum micronutrient status in the post harvest soil. But, the highest available N, $P_2O_5$, $K_2O$ and Exch. Ca, Mg in post harvest soil observed in control plot.

**Keywords:** aerobic rice, micronutrients mixture

## Introduction
Rice (*Oryza sativa*) ranks first among the cereals in the country. Rice is the staple food for nearly half of the world's population and most of them living in developing countries like Asia. In major rice growing areas mainly flooding method of rice cultivation is followed. Water needs for growing rice in conventional method is much higher. Worldwide, the rise in demographic pressure, climatic changes and industrial growth led to diminishing resources of water for agricultural production (Hanjra and Qureshi 2010) [5]. The decline in the availability of irrigation water threatens the productivity and sustainability of rice (Farooq *et al.* 2009) [4]. To overcome the problem, growing rice with minimum quantity of water for which aerobic system of rice cultivation is one such alternative method (Bouman *et al.*, 2001) [1].
Aerobic rice is a new system of rice cultivation. In this system land is brought to fine tilth under dry condition, the seeds are dibbled in definite row proportion and soil moisture regime is maintained almost around the field capacity. In aerobic rice 40-50 percent irrigation water saved compared to lowland transplanted rice cultivation. The areas receiving low rainfall of 600-800mm will be overcome the problem of water scarcity with the application of this method. The low and unstable yields of aerobic rice were mainly due to low water availability and nutrient stresses. Due to adoption of intensive mono cropping, use of high analysis fertilizers, decreased use of organic manures, use of high yielding varieties and different cropping systems, are leading to the deficiencies of micronutrients on a larger scale. The lower soil moisture content in aerobic rice cultivation therefore reduces nutrients supply to the roots and resulted in the lower rate of plant uptake.
The nutrient deficiencies have appeared much higher after following the aerobic system of rice cultivation due to changes in the physical, chemical and biological properties of the soil. In submerged soils, micronutrients are converted from unavailable to available form by microorganisms. But in aerobic condition the process is reverse. Therefore, to maintain soil productivity and to get sustainable yield, balanced use of fertilizers along with micronutrients are highly essential. Recent days farmers are growing crops without applying micronutrients, they are only focus on NPK fertilizers to increase the yield. This leads to the depletion of micronutrients and soil health. So there is a need to apply micronutrients along with NPK fertilizers either by soil or foliar application.

## Material and Methods
The field experiment was carried out during *Kharif* 2017 at College of Agricultural, V. C. Farm, Mandya. The soil of the experimental site was sandy loam in texture having pH 7.3. The organic carbon content was medium (5.5 g kg$^{-1}$), available N content was low (188.16 kg ha$^{-1}$) while that of $K_2O$ (229 kg ha$^{-1}$) and $P_2O_5$ (23.5 kg ha$^{-1}$) contents were found medium. The exchangeable Ca and Mg content (6.5 and 2.4 cmol (p+) kg$^{-1}$, respectively) were adequate and the available S (15.5 mg kg$^{-1}$) content was high. And sufficient with micronutrients like Fe

(4.55 mg $kg^{-1}$), Mn (2.10 mg $kg^{-1}$), Zn (0.88 mg $kg^{-1}$) and Cu (0.74 mg $kg^{-1}$) while B (0.46 mg $kg^{-1}$) content was in the deficient range. The experimental design used was Randomized Complete Block Design with eight treatments and three replications. The cultivar used was KMP-175 which was newly released and suitable for aerobic condition. The micronutrients mixture was applied to the soil at sowing and foliar application (0.5 and 1.0%) was given after 20 and 40 days after sowing. All other management practices were followed as per the recommendation of the UAS, Bangalore.

## Results and Discussion

### Yield of aerobic rice as influenced by application of micronutrients mixture

The straw and grain yield as influenced by the application of micronutrients mixture depicted in Table. 1. Significantly highest grain and straw yield (4352.21 kg $ha^{-1}$ and 6093.09 kg $ha^{-1}$ respectively) were observed in the treatment with the soil application of RDF + MMS @ 12.5 kg $ha^{-1}$ + foliar application of MMF @ 1% (T8) over rest of the treatments.

The significant difference in the grain and straw yield is due to the application of micronutrients mixture which consist Fe, Zn, Cu, Mn and B. These micronutrients play a major role in various enzymatic reactions and acts as catalyst in various growth processes, protein synthesis and also in hormone production (Fageria, 2002, Sarangi and Sharma, 2004) [3, 8]. The increased availability of micronutrients lead to higher growth parameters along with photosynthesis and translocation of photosynthates to grains and thereby increased grain and straw yield.

**Table 1:** Effect of soil and foliar application of micronutrients mixture on grain and straw yield of aerobic rice

| Treatments | Grain yield (kg per ha) | Straw yield (kg per ha) |
|---|---|---|
| $T_1$: Absolute control | 2244.77 | 3142.68 |
| $T_2$: RDF + FYM @ 10 t $ha^{-1}$ (Control) | 3088.77 | 4324.28 |
| $T_3$: RDF + FYM @ 10 t $ha^{-1}$ + $ZnSO_4$ @ 20 kg $ha^{-1}$ (POP) | 3195.55 | 4473.76 |
| $T_4$: $T_2$+ Foliar spray of MMF @ 0.5% | 3574.44 | 5004.21 |
| $T_5$: $T_2$ + Foliar Spray of MMF @ 1% | 3588.88 | 5024.43 |
| $T_6$: $T_2$ + Soil application of MMS @ 12.5 kg $ha^{-1}$ | 3942.21 | 5519.09 |
| $T_7$: $T_2$ + MMS @ 12.5 kg $ha^{-1}$ + MMF @ 0.5% | 4289.99 | 6005.98 |
| $T_8$: $T_2$ + MMS @12.5 kg $ha^{-1}$ + MMF @ 1% | 4352.21 | 6093.09 |
| SEm± | 109.21 | 152.89 |
| CD @ 5% | 331.26 | 463.77 |

**Table 2:** Effect of soil and foliar application of micronutrients mixture on primary and secondary nutrient content of post-harvest soil

| Treatments | N (kg $ha^{-1}$) | $P_2O_5$ (kg $ha^{-1}$) | $K_2O$ (kg $ha^{-1}$) | Exch. Ca (cmol $kg^{-1}$) | Exch. Mg (cmol $kg^{-1}$) | Available S (mg $kg^{-1}$) |
|---|---|---|---|---|---|---|
| $T_1$: Absolute control | 167.25 | 16.24 | 194.02 | 5.43 | 0.93 | 10.83 |
| $T_2$: RDF + FYM @ 10 t $ha^{-1}$ (Control) | 267.61 | 40.18 | 271.44 | 5.57 | 1.27 | 13.75 |
| $T_3$: RDF + FYM @ 10 t $ha^{-1}$ + $ZnSO_4$ @ 20 kg $ha^{-1}$ (POP) | 259.24 | 41.89 | 270.46 | 5.53 | 1.23 | 14.58 |
| $T_4$: $T_2$+ Foliar spray of MMF @0.5% | 242.52 | 34.20 | 251.69 | 5.50 | 1.23 | 16.92 |
| $T_5$: $T_2$ + Foliar Spray of MMF @ 1% | 238.34 | 32.49 | 249.74 | 5.47 | 1.17 | 17.08 |
| $T_6$: $T_2$ + Soil application of MMS @ 12.5 kg $ha^{-1}$ | 221.61 | 31.63 | 226.97 | 5.47 | 1.13 | 20.00 |
| $T_7$: $T_2$ + MMS @ 12.5 kg $ha^{-1}$ + MMF @ 0.5% | 204.89 | 28.21 | 216.05 | 5.37 | 1.13 | 21.92 |
| $T_8$: $T_2$ + MMS @12.5 kg $ha^{-1}$ + MMF @ 1% | 192.34 | 26.50 | 215.10 | 5.35 | 1.07 | 22.25 |
| SEm± | 5.00 | 1.04 | 5.88 | 0.04 | 0.04 | 0.38 |
| CD @ 5% | 15.16 | 3.16 | 17.83 | NS | 0.13 | 1.16 |

**Table 3:** Influence of micronutrients mixture on micronutrients status of post-harvest soil of aerobic rice

| Treatments | Fe (mg $kg^{-1}$) | Zn (mg $kg^{-1}$) | Mn (mg $kg^{-1}$) | Cu (mg $kg^{-1}$) | B (mg $kg^{-1}$) |
|---|---|---|---|---|---|
| $T_1$: Absolute control | 3.23 | 0.76 | 1.11 | 0.63 | 0.44 |
| $T_2$: RDF + FYM @ 10 t $ha^{-1}$ (Control) | 4.61 | 1.17 | 2.16 | 0.99 | 0.52 |
| $T_3$: RDF + FYM @ 10 t $ha^{-1}$ + $ZnSO_4$ @ 20 kg $ha^{-1}$ (POP) | 4.75 | 3.14 | 2.30 | 1.06 | 0.62 |
| $T_4$: $T_2$+ Foliar spray of MMF @0.5% | 5.58 | 1.53 | 2.37 | 1.13 | 0.74 |
| $T_5$: $T_2$ + Foliar Spray of MMF @ 1% | 5.72 | 1.80 | 2.74 | 1.22 | 0.91 |
| $T_6$: $T_2$ + Soil application of MMS @ 12.5 kg $ha^{-1}$ | 6.57 | 2.37 | 3.40 | 1.42 | 1.15 |
| $T_7$: $T_2$ + MMS @ 12.5 kg $ha^{-1}$ + MMF @ 0.5% | 7.27 | 2.58 | 4.21 | 1.54 | 1.23 |
| $T_8$: $T_2$ + MMS @12.5 kg $ha^{-1}$ + MMF @ 1% | 8.05 | 2.95 | 4.52 | 1.68 | 1.32 |
| SEm± | 0.04 | 0.1 | 0.08 | 0.05 | 0.04 |
| CD @ 5% | 0.14 | 0.3 | 0.26 | 0.15 | 0.12 |

### Macronutrient status of post-harvest soil of aerobic rice

The application of micronutrients has considerable effect on primary and secondary nutrient content of the post harvest soil (Table 2).

The available N, $P_2O_5$, $K_2O$ and Exch. Mg content of the soil after harvest of aerobic rice varied significantly due to treatments. The lower content of these nutrients were found in absolute control (167.25, 16.24, 194.02 kg $ha^{-1}$ and 0.93 cmol $kg^{-1}$of N, $P_2O_5$, $K_2O$ and Exch. Mg respectively) and highest content were recorded in control treatment (267.61, 40.18, 271.44 kg $ha^{-1}$ and 1.27 cmol $kg^{-1}$of N, $P_2O_5$, $K_2O$ and Exch. Mg respectively). This is due to the release of nutrients from the organic matter and nutrients added through inorganic fertilizers.

Among micronutrient applied plots, the lowest content of available N, P, K and Exh. Mg nutrients was recorded in treatment $T_8$ with the soil application of RDF + MMS @ 12.5 kg $ha^{-1}$ + foliar application of MMF @ 1% (192.34, 26.50, 215.10 kg $ha^{-1}$and 1.07 cmol $kg^{-1}$, respectively) and highest in treatment $T_3$ with the soil application of Zn @ 20 kg $ha^{-1}$ along with application of RDF + FYM (259.24, 41.89, 270.46 kg $ha^{-1}$ and 1.23 cmol $kg^{-1}$, respectively). That is due to uptake of nutrients by the crop in those plots and it corresponds to biomass production. Higher the biomass production higher will be uptake of nutrients resulting in depletion of nutrients in the soil (Sagarika *et al.*, 2017) [7].

Whereas the available sulphur content of the post-harvest soil recorded significantly highest in $T_8$ (22.25 mg $kg^{-1}$) and minimum in absolute control (10.83 mg $kg^{-1}$). The plot receiving the soil application of micronutrients mixture showed higher content of sulphur in post-harvest soil that is due to the indirect addition of sulphur through micronutrients mixture and single super phosphate and also by the mineralisation of sulphur containing organic compounds (Dhanya *et al.*, 2006) [2].

**Micronutrient status of post-harvest soil of aerobic rice**

The micronutrient status of post-harvest soil as influenced by the application of micronutrients mixture presented in Table 3.

Considerable variations in micronutrients content of post-harvest soil was observed due to the application of micronutrients mixture. Highest micronutrients (Fe, Cu, Mn and B) content were observed in $T_8$ with the soil application of RDF + MMS @ 12.5 kg $ha^{-1}$ + foliar application of MMF @ 1% (8.05, 1.68, 4.52 and 1.32 mg $kg^{-1}$ of Fe, Cu, Mn and B, respectively) over rest of the treatments. Whereas, the highest soil zinc content was recorded in treatment $T_3$ with the soil application of Zn @ 20 kg $ha^{-1}$ along with application of RDF + FYM (3.14 mg $kg^{-1}$), which was followed by treatment $T_8$ (2.95 mg $kg^{-1}$).

The increase in the micronutrients content in post-harvest soil attributed to the release of nutrients through mineralization of organic matter and added nutrients through micronutrients mixture. Soil application of micronutrients mixture with FYM increased the micronutrients status of the post-harvest soil (Kannan *et al.*, 2014, Sagarika *et al.*, 2017) [6, 7].

In conclusion, the present study has revealed that the soil application of RDF + MMS @ 12.5 kg $ha^{-1}$ at sowing + foliar application of MMF @ 1% at 20 and 40 DAS was recorded significantly higher yield of aerobic rice and micronutrients content in post harvest soil compared to other treatments.

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