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Effect of Organics and Micronutrients on Growth, Yield and Nutrient Uptake of Aerobic Rice

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ABSTRACT

A field experiment was conducted at S.V. Agricultural College, Tirupati, to study the effect of organics and micronutrients on aerobic rice. The experiment comprised of three organic practices *viz.,* farm yard manure, green leaf manure and no organics taken in main plots and two micronutrient applications taken under seven treatments in subplots *i.e*., application of iron and zinc either alone or in combination to the soil or foliage and tested in split-plot design. Among the organics, incorporation of FYM @ 10 t ha^{-1} and among the micronutrients, foliar application of 0.25% $FeSO_4$ and 0.5% $ZnSO_4$ twice at 20 and 30 DAS resulted in higher growth parameters, yield attributes, yield and nutrient uptake.

Key words : Aerobic rice, Micronutrients, Nutrient uptake, Organics.

Rice (*Oryza sativa* L.) is the staple food for nearly half of the world's population and rice cultivation is the single biggest user of fresh water. The declining water availability threatens the traditional way of lowland rice cultivation. Thus, in order to conserve precious water resources, growing of rice under aerobic system is one of the alternative methods (Bouman *et al.,* 2001).

The nutrient deficiencies have appeared in the aerobic system of rice cultivation due to changes in the physical, chemical and biological properties of the soil. In India, rice researchers have tested the lowland rice varieties under aerobic conditions and found that among the constraints in aerobic rice culture, one of the yield reducing factors was the micronutrient deficiencies (Amudha *et al.,* 2009). In aerobic situation the available ferrous form of iron is converted to unavailable ferric form thereby making it unavailable, due to absence of reduced zone. Further, in aerobic situation, limited use of organics and absence of proper recycling of crop residues has also aggravated the deficiency symptoms of major micronutrients. Thus, to achieve a higher yield and also to overcome micronutrient deficiencies especially in case of zinc and iron, optimum dose and proper method of application of these micronutrients become most relevant in aerobic rice system.

MATERIAL AND METHODS

A field experiment was conducted during *rabi,* 2010-11 at S.V. Agricultural College Wetland Farm, Tirupati Campus, Acharya N.G. Ranga Agricultural University, Andhra Pradesh. The soil of the experimental site was sandy clay loam in texture having pH 7.7, low in organic carbon and nitrogen content, high in phosphorus and potassium and medium in iron and zinc. The experiment was laid out in a split plot design and replicated thrice. The treatments consisted of three organic practices *viz.,* M_1- Farm Yard Manure @ 10 t ha^{-1}, M_2- Green Leaf Manure through *Glyricidia maculata* @ 5 t ha^{-1}, M_3- no organics, allotted to main plot and seven micronutrient applications *viz.,* S_1- soil application of $FeSO_4$ @ 25 kg ha^{-1} as basal, S_2- soil application of $ZnSO_4$ @ 25 kg ha^{-1} as basal, S_3- soil application of $FeSO_4$ and $ZnSO_4$ @ 25 kg ha^{-1} each as basal, S_4- foliar application of 0.25% $FeSO_4$ at 20 and 30 DAS, S_5- foliar application of 0.50% $ZnSO_4$ at 20 and 30 DAS, S_6- foliar application of 0.25% $FeSO_4$ and 0.50% $ZnSO_4$ at 20 and 30 DAS, S_7- control (no micronutrient) were allotted to sub plots with NLR- 33359 (Sravani) as test variety. Presoaked seeds were used for sowing @ 2 seeds per hill at 15 X 10 cm spacing. A uniform dose of 100-50-50 kg N, P_2O_5 and K_2O ha^{-1} were applied to all the plots. All other management practices were adopted for aerobic rice cultivation as per the recommendations of Acharya N.G. Ranga Agricultural University, A.P. The data recorded on various parameters *i.e*., growth, yield attributes, yield and nutrient uptake of crop was subjected to statistical scrutiny by the method of analysis of variance as outlined by Panse and Sukhatme (1985).

Table 1. Growth parameters, yield components and yield of aerobic rice as influenced by organic and micronutrient management practices at harvest

Treatments	Plant height (cm)	Dry matter production (kg ha^{-1})	Productive tillers m^{-2}	Filled grains panicle^{-1}	Test weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
Organics							
M_1- FYM @ 10 t ha^{-1}	67.65	9175	277	75	14.70	2932	5779
M_2- GLM @ 5 t ha^{-1}	65.54	9124	264	72	13.84	2750	5539
M_3- No organics	62.39	9050	249	67	13.26	2310	5203
SEm±	0.27	7.87	1.84	0.42	0.05	23.58	25.12
CD (P=0.05)	1.04	31	7	2	0.20	92	98
Micronutrient management							
S_1- $FeSO_4$ @ 25 kg ha^{-1} as basal	62.81	8997	238	65	17.70	2544	5392
S_{2--}- $ZnSO_4$ @ 25 kg ha^{-1} as basal	65.52	9153	271	72	19.80	2673	5522
S_3- $FeSO_4$ and $ZnSO_4$ @ 25 kg ha^{-1} each as basal	68.21	9285	304	79	20.22	2915	5749
S_4- FA of 0.25% $FeSO_4$ at 20 and 30 DAS	63.52	9020	246	67	17.96	2563	5408
S_5- FA of 0.50% $ZnSO_4$ at 20 and 30 DAS	66.34	9179	279	74	19.35	2704	5548
S_6- FA of 0.25% $FeSO_4$ and 0.50% $ZnSO_4$ at 20 and 30 DAS	68.96	9315	310	80	20.39	2946	5774
S_7- No micronutrient	60.98	8865	194	61	16.01	2306	5157
SEm±	0.40	11.56	3.94	0.95	0.14	36.6	38.11
CD (P=0.05)	1.16	33	11	3	0.40	104	109

NOTE: FYM – Farm Yard Manure; GLM – Green Leaf Manure; FA – Foliar Application

RESULTS AND DISCUSSION

Organics and micronutrient applications significantly influenced the growth and yield parameters. However, the interaction effect between them was found to be non-significant.

Among the organic treatments, incorporation of FYM @ 10 t ha^{-1} resulted in significantly higher plant height, drymatter production, and they were statistically superior to green leaf incorporation and no organics (Table 1).

The higher growth parameters with the incorporation of FYM @ 10 t ha^{-1} might be due to greater availability and steady supply of nutrients. These results are in conformity with the findings of Babu and Reddy (2000).

With regard to micronutrient applications, foliar application of micronutrients @ 0.25% $FeSO_4$ and 0.5% $ZnSO_4$ twice at 20 and 30 DAS resulted in significantly higher plant height (68.96 cm) and dry matter production (9315 kg ha^{-1}) (Table 1). However, it was comparable with the soil application of iron and zinc in all the growth parameters.

The higher growth parameters recorded with micronutrient application over non-supply of micronutrients might be due to the balanced availability of nutrients in adequate proportions, which enhanced the growth and led to better accumulation of photosynthates in the form of dry matter. Similar results were obtained by Sarangi and Sharma (2004).

Incorporation of FYM @ 10 t ha^{-1} registered significantly higher yield attributes *viz.*, productive tillers m^{-2} (277), filled grains panicle^{-1} (75), test weight (14.70 g), grain (2932 kg ha^{-1}) and straw yield (5779 kg ha^{-1}) compared to other treatments (Table 1). This might be due to better translocation of accumulated dry matter to the sink (grains) resulted in higher yield attributes and yield. These results were in conformity with the findings of Belder *et al.,* (2005).

Foliar application of 0.25% $FeSO_4$ and 0.5% $ZnSO_4$ twice at 20 and 30 DAS has recorded higher yield attributes *viz.*, productive tillers m^{-2} (310), filled grains panicle^{-1} (80), test weight (20.39 g), grain (2946 kg ha^{-1}) and straw yield (5774 kg ha^{-1}) compared to

Table 2. Nutrient uptake and economics of aerobic rice as influenced by organic and micronutrient management practices

Treatments	Nitrogen (kg ha^{-1})	Phosphorus (kg ha^{-1})	Potassium (kg ha^{-1})	Iron (mg kg^{-1})	Zinc (mg kg^{-1})	Net returns (‘ ha^{-1})	B:C ratio
Organics							
M_1- FYM @ 10 t ha^{-1}	91.47	24.47	151.19	14.46	7.39	18676	1.36
M_2- GLM @ 5 t ha^{-1}	85.31	21.51	140.80	11.66	6.90	17234	1.57
M_3- No organics	79.68	17.71	132.65	9.33	6.34	14274	1.29
SEm±	1.20	0.82	1.78	0.43	0.03	127.72	0.007
CD (P=0.05)	4.70	3.20	6.94	1.69	0.13	499	0.03
Micronutrient management							
S_1- $FeSO_4$ @ 25 kg ha^{-1} as basal	74.50	14.74	132.91	17.25	6.26	14823	1.73
S_{2--} $ZnSO_4$ @ 25 kg ha^{-1} as basal	87.82	21.79	146.21	6.67	7.87	16954	1.86
S_3- $FeSO_4$ and $ZnSO_4$ @ 25 kg ha^{-1} each as basal	100.01	29.36	158.06	12.99	6.89	18776	1.89
S_4- FA of 0.25% $FeSO_4$ at 20 and 30 DAS	78.65	16.12	136.28	21.05	6.33	15775	1.80
S_5- FA of 0.50% $ZnSO_4$ at 20 and 30 DAS	91.02	24.39	149.33	8.22	8.39	17414	1.89
S_6- FA of 0.25% $FeSO_4$ and 0.50% $ZnSO_4$ at 20 and 30 DAS	104.19	31.57	162.03	13.99	7.12	20339	2.03
S_7- No micronutrient	62.20	10.65	121.98	2.52	5.27	13018	1.68
SEm±	2.77	1.37	2.94	0.99	0.11	205.08	0.012
CD (P=0.05)	7.94	3.92	8.45	2.85	0.31	588	0.04

NOTE: FYM – Farm Yard Manure; GLM – Green Leaf Manure; FA – Foliar Application

other treatments (Table 1), which may be due to the adequate availability of macro and micronutrients as they play a major role as catalyst in various growth processes, hormone production and protein synthesis which inturn resulted in better translocation of photosynthates to sink (Ramana *et al.,* 2006).

The highest nutrient uptake (nitrogen, phosphorus, potassium, iron and zinc) by the crop was recorded with the FYM incorporation @ 10 t ha^{-1} (M_1), which was significantly higher than green leaf manure incorporation @ 5 t ha^{-1} (M_2). The lowest nutrient uptake was registered with non application of organics (M_3) (Table 2).

The higher nutrient uptake associated with the FYM incorporation might be ascribed to its beneficial effect in improving the nutrient availability through mineralization and mobilization of native nutrients besides addition of nutrients to soil. These results were in conformity with Majumdar *et al*., (2007).

Application of both the micronutrients either to foliage (S_6) or to soil (S_3) resulted in the highest uptake (nitrogen, phosphorus and potassium) by the crop which were significantly higher than with other practices, with an exception for the iron and zinc uptake, which were higher with individual application of respective nutrients either to foliage or to soil with statistical parlance among themselves. The uptake of nutrients by crop was the lowest with non-supply of micronutrients (S_7).

Net returns along with B: C ratio was significantly higher with the incorporation of 10 t of FYM ha^{-1} among the organics and foliar application of both iron and zinc among the micronutrient applications, due to less additional treatment cost coupled with enhanced yields.

In conclusion, the present study has revealed that incorporation of FYM @ 10 t ha^{-1} and foliar application of 0.25% $FeSO_4$ and 0.50% $ZnSO_4$ at 20 and 30 DAS was the economically sound practice with higher aerobic rice yields.

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