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INFLUENCE OF APPLIED MICRONUTRIENTS ON THE AVAILABILITY AND UPTAKE OF ZINC, COPPER AND MANGANESE IN RICE

Micronutrients play a very important role in crop growth. In recent years the importance of these nutrients in increasing agricultural production and correcting their deficiencies in plants has been greatly realised. From the results of experiments conducted so far it was observed that the application of Zn, Cu and Mn has increased the grain yield of rice crop in certain regions but not universally. The response depends largely on several soil factors such as soil reaction, soil texture, organic matter content, microbial activity and availability of micronutrients in soil (Padhi, 1971). In this study, the influence of applied micronutrients on the availability and uptake of Zn, Cu and Mn has been investigated.

A field experiment was conducted using rice var. Jyothi in a sandy clay loam soil of Kerala during the first and second crop seasons of 1991. The initial nutrient status of the soil was as follows: Total N 0.244%, available P 118.3 kg ha^{-1}, available K 310.6 kg ha^{-1}, available Zn 3.955 ppm, available Cu 4.218 ppm, available Mn 72.73 ppm, organic carbon 0.68%, pH 5.65, specific conductance 0.086 dS m^{-1} and CEC 30.77 cmol(+) kg^{-1}. The experiment was laid out in a randomised block design with ten treatments replicated thrice. The treatments applied were:

- T1 Control (No micronutrients; NPK and cultural practices as per the package of practices recommendations (KAU, 1989)
- T2 Zinc ($ZnSO_4$, 20 kg ha^{-1} in soil + 1% foliar)
- T3 Manganese (Manganous sulphate, 2.5 kg ha^{-1} in soil + 0.5% foliar)
- T4 Boron (Boric acid, 750 g ha^{-1} in soil + 0.1% foliar)
- T5 Copper (Cupric sulphate, 5 kg ha^{-1} in soil + 0.1% foliar)
- T6 Molybdenum (Sodium molybdate, 1.25 kg ha^{-1} in soil + 0.1% foliar)
- T7 Sulphur (Biologically activated with *Thiobacillus* sp. and *Aspergillus avomerii*, 10 kg ha^{-1} in soil + 1% foliar)
- T8 Magnesium ($MgSO_4.7H_2O$, 20 kg ha^{-1} in soil + 1% foliar)
- T9 Combination of nutrients given in the above treatments
- T10 Stanes Microfood (12.5 kg ha^{-1} in soil + 1% foliar)

The soil application of treatments was done 15 days after transplanting and the foliar application was performed at the active physiological stage using spray solution @ 250 1 ha^{-1}. The treatments were repeated in the second crop season also. Application of N, P and K was done uniformly in all the treatments. The soil and plant samples were collected at different stages of the crop growth for chemical analysis. For the determination of available Zn, Cu and Mn, the soil samples were extracted with 0.05*N* HC1 + 0.025*N* H_2SO_4 in the ratio 1:4 for 15 minutes and the elements were estimated in an atomic absorption spectrophotometer (Perkin, 1970). The triacid extracts of the dried plant samples were made use of for the estimation of the micronutrients in the plant in the atomic absorption spectrophotometer.

Significant increase in the available Zn content of the soil was obtained by the application of Zn in both the seasons of the crop (Table 1). Both the treatments containing Zn (T2 and T9) resulted in significant increase in available Zn content of soil. Rest of the treatments were *on* par in this regard. Zn content of the straw also followed the same trend in both the seasons. The highest total uptake of Zn was recorded by the application of biologically activated sulphur, but it could be due to the better vegetative growth resulted by the treatment. The second highest uptake of Zn was recorded by plants applied with Zn. So it could be observed that the application of Zn resulted in increased availability of Zn in soil and thus a better uptake by the rice plant.

The data on the available Cu content of the soil as influenced by the application of different micronutrients showed significant difference only in the second crop season (Table 2). The highest availability of Cu was resulted by the treatments containing Cu (T5 and T9). The plant content of Cu did not vary significantly among the treatments. The total Cu uptake by the crop was found to be considerably affected by the application of Zn

Table 1. Available zinc in soil after treatment application and total uptake in rice

Treatment	First crop			Second crop		
	Available Zn, ppm	Content of straw, ppm	Total uptake, $kg\ ha^{-1}$	Available Zn, ppm	Content of straw, ppm	Total uptake, $kg\ ha^{-1}$
T1	4.699	89.6	0.532	5.036	42.6	0.205
T2	5.981	125.0	0.666	8.505	78.7	0.349
T3	4.503	80.3	0.428	5.031	47.3	0.216
T4	3.393	78.2	0.421	4.944	38.1	0.223
T5	4.721	88.7	0.503	5.272	47.3	0.278
T6	4.613	78.9	0.338	5.127	52.4	0.212
T7	4.524	114.6	0.848	5.103	47.6	0.232
T8	4.543	82.9	0.341	4.956	45.2	0.176
T9	5.157	124.5	0.545	7.472	75.4	0.329
T10	4.724	93.8	0.647	5.184	56.9	0.250
CD (0.05)	0.697**	NS		1.439**	23.06*	

* Significant at 5% level ** Significant at 1% level

Table 2. Available copper in soil after treatment application and total uptake in rice

Treatment	First crop			Second crop		
	Available Cu, ppm	Content in straw, ppm	Total uptake $kg\ ha^{-1}$	Available Cu, ppm	Content in straw, ppm	Total uptake, $kg\ ha^{-1}$
T1	5.167	12.7	0.050	5.237	8.0	0.050
T2	5.109	30.7	0.265	5.371	8.6	0.053
T3	5.100	9.8	0.038	5.144	8.0	0.052
T4	5.030	20.3	0.170	5.292	7.8	0.066
T5	5.276	10.8	0.044	5.929	7.1	0.060
T6	5.135	13.7	0.085	5.337	6.9	0.057
T7	4.996	11.4	0.067	5.351	7.7	0.056
T8	4.992	11.4	0.044	5.205	7.9	0.043
T9	4.976	15.7	0.100	5.988	8.1	0.057
T10	4.976	10.8	0.044	5.309	8.5	0.055
CD (0.05)	NS	NS		0.407**	NS	

** Significant at 1% level

in the first crop season. The highest total Cu uptake of 0.265 kg ha^{-1} was recorded by the application of Zn. Similar observations indicating a positive correlation between Zn and Cu was earlier reported by Nair (1970).

Considerable increase has been noted in the available Mn content of the soil from 72.73 ppm in the initial soil to a mean content of 170.1 ppm during the crop period (Table 3). This may be attributed to the increased availability of the nutrient on submergence. Significant difference in the available Mn content of the soil or uptake by the crop was not observed in both the seasons. Thus the lack of a consistent influence of applied Mn on the availability in soil and uptake by rice was revealed.

Table 3. Available manganese in soil after treatment application and total uptake in rice

Treatment	First crop			Second crop		
	Available Mn, ppm	Content in straw, %	Total uptake kg ha[1]	Available Mn, ppm	Content in straw, %	Total uptake, kg ha[1]
T1	170.1	0.094	3.451	166.3	0.113	2.841
T2	156.2	0.111	5.037	143.5	0.082	2.880
T3	134.2	0.117	5.119	136.5	0.121	2.945
T4	132.1	0.110	4.727	147.6	0.117	3.272
T5	133.4	0.106	3.878	128.7	0.094	2.421
T6	147.3	0.097	3.102	138.3	0.074	3.134
T7	134.1	0.102	4.540	157.2	0.126	4.101
T8	124.7	0.092	2.591	144.6	0.120	3.299
T9	120.9	0.094	3.616	146.7	0.100	3.090
T10	123.6	0.112	4.410	146.6	0.126	3.850
CD (0.05)	NS	NS		NS	NS	

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REFERENCES

KAU, 1989. *Package of Practices Recommendations.* Kerala Agric. Univ., Directorate of Extension, Mannuthy, Kerala, p. 1-40

Nair, C.B. 1970. Studies on copper and zinc status of Kerala rice soils and the response to these elements by 1R 8. M.Sc.(Ag) thesis, Univ. of Kerala, Trivandrum

Padhi, S.C. 1971. Response of rice to micronutrients - A review. *Indian J. Agron.* 16 : 108-11 1

Perkin, A.F. 1970. *Analytical* ***Methods for Atomic Absorption*** *Spectrophotometry.* Perkin Elmer Corporation, USA