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EFFECT OF APPLICATION OF MAGNESIUM AND SULPHUR ON THE GROWTH, YIELD AND UPTAKE IN RICE

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Abstract: A field experiment was conducted to study the response of rice to application of magnesium and sulphur in a typical laterite soil, using rice (variety Jyothi) continuously for two seasons. Application of Mg had no influence either on the yield or uptake by the crop. Treatment receiving the application of sulphur biologically activated by inoculation with *Thiobacillus* sp. and *Aspergillus avomerii* gave the maximum straw yield in both seasons of crop and thus a higher total dry matter yield, indicating its influence on the vegetative growth of the crop. While lack of influence of Mg application on the content of exchangeable Mg in soil was revealed, application of biologically activated sulphur was found to ensure continued availability of S throughout crop growth.

INTRODUCTION

The response of rice to application of secondary nutrients varies with the status of these nutrients in the soil, crop variety and nutrient interactions. The results of studies on the response of rice to application of these nutrients are by and large inconsistent. Pot culture experiments on rice conducted by Varghese and Money (1965) with Vellayani sandy clay loam and by Padmaja and Varghese (1966) with Vellayani red loam soils indicated that Mg alone or in combination with Ca and Si appreciably improved crop growth and significantly increased grain yield. But Nayar and Koshy (1966) observed that the form or level of Mg had no significant effect on tillering, yield of grain and straw. Reports on the influence of sulphur on growth and yield of rice are not very much available since only recently this element has received the attention it deserves as a plant nutrient. Hence this study is carried out to assess the effect of application of magnesium and sulphur on the growth, yield and uptake in rice.

MATERIALS AND METHODS

A field experiment was conducted at the Agricultural Research Station, Mannuthy, Kerala using rice variety Jyothi during the first and second crop seasons of 1991. The soil was sandy clay loam in texture and the experiment was laid out in randomised block design with ten treatments replicated thrice.

1. Control (No micronutrients; NPK and cultural practices as per the package of practice recommendations of KAU (Anon., 1989)
2. Zinc ($ZnSO_4$ 20 kg/ha in soil + 1% foliar 250 l/ha at the active physiological stage)
3. Manganese (Manganous sulphate monohydrate 2.5 kg/ha in soil + 0.5% foliar 250 1/ha)
4. Boron (Boric acid 750 g/ha in soil + 0.1% foliar 250 l/ha)
5. Copper (Cupric sulphate 5 kg/ha in soil + 0.1% foliar 250 1/ha)
6. Molybdenum (Sodium molybdate 1.25 kg/ha in soil + 0.1% foliar 250 l/ha)
7. Sulphur (Biologically activated with *Thiobacillus* sp. and *Aspergillus avomerii* 10 kg/ha in soil + 1% foliar 250 1/ha)

8. Magnesium ($MgSO_4.7 H_2O$ 20 kg/ha in soil + 1% foliar 250 l/ha)

9. Combination of nutrients given in the above treatments

10. Stanes Microfood (12.5 kg/ha in soil + 1% foliar 250 1/ha)

Application of N, P and K was done uniformly in all the treatments. Soil and plant samples were collected at different stages of the crop growth for chemical analyses.

RESULTS AND DISCUSSION

1. Effect of Mg and S application on the growth and yield of rice

Biometric characters

Application of Mg and biologically activated S was not found to have significant influence on biometric characters such as number of tillers, height of plants at maximum tillering stage, number of spikelets per panicle and dry weight of 100 grains during the first crop season (Table 1). But during the second crop season maximum nuber of tillers and maximum height at tillering stage were recorded by the application of biologically activated S (Table 2). This could be attributed to the effect of inoculation of S with *Thiobacillus* sp. and *Aspergillus* organisms on the oxidation of S. It is assumed that the biologically activated elemental S assures better availability of S during the entire growth period of the plant.

Yield of grain

The second highest yield was obtained in plots which received the application of biologically activated S (T_7) in the first crop season (Table 1). Application of Mg resulted in slightly higher grain yield of 2276 kg/ha but both these were not significantly higher than the control. The lack of increase in yield to the extent of statistical significance may be attributed to the fair availability of these nutrients in the soil. Considering the critical limits of micronutrients in soil, the experimental soil was relatively rich in the content of micronutrients. No significant difference was observed beween the different treatments with regard to the grain yield in second crop also (Table 2).

Grain to straw ratio was higher in the case of both sulphur and magnesium treatments in the first crop compared to the control (Table 1). In the second crop season magnesium treated plants were on par with the control whereas the application of biologically activated S resulted in a lower grain to straw ratio (Table 2). This may be due to the higher straw production observed in this plot.

2. Uptake of Mg and S in rice

Application of Mg did not result in increased Mgcontent of straw in any of the growth stages in the first crop and uptake of Mg followed the same pattern as that of the content of Mg (Table 3). At the harvesting stge, the lowest uptake was recorded in plants applied with Mg. Varughese (1992) also observed that application of Mg sources to rice did not increase the plant uptake of Mg. Total Mg uptake was significantly and negatively correlated with available K ($r = -0.770^{**}$) which could be attributed to K-Mg antagonism in soil which was earlier reported by Varughese (1992). Lack of significant influence of the application of Mg on crop growth, yield and Mg uptake was confirmed in the second crop.

Table 1. Biom'etric observations of rice in the field experiment, first crop

Treatment	No. of , tillers at maximum tillering	Height of plant at tillering stage, cm	No. of spikeletes per panicle	Dry weight of 100 grains 8	Grain yield kg/ha	Straw yield kg/ha	Grain to straw ratio
T_1	9.7	63.87	8.40	2.823	2065	4049	0.51
T_2	10.4	69.23	8.37	2.883	1774	3663	0.48
T_3	8.7	65.67	8.37	2.990	2127	3731	0.57
T_4	10.2	65.80	7.97	2.817	2314	3961	0.58
T_5	10.0	68.77	8.37	2.817	2314	3770	0.61
T_6	10.6	66.00	8.13	2.833	2087	3416	0.61
T_7	10.4	70.70	8.50	3.030	2460	4197	0.59
T_8	9.0	65.57	8.10	2.950	2276	3680	0.62
T_9	9.8	70.10	8.87	3.183	2232	3712	0.60
T_{10}	8.6	65.70	8.53	3.183	2606	3755	0.69

F test : Not significant

Table 2. Biometric observations of rice in field experiment, second crop

Treatment	No. of tillers at maximum tillering	Height of plant at tillering stage, cm	No. of spikeletes per panicle	Dry weight of 100 grains g	Grain yield kg/ha	Straw yield kg/ha	Grain to straw ratio
T_1	6.1	58.03	8.87	2.803	2813	2808	1.00
T_2	6.1	56.37	7.33	2.777	2486	2628	0.95
T_3	6.0	52.97	8.37	2.810	2813	2551	1.10
T_4	6.2	56.73	9.47	2.830	29.64	3100	0.96
T_5	5.7	57.73	8.60	2.800	2943	2757	1.07
T_6	6.9	52.13	8.87	2.810	3005	2907	1.03
T_7	7.1	62.47	9.07	2.863	2689	3221	0.83
T_8	6.0	55.87	8.27	2.810	2709	2662	1.02
T_9	6.2	52.97	8.70	2.807	3185	2955	1.08
T_{10}	5.6	57.57	8.90	2.807	2464	2620	0.94

F test : Not significant

Uptake of S by straw was considerably higher at all the stages of growth (Table 4). The highest total S uptake was recorded by application of biologically activated S. It may be concluded that application of biologically activated sulphur has resulted in a vigorous growth and higher drymatter production. The uptake of S in control plot as well as in treatment plots was fairly good which shows that the status of available sulphur in the soil (65.63 ppm) can be rated as high (Mathew, 1989). In the second crop the second highest total S uptake was recorded by the same treatment.

REFERENCES

Anonymous, 1989. *Package of Practices Recommendations.* Kerala Agricultural University, Directorate of Extension, Mannuthy, Kerala, p 1-40

Mathew, C.P. 1989. Sulphur status of the Kuttanad soils of Kerala. M.Sc.(Ag) thesis, Kerala Agrl.Univ., Trichur

Nayar, M.A. and Koshy, M.M. 1969. Influence of the forms and doses of magnesium on the uptake of nutrients by rice. *Agric. Res. J. Kerala* 7(1) : 14-20

Padmaja, P. and Varghese, E.J. 1966. Effect of calcium, magnesium and silicon on the productive factors and yield of rice. *Agric. Res. J. Kerala* 4(1) : 31-38

Varghese, T. and Money, N.S. *1965.* Influence of calcium and magnesium in increasing the efficiency of fertilizers for rice in Kerala. *Agric. Res.J. Kerala* 3(1) : 40-45

Varughese, S. 1992. Suitability of magnesite as a source of magnesium in acid rice soils of Kerala. M.Sc. (Ag.) thesis, Kerala Agrl. Univ., Trichur

Table 3. Magnesium uptake (kg/ha) by the crop as influenced by the treatments at different stages of growth

Treatment	First crop				Second crop				Total (first crop + second crop)
	Tillering	Flowering	Harvesting	Total grain + straw)	Tillering	Flowering	Harvesting	Total (grain + straw)	
T_1	0.598	1.482	0.698	1.024	0.328	1.888	1.003	1.449	2.473
T_2	0.524	4.630	0.656	0.881	0.239	1.245	1.240	1.976	2.857
T_3	0.597	1.523	1.092	1.494	0.306	3.693	1.066	1.598	3.092
T_4	1.483	0.110	0.892	1.449	0.314	1.211	1.048	1.756	3.205
T_5	1.206	2.275	0.847	1.273	0.347	1.339	0.736	1.289	2.562
T_6	0.526	1.889	0.682	1.125	0.315	1.584	1.078	1.763	2.888
T_7	0.678	1.964	0.776	1.224	0.370	2.654	1.333	1.793	3.017
T_8	0.593	2.113	0.530	1.023	0.235	3.003	1.004	1.635	2.658
T_9	0.470	1.374	0.698	1.126	0.200	3.129	0.943	1.549	2.675
T_{10}	0.564	2.117	0.698	1.290	0.241	3.786	1.163	1.794	3.084

F test : Not significant

Table 4. Sulphur uptake (kg/ha) by the crop as influenced by the treatments at different stages of growth

Treatment	First crop				Second crop				Total (first crop + second crop)
	Tillering	Flowering	Harvesting	Total grain + straw)	Tillering	Flowering	Harvesting	Total (grain + straw)	
T_1	2.864	10.580	2.249	3.983	1.861	7.214	2.825	4.987	8.97
T_2	2.275	5.407	4.271	6.024	1.977	5.963	2.978	5.628	11.65
T_3	2.554	5.479	2.984	4.741	1.349	4.740	2.635	4.979	9.72
T_4	2.942	5.777	3.298	5.289	1.210	5.158	3.407	5.382	10.67
T_5	3.370	5.155	2.890	4.663	1.490	7.712	4.424	8.931	13.59
T_6	2.428	6.756	2.277	3.744	1.128	7.013	4.573	6.676	10.42
T_7	4.422	7.607	5.175	7.694	1.412	10.555	4.506	7.553	15.25
T_8	3.959	6.926	4.291	6.218	1.069	5.980	3.016	5.454	11.67
T_9	3.959	11.390	4.577	6.591	1.037	9.768	3.939	6.932	13.52
T_{10}	3.406	6.065	2.878	4.975	1.110	7.095	3.055	5.097	10.07

F test : Not significant