The Influence of Different Forms and Levels of Magnesium on the Growth and Yield of Rice

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Extensive fertility surveys carried out in Kerala have shown that the majority of soils of this state are highly acidic and extermely deficient in magnesium. Pot culture experiments on paddy conducted by Varghese and Money (1965) with Vellayani sandy clay loam an by Padmaja and Varghese (1966)with Vellayani red loam indicated that manesium, either alone or in combination with calcium and silica, appreciably imprroved crop growth and significantly increased grain yield. Hence it was considered likely that this element may be a serious limiting factor in crop production in these soils. The present study was therefore undertaken as a continuation of the above investigation to evaluate the extent to which the application of magnesium in different forms and levels would help to increase the yield of rice under field cenditions.

Review of Literature

The importance of magnesim as a plant nutrient element has been pointed out by many workers like Justus von Liebig (1850), Willstatter(1909), Zimmerman(1947), Jacob(1956) and Michael (1957).

A number of experiments on rice conducted in the Tokushima prefecture by Kyo GOTO (1960) have shown that plants treated with magnesium calcium silicate produced much higher yields than those treated with dolomite or fused magnesium phosphate. Utagawa and Kashima (1961) obtained higher yields for upland rice on Kasanohara and Makinohara soils by fertilizing with $MgO + Si0_2$. Increased yields and improvement in grain quality of barley were reported by Koter and Panak (1956) and Sluijsmans (1958) respectively by the application of magnesium fertilizers. Sheng and Yuan (1963) also reported higher grain yields of rice in lateritic acid soils by the addition of magnesium. Padmaja and Varghese (1966) observed that the application of magnesium in combination with silicon over and above the normal schedule of NPK manuring favoured tillering and root development and increased the grain and straw yields, earhead length and thousand grain weight.

Meterials and Methods

The influence of different forms and levels of magnesium on the growth characters and yield of rice was studied in a field experi-

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ment in randomised block design with nine treatments and four replications. The treatments were the following :—

1. Control—NPK
2. NPK with magnesium oxide at 25 kg MgO/ha.
3. ,, ,, ,, 50 kg Mg0/ha.
4. ,, magnesium carbonate at 25 kg MgO/ha.
5. ,, ,, 50 kg MgO/ha.
6. ,, magnesium silicate at 25 kg MgO/ha.
7. ,, ,, ,, 50 kg MgO/ha.
8. ,, magnesium sulphate at 25 kg MgO/ha.
9. ,, ,, ,, 50 kg MgO/ha.

The experiment was conducted in the Karapadam area adjoining the Vellayani kayal. The soil was clay loam in texture.

The net plot size was 5m × 5m (25 sq. m) and the total number of plots was 36. The spacing adopted was 20 cm. X 20 cm. between the rows and columns.

The rice variety used was Ptb 4 (165 days duration).

A basal application of N, P_2O_5 and K_2O at the rate of 40 kg/ha in the form of urea (45% N), superphosphate (18% P_2O_5) and muriate of potash (50% K_2O) was given. After the addition of the basal dose of fertilizers 40 day old rice seedlings were transplanted into the plots.

A second dose of N at the rate of 10 kg/ha in the form of urea was given at the time of flowering.

The growth and yield characters studied were :—

1. The number of tillers per plant.
2. Height of plant.
3. Length of earhead.
4. Weight of thousand grains.
5. Yield of grain.
6. Yield of straw.
7. Weight of chaff.

The growth characters were studied in nineteen plants selected randomly from each plot.

Results

1. *Effect of magnesium on the growth characters of rice*

The results relating to the effect of different treatments on the growth characters of rice (Table I) reveal that magnesium oxide and magnesium silicate are quite effective in increasing the height of plants. However, the effect of different treatments on the number of tillers produced at the flowering and harvesting stages was not appreciable.

TABLE I

Effect of different magnesium treatments on the growth characters of rice at different stages of growth

Magnesium treatments		Tillering		Flowering		Harvesting		
Form	Level kg MgO/ ha.	Height of plants (cm)	Number of tillers/ plant	Height of plants (cm)	Number of tillers/ plant	Height of plants (cm)	Number of tillers/ plant	Total length of earheads/ plant (cm)
Control	0	49.0	12.5	71.4	11.7	129.3	9.8	156.7
Magnesium oxide	25	52.2	13.5	73.7	12.0	135.0	9.9	163.2
	50	51.0	13.3	74.5	11.1	136.3	9.8	167.1
	Mean	51.6	13.4	74.1	11.6	135.6	9.8	165.2
Magnesium carbonate	25	49.8	12.5	72.7	11.5	130.5	10.2	155.6
	50	49.7	12.3	72.2	11.1	129.3	9.6	154.7
	Mean	49.8	12.4	72.5	11.3	129.9	9.9	155.2
Magnesium silicate	25	49.9	12.3	74.7	12.1	136.8	9.8	164.3
	50	51.1	11.0	74.5	10.2	134.8	8.1	136.9
	Mean	50.5	11.6	74.6	11.2	135.8	8.0	150.7
Magnesium sulphate	25	49.2	11.3	72.5	10.8	133.8	9.2	155.0
	50	48.7	12.5	73.3	11.6	135.5	9.9	164.4
	Mean	48.9	11.9	72.9	11.2	134.7	9.6	159.7
All forms	25	50.3	12.4	73.4	11.6	134.0	9.8	159.5
	50	50.1	12.3	73.6	11.0	133.9	9.4	155.8
Critical difference at 5% level of significance								
between (1) Treatments		1.79	—	—	—	—	—	—
(2) Forms		1.26	1.17	2.89	—	4.66	—	—
(3) Levels		—	—	—	—	—	—	—

2. *Effect of magnesium on the yield characters of rice*

The data in Table **II** show that there was no significant difference in the yield of grain and straw for the different magnesium treatments. The influence of these treatments on the proportion of chaff to grain was also not significant. However, magnesium was found to have a beneficial effect on the weight of the grain as indicated by the thousand grains weight. No other favourable effect has been noticed as a result of the application of magnesium at the levels used in this study. Among the different forms of magnesium used the beneficial effect on the weight of the grain decreased in the order, magnesium sulphate, magnesium oxide, magnesium carbonate and magnesium silicate. This effect tended to increase with the increase in the level of magnesium.

TABLE II

Effect of different magnesium treatments on the yield characters of rice

Magnesium treatments		Weight of grain per plot (kg)	Weight of straw per plot (kg)	Weight of chaff per plot (kg)	Thousand grains weight (g)
Form	Level kg MgO/ha.				
Control	0	3.67	13.58	0.36	28.10
Magnesium oxide	25	3.96	14.25	0.35	29.05
	50	3.82	14.38	0.38	29.09
	Mean	3.89	14.31	0.36	29.07
Magnesium carbonate	25	3,52	13.63	0.29	28.65
	50	3.38	13.58	0.23	28.60
	Mean	3.45	13.60	0.26	28 62
Magnesium silicate	25	2.93	14.38	0.37	27.94
	50	3.85	14.25	0·28	28.78
	Mean	3.39	14.31	0.33	28.36
Magnesium sulphate	25	3.71	13.05	0.21	28.95
	50	3,80	14.75	0.32	29.34
	Mean	3.76	13.03	0.27	29.14
All forms	25	3.53	13.83	0.31	28.65
	50	3.71	14.24	0.30	28.95
Critical difference at 5% level of significance between (1) Treatments		—	—	—	0.846
(2) Forms		—	—	—	0.599
(3) Levels		—	—	—	0.423

Discussion

The soil used in the present study, like most other rice soils of Kerala, was acidic and contained only 15 - 57 ppm MgO. According to Seo (1957) magnesium deficiency symptoms appear when the exchangeable MgO content of the soil is less than 100 ppm. Semb and Tragethon (1958) have reported that deficiency of this element may occur when the MgO content of the soil is less than 50 ppm. But in the presence of excessive potassium, magnesium deficiency symptoms might occur even when the MgO content is above 100 ppm. Stenuit and Piot (1958) obtained an increase in yield of oats by the application of magnesium sulphate on a sandy soil containing less than 6 ppm of MgO. Ishizuka and Tanaka (1959) secured a higher yield of paddy at a concentration of 5 ppm of MgO in culture solution. In the light of these results it would appear that the soil used in this study was not seriously deficient in magnesium and that the potassium content of the soil (0.069–0.086% K_2O) was not sufficiently high to induce magnesium deficiency symptoms.

Influence of magnesium on growth characters

It is seen from the Table I that the effect of magnesium oxide and silicate treatments on the height of plants is more marked than that of the other compounds. This may be due to the greater efficiency of magnesium oxide in neutralising acidity and effecting a more favourable soil environment. The beneficial influence of magnesium silicate may to some extent be attributed to its silicon content, which is responsible for the release and increased availability of other nutrients such as phosphorus.

Influence of magnesium on yield of rice

The results of the present study reveal that the yield of grain and straw is not influenced to any appreciable extent by the application of magnesium at the rates of 25 and 50 kg MgO/ha. This agrees with the findings of Kobayashi *et al* (1956) who reported that magnesium had little effect on the yield of rice. However, the quality of the grain, as judged by the thousand grains weight and the ratio of grain to chaff were found to be high for the magnesium treated plants. Similar findings have been reported for wheat by Sadapal and Das (1961) and for rice by Varghese and Money (1965). These beneficial effects were more marked in the case of plants treated with magnesium oxide and magnesium sulphate, which might be attributed to the fact that magnesium oxide is more quick acting and magnesium sulphate more soluble than the other forms of magnesium used in this study. It may also be noted that though significant differences have not been found in the yield of grain and straw between different forms and levels of magnesium, the magnesium oxide and magnesium sulphate treated plants tended to produce a higher yield of grain over that of the control. The yield of straw was also maximum for plants supplied with magnesium oxide and magnesium silicate. The lack of any significant difference in yield might be due to the low levels of magnesium (25 and 50 kg MgO / ha.) tried in the present experiment.

Summary and Conclusions

A field experiment with a 9x4 randomised block design was carried out in the Vellayani lake area to study the effect of different forms and levels of magnesium on the growth and yield of rice. The different

forms of magnesium used were magnesium oxide, magnesium carbonate, magnesium silicate and magnesium sulphate. The levels of application were 25 and 50 kg MgO/ha. The main findings were the following:

1. Of four forms of magnesium tried, magnesium silicate and magnesium oxide induced the maximum height of plants at the harvesting stage. The form or level of magnesium had no significant effect on tillering.
2. The yields of grain and straw were not significantly influenced by the different forms of magnesium at the rates of application used in this study. However, the magnesium treatments tended to increase the yield of rice over control. This effect was more marked in the case of magnesium oxide and magnesium sulphate. The weight of thousand grains was also higher for treatments with these compounds.

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