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INFLUENCE OF MAGNESIUM AND POTASSIUM ON THE AVAILABILITY OF N,P,K,Ca and Mg IN LOW LAND RICE SOIL (Typic Haplustalf)

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ABSTRACT

Field experiment was conducted during summer season of 1988 to evaluate the availability of N, P, K, Ca and Mg in lowland rice soil (Typic Haplustalf) with the application of graded doses of magnesium and potassium at Tamil Nadu Agricultural University, Coimbatore. Rice crop (Var. IR 64) was grown with four levels of magnesium (0, 20, 40 and 60 kg/ha) combined with four levels of Potassium (0, 25, 50 and 75 kg K_2O/ha). Application of Magnesium influenced the availability of nitrogen and phosphorous during later stages of the crop growth. The availability of potassium at all stages and calcium in the panicle initiation stage decreased with increasing dose of magnesium indicating antagonistic effect. The availability of magnesium in soil increased due to increased magnesium fertilization while application of potassium decreased the availability of nitrogen and magnesium.

Keywords: Magnesium and Potassium availability, rice yield.

With the introduction of high yielding varieties and the use of complex fertilizers, the magnesium content gets depleted from the soil. In addition, magnesium concentration in the soil is also affected by the application of other cations, particularly potassium. Tewari and Mandal (1970) observed that addition of K and Mg in soil affected the ease of replacement of soil Mg by the applied potassium. An investigation has been made to study the effect of magnesium and potassium application in graded doses on the availability of nitrogen, phosphorus, potassium, calcium and magnesium in soil and the yield of rice crop (Var.IR 64).

MATERIALS AND METHODS

Field experiment was conducted during the summer season of (Feb-April) 1988 at wetlands of Tamil Nadu Agricultural University, Coimbatore, with the test crop of rice. The soil of the experimental field belonged to Noyyal series (Typic Haplustalf). The initial soil test values are summarized in Table 1.

The experimental plots (4 x 5 m) were laid out in a factorial randomized block design repli-

Table 1.The characteristics of the experimental soil

Parameter	Depth in cm 0-15	15-30
Physical Properties		
Clay (%)	35.2	30.9
Silt (%)	22.8	24.8
Coarse sand (%)	16.1	20.8
Fine sand (%)	24.3	21.8
Bulk density (g/cc)	1.24	1.3
Chemical properties		
pH (1:2)	7.8	7.9
Electrical conductivity (mmhos/cm)	0.7	0.7
Organic carbon (%)	0.96	1.03
Total nitrogen (%)	0.10	0.11
Total phosphorus (%)	0.09	0.08
Total potassium (%)	0.58	0.70
Total calcium (%)	1.54	1.42
Total magnesium (%)	0.83	0.74

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cated thrice. The treatments were of four levels of magnesium as magnesium sulphate ($MgSO_4.7H_2O$) (0, 20, 40 and 60 kg/ha) tried with the combination of four levels of potassium applied as muriate of potash (KCl) (0, 25, 50 and 75 kg K_2O/ha). All the treatments received a common dose of 100 kg N/ha and 50 kg P_2O_5/ha applied in the form of urea and superphosphate respectively as per normal recommendation. Nitrogen was applied in three split doses, viz., half as basal and one fourth at tillering and one fourth at panicle initiation stage. Magnesium and potassium and P were applied basally.

The soil samples collected from 0-15 and 15-30 cm depth at tillering, panicle initiation and post harvest stages were analysed for available N, P, K, Ca and Mg. The available nitrogen was estimated by alkaline permanganate method of Subbiah and Asija, (1956). Available phosphorus was estimated colorimetrically using Olsen's extractant (Jackson 1973). The available potassium was estimated in the neutral normal ammonium acetate extractant using flame photometer (Toth and Prince, 1949). The available calcium and magnesium were estimated in the neutral normal ammonium acetate extractant by titrating with EDTA (Jackson, 1973). The grain yield of the crop was recorded at 14 per cent moisture level. The straw yield was recorded after sun drying.

RESULTS AND DISCUSSIONS

Available nitrogen

The availability of nitrogen in soil at tillering stage was not significant. However, the increased application of magnesium upto Mg_2 level resulted in higher availability of nitrogen than control in both 0-15 and 15-30 cm depth at the panicle initiation and post harvest stages. This perhaps indicated that the influence of magnesium on increasing availability of nitrogen is only at later stages of crop growth. Application of potassium reduced the available nitrogen in the soil over control during the middle stage of the crop growth. There was a significant but negative correlation between available potassium content and the available nitrogen in surface and subsurface soils at Panicle initiation

Table 2. Effect of treatments on the available nitrogen and phosphorus in surface and sub surface soils (kg/ha)

	Tillering				Panicle initiation				Post harvest			
	0-15 cm		15-30 cm		0-15 cm		15-30 cm		0-15 cm		15-30 cm	
	N	P	N	P	N	P	N	P	N	P	N	P
Mg_0	195	19.9	217	15.3	298	21.8	304	22.4	374	42.3	377	63.7
Mg_1	216	18.7	235	16.6	318	22.7	311	23.4	420	52.9	389	76.8
Mg_2	224	19.5	237	18.5	312	24.1	333	23.3	433	54.7	440	57.6
Mg_3	218	20.2	250	19.6	326	25.8	379	25.0	483	59.8	468	66.6
SE_D		0.5		0.7		-	12.1	0.8	21.1	3.5	-	-
CD(P=.05)	NS	1.0	NS	1.5	NS	NS	24.7	1.8	43.2	7.1	58.3	NS
K_0	232	18.2	253	15.7	233	23.2	361	21.1	453	46.1	426	57.4
K_1	202	17.8	232	16.0	323	22.3	346	22.5	427	54.9	418	75.6
K_2	208	20.1	217	18.9	304	24.4	320	25.7	48	54.9	425	53.8
K_3	212	20.2	237	19.3	293	24.5	299	24.9	43	53.8	398	78.0
SE_D	-	0.52	-	0.77	12.3	-	12.1	0.9	-	3.5	-	-
CD(P=.05)	NS	1.06	NS	1.57	25.3	NS	24.7	1.8	NS	7.1	NS	NS

Mg_0 = No magnesium K_0 = No potassium
Mg_1 = Mg at 20 kg//ha K_1 = K_2O at 25 kg/ha
Mg_2 = Mg at 40 kg/ha K_2 = K_2O at 50 kg/ha
Mg_3 = Mg at 60 kg/ha K_3 = K_2O at 75 kg/ha

Table 3. Effect of treatments on the available potassium (kg/ha) and calcium (m.e/100g) in surface and subsurface soils (kg/ha)

	Tillering				Panicle initiation				Post harvest			
	0-15 cm		15-30 cm		0-15cm		15-30 cm		0-15cm		15-30 cm	
	K	Ca	K	Ca	K	Ca	K	Ca	K	Ca	K	Ca
Mg_0	854	18.2	975	22.6	833	19.7	769	23.1	863	14.4	954	18.1
Mg_1	801	18.0	888	23.1	783	20.4	751	23.5	871	19.9	925	19.0
Mg_2	800	17.7	787	21.7	745	19.0	722	21.5	817	20.6	867	19.0
Mg_3	735	18.6	728	22.4	714	18.7	678	21.3	754	19.7	810	18.4
SE_D	23.2	-	32.4	-	12.3	-	30.5	0.8	28.8	-	35.5	-
CD(P=.05)	47.4	NS	66.2	NS	25.2	NS	62.4	1.8	58.8	NS	72.6	NS
K_0	784	17.3	800	22.4	758	18.9	711	21.7	759	19.9	813	18.5
K_1	788	18.6	802	23.2	758	19.8	705	22.7	771	20.2	908	18.9
K_2	805	18.1	816	21.0	775	20.0	749	22.9	883	19.3	904	18.9
K_3	814	18.5	960	23.1	783	19.1	753	22.3	892	20.1	931	18.4
SE_D		32.4	0.7	-	-	-	-	-	28.8	-	35.5	-
CD(P=.05)	NS	NS	66.2	1.5	NS	NS	NS	NS	58.5	NS	72.6	NS

stage. The interaction effect of Mg x K revealed, under the different levels of magnesium, potassium did not influence the availability of nitrogen in the soil. This was in confirmation with the results of Hovland and Caldwell (1960).

Available Phosphorus

Application of magnesium had significantly increased the available phosphorus in soil. 60 kg Mg/ha (Mg_3) resulted in the highest amount of available phosphorus in the soil of both depths. There was a significant positive correlation between available magnesium of soil and the availability of phosphorus in surface soil. In the surface soil at tillering, panicle initiation and harvest stages the 'r' values were 0.583^{***}, 0.623^{***} and 0.687^{***} respectively. Similar reports were made by Aghim (1981). Addition of Potassium increased the available phosphorus in soil upto 50 kg K_2O/ha only as compared to control and the interaction effect of K x Mg on the availability of phosphorus in soil was not seen.

Available Potassium

As the magnesium dosage increased the availability of potassium in soil decreased at all stages at surface and subsurface soils. Similar observations were made by Stout (1962). It was further confirmed by a significant negative correlation observed between available magnesium and potassium in both the depths at tillering, panicle initiation and harvest stages. Application of potassium significantly increased potassium availability.

Available Magnesium

The available magnesium content of soil increased with addition of magnesium fertilizers, at all stages. Magnesium applied at 60 kg/ha recorded the highest amount of available magnesium and O level recorded the lowest at all the stages at both the depths. Higher application of potassium lowered the availability of magnesium at later stages indicating that there was an antagonistic effect between magnesium and potassium in soils. This was confirmed by the existence of negative correlation between available magnesium and available potassium content in soil. Similar results were reported by Hovland and Caldwell (1960).

Available Calcium

Application of magnesium did not influence calcium availability but the available calcium tended to increase at lower levels of applied magnesium in the subsurface soil at panicle initiation stage. There was a negative correlation between soil available magnesium and available

Table 4. Effect of treatments on the available magnesium in surface and subsurface soils (m.e/100g) and yield

	Tillering		Panicle initiation		Post harvest	
	0-15	15-30	0-15	15-30	0-15	15-30
Mg_0	6.9	7.7	8.6	8.3	9.4	8.8
Mg_1	7.5	9.0	9.5	9.4	11.0	9.6
Mg_2	8.1	9.8	10.8	10.3	12.3	10.1
Mg_3	8.6	10.5	11.7	10.9	14.0	10.6
SE_D	0.45	0.72	0.58	0.49	0.68	0.39
CD (P=0.05)	0.92	1.47	1.18	1.00	1.39	0.79
K_0	7.9	10.3	10.7	10.0	12.1	10.3
K_1	7.7	9.0	10.3	9.6	11.8	9.7
K_2	7.7	9.3	9.8	9.5	11.6	9.5
K_3	7.8	8.4	9.7	9.9	11.1	9.4
CD (P=.05)	NS	NS	NS	NS	NS	NS

calcium at the panicle initiation stage at both the depths, the 'r' values being -0.610** and -0.620** respectively. Application of potassium also did not influence the calcium availability. Similar results were reported by Metezger (1929).

Yield of the crop

Application of magnesium @ 20 kg/ha increased the grain yield of paddy. The yield increase over control being 48.5 per cent. Similar results were obtained by Padmaja and Varghese (1972).

The straw yield also increased significantly over control by magnesium fertilization, but Mg_2 level was found to be significantly higher than others.

Application of potassium also increased the grain and straw yields of rice at 25 kg K_2O/ha level (K_1). At higher levels of potassium, there was no significant difference. The increase of grain yield at K_1 level was 43.2 per cent. Similar response to potassium application was obtained by Bhargava *et al.*, (1985).

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