Agri. Res. J. Kerala, 1973, 11 (1) 9—13

EFFECT OF LIMING ON EXCHANGEABLE CATIONS AND pH. OF ACID SOILS OF KUTTANAD

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The soils of Kuttanad are highly acidic in reaction and have a high content of exchangeable hydrogen and aluminium presence of toxic concentrations of ferrous iron and aluminium and extremely low microbial activity are the special features of these soils which pose some baffling problems to the rice cultivators of this area. Liming is an important agronomic practice in the area. However data on the effect of liming in soil reaction and interchangeable bases of the absorbing complex are not yet available, hence the present venture is undertaken- Magistad (1921) Menehikovsky and Puffier .(1938) and Vlamis (1953) found that pH values lower rapidly and hampers plant growth as the solubility of aluminium rapidly increases; toxic effect of Fe and Al can be corrected by applications of lime - Allway (1957). As regards Kuttanad soils Kurup (1967) got zero values for exchangeable Al immediately after treating with twice the lime requirement of the soils and this was maintained in the samples taken after 15th, 30th and 60th day of liming.

Materials and methods.

Bulk quantities of Kari and Karapadom soils were collected from water-logged fields of Purakad and Ambalapuzha and were filled in pots Two sets of pots were taken, one with crop (4 replications) and the other without crop (3 replications! to draw periodical samples of soil for analysis, Three levels of lime viz half lime requirement (½ L. R) and full lime requirement of the soil (LR) were applied. The lime was applied in the form of GaO two days before planting. Fertilizers were applied on the day of planting at the rate of 60 Kg. N, 50 Kg. P_2O5 and 50 Kg. K_2O. All the pots were exposed to the same conditions and watered daily at uniform rate. Periodical soil samples were analysed for pH, exchangeable hydrogen, Ca, Mg, Al, ferrous iron and C.E.C.

Results and discussion.

Table 1 shows the changes in pH, exchangeable H, Al and ferrous iron content of soils due to liming. Both soils showed substantial increase in pH due to liming. Originally Karapadom soil was having a higher pH than Kari soil. Maximum pH in Kari soil was recorded in treatment which received higher dose of lime at 45th day of liming where as in Karapadom soil the maximum pH was found at 75th day in the treatment receiving $\frac{1}{3}$ LR. Thus the soils differ rei significantly in their nature of acidity.

Application of lime at full lime requirement doses have reduced exchangeable Al content of the soils to zero. The Kari soil is found to have a high content of exchangeable Al than Karapadom soil. This can be attributed to lower pH value of the Kari soil (Magistad 1921). Zero value of exchangeable Al was obtained at full lime requirement dose in Kari soil while $\frac{1}{2}$ lime requirement dose in Karapadom soil produced the same effect and this brings to light the characteristic differences between the soils. In both types of soils the exchangeable Al content decreased with time of sample collection. Maximum reduction was noticed at 4.Sth day (after liming) soil sample (Table 1). A slight increase in exchangeable Al was noticed in Kari soil at $\frac{1}{8}$ LR and in the control tretment of Karapadom soil at 75th day of sampling. This may ba due to slight fall in pH of these treatments at this period of sampling In all cases high negative correlation was noticed between pH and exchangeable Al (r = 0.758).

Both soils showed a progressive reduction in exchangeable H with increasing levels of lime (vide Table 1). Maximum reduction was noticed in 45th day sample. A sharp decrease in exchangeable H with lime and time of collection was noticed in general As is evident from the results, Kari soil has a much higher content of exchangeable hydrogen than Karapadom soil. Liming has resulted in an increase in Ga content of the soils and Ga ions in the solution replaced hydrogen ions from the exchange position The replaced hydrogen ions are however oxidised to water and thus liming results in a decrease of exchangeable hydrogen. A definite relationship exist between pH and exchangeable H and exchangeable Al and also H and ferrous iron. Since soluble iron and Al are the sources of exchangeable H a decrease in activity of these elements will evidently decrease exchangeable H. Beacher *et al* (1952; noted that liming raises soil pH and lowers replaceable H, Al and Mg.

The two soils differ widely in respect of their ferrous iron content, and this was found to decrease progressively with increasing level of lime and Kari soil showed a better response in this respect. In general, for both tvpes of soils the ferrous iron decreased with duration (vide Table *1).* A slight increase in ferrous iron content noted in the case of Kari soil at the third sampling period may be attributed to slight fall in pH of the soil in this period. In all the sampling, there was a high negative correlation between pH and ferrous iron (r = – 0.843)

Table 2. Ef[redacted]ct of Liming on Exchangeable Cations and Cation Exchange Capacity of Soils
(Expressed in me/100 g of soil)

Date of sampling	Character (mean value)	KARI SOIL No lime	KARI SOIL Half lime	KARI SOIL Full lime	KARAPADON SOIL No lime	KARAPADON SOIL Half lime	KARAPADON SOIL Full lime
15th day of liming	C.E.C.	30.08	20.06	21.42	19.00	15.7[illegible]	14.16
	Total Exch. cation	7.50	1[illegible].56	20.10	7.94	10.5[illegible]	12.53
	Exchangeable Ca	3.02	[illegible].66	12.60	2.83	4.52	5.83
	Exchangeable Mg.	1.25	[illegible].66	4.75	3.92	4.12	4.88
45th day of liming	C.E.C.	27.69	24.54	21.62	14.76	1[illegible].46	14.65
	Total Exch. cation	6.83	12.83	20.34	8.83	12.00	14.12
	Exchangeable Ca	2.81	6.55	12.72	1.46	4.41	5.66
	Exchangeable Mg.	1.38	4.10	4.96	3.10	4.3[illegible]	5.20
75th day of liming	C.E.C.	22.79	18.39	19.38	15.64	13.66	11.64
	Total Exch. cation	4.20	10.63	19.00	6.23	11.41	14.83
	Exchangeable Ca	1.93	5.61	11.92	2.46	6.4[illegible]	8.07
	Exchangeable Mg	1.39	4.16	5.03	3.10	4.36	5.26
After harvest from cropped pots (Culture-28)	C. E. C.	28.34	26.40	25.80	13.17	12.57	14.17
	Total Exch. cation	5.96	9.00	11.00	5.50	9.20	10.67
	Exchangeable cation	3.85	3.57	2.64	1.[illegible]	3.28	4.12
	Exchangeable Mg.	0.37	1.92	2.47	1.[illegible]	2.42	2.75

Table I. Effect of liming on pH and exchangeable H, Fe and Al

Date of sampling	Character (mean value)	KARI SOIL			KARAPADOM SOIL		
		No lime	Half lime	Full lime	No lime	Half lime	Full lime
15th day of liming	PH	3.5	4.5	4.8	5.0	6.0	6.4
	Ferrous iron	8.88	5.93	2.87	4.51	3.69	2.87
	Exchangeable Al	4.42	0.95	Nil	0.22	Nil	Nil
	Exchangeable H	23.25	17.11	1.32	11.07	5.12	1.83
45th day of liming	PH	4.2	4.9	5.5	5.7	6.5	6.8
	Ferrous iron	7.25	2.44	1.59	4.86	2.44	1.94
	Exchangeable Al	3.93	0.45	Nil	0.11	Nil	Nil
	Exchangeable H	20.84	11.71	0.98	5.93	1.25	0.55
75th day of liming	PH	4.0	4.4	5.2	5.2	6.6	6.8
	Ferrous iron	8.33	4.40	2.85	3.25	1.49	1.24
	Exchangeable Al	4.15	0.81	Nil	0.34	Nil	Nil
	Exchangeable H	18.59	10.96	0.39	5.50	3.34	0.71
After harvest from cropped (Culture-)	PH	3.4	4.5	4.6	4.8	5.0	5.3
	Ferrous iron	7.11	3.73	3.55	3.74	3.49	1.99
	Exchangeable Al	11.96	6.26	1.19	4.84	0.56	Nil
	Exchangeable H	22.38	17.40	14.80	7.67	3.37	3.57

Table 2 presents the data on the effect of liming on C.E.C., total exchangeable metals and exchangeable Ga and Mg. As in the case of other factors the two soils differ significantly in the case of C.E.C. also and Kari soil claims the superiority in this respect. C.E.C. was found to decrease in both the cases with lime dose. Incidentally it may be pertinent to point out the result of "effect of liming on available nutrients', where availability of potassium is found to decrease with increasing levels of lime application. Hoagland and Martin (1933) have reported that a reduction in C.E.C. is a possible consequence of the fixation of 'K' by soils which would further corroborate the findings of the present study.

Both total exchangeable metals and exchangeable Ca and Mg were increased by lime application. A slight fall in total metals was noticed in the last sample, Kari soil is having higher value in the case of total metals.

Summary

A pot culture experiment to study the changes brought about on the exchangeable cations in the acid soils of Kuttanad was carried out. The Kari and Karapadom soils differed in the nature of acidity effect of liming was more persistant in Karapadom soil. Full LR was found to be the optimum dose for Kari soil while I LR was sufficient for the Karapadom soil for similar effects. Ferrous ion content and exchangeable Al and exchangeable hydrogen were effectively reduced due to lime application and high negative correlations of the these elements with pH was noticed. Thus the present study have adduced sufficient evidence to the essentiality of liming these soils for better production.

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(M.S. *received. 27-6-1972.*)