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Liming Acid Soils of the Nilgiris - An Incubation Study*

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ABSTRACT

Soil incubation study was conducted to study the effect of lime, and fertilizers on the availability of phosphorus. Based on the observations a tentative division of the soils was attempted with reference to response of lime.

INTRODUCTION

It is reported that liming had on effect on the availability of the native phosphate in any of the soils studied. However the use of lime with super aids in keeping the phosphorus in more readily available forms. It has been reported that lime by itself or in conjuction with any phosphates or nitrogen failed to show any beneficial effect on potato crop (Anon, 1951). Sileanpaa (1961) observed an increase in available phosphorus due to phosphorus application in limed soils, but liming normally does not significantly affect the solubility of the native soil phosphorus. A study with the Pattambi low level laterite soils undertaken as early as 1954 in the composite Madras State indicated the conditions favourable for production of high availability of phosphorus from super-phosphate due to the application of lime and green leaf.

MATERIAL AND METHODS

The experiment was carried out in beakers to evaluate the effect of super phosphate, Nanjanad mixture, a special fertilizer very popular with potato growers of the Nilgiris with and without lime on the availability of phosphorus in the soil.

Ten representative soils were selected based on their geographicai distribution and rainfall. One hundred gram of each soil were taken separately to have the following six treatments.

A. Control
B. Lime alone at 3000 kg/ha
C. Super alone at 93.37 kgP/ha
D. Super at 93.37 kg/ha
E. Nanjanad mixture alone at 93.37 kg P/ha
F. Nanjanad mixture alone at 93.37 kg P/ha + lime at 3000 kg/ha.

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Lime or calcium carbonate was added 10 days before the commencement of the experiment. Nitrogen and potassium in doses found in Nanjanad mixture were added to all the other treatments and the soils were kept at their respective water holding capacity throughout the period.

At periodical intervals representative samples were drawn and analysed for available phosphorus by Bray and Kurtz No. 2 extraction method as described by Jackson (1958). The Klett-Summerson colorimeter was used for the estimations.

RESULTS AND DISCUSSION

The general characteristics of the soils are presented in Table 1. The analytical data showig the 4 progressive variation of available phosphorus due to various treatments are furnished

TABLE 1. Characteristics of Soils Studies

S. No.	Locality	pH	Sesquioxides (R_2O_3) %	Iron Oxide (Fe_2O_3) %	Alumina (Al_2O_3) %	Lime(CaO)%	Molar ratios	
							Silica/R_2O^3	Silica Alumina
1.	Cherambadi	4.7	17.82	5.46	12.36	0.11	0.04	0.52
2.	Masanigudi	5.9	11.69	3.38	8.32	0.64	1.35	1.70
3.	Assanbala Estate	4.7	24.22	8.92	15.31	0.15	0.83	1.40
4.	Kengarai	4.8	30.31	8.19	22.12	0.12	0.81	1.01
5.	Aravence	4.5	28.84	11.19	17.65	0.06	0.93	1.30
6.	Ketty	5.0	20.04	9.30	10.74	0.13	0.47	0.83
7.	Devershola	4.9	31.68	11.31	20.38	0.15	0.60	0.81
8.	Nanjanad	4.9	25.15	7.36	17.79	0.16	0.98	1.25
9.	Ootacamund	4.6	19.81	10.65	9.16	0.13	2.81	5.49
10.	Doddabetta	4.6	31.81	11.20	20.61	0.12	0.15	0.62

in Table 2. Since there were several Zero values, the numerals were transformed by the formula $X + 0.5$, and was statistically analysed. When ten soils were studied together, the effect of various treatments was not seen. Further, liming did not increase the availability of phosphorus. The soils were then segregated according to their response to lime and those with no response to lime.

The data on available phosphorus recovered by the lime response group of soils were pooled together (Table 3) and it was evident that by addition of

TABLE 2. Progressive Variation of Available P (Bray and Kurl. No. 2) in ppm.

Sl. No.	Days of observation	Treatments					
		A	B	C	D	E	F
1.	I	2.5	22.0	7.4	37.5	12.0	48.9
	II	1.4	46.8	2.1	32.6	1.3	40.4
	III	5.3	7.8	1.8	6.7	1.08	5.0
2.	I	24.0	32.2	52.5	63.7	30.7	40.9
	II	1.5	26.2	32.9	9.0	18.7	30.0
	III	9.0	11.2	17.2	13 9	38.7	6.4
3.	I	5.1	20.4	10.2	34.6	5.1	53.2
	II	6.9	2.6	5.1	18.6	—	0.4
	III	6.2	2.9	3.5	4.7	3.6	4.4
4.	I	20.0	46.2	39.1	15.6	50.3	8.9
	II	5.6	3.0	—	—	0.4	4.5
	III	5.6	5.6	2.2	3 0	12.7	—
5.	I	23.5	18.7	35.1	26.8	42.5	13.4
	II	6.34	3.7	5.2	4.5	6.0	5.2
	III	0.4	0.7	4.9	11.9	11.2	11.2
6.	I	10.2	20.5	9.9	27.4	5.12	30.0
	II	4.0	1.8	5.1	6.6	4.4	3.7
	III	4.4	4.8	4 8	—	5.8	2.2
7.	I	16.4	9·5	13.1	17.5	11.6	38.6
	II	4.0	1.8	3.3	5.1	3.3	4.1
	III	9.8	4.4	3.3	4.4	2.5	4.0
8.	I	18.4	21.7	39.4	46.0	32.4	32.4
	II	4 4	1.1	4.0	1.8	2.6	2.6
	III	—	—	—	—	—	—
9.	I	27.7	31.4	40.8	37.5	45.4	28.9
	II	7.2	10.1	10.8	10.1	5 7	2.9
	III	9.4	14.4	—	4.0	13.8	8.7
10.	I	9.8	26.2	36.3	37.8	16.4	27 7
	II	5.5	3.5	6.6	6.2	9.0	4.3
	III	7.0	5.4	—	14.4	3.5	4.3

I, II, III = Days

TABLE 3. Recovery of Added Phosphorus

Days of incubation	Release of P over control - Lime alone (ppm)	Percentage recovery of added P (46.7 ppm) *			
		Supper phosphate	Super + lime	Nanjanad mixture	Nanjanad mixture + Lime
15	10.9	30.6	54.9	17.9	43.3
45	14.0	14.8	18.0	9.2	28.9
65	1.1	5.7	10.8	17.9	4.6

* 46.7 ppm P is the amount contained in Najanad potato fertilizer Mixture.

lime, 10.9 ppm of additional available P was released on the 15th day and was observed to increase to 14 ppm on the 45th day. After 65 days the beneficial effect of additional release was reduced to 1.1 ppm. When 46.7 ppm of an inorganic source of P was added to the soils as superphosphate, 30.6 per cent of the added P was recovered on the 15th day which was noted to decline to 5.7 per cent on the 65th day. Addition of superphosphate with lime resulted in a recovery of 54.9 per cent on the 15th day resulting in a reduction of 18.0 and 10.87 per cent on the 45th and the 65th day respectively.

When P was added in the form of Nanjanad mixture where 50 per cent of P is in the organic form, the initial recovery on the 15th day was only 17.9 per cent The recovery percentage was reduced to 9.2 on the 45th day. It increased again to 17.9 per cent. After the 65th day the recovery was observed to be better than the treatments with superphosphate possibly due to the slow release of available P from the organic source of the fertilizer as bone meal. Nanjanad mixture when added along with lime, the release of added P was better resulting in the fixation of the released P in due course.

It could be seen from the Table 1 that the group of soils showing response to lime were distinctly of the lateritic category on the basis of silica/alumina ratio of Martin and Doyne (1927). In laterites, kaolinites with a higher anion exchange capacity are the dominant clay minerals. Lime, when applied to such soils, supplies, hydroxyl anions (OH) for anion exchange resulting in release of phosphorus. In addition liming might favourably influence the soil pH inducing higher phosphorus availability. The observed response to liming in lateritic soils may be due to the above fact.

In the lime non-response group, the treatments showed no significance, indicating the masking action of the heterogenity of soil. This effect is also reflected by a high statistical significance for the effect of soil on the release of available phosphorus.

Thus it is evident that liming is one of the economic means of tapping the large amounts of unavailable native phosphorus present in some of the Nilgiris soils, which are laterites according to the criteria of Martin and Doyne. Liming at the rate of 3,000 kg/ha even without the addition of any of the phosphatic fertilizers is beneficial in releasing P efficiently.

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