

Preliminary Studies on the Liming of Kerala Soils

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Introduction

Soil reaction is perhaps the most important single chemical character of soils as it affects growth of plants directly and indirectly. Soil reaction controls the solubility of

elements such as Ca, Mg, K, P, B, Mn, etc. It is a very important factor which controls the activity of soil microorganisms. Soil tests show that in Kerala 82.8% of the wet-land soils are acidic.

* Summary of soil tests up to December 1960

District.	pH		
	Percentage under each group		
	Acid	Neutral	Alkaline
Trivandrum	95.4	4.6	—
Quilon	93.2	6.3	0.5
Kottayam	88.2	11.8	—
Alleppey	89.5	10.4	0.1
Ernakulam	92.5	7.4	0.1
Trichur	87.0	13.0	—
Palghat	75.6	21.2	3.2
Kozhikode	92.3	7.6	0.1
Cannanore	87.8	12.2	—
Whole State	82.8	16.7	0.5

Liming of these soils is essential for getting higher yields. The cultivators who are aware of this often enquire about the type, time of application and dose of lime best suited for their wet lands. In view of this

a preliminary study on the above problem was initiated at the Chemistry Division, Agricultural College, VeHayani. Soil samples were collected for this study from seed farms situated in various parts of the State.

FIGURE I

KUTTANAD SOIL LIME REQUIREMENT GRAPH (PUNTA SOIL)

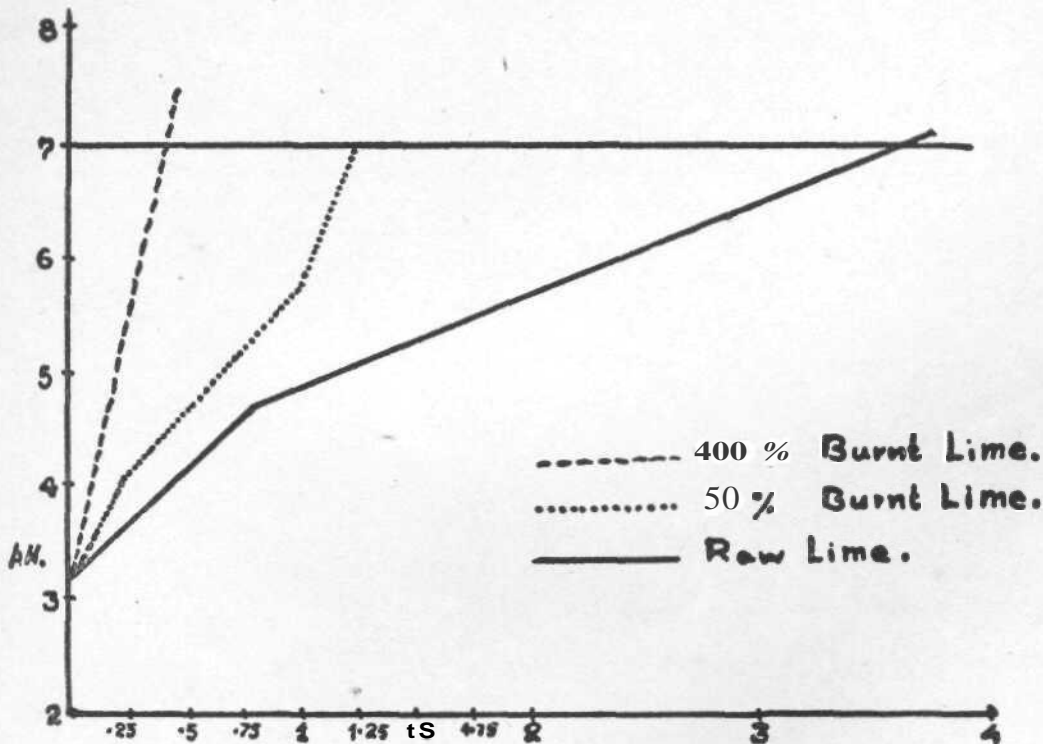


FIGURE II

KARI SOIL LIME REQUIREMENT GRAPH.

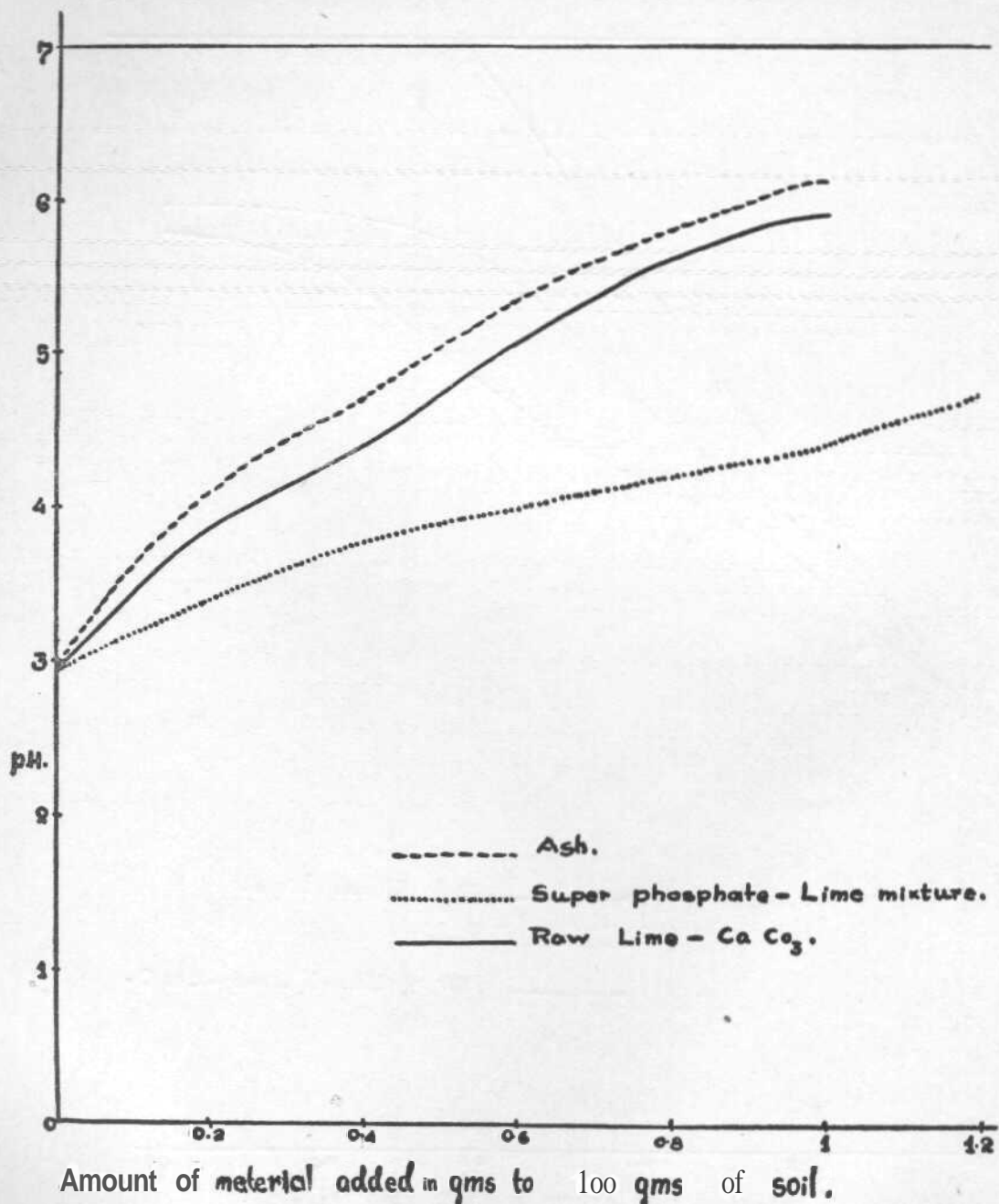
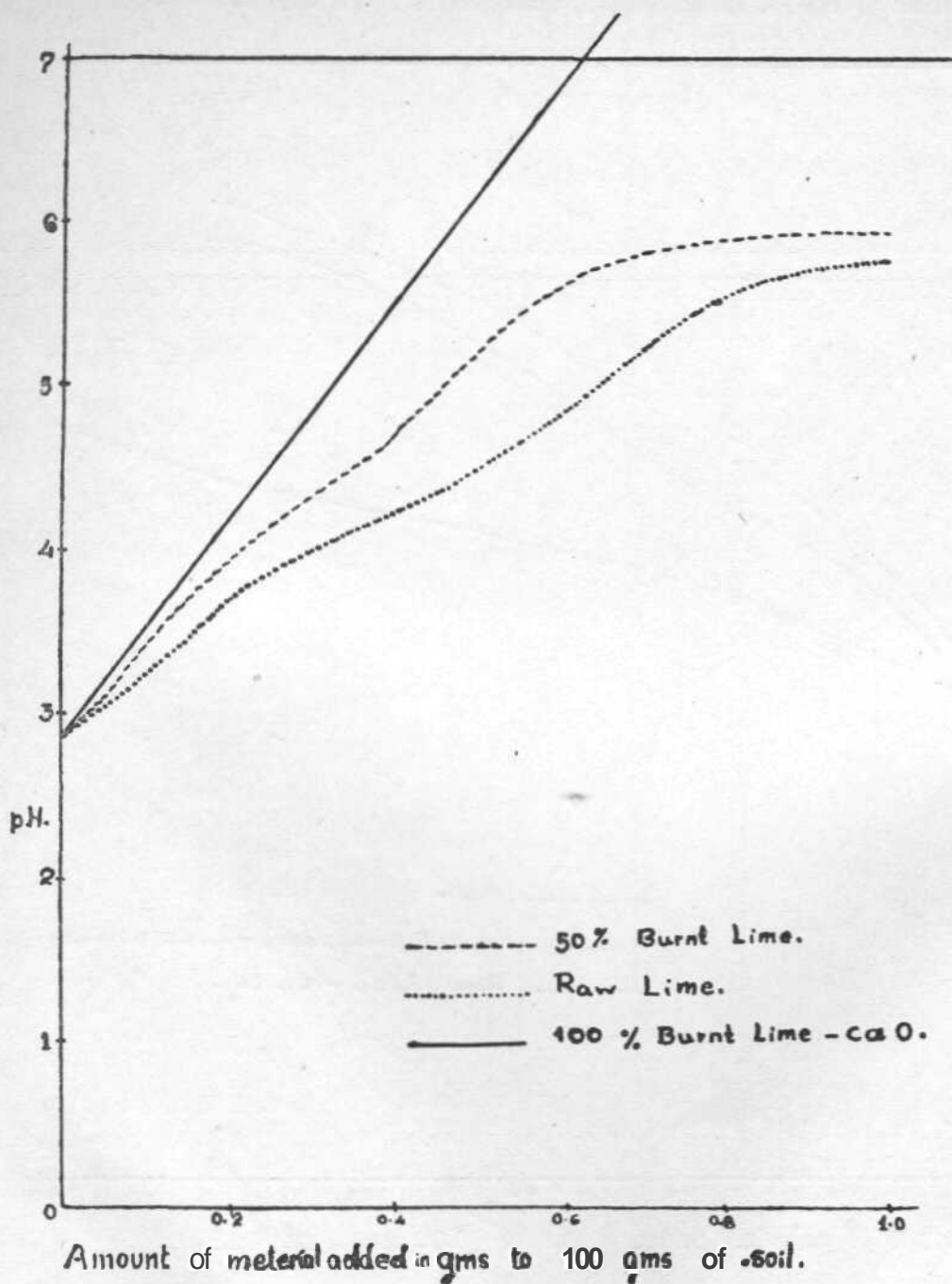


FIGURE III

KARI SOIL LIME REQUIREMENT GRAPH



Review of Literature

Literature on the effect of lime is quite large, more recent review being that of Allaway (1) who, while discussing about lime, has noted that the toxic effect of dissolved Fe & Al can be corrected by the application of lime.

Materials and Methods

The different surface samples of soil collected from the various seed farms and Research Stations were tested for the following.

- (i) pH of the soil with a Beckmann's. pH meter using 1 : 2 soil-water ratio.
- (ii) Lime requirement of soil by the method outlined by Prince (2)
- (iii) Determination of electric conductance of the soil solutions (1:2 soil water ratio) using a conductivity bridge, having a cell constant range 0,1 to 2.0 (4)

The results are tabulated in table I.

* TABLE I

Sl. No.	Details of sample	Initial PH	Lime requirement expressed as lb. of CaCO_3 & CaO required per acre to bring the pH to 7.		Conductivity expressed as millimhos per cm.
			CaCO_3	CaO	
1	Seed Farm, Karunagapalli, Sample 1	3.2	776	446	0.25
2	Mundar Estate, Vaikom	3.2	34800	20000	8.5
3	Vadayar Estate, Vaikom, Sample I	3.5	17400	10000	7.0
4	Vadayar Estate, Vaikom, Sample II	3.8	24360	14000	7.0
5	Agrl. Research Station, Thaliparamba Sample I	3.8	5432	3122	0.95
6	State Seed Farm, Kadakkal	3.9	1938	1114	0.30
7	Agl. Research Station, Thaliparamba Sample II	4.3	9112	5237	1.05
8	State Seed Farm, Karumanoor	4.3	1745	1003	0.25
9	Seed Farm, Karunagapally Sample II	4.5	776	446	0.25
10	State Seed Farm, Panamcheri	4.5	3877	2228	0.60
11	Seed Farm, Karunagapally Sample III	4.7	776	446	0.25
12	State Seed Farm, Karumanoor	4.9	2784	1600	0.46
13	State Seed Farm, Palghat,	5.6	776	446	0.35
14	Agt. Research Station, Thaliparamba Sample III	5.6	5622	3231	2.6

* In the case of paddy lands the samples were collected after the harvest of paddy, except in Vadayar, and Mundar where the samples were collected one month before de-watering, ie August.

To find out the best form of lime various liming materials used in the State were collected and analysed for Ca content and neutralization value, by the methods prescribed

in A. O. A. C. (3). Wood ash was included since it is used in the State in large quantities from time immemorial. The results of analysis are given in table II.

TABLE II

Sl. No.	Liming material	Total lime content expressed as % of Ca	Neutralization value expressed as number of ml of normal HCl required to neutralize 1 gm. of the substance.
1	Fully burnt lime	59.00	29.90
2	Half burnt lime	46.50	22.70
3	Raw lime	37.20	19.20
4	Wood ash	42.50	14.40

Two typical acid soils were taken to test the comparative efficiency of different liming materials including wood ash in raising the soil pH. 100 gms. of these soils were mixed with 200 ml. of distilled water in beakers and the initial pH was recorded. Weighed quantities (0.1 gm) of the various liming materials were added to the soil paste and stirred well. The rise in the pH was recorded. The process was repeated till the pH reached 7. The results are represented in graphs 1 to III appended.

It was found that if fully burnt lime (calcium oxide) was used, small quantities were sufficient to raise the soil pH to 7.

To find out how lime requirement varies with season soil samples from Mundar Estate and Vadayar Estate of Vaikom were collected in different seasons. The lime requirements of these samples were estimated as before.

Results are given in table III.

TABLE III

Details of sample	pH of the sample			Lime requirement expressed as lb. of CaO per acre to bring the pH to 7		
	At the time of dewatering before sowing.	Sowing period	After harvest	At the time of dewatering before sowing.	At sowing period.	After harvest.
Mundar Estate Sample I	4.7	5.6	2.8	7000	3000	26000
Mundar Estate Sample II	5.8	6.2	3.9	6000	2500	8000
Vadayar Estate Sample I	5.3	6.7	3.8	2000	200	10000
Vadayar Estate Sample II	5.4	6.9	3.8	2200	150	13000

It was found that lime requirement of the same soil varies widely from season to season and minimum quantity required at the time of sowing.

Having found that the quantity of fully burnt lime is low if applied at the sowing period, its effect on germination of paddy seeds and growth of seedlings was studied. Weighed quantities of soil were taken in pots and calculated quantities of fully burnt lime, to represent from doses of 2 cwts. to 20 tons per acre were added to the soil and mixed well. Sprouted seeds were sown and germination and growth of seedlings observed. The seedlings came up without any adverse effects. In the field freshly burnt lime was applied at 2500 lb. per acre one day before transplanting of seedlings. The seedlings came up well.

Discussion of Results

(a) *Best form of lime for correcting soil acidity.*

From a review of table II it can be observed that fully burnt lime has the maximum Ca content and highest neutralization value. Ash is also found to contain more Ca than raw lime and its neutralization value is also fairly high. The application of wood ash in the usual cropping pattern might have been responsible for successful cropping in certain areas. The content of Magnesium may also add to the neutralization value of wood ash.

Theoretically Calcium oxide (fully burnt lime) can only be twice as effective as Calcium carbonate (raw lime) in correcting soil acidity; but in actual practice it is seen that Calcium Oxide (fully burnt lime) is ten times more effective than Calcium carbonate (raw

lime). Graphs I and III give a clear picture of the efficiency of Calcium Oxide.

Small quantities of Calcium oxide are enough to raise the soil reaction to pH 7, while if Calcium carbonate is used large quantities are necessary to get the same effect. From the point of view of the cultivator fully burnt lime is likely to be much more economical than raw lime. Graph II shows that wood ash is equally good as raw lime in correcting soil acidity.

(b) *Time of application.*

The time of application of lime is an important factor for the farmer as far as certain soils in Kerala are concerned. From table III it is seen that soil samples collected at the time of sowing require a much less quantity than when the fields are dry. This is in conformity with the findings of Subramoney (6) that the increase in acidity when soils are exposed to air is a character exhibited by most of the soils in Kuttanad area even though it varies in degree from place to place. Subramoney and Kurup (7) have reported that Iron solubilisation and red scum formation in acid soils could be fairly suppressed by treatment with lime. The red scum appears soon after sowing when the fields are given a drying. Hence if Calcium oxide (fully burnt lime) is applied at the sowing period the red scum formation and consequent wilting of seedlings in patches are prevented.

It is an important point to note that if lime is applied at the harvest period very little residual effect is seen in such soils. It is an indication that floods wash off a lot of acidity thus making the soil require a lesser quantity of lime at pre-sowing period.

Thus fully burnt lime when applied at the time of sowing gives maximum benefit at minimum expenditure to the farmer.

Summary and Conclusions

The type, time of application and dose of lime required for Kerala soils to correct acidity have been studied in the laboratory. The findings are summarised below :-

(i) Fully burnt lime (Calcium oxide) is the best type of lime that can be used for correcting the acidity of Kerala soils,

Russel has pointed out that the form of lime, CaCO_3 or CaO does not very much matter. But in this case field experiments carried out for a period of two years (Subramoney and Kurup (8) have definitely shown that as far as Kerala soils are concerned CaO is better. The laboratory studies were repeated in the field and concurrent results were obtained.

(ii) Fully burnt lime is required only in small quantities when compared to the few tons required as raw lime.

(iii) Wood ash is equal in value in correcting soil acidity as raw lime.

(iv) It is very economical for a farmer if fully burnt lime is applied at the time of sowing since a smaller dose can correct acidity and suppress iron solubility.

(v) Dose of lime required for a soil can be decided only after determination of its lime requirement.

(vi) The time of collection plays an important part in determining lime doses. Lot of acidity is washed off by rain and tides and lime application in large quantities at the post-harvest period is of very little use.

The seed farms are located in typical soil climatic regions. Hence the results obtained for a soil in a seed farm is fairly applicable to the surrounding area.

Acknowledgements.

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