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Effect of Application of Calcic Materials on Soil Reaction*

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The effect of different forms and levels of liming materials on soil reaction was studied. Calcium carbonate, calcium hydroxide and calcium oxide were added to representative black, red, alluvial and laterite soils at two levels namely 3 tons and 6 tons/ha. Moisture level was maintained at field capacity. Soil samples were drawn at different periods of incubation and pH was estimated. The increase in pH due to application of liming material was higher in laterite soil and low in black soil. Calcium oxide was found to cause the maximum shift in pH followed by calcium hydroxide and calcium carbonate. Application of six tons of liming material resulted in greater increase in pH than three tons/ha. The values for pH registered an increase in initial stage and then there was a drop in pH values, followed by steady increase thereafter.

The most important chemical test for a soil as a medium for plant growth is perhaps its pH value. The solubility and availability of many nutrients are closely dependent upon soil pH. Many liming materials are recognised for increasing soil pH and bringing about desired conditions but no conclusive information is available with regard to the comparative merits, demerits and efficacy of different liming materials. On the other hand, overliming will bring ionic Imbalance and ion antagonism in soil. Therefore this study was undertaken to determine the relative effectiveness of various liming materials at diffetent levels of application to various soil types.

MATERIALS AND METHODS

Eleven representative suface soil samples (0-22 cm) differing in pH consisting of black, red, alluvial and laterite soil groups were collected from all over South India.

The commonly used liming materials like calcium carbonate, calcium hydroxide and calcium oxide were employed. Two levels of liming viz., 3 tons and 6 tons of calcium carbonate per hectare were applied. The quantities of calcium hydroxide and calcium oxide applied were on equal neutralising value taking calcium carbonate as 100.

Two hundred grams of soil was weighed into beakers and calculated quantities of liming materials were added. The water holding capacity of the eleven soils was determined by Keen-Raczkowski cup measurement and calculated quantities of distilled water were added to the soil to maintain the moisture at the water holding

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capacity level. The beakers were kept at room temperature and the moisture level was maintained daily by adding the required amount of distilled water to compensate for loss due to evaporation and stirred thoroughly. Appropriate control without adding liming materials was also run.

Soil samples from the beakers were drawn on 10th, 20th, 40th, 60th and 80th day after the starting of the experiment. The pH of soil samples was determined with the Beckman pH meter using a soil : water ratio of 1:2 (Jackson, 1967).

RESULTS AND DISCUSSION

The pH values determined at various stages are given in Table I. The pH values of soils under different treatments varied from 7.6 to 8.9, 6.5 to 8.5, 5.4 to 8.3 and 5.1 to 8.5 in the case of black, red, alluvial and laterite soils respectively. A general increas in pH values was observed due to liming materials but the magnitude of increase varied according to the soil group, type of liming material and doses used. The data were analysed statistically.

1. **Effect of soils**: Among all soils, black soils, ranked first followed by red, laterite and alluvial soils. This was based on the pH recorded after applying liming material and did not take into account the actual increase over the initial pH. This increase in pH might have been brought about by replacement of H ions by Ca ions in the exchange complex. McLean *et al*. (1964) noticed that addition of lime decreased both exchangeable actidity and the pH dependent acidity.

In the present study the increase in pH was found to be greater in soils with low initial pH than those with a high pH. The lowest increase in pH was observed in the case of black soils.

This could be attributed to the high initial pH and calcium status. Laterite soils would represent the other extreme because of the very low initial pH, negligible content of calcium and high organic matter content; even the higher dose of 6 tons/ha of liming material might have been a trifle in such acid soils. A similar view was expressed by Varghese and Money (1965) for soils of Kerala State which are acidic.

2. **Effect of forms of liming materials.** The action of liming material in increasing the pH might be through the Calcium-carbondioxide pH equilibrium in soils as suggested by Bradfield (1941).

In the present investigation all the liming materials increased the soil pH significantly compared to untreated soils. Among the three forms, calcum oxide was more active than the other two. Calcium carbonate was least effective. This could be due to the poor solubility of calcium carbonate. The better action of calcium hydroxide than calcium carbonate was also due to higher solubility and fineness. The study of Hoyert and Axley (1952) on Maryland soils lends support to the present findlings.

TABLE I Progressive change in soil pH

S.No.	Soil group and locality	Treatment	Day of observation 10th	20th	40th	60th	80th
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
I.	Black						
1.	Peelamedu	L_1D_1	8.4	8.6	8.1	7.7	8.5
2.	,,	L_1D_2	8.6	8.6	8.2	8.1	8.5
3.	,,	L_2D_1	8.7	8.7	8.3	8.3	8.6
4.	,,	L_2D_2	8.8	8.9	8.3	8.4	8.7
5.	,,	L_3D_1	8.7	8.7	8.3	8.5	8.7
6.	,,	L_3D_2	8.8	8.8	8.2	8.5	8.7
7.	Medikerepura	L_1D_1	8.0	8.1	7.6	8.0	8.3
8.	,,	L_1D_2	7.9	8.0	7.6	7.9	8.1
9.	,,	L_2D_1	8.1	8.3	7.7	8.1	8.1
10.	,,	L_2D_2	8.4	8.5	7.8	8.2	8.1
11.	,,	L_3D_1	8.2	8.4	7.8	8.1	8.1
12.	,,	L_3D_2	8.2	8.3	7.8	8.1	8.0
13.	Chowtapally	L_1D_1	8.3	8.5	8.1	8.3	8.4
14.	,,	L_1D_2	8.4	8.4	8.2	8.5	8.2
15.	,,	L_2D_1	8.4	8.6	8.1	8.5	8.4
16.	,,	L_2D_2	8.6	8.7	8.3	8.4	8.3
17.	,,	L_3D_1	8.5	8.7	8.3	8.5	8.4
18.	,,	L_3D_2	8.7	8.7	8.4	8.5	8.4
II.	Red						
19.	Sathiamangalam	L_1D_1	8.0	8.1	7.6	8.1	7.9
20.	,,	L_1D_2	7.7	8.0	7.5	7.9	7.8
21.	,,	L_2D_1	8.0	8.1	7.6	7.5	7.8
22.	,,	L_2D_2	8.3	8.4	7.9	8.0	8.0
23.	,,	L_3D_1	8.1	8.2	7.8	8.0	7.9
24.	,,	L_3D_2	8.1	8.3	7.8	8.0	8.0
25.	Tirupathi	L_1D_1	7.6	7.9	7.8	7.9	8.1
26.	,,	L_1D_2	7.5	7.6	7.6	7.8	8.0
27.	,,	L_2D_1	8.2	8.0	7.9	8.0	8.3
28.	,,	L_2D_2	8.1	8.1	7.9	8.1	8.2
29.	,,	L_3D_1	8.1	8.0	7.9	8.1	8.3
30.	,,	L_3D_2	8.5	8.1	7.9	8.0	8.2
31.	Manvi	L_1D_1	6.7	6.8	6.5	7.5	7.5
32.	,,	L_1D_2	7.5	7.2	7.1	7.6	7.7
33.	,,	L_2D_1	7.6	7.5	7.2	7.7	7.6
34.	,,	L_2D_2	7.8	7.8	7.5	7.8	7.8
35.	,,	L_3D_1	7.6	7.6	7.4	7.6	7.7
36.	,,	L_3D_2	7.8	7.8	7.6	7.8	8.0
III	Alluvial						
37.	Aduthurai	L_1D_1	7.6	7.6	7.5	7.8	8.0
38.	,,	L_1D_2	7.7	7.9	7.6	7.8	8.0
39.	,,	L_2D_1	7.9	7.9	7.7	7.9	7.9
40.	,,	L_2D_2	8.1	8.2	7.9	8.1	8.1
41.	,,	L_3D_1	8.0	8.0	7.8	8.0	8.0
42.	,,	L_3D_2	8.0	8.0	7.9	8.0	8.2
43.	Avanigada	L_1D_1	7.9	8.0	7.7	7.8	7.8
44.	,,	L_1D_2	8.0	7.9	7.7	7.8	7.7
45.	,,	L_2D_1	8.1	8.1	7.8	7.9	7.8
46.	,,	L_2D_2	8.3	8.2	7.8	7.9	7.9
47.	,,	L_3D_1	8.1	8.1	7.8	7.9	8.0
48.	,,	L_3D_2	8.2	8.1	7.9	7.9	8.1
IV.	Laterite						
49.	Nanjanad	L_1D_1	5.8	6.5	6.4	5.6	6.1
50.	,,	L_1D_2	6.3	6.5	6.6	6.0	6.2
51.	,,	L_2D_1	5.7	6.0	6.1	5.7	5.8
52.	,,	L_2D_2	6.3	6.5	6.4	6.1	6.0
53.	,,	L_3D_1	5.7	6.1	6.0	5.5	5.4
54.	,,	L_3D_2	6.1	6.4	6.4	5.8	5.9
55.	Pattambi	L_1D_1	6.7	6.8	6.8	6.7	6.7
56.	,,	L_1D_2	6.8	6.9	7.1	7.0	7.4
57.	,,	L_2D_1	7.0	7.0	6.8	7.1	7.2
58.	,,	L_2D_2	7.5	7.4	7.2	7.4	7.5
59.	,,	L_3D_2	7.1	7.1	7.1	7.0	7.1
60.	,,	L_3D_2	7.5	7.4	7.3	7.4	7.5
61.	Mercara	L_1D_1	6.8	7.1	7.2	7.3	6.9
62.	,,	L_1D_2	6.9	7.2	7.3	7.4	7.4
63.	,,	L_2D_1	7.0	7.4	7.1	7.2	7.2
64.	,,	L_2D_2	7.5	7.4	7.4	7.3	7.6
65.	,,	L_3D_1	7.1	7.2	7.2	7.1	7.1
66.	,,	L_3D_2	7.3	7.3	7.4	7.3	7.5
67.	Peelamedu	Control	8.4	8.4	7.9	8.2	8.5
68.	Medikerepura	,,	7.9	8.0	7.4	7.8	8.1
69.	Chowtapally	,,	8.2	8.2	8.1	8.2	8.2
70.	Sathiamangalam	,,	7.7	7.7	6.6	7.8	7.7
71.	Tirupathi	,,	7.2	7.3	6.2	7.5	7.4
72.	Manvi	,,	6.7	6.8	6.7	6.5	6.6
73.	Aduthurai	,,	7.3	7.5	7.1	7.1	7.2
74.	Avanigada	,,	7.6	7.7	7.6	7.2	7.2
75.	Nanjanad	,,	5.3	5.8	5.3	5.2	5.1
76.	Pattambi	,,	5.6	5.8	5.4	5.1	5.1
77.	Mercara	,,	6.0	6.0	5.4	5.1	5.1

L^1 = $CaCO_3$ D_1 = 3 tons/ha

L_2 = $Ca(OH)_2$ D_2 = 6 tons/ha

L_3 = CaO

3. **Effect of dosages of liming materials.** Liming materials at 6 tons/ha had higher influence on pH changes than 3 tons/ha. A larger pH increase from the higher dosage of liming material could be due to the operation of law of mass action. The control recorded the lowest value. This was in accordance with the findings of Abichandani and Patnaik (1961).

TABLE II Relative increase in soil pH due to application of two doses of liming materials

Soil group	Locality	pH of untreated (soil control)	pH at 3 tons/ ha(D_1)	pH at 6 tons/ ha (D_2)
Black	Peelamedu	8.3	8.7	8.9
	Medikerepura	7.4	8.4	8.5
	Chowtapally	8.1	8.7	8.7
Alluvial	Aduthurai	6.9	8.0	8.2
	Avanigadda	7.6	8.1	8.3
Red	Sathiamangalam	6.6	8.2	8.4
	Tirupathi	6.2	8.3	8.5
	Manvi	6.4	7.7	7.8
Laterite	Nanjanad	4.5	6.5	6.6
	Pattambi	4.8	4.2	7.5
	Mercara	4.7	7.4	7.6

4. **Effect of stages :** The increase in pH was high at first and second stage followed by fifth, fourth and third stages. This showed that the pH registered a sudden increase in the initial stage but there was a drop in pH at third stage and thereafter it increased steadily and reached at fifth stage the same pH value as that of the first stage. Hoyert and Axley (1952) found that the greatest change in soil reaction occurred in the initial stage after adding the liming materials.

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