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STUDIES ON THE CHANGE OF LIME POTENTIAL OF ACID SULPHATE SOILS OF KERALA ON SUBMERGENCE*

Lime potential (pH-1/2 p Ca), the chemical potential of **Ca** $(OH)_2$, is consid. ered to be a more appropriate parameter for characterising acid soil (Schofield and Taylor 1955; Turner and Nichol, 1963) than pH, because the activity of a single ion need not be constant throughout the solution. Turner *et al.* (1963) reported **that** the values of Al $(OH)_3$ was the most important factor affecting the magnitude of lime potential and when correction was applied to eliminate this, lime potential was pH-1/2 pCa–1/3(33.8–pK_2), were pK_2 was the value for the soil. The corrected lime potential was subjected to lowest variation with moisture level and period of flooding (Chen and Li, 1970). Bache (1970) suggested that in moderate to strong acid soils, lime potential varied with salt concentrations with a single salt solution, only when the reference cation in the extracting solution was the dominant exchangeable cation.

Surface (0-15 cm) samples of acid sulphate soils were collected from the districts of Alleppey, Kottayam, Ernakulam and Canannore. These soils have been termed according to the local nomenclature such as *kari, kayal, karapadam, kole, pokkali* and swamp soils. The pH (water) varied from 3.2 to 5.0 except in the *kayal* soil which had a pH of 5.5 (Table 1), These soils had a lime requirement (Woodruff, 1948) of 400 to 20,000 kg/ha and were high in salt concentration 5.2 to 16 m mhos/cm).

These soils had moderate to high content of total N (0.095 to 0.37%-micro kjeldhal) and organic carbon (1.4 to 8.4%-Walkley and Blook) and were low in available P (1 to 10 ppm-Olsen).

The cation exchange capacity (Neutral normal Ammonium acetate method) of these soils ranged from 8 to 28 me/100g of soil. Exchangeable Ca and K (Flame photometer) were between 0.9 to 11.5 and 0.14 to 0,45 me/100g soil respectively. Exchangeable Fe (Thiocyanate method) and Mn (Periodate method) were found **to be** between 8 to 32 and trace to 77 ppm respectively. These soils had very high exchangeable Al (20—580 ppm, Aluminon method in I N KCl extract) and exchange acidity (Barium chloride TEA method) was between 6 and 40 me/100g soil. The active Fe content of these soils ranges from 0.06 to 3,28% (Asami and Kumada, 1969).

Minerological analysis (Ghosh *et al.*, 1973) of these soils indicated that kaotinite was the dominant mineral in the clay fraction, associated with fairly large amounts of smectite and small amounts of halloysite. The fine silt and coarse silt fractions contained quartz, mica, felspar, kaolinite and chlorite as the dominant minerals.

For study of change in lime potential, 40g soil contained in 100 ml plastic centrifuge tubes were flooded with 40 ml distilled water and incubated at room temperature. Water loss due to evaporation was made up every day. At the respective times of sampling, duplicate samples were drawn and treated with 100 ml of 0.01 M $CaCl_2$ or 0.001 M $AlCl_3$ solution making allowance for water used for flooding. The suspension was shaken for 2 hours in a mechanical shaker After allowing the suspension to settle for 15 minutes, the glass electrode was immersed in the suspension for 2 minutes before bringing the reference electrode into contact with the supernatent liquid. The pH of the suspension was read from the Beckman Zeromatic pH meter. The suspension was then centrifuged and filtered (Bache, 1970). Al was determined in suitable aliquots by aluminon method. Ca + Mg was determined by titrating the solutions with Sodium EDTA (Cheng and Bray, 1951). The simple lime potential was calculated as pH-1/2p (Ca+Mg) where p (Ca+Mg) was negative log of (Ca+Mg) expressed as moles/litre.

Excepting the *Kayal* soil the lime potential of those soils in $CaCl_2$ extraction was corrected for Al^{+++} as per the equation pH—1/2 p (Ca + Mg) — 1/3 (33.8 — p Al — 3pOH) (Turner and Clark, 1965). This corrected lime potential is referred to as true or corrected lime potential. In addition, lime potential of the soils was also calculated from $AlCl_3$ extract (Bache, 1970).

The change in pH was studied separately in 50g soil samples incubated with 50 ml of water in 100 ml beakers under the same conditions as above.

From the Figure 1 it may be seen that in the different soils, the values of true lime potential measured from $CaCl_2$ or $AlCl_3$ extract were not very much different in most cases except in the *kayal, pokkali* M and swamp soils. In *karapadam* and *kole* soils, the true lime potential as well as lime potential in $AlCl_3$ extract remained more or less constant with period of submergence, except for a slight increase (from 3 to 3.8) of lime potential from $AlCl_3$ extract for *karapadam* A. On the other hand *kayal* soil showed a sharp increase in the true lime potential with submergence, but lime potential of this soil when extracted with 0.001 M $AlCl_3$, remained constant with period of submergence.

In the *kari*. swamp and *pokkali* soils, the true lime potential was between 2,57 to 2.87. With submergence it showed only slight increase to attain values between 2.89 to 3.04, However, when these soiis were extracted with 0.001 M $AlCl_3$ the lime potential was found to increase from initial values of 2.2 to 2.5 to final values of 2.7 to 4.1 which was approximately in proportion to increase in pH observed due to submergence (Fig. 2).

From the results, it can be inferred that in the case of strongly acid soils, if lime potential is calculated from $CaCl_2$ extractions, correction should be applied for Al. Hence this result is in agreement with that of Turner and Clark (1965).

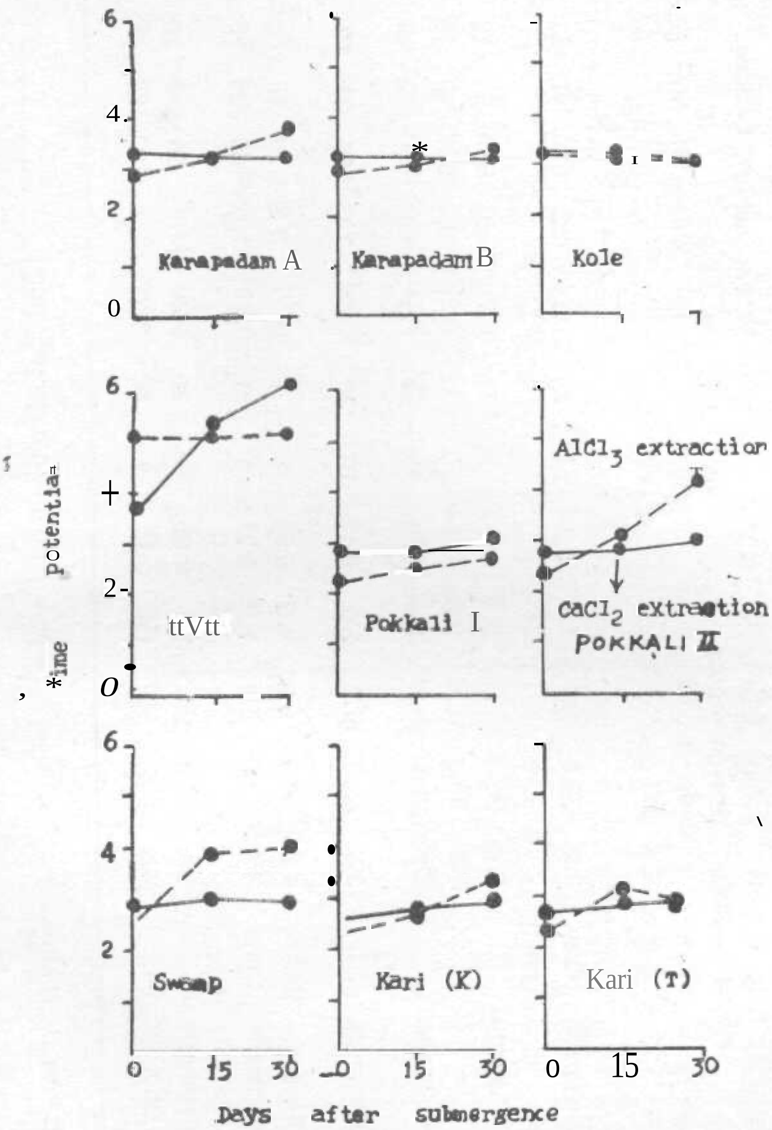

Fig.1 Effect of flooding on the change in lime potential of acid sulphate soils

Table-1.

Characteristics of acid sulphate soils of Kerala

Soil type & location	Districts	Textural class	pH (Water)	Exchange acidity	ECe m mhos/cm	C%	N%	Available P ppm (Olsen)	CEC me/100g	Exchangeable Cations me/100 g K	Ca	ppm Al	Mn	Fe	Active Fe%
Kari Thottappally	Alleppey	Clay loam	3.2	39.6	8.7	7.3	0.34	Tr	24	0.14	3.8	510	43	32	0.75
Kari	Kottayam	...	3.4	30.0	5.5	8.4	0.37	Tr	28	0.20	2.6	580	51	19	3 28
Saline		...	3.0	30.0	16.0	3.5	0.24	7	22	0.30	6.2	504	77	13	1.00
**Pokkali I* / **Pokkali II*	Ernakulam	...	5.1	25.0	15.5	3.6	0.26	10	25	0,45	6.3	200	42	10	1 02
Swamp Kattampally	Cannanore	...	3.5	26,0	11.2	2,5	0.18	10	20	0.25	2.8	584	31	13	1.37
Karapadam A	Alleppey	Sandy	4.8	6.3	5.2	4.3	0.24	5	8	0.17	0,9	30	Tr	8	0.06
Karapadam B	Alleppey	Clay loam	4.0	10.9	8.4	1.5	0.11	9	19	0.30	1.5	130	26	13	0.78
Kayal	Alleppey	...	5.6	8.0	9.8	1.5	0.09	5	20	0.40	11.5	20	22	22	2.76
Kole	Trichur	...	4.9	14.6	5.2	1.4	0.15	9	20	0.22	2.8	102	66	8	3.28

** *Pokkali I* and *Pokkali II* represents saline soils collected from two different spots

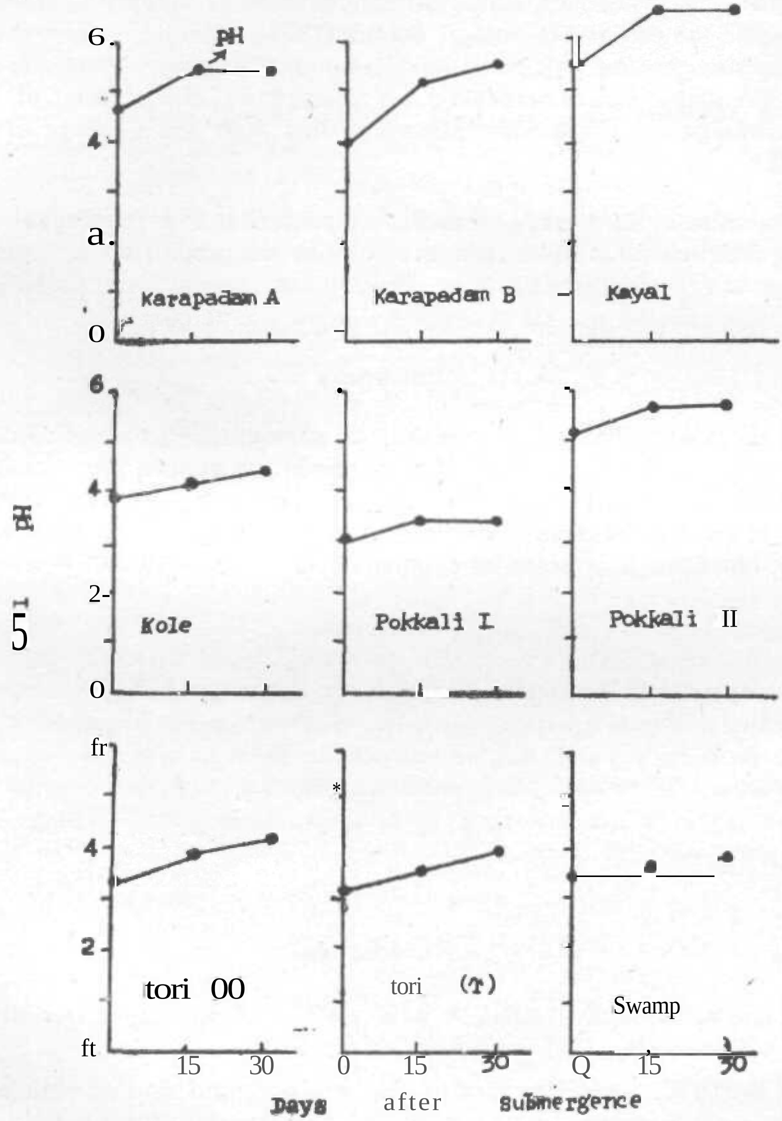

Fig.2 Effect of flooding on the change in pH of acid sulphate soils

Similarly, in such soils, because Al is the dominant cation, it will be better to use $AlCl_3$ extractions instead of $CaCl_2$ extractions and then applying correction. This is in line with the earlier findings of Bache (1 970). Similarly, from the results it can also be seen that the lime potential of strongly acid soils (where the pH remains below 5 even after submergence) is not affected by either level of moisture or days of submergence. This observation is in line with the findings of Chen and Li (1970).

In spite of all these, a close examination of the lime potential values will reveal the fact that this has a tendency to rise in proportion to increase in pH. This brings out the fact that pH is as good an indicator as lime potential of submerged paddy soils whose pH shoots up due to submergence.

Summary

Laboratory incubation experiments conducted using acid sulphate soils collected from different parts of Kerala revealed that simple lime potential of soil is markedly influenced by moisture and days of submergence. The corrected lime potential of strongly acid soils whose pH remained below five even after submmergence, remained unaffected by submergence.

സംഗ്രഹം

കേരളത്തിന്റെ വിവിധഭാഗങ്ങളിൽ rot ന്നു ശേഖരിച്ച അമ്ലസൾഫേറ്റ് മണ്ണുകളെ പരീക്ഷണശാലയിൽ ഇൻക്യുബേററു ചെയ്തു പരീക്ഷിച്ചതിൽ അവയുടെ കുമ്മായക്ഷമത (ലഘു)യെ സ്വാധീനിച്ച ഘടകങ്ങളിൽ മുഖ്യം, ജലാംശവും ജലനിമജ്ജന കാലദൈർഘ്യവുമാണെന്നു കണ്ടു. ജലനിമജ്ജനത്തിനുശേഷവും pH 5-ൽ താഴെയായി നിന്ന് തീവ്രാമ്ള മണ്ണുകളുടെ ശരിയായ കുമ്മായക്ഷമതയിൽ സാരമായ യാതൊരു വ്യത്യാസവും, ജലനിമജ്ജനം കൊണ്ടുണ്ടാകുന്നില്ലെന്നും കണ്ടു.

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