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INFLUENCE OF SOIL REACTION ON CERTAIN SOIL PROPERTIES AND AVAILABILITY OF MAJOR NUTRIENTS IN KERALA SOILS*

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It is now well known that a knowledge of soil p^H can give a clear picture of the distribution pattern of certain important soil properties and that the understanding of the properties of a given soil will be rendered considerably simple in the event of these properties being related to the soil p^H. No information is available on these correlations relating to the soils of Kerala except for the observations of Koshy and Britto-Muthunayagam (1961) that high acidic nature and high sesquioxide content are prevalent in the soils of Kerala and of Vijayachandran (1963) that acid soils of Kerala contain only meagre quantities of potassium, calcium and magnesium. So studies reported in this paper were taken up to establish possible relationships of soil p^H with significant soil properties and availability of major nutrients, using all the major soil types of Kerala.

Thirty six surface soil samples (0-9") representing all the six main soil groups of Kerala, namely, laterite and red, forest and hill, sandy, alluvial, peat and black soils, were taken from selected areas of the State. The method of chemical analysis followed were those outlined in A. O A. C. (1955) and Jackson (1962).

Results and Discussions

Tables I and 2 summarise the properties and nutrient contents respectively of the soils.

It is found that the soils vary widely in respect to their p^H. The p^H values are seen to be correlated with total nitrogen, available phosphoric acid, loss on ignition, organic carbon, cation exchange capacity, cation saturation percentage, exchangeable calcium saturation percentage and lime requirement, as has been revealed in statistical analysis (Table 3).

One of the striking relationships is that the loss on ignition in most soils, especially in peat and forest soils, which are extremely acidic in reaction is comparatively high. A significant negative correlation between p^H and this property is observed. This may be because the organic matter content which is the main contributing factor for loss on ignition is more in acid

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soils (Russell and Rusell, 1950) • In fact an increase in organic carbon with an increase in hydrogen ion concentration is also observed in the present study •

The sesquioxides in laterite and red soils are seen to be comparatively high and there is a tendency for these constituents to increase with a decrease in soil p^H in them. But no significant relationship could be observed between p^H and sesquioxides when all the soils are taken together which may be due to the diversity of the different soil groups with regard to this property.

TABLE 1

Chemical properties of different soil types of Kerala

Sl· No.	Soil type	p^H	Loss on ignition %	Sesqui-oxide R_2O_3 %	Lime (GaO) %	Magnesia (MgO) %	C·E·C (me/100gm	Base sat· %	Calcuim sat· %	Lime require-ment ($CaCO_3$ in lb/acre)
1.	Laterite & Red	5 1	5·04	26.33	0.106	0.047	S.85	71.4	39.5	3,500
2·	Forest and Hill	4,7	15·02	20.77	0.115	0063	14.03	53.1	27.9	5,600
3.	Sandy	6.0	1.74	1.88	0.098	0.042	1,95	83.3	40.1	1,317
4.	Alluvial	5.2	9.11	11.92	0.138	0·061	8.37	70.9	34·9	5,567
5.	Peat	4.1	26.30	12.04	0.079	0.139	40.29	45.9	14.4	9,683
6.	Black	7:5	10.34	1.72	1.023	0.272	43.25	96.2	81,6	. —

TABLE 2

Percent contents of organic carbon and nutrient elements in different types of Kerala toils

Si. No	Soil type	Organic carbon	Total nutrients			Available		
			N	P_2O_5	K_2O	N	P_2O_5	K_2O
1·	Laterite and Red	1.44	0.1111	0.0791.	0.0641	0.0186	0.0031	0.0231
2·	Forest and Hill	4.76	0.1937	0.1025	0.0381	0.0222	0.0038	0.0232
3·	Sandy	0.42	0·0239	0.0284	0.0185	0.0082	0.0046	0.0063
4.	Alluvial	2.81	0.1288	0.0957	0.0840	0.0194	0.0031	0.0204
5·	Peat	12.28	0.2614	0.0681	0·5889	0.0138	0,0015	0.0813
6·	Black	1.21	0,0761	0.0770	0.3910	0.0167	0.0056	0.0343

TABLE 3

Results of Statistical Analysis

Sl. No.	Independent variable X	Dependent variable Y	Correlation coefficient r
1.	Soil Reaction (p^H)	Loss on Ignition (%)	0.438**
2.	Hydrogen ion concentration	Organic carbon (%)	0.830***
3.	Soil Reaction (p^H)	Cation Exchange Capacity (me/100 g. soil)	0.764***
4.	do	Cation saturation percentage	0.928***
5.	do	Exchangeable calcium saturation percentage	0.928***
6.	do	Lime requirment (lb/acre)	0.831***
7.	do	Total Nitrogen (%)	0.748***
8.	do	Available Phosphoric Acid (%)	0.497**

Note: ***Significant at 0.1 percent level **Significant at 1.0 percent level

Further, the cation exchange capacity and p^H values are high in black soils. There is a tendency for cation exchange capacity to increase with increase in p^H in these soils. However, an interesting point brought out by the present work is the negative correlation between p^H and cation exchange capacity of acid soils. This appears to be due to the fact that in the extremely acid soils like peat and forest soils the main contributing factor towards cation exchange capacity is organic matter.

A very appreciable increase in base saturation with increase in p^H is evidenced as previously recorded by Livens (1954) and others. The calcium saturation percentage is also found to be significantly correlated with soil p^H.

The lime requirement estimated by the method of Hutchinson and Maclennon (1914) is found to be negatively related to soil p^H, making it possible to derive lime requirement rapidly from p^H, an easily determined constant. Rose *et al* (1964) reported similar relationship in nine Michigan soils.

Studies on the effect of soil reaction on nutrient availability show that the total nitrogen content in most soils is comparatively high and that a significant negative correlation exists between soil p^H and total nitrogen content. This relationship is possible because of the poor rate of nitrogen mineralisation in acid soils. Inspite of the high content of total nitrogen the available nitrogen content is seen to be very poor. There is a tendency for the available nitrogen content to increase with an increase in soil p^H though this relationship is not significant. The available nitrogen content appears to be governed by

the rate of mineralisation of organic nitrogen which in turn is suppressed by low p^H values. Since there is a close negative correlation between p^H and total nitrogen in the soils studied the possible correlation between available nitrogen and the p^H seems to have been masked. Thompson *et al* (3954) also had reported nitrogen mineralisation as dependent more on total nitrogen than p^H.

The total phosphorus content like total nitrogen is found to be comparatively high. Accumulation of organic forms of phosphorus due to slow mineralisation of organic matter (Thompson *el al,* 1954) and precipitation of iron and aluminium phosphate (Ghani and Islam, 1946) under acid conditions might have resulted in the high content of total phosphorus in these soils. However, no significant correlation between p^H and total phosphorus is noted. The available phosphoric acid content is found to be increased with an increase in soil p^H This may be due to lower fixation and high solubility of phosphorus at comparatively high p^H values of the soils studied compared to other higher acid soils. Similar observations have been reported by Kanwar and Grewal (1960), Raychaudhuri and Landey (1960) and Yadav and Pathak (1963).

The total and available potash status of the soils are found to be considerably poor. There is no strict relationship with p^H values for both total and available potash. Poor status of potash in these soils can be attributed to the greater loss through leaching under acid conditions as reported by Nolan and Pritchett (1960).

Summary

Relationship between soil reaction and certain significant soil properties and availability of major nutrients in the laterite and red, forest and hill, sandy, alluvial, peat and black soils of Kerala has been studied.

The loss on ignition, organic carbon, total nitrogen, lime requirement and cation exchange capacity of the acid soils are negatively correlated with soil p^H. Positive correlations exist between soil reaction and soil properties like cation saturation percentage, calcium saturation percentage and available phosphorus.

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