Madras. Agric J. 44 - 313-325
1957
https://doi.org/10.29321/MAJ.10.A04161

The Soils of Madras — Part - III
The Red Soils of Madras

by

P. K. R. MENON and Dr. A. MARIAKULANDAI,
Agricultural College and Research Institute, Coimbatore.

Introduction: In Part of I of the series (1) the distribution of the different soils in the state as a whole and in the various districts and taluks was described. In the second part (2) a fairly detailed description of the black soil of Madras was presented with data as to the mechanical composition, alkalinity, cation exchange properties and the fertility status of two of the important types. In the present paper the red soil of Madras including the red earths, lateritic and laterite soils are dealt with.

The broad basis for the revenue classification of soils are colour and texture and all soils with red colour are put into one group irrespective of their mineralogical and chemical composition. However, from a consideration of their properties and composition the red soils can be subdivided into two main categories: (1) the red earth with Kaolinitic clay and (2) the lateritic and laterite soils with a preponderance of hydrous oxide clay. The red soil is the most important soil in Madras in respect of area. It occupies 19 million acres (63% of the total cultivable area) as compared with less than 6 million acres of black soil.

Geology of the Red Soil: The main geological formations which have given rise to the red soils of Madras are the granites and gneisses of the Archean period. They cover extensive areas in the state. The rock formations are of a mixed character containing both acidic and basic components. The acidic part is rich in silica containing over 65% of the compound and with a molecular silica-sesquioxide ratio of over six. It is poor in lime but contains alkali felspars. It is generally the acidic component of granites and gneisses rich in alkali felspars which give rise to red soils on weathering. The other rock formations from which red soils have developed in Madras are the Cuddalore sand stones, mica schists, acid traps, quartzites, shales etc. On weathering, the alkali felspars present in these rocks form minerals of the Kaolinite group. These clay minerals become coated with red haematite or yellow limonite or a mixture of the two oxides of iron forming a red, yellow or a reddish-yellow soil. The yellowish soil becomes red when the limonite undergoes dehydration and changes to haematite.

Ferrugingeous gravel (impure iron, alumina and silica concretions) and bits of quartz are the common accessory constituents in red soils. Kankar or calcium carbonate is also found in some red soils. There are also instances where parent materials rich in calcium have given rise to reddish soil. For example, the limestone beds of Kurnool have developed into red soils. This is mainly due to the nature of the non-calcareous impurity in the limestone.

Except under extreme conditions as in the West Coast, climate has very little influence and the character of the parent material is the most important factor in respect of soil formation in Madras. In the West Coast and other regions with heavy rainfall of over 100 inches per annum and high summer temperature any rock formation can give rise to lateritic and laterite soils.

The Red Soil of Madras — General: The red variety is the most extensive soil type in Madras State and occurs in some form or other in all the districts. The largest areas are in Malabar and South Canara districts of erstwhile Madras and in the districts of Madura and North Arcot. It also occupies about 60% and more of the cultivable area in the districts of Chingelpet, South Arcot, Salem, Coimbatore, Tiruchirapalli, Tirunelveli etc. Tanjore and Ramanathapuram are the only localities where this soil type is not predominant. But in Tanjore district, the Cauvery alluvium is deposited over the red soil and so the native soil may be regarded as the red soil. Although complete data is not available for Nilgris, it is found that almost the entire area is covered with some variety of red soil. The red soil (including lateritic and laterite soils) is found in all rainfall regions from the semi-arid to the humid parts of the State.

The texture of the red soil varies from sands to clays. However, the majority are loams of some kind. The colour of the soil is due mainly to ferric oxides which occur as thin coatings on the soil particles. Where the iron oxide occurs as haematite or anhydrous ferric oxide the colour imparted is red. With limonite or hydrated ferric oxide the soil gets a yellowish colour and mixtures of the two oxides give different shades of red and yellow depending on which oxide predominates. Ordinarily the surface soil is reddish in colour and the lower depths may show a reddish-yellow or distinctly yellow colour because the dehydration of the iron oxides is generally greater in the surface layers.

The characteristic clay mineral present in the soil is of the kaolinitic type and one gram of clay is approximately responsible for a cation exchange capacity of 0·25 to 0·5 milliequivalents. The base exchange capacity of the soil generally varies from 5 to 25 milliequivalents per 100 grams depending on the amounts of clay and organic matter. Calcium forms 40 to 70% of the exchange capacity. Acidic soils show lower content of exchangeable calcium while in the material of slightly alkaline soils it forms the major portion of the exchangeable cations. In the lateritic and laterite soils there is very little of silicate minerals. Even the coarser particles consist mainly of secondary products of weathering and there is a large proportion of hydrous oxides mixed with a little silica. Lateritic soils have, therefore, base exchange capacities varying from 4 to 7 milliequivalents per 100 grams of the soil while the values for laterites may be as low as 2 to 4 milliequivalents per 100 grams.

The red soil generally contains very low amounts of soluble salts (0·1% and less). The salts consist mainly of the bicarbonate, chloride and sulphate of sodium, calcium and magnesium. Soluble carbonates are seldom met with in the soils.

The red soils have a lower fertility status than the black soil. As is common with most of the tropical soils, organic, matter is generally much below the minimum requirement even where the total phosphoric acid is adequate. Potash, total and available, is present in the soils in good amounts except in the heavily leached lateritic and laterite soils. Most of the red soils of Madras contain enough of lime but there are some which would benefit by its application. This is particularly true of laterite and lateritic soils. The majority of the red soils are slightly on the acid side, while a few may be slightly alkaline, the pH ranging from 4·5 to 7·5. Although the nutrient content is low many crops can be successfully grown in the red soil with manuring on account of their favourable loamy texture.

As there is considerable variation in the minerological composition, the red soils can be studied under two main groups, namely the red earth and the lateritic soils including the laterites. The red earths contain Kaolinitic clay while the lateritic and laterite soils have mainly non-silicate hydrous oxides in the clay complex.

The Red Soil or the Red Earth: *Profile Characteristics:* The red earth vary considerably in texture. Some are sandy soils, most are loams of some kind and very few are clay soils. The profile descriptions of the true types are given below diagramatically.

Depth	Red Sandy Soil Palur.	Red Loam Palakkuppam.	Red Clay Soil Coimbatore.
1'9"	Brownish Loose Soil 6"	Loose Yellow Soil	Reddish Brown Soil free from Calcium Carbonate
3'	Dark Brown 1'6" Compact	Red Sandy Soil 2½'	
	Brownish Yellow Sandy Loam 2½' Loose	Red Angular Gravel & Sand	Loose Sandy Gravel free from Calcium Carbonate
5'	Fine Sand Light Brown	3'9"	
6'9"		Red Angular Gravel & Sand with Yellowish White Clay 5'3"	Stiff Soil (Brown) with Calcium Carbonate
	Coarse Sandy Soil	Clay	Loose Kankar with Reddish Gravel & Sand
9'	Water table		

The soils are red on the surface layer with a yellowish tinge in the lower depths indicating that the dehydration of the iron oxides is not complete below the surface. The sandy soil type contains a major part of the coarse fraction in all the depths while the loamy soil shows sand and gravel in the sub-soil and these are mixed with kaolin below the third foot. The sandy red soil and the loam do not contain much calcium carbonate in any of the depths but the clayey red soil of Coimbatore shows *Kankar* streaks below 2½ feet. The quantity of Kankar increases with depth and below 5 feet there is a considerable quantity of this material.

Mechanical Composition: The results of analysis of the soils for mechanical composition as carried out by the International A method without hydrogen peroxide treatment are tabulated below for the three types of red soil; sandy, loamy and clayey:

	Red Sandy Soil Palur		Red Loamy Soil Palakkuppam		Red Clay Soil Coimbatore	
	0–8"	8"–21"	0–6"	6"–18"	0–6"	6"–18"
Clay %	7·6	17·0	17·9	35·1	38·8	24·3
Silt %	6·5	7·3	2·1	3·4	14·6	6·3
Fine Sand %	44·4	41·8	28·0	21·2	20·8	24·3
Coarse Sand %	40·6	32·8	50·9	40·1	25·8	45·1
Matter soluble in dil Hcl. % etc. (By diff.)	0·9	1·1	1·1	0·2	...	...
Total	100·0	100·0	100·0	100·0	100·0	100·0

The Palur soil may be taken as typical of red sandy soil. The top soil contains less than 20% of the finer fractions and the sands are present in about equal proportions. The lower depth contains a higher percentage of clay probably as a consequence of leaching. The loamy soil of Palakkuppam is a loam only on the surface and becomes a clay in the lower depth containing twice as much of the fine particles. Coarse sand is found in both the soil and sub - soil in a larger proportion than fine sand.

The Coimbatore red soil is a clay soil only in the surface and becomes a clay loam in the lower depth. In the sub - soil there is a preponderance of coarse sand.

Water Soluble Salts : The results of analysis of water soluble salts in 1 : 5 soil exact are tabulated below for the three different types of red soil :

	Red Sandy Soil Palur		Red Loamy Soil Palakkuppam		Red Clay Soil Coimbatore	
	0–8″	8″–21″	0–6″	6″–18″	0–6″	6″–18″
Total Soluble salts %	0·040	0·063	0·040	0·014	0·025	0·025
Carbonate (CO_3) %	Nil		Nil		Nil	
Bicarbonte (HCO_3) %	0·013	0 017	0·018	0·0073	0·0026	0·0020
Chloride (Cl) %	0·0050	0·0070	0·0025	0·0025	0·0040	0·0035

The soluble salts are low in all the three soil types being less than 0·1%. This is, in the main, true of most red soils and carbonates are invariably absent. The most important ion in the soil extract is the bicarbonate with chloride closely following. The cations and the probable nature of the salts have not been determined as the total salt content is less than 0·1%. Monovalent cations (sodium and potassium) are generally more abundant in the soil extract of red soils than the divalent cations calcium and magnesium.

Cation Exchange Properties : On account of the Kaolinitic type of clay present in the red soil its base exchange capacity is much lower than that of the black soil : one hundred grams of the red soil clay possess a cation exchange capacity of only 25 to 50 millicquivalents. So, depending on the clay and organic matter contents, the exchange capacity of the soils in the field varies considerably. The base exchange properties of the three types of red soil are tabulated below:

		Red Sandy Soil Palur		Red Loamy Soil Palukkuppam		Red Clay Soil Coimbatore	
		0–8″	8″–21″	0–6″	6″–18″	0–6″	6″–18″
Cation exchange capacity per 100 grams of soil		7·2	12·5	7·6	10 0	29·6	16 8
Exchangeable	Ca.	5·2	9 6	5·0	6·6	23·7	14·0
,,	Mg.	1·9	2·5	2·4	3·4	4·9	2·4
,,	K.	0·1	0·1	0·15	0·03	0·99	0·55
,,	Na.	..	0·2	..	..	..	..
		(Per 100 grams of soil)					

The cation exchange capacity and other exchange properties of the surface soil are invariably higher than can be accounted for from the clay content above. This is because of the organic colloids which are also present in the surface layer and which have 8 to 10 times the base exchange capacity of red soil clay. This is the reason for the comparatively higher exchange properties of the Palur sandy soil as compared with the loamy Palakkuppam soil. In Coimbatore surface soil also, organic matter has contributed to the exchange phenomenon and the cation exchange capacity is higher than what the mineral clay would show. In the cations of the exchange complex, calcium is the most important, forming 65 to 80% of the total. Next in importance is magnesium and potassium in the given order. Most of the red soils show little or no exchangeable sodium.

Fertility status: The red soil generally has a lower fertility status than the black soil. It is poorer in nitrogen, organic matter and available phosphoric acid. Some types of red soil do not also contain adequate amounts of calcium. Even though the red soils are lower in fertilty status than the black soils they can be adopted for the cultivation of a greater variety of crops on account of their loamy character or intermixture of the coarse and fine particles. The results of the chemical analysis of the three types of red soil are tabulated below. The total amounts of the nutrients were estimated in the hydrochloric acid extract prepared by disgesting the ignited soil with 1 : 1 hydrochloric acid in the ratio of 1 of soil to 3 of the acid mixture for 8 hours and filtering and washing. The available phosphoric acid and potash were determined by Dyer's 1% Citric acid method. Nitrogen (total) was estimated by digesting the soil with 1 : 1 sulphuric acid using reduced iron to bring into account any nitrate present in the soil.

Chemical analysis of red soils

	Red Sandy Soil Palur	Red Loamy Soil Palakkuppam	Red Clay Soil Coimbatore
	0—1'	0—1'	0—1'
Moisture	0·98	2·8	4·3
Loss on ignition %	1·71	3·19	4·19
Insoluble mineral matter %	91·49	85·34	78·70
Solubles (By. diff.)	6·80	11·47	17·11
Total	100·00	100 00	100·00
Iron (Fe_2O_3) Percent	2·09	6·21	5·31
Alumina (Al_2O_3) ,,	2·90	3·26	8·00
Lime (Ca O) ,,	0·75	0·23	1·72
Magnesia (Mg O) ,,	0·36	0·13	0·40
Potash (K_2O) ,,	0·24	0·13	0·61
Soda (Na_2O) ,,	0·07	0·061	0·30
Carbon dioxide (CO_2) ,,	--	0·032	1·17
Phosphoric acid (P_2O_5) ,,	0·0051	0·013	0 089
Sulphuric acid (SO_3) ,,	0·062	0·041	0·11
Nitrogen (N) ,,	0·033	0·028	0·056
Available Potash (K_2O) ,,	0·010	0·0063	0·019
Available Phosphoric acid (P_2O_5) ,,	0·00053	0·022	0·0022
Silica - Sesquioxide molar ratio $\left(\frac{SiO_2}{R_2O_3}\right)$	3·2	2·5	2·7
Silica - alumina molar ratio $\left(\frac{SiO_2}{Al_2O_3}\right)$	4·2	3·0	3·6
pH.	8·1	7 8	8·5

From the table it is seen that the red sandy soil has a low fertility status. It is poor in nitrogen and organic matter and in total and available phosphoric acid. Potash, both total and available are present in adequate amounts. There is a sufficiency of lime in the soil and calcium forms more than 70% of the cations in the exchange complex. Insoluble mineral matter constitutes more than 90% of the soil and iron and alumina are found in much smaller quantities than in other types of soil. The red sandy soil of Palur is on the alkaline side with pH value of 8.

The loamy red soil of Palakkuppam is also poor in nitrogen, organic matter and available phosphoric acid. In addition, it does not contain adequate amounts of calcium. However, potassium total and available and total phosphoric acid are present in the soil in sufficient quantities. The soil is on the alkaline side. Calcium constitutes about 65% of the exchangeable cations. The molecular silica sesquioxide ratio of the separated clay is typical of the Kaolinitic character of the red soil.

The clayey red soil of Coimbatore is more fertile than the other two types. It contains adequate amounts of nitrogen, total phosphoric acid, potash and lime. Available phosphoric acid and potash are also present in amounts more than the minimum required for plant growth. The soil contains free calcium carbonate as *Kankar* and calcium constitutes 80% and more of the cations in the exchange complex. The pH of the soil is about 8·5 without sodium carbonate. As is the common feature of the tropical soils, organic matter is not present in this soil in adequate amounts.

Lateritic and Laterite Soils: Although lateritic and laterite soils differ considerably from red soils in many important respects, they have been classified under red soils by the revenue authorities and so their characteristics are presented in this paper. They are generally developed in regions of heavy rainfall. Under conditions of heavy leaching due to rainfall, and high summer temperature, lateritic and laterite soils may be formed from any geological formation. But acidic rocks undergo these changes more readily than basic rocks. When large quantities of water percolate through the soil as in regions of heavy rainfall, the soluble salts are first washed out. Simultaneously and later on, the cations of the colloidal complex are gradually leached out, their places being taken by the hydrogen ions of the percolating carbonated waters. When the hydrogen ions in the exchange complex or colloidal complex exceed a certain limit they probely enter the clay micelle and break it up liberating iron and aluminium hydroxides and silicic acid. The silicic acid being soluble is gradually lost in the drainage waters and a matrix is left behind rich in iron and aluminium hydroxides and oxides and some silica. There may also be a small amount of Kaolinitic minerals but not much. Soils containing Kaolinitic clay also readily undergo laterization on account of heavy leaching. Strictly speaking the laterite thus formed cannot be called a soil but only as a degraded or decomposed soil material. There is not much of primary silicate minerals and even coarser particles consist chiefly of secondary products of weathering. The laterite is generally reddish or yellowish-red in colour and often has a vermicular structure with iron concretions. At or near the water table it is soft and can be cut out into blocks. These blocks dry up on exposure and become as hard as granite. So the material is quarried for use as bricks for building purposes. The material was given the name "laterite" from the latin term "later" meaning a brick. Latosol and Ferralite are two of the newer forms used to designate laterite soils.

Lateritic soils have not degenerated to the same extent as the true laterites. Here also there is the decomposition of the clay complex and the accumulation of iron and aluminium hydroxides. But the decomposition of only a smaller part of the colloidal complex has taken place and there is a slightly larger proportion of the primary Kaolinitic minerals than in laterites. Lateritic soils are therefore more fertile than the laterites.

Under the climatic conditions of South India, the amount and intensity of rainfall appear to be more potent in laterite formation than the temperature. Laterite soils are found extensively in the west coast and on the hills and in patches on the east coast. In Malabar these soils occur in all regions with an annual preciptation of over 100 inches concentrated in the South – West monsoon months of July August and September. In the extreme south of the district, in Palghat taluk the rainfall is less: it is only 70–80 inches per annum and it is distributed in the South – West and North – East monsoons (50 to 60″ in the South West and 20 to 30″ in the North East monsoons). The soils in this region have not developed into laterites: they are only lateritic in character. The lateritic soils do not have the vermicular structure peculiar to laterites. They cannot be used as building stones.

As the laterites do not contain primary clay minerals they show the typical clay properties such as plasticity, cohesion, shrinkage, expansion, base exchange properties etc., to a very small extent. Even a clayey laterite soil is highly porous and is not able to retain water and manures added to it. The base exchange capacity of the mineral colloids may range from 2 to 4 milliequivalents per 100 grams for laterites and from 4 to 7 for lateritic soils. The molecular silica-sesquioxide radio of laterite soils is below 1·33 and that of lateritic soils between 1·33 and 2.

Detailed Study of the Lateritic and Laterite Soils

PROFILE CHARACTERISTICS

Lateritic Soil, Pattukkottai.		Laterite Soil, Taliparamba.	
6″	Brown Sandy Loam	1′	Dark Red
	Buff Coloured Red loam Tending to be heavier downwards		Red in Colour with Vescicular Structure & Iron Concretions
3′			
	Brown Loam with Gravel (Iron Concretions) which increases with depth	6′	Yellowish Red
6′			

Mechanical composition of Lateritic and Laterite Soils:

	Lateritic Soil Pattukkottai		Laterite Soil Mangalore	
	0—6″	6″—12″	0—1′	1′—2′
Moisture %	0-61	0-81	1-80	1-92
Clay per cent	13·0	25·7	31·8	43·8
Silt ,,	2·5	2·6	14·3	16·5
Fine Sand per cent	22·7	17·7	9·8	9·5
Coarse Sand ,,	62·8	54·5	45·0	30·5

Water Soluble Salts: alkalinity in Lateritic and Laterite Soils

	Lateritic Soil Pattukkottai		Laterite Soil Mangalore	
	0—6″	6″—12″	0—1′	1′—2′
Total Soluble Salts %	0·01	0·01	..	..
Carbonate (CO_3)	not estimated		nil	nil
Bicarbonate (HCO_3)	..	..	0·0031	0·0024
Chloride (Cl.)	..	..	0·021	0·013

Base Exchange Properties of Lateritic and Laterite Soils

	Lateritic Soil Pattukkottai		Laterite Soil Mangalore	
Cation exchange capacity	0—6″	6″—12″	0—1′	1′—2′
m. e. per 100 grams of Soil	2·4	3·6	7·9	1·2
Exchangeable Calcium m. e. per 100 grams of Soil	1·3	1·9	1·7	1·2
Exchangeable Magnesium	0 8	1·5	1·1	1 0
,, Potassium	0·3	0·2	0·2	0·1
,, Sodium	0·02	0·1	..	..
Degree of alkalinisation %	12·5	6·3	..	..

Fertility Status of Lateritic and Laterite Soils:

	Lateritic Soil Pattukkottai		Laterite Soil Mangalore	
	0—6″	6″—12″	0—1′	1′—2′
Moisture %	0·61	0·81	1 80	1·92
Loss on ignition %	1·23	2·56	7·74	9·08
Lime (Ca O) %	0·049	0·063	0·042	0·049
Total Nitrogen % (N)	0·020	0·023	0·068	0·020
Total phosphoric acid (P_2O_5)	0·0081	0·024	0·095	0·022
Total Potash (K_2O)	0·19	0·21	0·19	0·12
Available phosphoric acid (P_2O_5) %	0·0013	0·0011	0·0021	0·00053
Available Potash (K_2O) %	0·01	0·008	0 011	0·007
Organic carbon (Walkley and Black Number)	0·20	0·12	0 32	0·24
Silica sesquioxide $\frac{SiO_2}{R_2O_3}$ molar ratio	..	..	1·32	1·33
$\frac{SiO_2}{A_2O_3}$ molar ratio	..	..	1·67	1·75
pH	6·80	7 05	4·8	4 9

Profile characteristics : The soils are often deep; the lateritic soil in some localities, however are shallow. The lateritic soil generally is some kind of loam in the different horizons without the vescicular structure characteristic of the true laterites. Both clays and loams are noted in the laterite type, with over 50% of clay particles in some localities. Both the soils are red on the top and the colour changes to reddish yellow and finally to yellow in the deeper layers. Ferrugineous gravel is met with in both the soil types in some part of the profile. At and below the water table the laterite is soft and cheesy.

Mechanical composition : The lateritic soil is often a loam of some kind with good internal drainage. The percolating waters carry down some of the finer particles. This is why the lower depth in Pattukkottai contains about twice as much clay as the surface soil. The coarser fractions form about 80% of the surface soil and the sub - soil, with coarse sand preponderating.

The laterite soil is a clay soil in both the depths. Here also there is a considerable washing down of the finer particles into the sub - soil. Both the soil and the sub - soil contain about equal amounts of the finer and the coarser fractions. The sub - soil, however, is richer in finer particles.

Water soluble salts : The lateritic and laterite soils contain very little of soluble salts. This is to be expected from the considerable leaching to which the soils are subjected. There is no carbonate among the soluble salts and the acid a radicals consist mainly of bicarbonate and chloride. The probable nature of the salts has not been worked out, but the cations of the salts are usually consist of sodium.

Cation Exchange properties : Since the clay complex of the lateritic and laterite soils consists mainly of hydrous oxides (iron and aluminium oxides and hydroxides) with very little of silicate minerals, they posess very low exchange capacity. The mineral complex of laterite soils generally show a base exchange capacity of 2 - 4 milliequivalents per 100 grams of soil while the values for lateritic soils range from 4 to 7 milliequivalents per 100 grams. Where the field soils show higher values as in the laterite soil, it is due to the presence of organic colloids which have 5 to 6 times the base exchange capacity of the best clay. In the lateritic soil 50% and more of the exchangeable cations consist of calcium with magnesium next in the order of importance. The monovalent metallic cations (potassium and sodium) are present in small amounts and the degree of alkalinisation $\left[\frac{\text{(Monovalent metallic cations)}}{\text{Base exchange capacity}} \times 100\right]$ ranges from 6 to 12·4%. There is only a trace of hydrogen in the exchange complex of the Pattukkottai lateritic soil and the pH value of the surface soil is 6·80 with 7·05 for the sub-soil. However, same lateritic soils have been found to contain more hydrogen and have lower pH values.

In the laterite soil of Mangalore, calcium forms less than 25% of the total exchangeable cations. The other metallic cations together constitute another 25% or less and the rest is made of hydrogen. The soil is therefore distinctly acid having a pH of 4·8 to 4·9. Laterite soils contain no free calcium carbonate and exchangeable calcium in the colloidal complex is low with the result that the soils are always on the acid side. The soils are notoriously deficient in all bases with the result that the crops and pasture grown on them lead to mineral deficiency in man and animals. The only means of increasing the base exchange capacity and the power of the soils to retain manures and water is to incorporate heavy doses of organic manures into them, since the organic colloids have high base exchange capacity and water holding capacity. The application of lime will decrease the acidity and help in the beneficial bacterial decomposition of organic matter.

Fertility Status: The lateritic and laterite soils have low fertility status. They are generally poor in nitrogen, available phosphoric acid and lime. Total potash and total phosphoric acid may be present in adequate quantities. But the soils are notoriously poor in available phosphoric acid and any soluble phosphatic manures added to them would be immediately reverted and converted into unavailable iron and aluminium phosphates by the hydrous oxide clays. Phosphate manuring is a problem in these soils and the salvation appears to be in the application of silico-phosphates or fused phosphates which are not so readily converted into insoluble iron and aluminium phosphates. Available potash is generally deficient or on the marginal level in the lateritic and laterite soils and response to potassic manures is obtained in them. The deficiency of lime can be corrected by the application of calcium carbonate or slaked lime, and as the base exchange capacity of the soils is low the applications of one to two thousand pounds would have a marked effect on the pH of the soil.

The minimum requirement of nutrients for good crop production under the soil-climatic conditions of Madras are nitrogen (N) 0·05%, available phosphoric acid (P_2O) 0·01% available potash, (K_2O) 0·005% and lime (CaO) 0·5%. Judged by these standards it will be found that the lateritic soil of Pattukkottai and the laterite soil of Mangalore are below the minimum limit in all the essential nutrients.

BIBLIOGRAPHY

1. Menon P. K. R. and Maria Kulandai, A., Soils of Madras State Part I Madras Agri. Journal 1957, 44, Pp. 121—130.
2. Menon P. K. R. and Maria Kulandai, A., Soils of Madras State Part II Madras Agri. Journal 1957, 44, Pp. 175—184.
3. Annual Reports of the Government Agricultural Chemist, Coimbatore 1940—1955.
4. Robinson, G. W., Soils, Their Constitution, classification and properties.
5. Bonnet Jnan, A. Soils Science. 48, 25—40, 1939.
6. Pendelton R. L. & S. Scharaswana Soil Sci. 62 423—40. 1946.
7. Humbert, R. P. Soil Sci. 65. 281—290. 1948.
8. Kellogg, C. E. Commonwealth Bur. of Soil Sci. Tech Communication No. 46 76—85. 1949.

OBITUARY.

We regret to announce the sudden and unexpected demise of Sri P. KUNHIRAMAN MENON, Lecturer in Agricultural Chemistry, on 10th August 1957 at the age of 49. He was ill only for a day and he had taken a lecture class even two days prior to his demise, though he was feeling indisposed reflecting his high sense of duty and love towards his students which they could repay only by attending his funeral in large numbers.

Sri P. K. Menon entered service as an Assistant in Agricultural Chemistry in 1931 and during all these years his contributions to the Science of Soil Chemistry has been many and varied. His contributions to methods of soil, analysis, base exchange and Madras soils are well-known. Readers would recall his series of papers in the earlier issues of our Journal and elsewhere in this issue we publish the third in the series on 'Madras Red Soils' which was received for publication. We regret we could not complete the series owing to his unexpected demise.

Sri P K. Menon was a good sportsman and an excellent hockey player and was for sometime a hockey coach to the students. On his demise the Agricultural College and Research Institute loses one of its outstanding workers. We convey to his bereaved family our heartfelt condolences. May his soul rest in peace.