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REPULIC OF KENYA
MINISTRY OF AGRICULTURE

SOILS OF KURAIHA ESTATE

- THIKA -

BY

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FOREWORD

This report is a record of the soil conditions which prevailed in the Estate at the time of the survey. It outlines seven soil units which not only differ in texture but also in drainage and depth. The soils are generally shallow with plinthite (murrum) within 90 cm. They are also generally low in available phosphorus. Various points where observations were made are plotted on the soil map. These points should form appropriate sites for future reference and monitoring of the changes that may occur in the soil following development particularly under irrigation.

The practice of breaking up murrum layer to deepen the soil depth may help in the development of deep rooted crops. It should nevertheless not be forgotten that such operation may not improve the moisture retention capacity unless heavy doses of organic matter are incorporated. The rate and frequency of water application in such areas may also of necessity be different from those for the areas where the soil texture is fine throughout the profile.

Where the drainage is poor as in the area of soils 4 and 5 the need for adequate drainage system to reclaim the soils and also guard against future deterioration cannot be over emphasized. It is also essential to lay down effective drainage system for the whole of the farm if irrigation is practiced. With appropriate measures to take care of the excess irrigation water, the quality of the water intended for irrigation is at present so high that no problem of salt and alkali build up may be contemplated.

N.N. Nyandat
SOIL SURVEYOR

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SOILS OF KURAIHA ESTATE1. INTRODUCTION

The 218.8 hectares (547.2 acres) of land surveyed is owned by the Agricultural Development Co-operation (ADC). The Estate is situated at the western side of Nairobi - Thika road about 41 kilometres north east of Nairobi and about 12 kilometres south west of Thika Township. It lies at an elevation of about 1485 M (4950 ft) above sea level.

The detailed soil survey of this estate was requested by the Director, National Agricultural Research Station Thika, with a view to determining the suitability of the soils for the production of horticultural crops under rainfed or irrigation system. This report therefore aims to indicate the soil types and to outline on a map 1:5,000 their distribution and extent. The soils in the area broadly consist of deep and well drained dark reddish brown clay; shallow and well drained dark reddish brown clay over plinthite; moderately well drained and shallow dark reddish brown sandy clay over plinthite (murrum); and poorly drained very dark grey brown clay over plinthite. In certain areas tuff and indurated plinthite (ironstone) are exposed to the surface.

The author wishes to acknowledge the help rendered by the staff of the National Agricultural Laboratories and Kuraiha Estate during the investigation.

2. GENERAL FEATURES OF THE STATIONGeology, landscape and soil genesis

The soil of Kuraiha Estate are derived from volcanic deposits - Tertiary sediments, agglomerates, soft tuff and trachytic tuffs (Geological report No. 59). The main soil forming process may be considered to be ferralization or laterization. The process is characterised by intensive continuous weathering, with hydrolysis of silica; a leaching of bases and silica, resulting in a relative accumulation of sesquioxides and formation of 1:1 lattice clay of kaolinite group (Buringh 1970).

The area can be considered as gently undulating with broad ridges. The alternating ridges and valleys as may be expected give rise to a sequence of soils. The better drained soils and deeper soils are found on the ridge tops and on the upper middle slopes; whereas the shallow soils occur on the lower slopes and the poorly drained soils occur in the depressions. Areas with rock outcrops occur where the slopes are excessively steep as found on the

valley sides of a stream west of the estate and may be attributed more to erosion. The poorly drained soils may have been partly formed from colluvial alluvial materials under conditions of poor drainage. The shallow and poorly drained soils on the lower slopes may be considered to be the result of the incursion of massive and loose rounded plinthite arising from the seepage waters from higher slopes and being checked by change of slope. The laterization process is facilitated by the deposition of sesquioxides and manganese materials from the seepage water. Inactive termite mounds of 10 to 30 M. diameter and 1 to 2 M in height some even higher with domed or conical structure are scattered all over the estate. They have deep dark brown soils with more trees and shrubs around them.

Vegetation and Climate

The estate is situated in a region of wooded grassland with scattered or grouped trees having a canopy cover of less than 20 percent. This original vegetation has now largely disappeared from the Estate.

The climate can be considered warm. Minimum temperatures range between 10° - 14° C and maximum temperature range between 22° - 26° C. The relative humidity in the morning range from 85 per-cent to 95 percent and in the afternoon it ranges from 35 percent to 58 percent. (New National Atlas of Kenya).

The rainfall distribution pattern for the Kuraiha Estate has been extrapolated from that of District Office Thika which is about 12 km north east of the estate. It covers the period between 1960 to 1972. Over this period the total annual rainfall varies from a maximum of 6047 mm to a minimum of 1230.8 mm. The year 1969 was one with minimum rainfall while the maximum rainfall occurred in the year 1967. There are two marked rainfall seasons; March to May and October to December. The months of January, February, June July, August and September appear to be the driest months.

Table I gives the monthly and annual rainfall for the station from 1960 - 1972. Kuraiha Estate which is a few kilometres away from the meteorological station is likely to receive same amount of rainfall.

Land Use:

The better drained soils are at present under coffee, passion fruits and paw-paw. Whereas deserted sisal, beans and other horticultural crops are being grown on shallow soils. Other shallow areas with massive plinthite on the surface or depression areas with poor drainage support scrub grass, shrubs, herbs and a few trees. The swampy area is covered with papyrus.

3. DRAINAGE SYSTEM AND WATER RESOURCES

Drainage system: This refers to the rapidity and extent of the removal of water from the soil in relation to addition, especially by surface run off and flow through the soil to underground spaces. It in other words refers to the frequency and duration of periods when the soil is free of saturation or partial saturation.

TABLE: I

AVERAGE MONTHLY RAINFALL (MM) - NIKA DISTRICT OFFICE (91.3718)
 (12 KM NORTH EAST OF THE ESTATE)

YEAR	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL R/P
1960	65.3	3.3	145.0	137.9	36.3	4.3	11.9	5.1	12.2	88.1	50.8	44.5	604.7
1961	2.8	20.8	74.7	118.1	12.7	15.2	1.0	11.2	32.8	283.7	345.4	171.7	1090.1
1962	103.9	0.0	54.4	180.6	105.9	24.6	0.0	26.4	32.0	97.0	91.4	81.5	797.7
1963	75.4	98.8	98.8	284.4	228.0	7.9	0.0	43.9	8.9	29.2	174.0	147.2	1196.5
1964	50.2	4.5	120.3	344.2	27.7	61.4	0.0	58.2	7.0	21.1	140.6	84.8	920.0
1965	28.1	3.1	51.0	152.4	42.1	19.2	8.1	0.0	0.2	107.4	171.3	34.3	617.1
1966	94.3	13.3	307.1	99.5	17.2	18.7	0.0	19.1	41.2	100.0	0.0	29.5	839.9
1967	0.0	0.0	95.0	180.8	405.0	28.0	39.0	16.0	40.0	198.0	229.0	0.0	1230.8
1968	0.0	162.0	172.0	213.0	65.5	64.0	9.5	7.0	0.0	19.0	349.6	47.5	1109.1
1969	46.0	70.0	146.1	31.2	113.6	9.0	12.8	5.0	0.0	19.1	72.8	17.0	542.6
1970	49.8	4.2	303.9	214.0	123.0	13.3	17.6	5.9	6.5	26.5	13.4	39.0	817.1
1971	11.9	0.0	38.6	297.9	186.5	26.1	1.2	3.4	1.0	34.5	86.6	182.9	870.6
1972	20.8	110.6	41.1	80.3	134.1	110.2	0.0	0.0	23.2	93.4	128.6	30.8	773.0

Kyamine

1973 6.10 15.60 13.20 134.2 34.9 58.40 4.70 0.0 68.1 20.3 92.20 21.50 529/20
/5

The drainage system of this area follows its topography. During the rains the excess water drains from higher grounds to the low lying lands, and then to the depressions or to the streams.

Water Quantity and Water Quality:

There is only one permanent stream (Karakutu) at the western side of the farm which flows from northern to southern direction. Along this stream two dams have been constructed. The water which is used for irrigation is pumped from the southern dam. In the far south east corner of the farm there is a pond or a watercatchment formed over a plinthite sheet (laterite). During the rains the pond is flooded and the water overflows into the Komu stream. If the pond is conserved it may be another source of irrigation water.

The water for irrigation has been tested at three different points namely: from the first dam in the south; from the second dam in the north; and along the stream which joins the two dams.

The waters from these three points appear to have no salinity and alkalinity hazard as shown by the electrical conductivity and Sodium Adsorption Ratio (SAR) data. They may therefore safely be used for irrigation. Table No. 2, gives the results of the test.

TABLE 2: Water Analysis for Irrigation Suitability

Description	Lab. No./72		
	2982	2983	2984
Dam I (the dam in the south)			2982
A long the stream joining the two dams			2983
Dam II (the dam in the North)			2984
	<u>2982</u>	<u>2983</u>	<u>2984</u>
pH	6.6	7.8	7.7
Conductivity (Microhmos/cm)	245	222	215
Calcium	0.67	0.56	0.43
Magnesium	0.34	0.29	0.35
Carbonates	Nil	Nil	Nil
Bicarbonates	1.80	1.78	1.72
Chlorides	0.97	1.04	1.14
Potassium	0.15	0.18	0.16
Sodium	1.29	1.34	1.32
Sulphate	Nil	Nil	Nil
S.A.R.	1.80	2.04	2.11
R.S.C.	1.79	0.93	0.94

4. SOIL DESCRIPTION AND ANALYTICAL DATA

The section outlines the method of investigation, terminology used, abbreviations, morphological features of the soils that have been delineated and chemical and physical properties of the soils. It carries also a discussion of the soils in terms of soil fertility.

Methods of field investigation, terminology used and the methods of soil analysis:

The investigation was carried out by first examining in detail the 1:10,000 aerial photographs which were then enlarged to 1:5,000 for a base Map. The tentative soil boundaries were drawn using variations in topography, vegetation and other natural features and then transferred on to the base map where a spacing of 300 metres by 200 metres interval was laid for soil examination in augerings. Fifteen soil profile pits were then sited based on apparent differences in the soils. The pits were morphologically described in detail and sampled according to evident distinction in soil horizon morphology. The auger and pit soil samples were analysed in the laboratory and the results together with those of the aerial photointerpretation and profile description used to draw the final soil boundaries.

The soil description terms follow those of the soil Survey Handbook No. 18 of the United States Department of Agriculture (1951) and Guidelines for Soil Description of the Food and Agriculture Organisation of the United Nations. The colours are standardised according to the Munsell notations. The soil phases are simply outlined on the soil map legend without relating them to a higher category in a classical classification system such as the U.S.D.A. 7th Approximation (1967) or that of the Food and Agricultural Organisation of the United Nations. (Definitions of Soil Units for the Soil Map of the world, report No.33(1968)).

Conductivity assessment followed methods of the U.S. Department of Agriculture (1954) C.E.C., Exchangeable cations, pH and available nutrients were estimated by Methods currently used at the National Agricultural Laboratories. Mechanical analysis were performed by hydrometer (Bouyoucos 1934). The texture was graded using the U.S.D.A. Texture triangle.

ABBREVIATIONS

The following abbreviations have been used in the report:-

- C - organic carbon
- Ca - calcium
- C.E.C. - cation exchange capacity
- Cl - chloride
- CO₃ - carbonate
- HCO₃ - bicarbonate
- K - Potassium
- M.e. - Milli equivalent
- Mg - magnesium

M. mhos/cm	- Milli mhos per centimeter
Mn	- Manganese
N	- Nitrogen
P	- Phosphorus
pH	- The negative logarithm of the hydrogen ion activity in the soil solution
ppm	- Parts per million
S	- Sulphur
SO ₄	- Sulphate
Na	- Sodium
R.S.C.	- Residual sodium carbonate
S.A.R.	- Sodium adsorption ratio
E.S.P.	- Exchangeable Sodium Percentage
KCl	- Potassium chloride
Hp	- Concentration of the Permanent charge Hydrogen
EC	- Electrical conductivity
H ₂ O	- Water

Description of the Typical Soil Profile and Analytical Data

The section outlines the salient morphological, chemical and physical features of the soils that occur in the station. It also contains analytical data and profile description of the typical profiles.

Well drained soils:

Soil I More than 90 cm. of dark reddish brown clay over plinthite (Murrum).

This is a deeply weathered dark reddish brown clay which overlies dark reddish clay found on the ridge tops and on the upper middle slopes. The soil is derived from volcanic deposits - trachytic tuffs and may have been developed under past humid conditions. The soil which is well drained is friable when dry, firm when moist, sticky and plastic when wet. It has subangular blocky structure with fine and medium peds which are moderately developed. Massive soft plinthite (murrum) is found below 90 cm. The soil is medium to neutral acid with average pH ranging from 5.2 to 7.2, but it may be higher in areas with levelled termite mounds. The soils are deficient in phosphorus and slightly poor in calcium. Other major plant nutrients seem to be sufficient. The C.E.C. decreases with the depth whereas the clay content increases with the depth.

The soil is under coffee and passion fruits which are doing very well.

The soil profile in observation point No. 41 is typical of this class of soils and Table 3 below provides the analytical data.

Information on the site:

PIT NO 41

LOCATION

SLOPE

ASPECT

MACRORELIEF

PARENT MATERIAL

ROOTING DEPTH

DEPTH OF MAX. ROOT DENSITY

SOIL DEPTH

DRAINAGE

LAND USE

Profile description
Observation Point No. 41
2°
North East
Slightly Undulating
Trachytic tuffs
More than 140 Cm.
0-50 Cm.
More than 138 Cm.
Good
Under Coffee

0-35 Cm.

Dark reddish brown (5YR 3/3) clay with subangular blocky structure. It has fine and medium peds which are moderately developed. The soil is hard when dry, firm when moist and sticky when wet. Coarse, medium and fine roots are many. The lower boundary is diffuse and smooth.

35-110 Cm.

Dark red (2.5YR 3/6) clay with subangular blocky structure. It has fine and medium peds which are weakly developed. The soil is friable when dry, loose when moist and sticky when wet. Fine, medium and coarse roots are few. The lower boundary is diffuse and smooth.

110 - 140 Cm.

Dark red (2.5YR 3/6) clay whose structure is subangular blocky. The soil has fine and medium peds which are moderately developed. It is slightly hard when dry, friable when moist and sticky when wet. Medium and fine roots are rare. At 140 cm. massive plinthite (Murrum) is met.

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TABLE 3

Lab. No. 3141-3143/72
SOIL I

LOCATION: Observation Point No. 41
PIT NO. 41

Oms Depth	% C	% Sand	% Silt	% Clay	m.e.% C.E.C	EXCHANGEABLE BASES			E.S.P.	Base sat. %		
						Ca	Mg	K				
0-35	1.70	15	22	63	17.8	6.4	2.4	1.1	0.45	2.53	58.15	
35-110	-	11	10	79	12.8	7.4	1.4	0.4	0.45	3.52	75.70	
110+	-	15	8	77	12.4	4.8	3.4	0.2	0.15	1.21	65.72	
Oms Depth	1:1 H ₂ O	pH 1:5 KCl	EC M. mhos/Cm.	Hp m.e.%	Hv m.e.%	AVAILABLE NUTRIENTS m.e.%					P ppm	% N
						Mn	Na	K	Ca	Mg		
0-35	6.3	5.2	0.15	-	-	0.28	0.44	0.62	5.2	2.9	17	0.16
35-110	5.6	5.0	0.13	-	-	0.63	0.48	0.50	4.8	2.6	12	-
110+	4.7	4.0	0.08	2.0	-	0.66	0.69	0.33	7.2	3.6	15	-

For % organic Matter, Multiply % C by 1.73.

SOIL 2 40 to 90 Cm. of dark reddish brown clay loam over plinthite (Murrum);

some termite mounds: This soil which occurs mainly on the upper middle slopes is fairly deep. Like soil I, it is derived from volcanic deposits-trachytic tuffs. The soil is well drained and has subangular blocky structure. It has coarse, medium and fine peds which are moderately developed. The soil has common small pockets of stones from the second horizon, also common in the same horizon are iron and manganese concretions. Discarded termite mounds of dome structure with a diameter of 10 to 20 M and the height of 50 cm to 2m are common. They have deep brown soils which sometimes strongly react with HCl. from 50-80 cm. These termite mounds are covered with more trees, shrub and herbs.

The soil has medium to mildly alkaline reaction, with pH ranging from 5.4 to 7.8. It is deficient in phosphorus and slightly deficient in calcium. Other major plant nutrients appear to be moderate.

Soil profile in observation point No. 47(a) represents this class of soils and table No.4 provides the analytical data.

General Information on the site

PIT NO. 47(a)

LOCATION

SLOPE

MACRORELIEF

PARENT MATERIAL

ROOTING DEPTH

DEPTH OF MAX. ROOT DENSITY

SOIL DEPTH

DRAINAGE

LAND USE

0-20 Cm

Profile description

Observation point No. 47(a)

Level

Flat to very gently undulating

Trachytic tuffs

44 Cm.

0-40 Cm.

44 Cm.

Good

Virgin

Dark reddish brown (5YR 3/2) clay loam whose consistence is hard when dry, firm when moist and sticky when wet. The soil has subangular blocky structure with fine, medium and coarse peds which are moderately developed. Fine, medium and coarse roots are abundant. The lower boundary is clear and smooth.

TABLE 4

LOCATION: Observation Point 47(a)
 PTF NO. 47 a

Lab. No. 3149-3150/72
 SOIL. 2

CM DEPTH	% C	% Sand	% Silt	% Clay	m.e.% C.F.C.	EXCHANGEABLE BASES m.e.%				E.S.P.	% Base Sat.
						Ca	Mg	K	Na		
0-20	1.61	35	26	39	16.8	5.6	2.6	1.2	0.40	2.38	55.06
20-44	-	35	30	45	15.0	3.0	1.2	0.4	0.40	2.67	33.33

CM DEPTH	pH	EC m.mhos/cm	Hp m.e.%	Hv m.e.%	AVAILABLE NUTRIENTS m.e.%					P ppm	% N
					Mn	Na	K	Ca	Mg		
0-20	5.9	4.5	-	-	0.26	1.82	0.22	15.2	3.6	29	0.18
20-44	5.4	4.0	1.4	-	1.00	0.18	0.26	1.6	1.3	10	-

For % Organic Matter, multiply % C by 1.73.

20-44 Cm. Dark reddish brown (5YR 3/3) clay loam with subangular blocky structure. It has medium and coarse peds which are moderately developed. The soil is sticky when wet, firm when moist and hard when dry. Iron and manganese concretions are common and small pockets of stones are many. Coarse, medium and fine roots are many. The lower boundary is abrupt and smooth.

44Cm. + Massive plinthite (Murrum).

Moderately well drained soils:

Soil 3 Less than 40 Cm of dark reddish brown sandy clay loam over plinthite (Murrum); some termite mounds:

These soils occur on the middle and lower slopes and are shallow. Within the depth of 8-40 cm massive plinthite (Murrum) is met. In some areas loose rounded plinthite or laterite stone are exposed to the surface. This soil cover the largest portion of the farm and is under healthy beans and deserted sisal. The very shallow parts support wooded grassland vegetation which is inhabited by wild animals like gazelles and giraffes.

The soil is derived from volcanic deposits, which are tertiary sediments, agglomerates, soft tuff and trachyte tuff. The soil which is moderately developed has subangular blocky structure with fine and medium peds which are moderately developed. Iron and manganese concretions are common. The soil is poor in phosphorus and slightly poor in calcium. Other major plant nutrients seem to be sufficient. It has medium to mildly alkaline reaction with pH ranging from 5.2 to 7.5.

Inactive termite mounds of dome structure which are 10 to 20 M diameter and 50 cm to 3 M high are common in the area. They have moderately deep to deep brown soils which occasionally strongly react with 10% HCl. These termite mounds are in general more covered with vegetation.

The soil profile in observation point No. 13 is typical of this class of soils and table 5 below provides the analytical data.

General Information on the soil

<u>PIT NO. 13</u>	Profile description
<u>LOCATION</u>	Observation point No. 13.
<u>SLOPE</u>	Level
<u>MACRORELIEF</u>	Slightly undulating
<u>PARENT MATERIAL</u>	Tertiary sediments, agglomerate and soft tuff
<u>ROOTING DEPTH</u>	40 cm.
<u>DEPTH OF MAX. ROOT DENSITY</u>	0-20 cm.
<u>DRAINAGE</u>	Moderately well drained
<u>LAND USE</u>	Under beans

LOCATION: Observation Point No. 13
 PIT NO. 13

TABLE 5

Lab. No. 3127-3128/12
 SOIL 3.

OMS DEPTH	pH	1:1 H ₂ O	1:5 KCl	EC m.mhos/Cm.	m.e.%		EXCHANGEABLE BASES m.e.%					E.S.P.	Base Sat. %
					Hp	Hv	Ca	Mg	K	Na	Mg		
0-20	6.6	5.7	0.07	-	-	0.75	0.24	0.38	3.2	3.0	29	0.16	
20-40	6.4	5.0	0.07	-	-	0.74	0.20	0.24	3.6	3.1	31	-	

For % Organic Matter, Multiply % C by 1.73.

....13

0-20 Cm.

Dark reddish brown (5YR 3/2) sandy clay loam with subangular blocky structure. It has fine and medium moderately developed peds. The soil is slightly hard when dry, slightly firm when moist and sticky when wet. Fine roots are many, whereas medium and coarse ones are few. The lower boundary is clear and smooth.

20-40 Cms.

Dark reddish brown (5YR 3/3) sandy clay loam whose consistence is slightly hard when dry, slightly firm when moist and sticky when wet. The soil has subangular blocky structure with fine and medium moderately developed peds. Iron and manganese concretions are few and loose rounded plinthite are common. Fine roots are many, medium ones few and the coarse ones rare. The lower boundary is clear and smooth.

40 Cm. +

This is a horizon of loose rounded and massive plinthite (Murrum).

SOIL 3a

This soil is like 3, but has many termite mounds and undulating topography. The soil is found in the eastern side of the estate and is shallow. The soil has few and very small patches of deep and poorly drained soils. The soils on the inactive termite mounds are moderately deep to deep and are dark brown on the top horizons and strong brown on the lower horizons. The soil react strongly with HCl from 50-80 cm. In rare cases they do not react. These termite mounds, like others found in the estate are 10 to 20 M. in diameter and 50 cm. to 3 M in height. They have domical or conical structure and are deserted. They are covered with more trees, shrubs, herbs and grass. The area which was formerly under sisal cultivations has been left for the wild animals to graze. The soils in this area in general have poor contents of phosphorus and are slightly poor in calcium. The pH ranges from 5.4 to 7.6. The soils are moderately well drained and have the same physical status like soil 3. The soil profile in observation point No. 13 in soil 3 represent this class of soils and the table 5 also of soil 3 provides the analytical data.

Poorly drained soils:

SOIL 4: 30 to 80 cm of very dark grey brown clay over plinthite; impeded drainage; few termite mounds

These are soils with impeded drainage and occur in the depressions. The soils are heavy clay and are slightly lighter in top soil than subsoil. The topsoil is very dark grey clay and is underlain by very dark grey brown clay.

Faint dark yellowish brown mottles start from the topsoil and increase with the depth. Moderate and common slickensides start from 20 cm. and they also increase with the depth. The soil has subangular blocky structure with coarse and medium peds which are strongly developed. They are very hard when dry, very firm when moist and very sticky and plastic when wet. The first horizon has very slight reaction with 10% HCl. They have few small pockets of stones all over the profile. Like the other soils in the estate, these soils have been derived from volcanic depositis-trachytic tuffs and are poor in phosphorus and marginally rich in some other major plant nutrients. The soil is medium to slightly acid with pH ranging from 5.4 to 6.1.

For growing the horticultural crops, these soils require drainage layout to counteract flooding and improve permeability.

The soil profile in observation point No. 33 is typical of this class of soils and table 6 provides the analytical data.

General Information of the Site:

<u>PIT NO:</u> 33	Profile description
<u>LOCATION</u>	Observation point No. 33
<u>SLOPE</u>	Depression to level
<u>MACRORELIEF</u>	Very gently undulating
<u>PARENT MATERIAL</u>	Trachytic tuff
<u>ROOTING DEPTH</u>	80 cm.
<u>DEPTH OF MAX. ROOT DENSITY</u>	0-40 cm.
<u>SOIL DEPTH</u>	80 cm.
<u>DRAINAGE</u>	Imperfectly drained
<u>LAND USE</u>	Under deserted sisal
<u>0-20</u>	Very dark grey (10YR 3/1) clay with subangular blocky structure. It has coarse and medium peds which are moderately developed. The soil is very hard when dry, very firm when moist and very sticky and plastic when wet. It has faint dark yellowish brown mottles (10YR 4/4). Small pockets of stones are few. It has very slight reaction with 10% HCl. Coarse medium and fine roots are many. The lower boundary is diffuse and smooth.

TABLE 6

LOCATION: Observation Point No. 33
 PIT NO. 33

Lab. No. 3132 - 3134/72
 SOIL 4

CMS DEPTH	% C	% Sand	% Silt	% clay	m.e.% C.E.C	EXCHANGEABLE BASES m.e.%				E.S.P.	% Base Sat.
						Ca	Mg	K	Na		
0-20	1.64	23	30	47	25.0	6.8	2.8	0.3	0.75	3.0	42.60
20-50	-	15	6	79	50.4	22.2	8.8	0.5	2.30	4.56	67.06
50+	-	19	8	73	50.4	27.6	14.4	0.6	2.90	5.75	90.27

CMS DEPTH	pH	EC m.mhos/cm.	Hp m.e%	Hv	AVAILABLE NUTRIENTS m.e.%					P ppm	% N
					Mn	Na	K	Ca	Mg		
0-20	5.4	4.0	4.0	-	0.52	0.10	0.66	2.2	1.2	14	0.19
20-50	5.4	4.0	2.0	-	0.48	0.04	0.42	2.0	1.1	20	-
50-80	5.8	4.5	-	-	0.46	0.12	0.38	2.0	1.0	16	-

For % Organic Matter, multiply % C by 1.73.

20-50 Cm.

Very dark grey brown (10YR 3/2) heavy clay whose consistence is extremely hard when dry, very firm when moist and very sticky and plastic when wet. The soil has subangular blocky structure with coarse and medium peds which are strongly developed. It has abundant, medium and distinct dark yellowish brown mottles (10YR 4/4). It has few small pockets of stones. Strong slickensides are abundant, coarse medium and fine roots are many. The lower boundary is diffuse and smooth.

50-80 Cm.

Very dark grey brown (10YR 3/2) heavy clay with subangular blocky structure. It has coarse and medium peds which are moderately developed. The soil is extremely hard when dry, very firm when moist and sticky and plastic when wet. It has abundant, medium and distinct dark yellowish brown mottles (10YR 4/4). The slickensides are abundant and strong. Small pockets of stones are few. Fine and medium roots are many, whereas coarse ones are few.

80 Cm. +

This is a horizon of loose rounded and massive plinthite (murram).

SOIL 5

40 to 80 cm. of very dark grey brown clay over plinthite (murram);
seasonally water logged

These soils like soil 4 occur in depression areas and have developed under the conditions of poor drainage from colluvial/alluvial deposits. The soil is found in the eastern end of the farm and stretches from northern to the southern ends of the farm. The incursion of seepage and stagnant waters have resulted in the presence of manganiferous loose or massive plinthite overlying the welded tuff which appear to be present at the depth below 80 cm. The top horizon of these soils have very dark grey colour which change to very dark grey brown in the subsoil. They have dark yellowish brown mottles. The soil has prismatic structure, It is poor in phosphorus; calcium is just marginal. Other major plant nutrients seem to be sufficient. The soil is medium acid to slightly acid with the pH ranging from 5.1 to 6.3. Deserted termite mounds are few. The area is left for open grazing at present. To support horticultural crops, the area will require drainage layout.

The soil profile in observation point No. 50 is typical of this class of soils and table 7 provides the analytical data.

General Information of the site

PIT NO. 33

Profile description

LOCATION

Observation Point No. 50.

SLOPE

Depression

MACRORELIEF

Very gently undulating

<u>PARENT MATERIAL</u>	Welded tuffs
<u>ROOTING DEPTH</u>	More than 40 cm.
<u>DEPTH OF MAX. ROOT DENSITY</u>	0-30 cm.
<u>SOIL DEPTH</u>	40 cm.
<u>DRAINAGE</u>	Poorly drained
<u>LAND USE</u>	Virgin
<u>DEPTH OF WATER TABLE</u>	40 cm.

0-20 cm.

Very dark grey (10YR 3/1) clay with prismatic structure it has coarse and medium peds which are weakly developed. The soil is very hard when dry, very firm when moist and very sticky and plastic when wet. It has dark yellowish brown mottles (10YR 4/4). Coarse, medium and fine roots are many. The lower boundary is diffuse and smooth.

20-40 cm.

Very dark grey brown (10YR 3/2) clay whose consistence is very hard when dry, very firm when moist and very sticky and plastic when wet. The soil has prismatic structure with coarse and medium peds which are moderately developed. Coarse, medium and fine roots are many. Loose and massive plinthite is met at 40 cm. Also water is met at 40 cm.

Addition

Levelled area: This is the area covered by soil 1 and part of soil 3 and 4. The area covered by soil 3 and 4 occur on the left side of the railway line and road in the north. These soils like other soils in the estate, formerly hard termite mounds which might have had the same characteristics like the ones which are still existing. At the time of planting coffee, sisal and beans, these termite mounds were levelled. Patches or remnants of these were clearly seen during field investigation and even from the aerial photographs. Some auger and pit observation points fell on these spots. The soils here have high pH e.g. Pit no 34a where pH ranges from 8.0 to 8.4 although not on the levelled area at the moment.

The areas with soft plinthite (murrum) almost on the surface have also been ploughed up by heavy tractors. The hard laterite stones which cannot be crashed down have been removed from the fields and heaped aside. These areas after they have been applied with organic (manure) and mineral fertilizers produce very healthy horticultural crops (for example beans).

The process of ploughing up soft plinthite and levelling termite mounds is still going on. Some of these areas are new and cannot be mapped because the soil survey was conducted a bit earlier. To acquire moreland for the horticultural crops, this system should be very much encouraged.

Miscellaneous

6. Rock outcrop

Trachytic tuffs, welded tuffs and agglomerates rock outcrops are seen in the western end of the estate along the main stream. They also occur on the high ridge which is on the right side of the stream under the influence of continued surface wash. Because of stoniness and topographic position these soils are unsuitable for horticulture. These areas are suitable for quarry.

7. Swamp and open water

Permanently swampy area occur on the south east corner of the estate within soil 6. The soils here are very dark grey to very dark grey brown with abundant prominent rust mottles on the profile. Most of the area is covered by papyrus and small portion is under open water or pond. This pond may be another source of getting water for irrigation if a water catchment is constructed. The pond is flooded during the rains, but the water drain through Komu stream passing through Mangu High School. Other areas with open water in the western end of the estate are the dams where water for irrigation is obtained at present.

5 SOIL PROPERTIES OF SIGNIFICANCE IN THE STATION

Stoniness and depth of soil

Rocks or stones play significant part in soil formation in an area, but problems may be encountered in mechanised cultivation and the hindrance of root development if these stones are within 40 cm. of the surface. The presence of loose rounded plinthite which may be less than 30 cm. of the surface is also regarded a detrimental feature even if they do not hinder the penetration of roots. Soils mixed with loose rounded plinthite contain less available moisture and have reduced capacity for retaining nutrients as compared with non plinthite soils. All the soils in the estate a part from soil 1 and partly soil 2 may in this respect be affected to some extent.

The depth of the soils may be examined in relation to the requirement of the wide range of crops that are grown in a region. The soils which are considered best suited for horticultural crops should be deep, well drained and with good natural structure and adequate nutrients reserves. The trees and long term crops because of their extensive deep rooting system require soils which are at least more than 90 cm. deep whereas annual and short term

crops require at least 60 cm depth of soil. On soil 1 therefore most horticultural crops, including tree crops can be grown successfully. The annual crops could also be grown on soil 2.

The shallow stony soils and shallow soils with massive plinthite (murrem) like soil 3 and 3a have only limited suitability unless the stones are removed.

Soil 3 and 3a can only support shallow rooted horticultural crops like beans, cabbages, onions, pineapples etc. if the present method of deepening these soils by breaking down the soft massive plinthite by heavy tractors and adding manure or mineral fertilizers is continued.

Areas of hard laterite sheet and rock outcrops are clearly unsuitable for development.

Drainage status:

The shallow and poorly drained soils are also of limited suitability as they require soil amendments. They would necessitate drainage layout to improve permeability and guard against seasonal flooding. Poor drainage inhibits rooting system and causes droughting during dry seasons. Root respiration may be reduced and hence retard nutrients uptake. Some nutrients may also be rendered either unavailable or excessive to the plants.

It is therefore necessary that the trouble should be taken to improve the drainage status of soil 3 and 5 by installing ditch drains and applying gypsum if possible which may increase the soil solution concentration and so guard against deflocculation of clay minerals. The present method also of deepening the soils by using heavy tractors for breaking down the soft massive plinthite in shallow soils can be continued on these soils.

Soil fertility

Table 7 provides the range of available nutrients encountered for each soil unit whereas the data for individual observation points are found in the appendix II. It is evident from these data that the status of available nutrients is very variable over the estate. These range from deficiencies to moderately high levels by standard at the National Agricultural Laboratories which are outlined in appendix I. In general, the soil of the estate appear poor in phosphorus and calcium. Other major plant nutrients seem to be sufficient. The organic matter content appear fairly high. The result of the test for Hp (concentration of the permanent charge hydrogen) on soils with pH less than 5.5 suggest that liming may not be required.

RANGE OF AVAILABLE NUTRIENTS TABLE NO. 8

SOIL UNIT	1	2	3	3a	4	5
pH	5.6-7.6 5.3-8.0	6.8-7.8 5.4-5.8	5.4-8.3 5.3-7.7	5.8-6.9 5.8-5.9	5.4-6.8 5.6-8.0	5.3-6.3 5.6-5.9
K m.e.%	0.48-1.52 0.26-2.00	0.90-1.18 0.30-1.04	0.08-1.56 0.07-1.32	0.16-0.46 0.20-0.42	0.14-1.14 0.08-1.00	0.04-0.97 0.32-0.98
Ca m.e.%	3.4-10.6 0.6-9.4	7.6-12.4 0.8-1.4	Trace-22.0 0.4-9.4	Trace-8.4 2.0-7.4	0.8-5.0 1.2-9.6	1.6-36.0 4.4-8.8
Mg m.e.%	1.6-5.1 1.7-7.4	5.2-6.4 2.0-2.9	0.6-6.6 0.9-5.1	0.2-3.5 2.5-4.4	1.0-4.7 3.5-4.7	1.5-3.2 3.3-4.4
Mn m.e.%	0.56-1.22 0.36-0.96	0.63-0.88 0.79-1.00	0.43-1.48 0.37-1.36	0.22-1.58 0.08-0.24	0.32-1.50 0.02-0.56	0.01-1.14 0.37-1.14
P ppm	6-90 6-48	16-26 9-14	4-120 6-21	8-21 15-24	4-23 8-14	12-29 16-25
N%	0.16-0.23 --	0.24-0.25 --	0.09-0.30 --	0.17-0.24 --	0.4-0.21 --	0.16-0.29 --
C%	0.18-1.89 --	2.82-2.88 --	0.59-4.49 --	1.35-2.59 --	0.79-1.58 --	1.30-2.74 --

Note: First row=Top horizon; Second row=Second horizon for each pair.

SUMMARY

Seven soils, based on soil phase, have been delineated on approximate scale of 1:5,000. The well drained group of soils consist of 2 variants, (soil 1 and soil 2) which differ in depth and texture. The moderately well drained group of soils consists also of two variants (soil 3 and 3a). They differ in the amount of termite mounds they contain. Two variants (soil 4 and soil 5) of poorly drained soils resulting from condition of water table and drainage have also been delineated. Also occurring are areas of rock outcrop, swamp and open water. All the soils in the farm seem very shallow apart from soil 1.

The soil fertility appears very variable over the farm. Both condition of extreme deficiencies and fairly high level of nutrients are encountered.

The quality of the water in the station seems satisfactory for irrigation.

To have enough water for irrigation it may be advisable to construct another dam on the swampy area of soil 7 in the south east.

D.O. Michieka

KENYA SOIL SURVEY PROJECT

Nairobi, March, 1972.

APPENDIX I

Minimum Fertilizer Standards of the National Agricultural Laboratories:

Deficiencies are suspected if the nutrient levels are below the following values:-

N	3.0 mg/l	P	1.0 mg/l
K	44.8 mg/l	Mg	0.1 mg/l
Ca	20 ppm	K	0.4 mg/l

To convert N to Kg/ha multiply by 2,000.

To convert P to % organic matter, multiply by 1.75.

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A P P E N D I X I

Nutrient Efficiency Standards at the National Agricultural Laboratories:

Deficiencies are suspected if the nutrient levels are below the following values:-

Ca:	3.0 m.e.%	Mg:	1.0 m.e.%
N:	44.8 Kg/ha	Mn:	0.1 m.e.%
P:	20 ppm	K:	0.4 m.e.%

To convert %N to Kg/ha N multiply by 2,000.

To convert %C to % organic matter, multiply by 1.73.

APPENDIX II

Field Designation	AUGER No.1				AUGER No.5				
Lab. No.	3042	3043	3044	3045	3039	3040	3041		
Depth (cm)	0-40	40-80	80-90	90-140	0-50	50-100	100+		

AVAILABLE NUTRIENTS

pH 1:1	6.1	6.0	7.3	7.7	6.5	7.4	8.2		
Na m.e.%	0.44	1.04	1.3	1.25	0.14	0.18	8.2		
K m.e.%	0.36	0.14	0.23	0.32	0.18	0.07	0.18		
Ca m.e.%	8.6	9.4	9.6	8.8	4.4	7.0	14.0		
Mg m.e.%	5.3	4.9	4.9	4.2	2.3	2.8	4.0		
Mn m.e.%	0.79	0.37	0.20	0.15	0.90	1.12	0.87		
ppm	18	21	24	20	15	20	21		
N%	0.14	-	-	-	0.09	-	-		
C%	1.47	-	-	-	0.59	-	-		
Hp m.e.%	-	-	-	-	-	-	-		

TEXTURE AND EXCHANGEABLE BASES

Sand %	25	21	19	29	59	47	47		
Silt %	42	14	12	14	16	20	28		
Clay %	33	65	69	57	25	33	25		
Class	CL	C	C	C	SCL	SCL	L		
C.E.C. m.e.%	41.1	48.6	48.6	43.2	17.0	19.6	28.6		
Ca m.e.%	19.6	25.2	33.6	25.8	8.4	12.4	26.4		
Mg, m.e.%	7.0	9.1	8.9	5.7	0.6	0.6	3.4		
K m.e.%	0.9	0.5	0.8	0.7	0.5	0.3	0.5		
Na m.e.%	0.65	1.90	2.00	2.0	0.25	0.80	1.05		

Field Designation	AUGER No.6			AUGER No.7			AUGER No.8		
Lab. No.	3036	3037	3038	3033	3034	3035	3030	3031	3032
Depth (cm)	0-30	30-80	80-90	0-30	30-66	60-70	0-40	40-80	80+

AVAILABLE NUTRIENTS

pH 1:1	6.8	6.9	6.5	6.9	7.4	7.5	6.7	6.7	6.7
Na m.e. %	0.18	0.14	0.18	0.50	0.62	0.65	0.08	0.04	0.48
K m.e. %	1.30	0.86	0.52	0.75	0.52	0.50	1.44	1.08	0.92
Ca m.e. %	3.2	1.8	1.2	5.2	2.8	2.8	5.2	2.8	2.8
Mg m.e. %	2.5	2.8	2.4	3.3	2.6	2.4	3.5	3.3	2.8
Mn m.e. %	0.57	0.64	0.85	0.62	0.57	0.54	1.08	1.03	0.62
ppm	16	14	15	18	15	16	21	20	20
N%	0.16	-	-	0.16	-	-	0.21	-	-
C%	0.87	-	-	1.33	-	-	1.41	-	-
Hp m.e. %	-	-	-	-	-	-	-	-	-

TEXTURE AND EXCHANGEABLE BASES

Sand %	25	23	37	35	39	37	27	19	21
Silt %	18	20	14	20	16	20	22	24	22
Clay %	57	57	49	45	45	43	51	57	57
Class	C	C	C	C	C	C	C	C	C
C.E.C. m.e. %	18.0	15.2	14.3	18.0	14.3	14.3	22.0	17.0	15.6
Ca m.e. %	6.4	5.2	3.6	6.8	4.4	6.4	7.4	5.2	4.4
Mg, m.e. %	1.3	1.4	1.7	2.2	1.2	1.1	2.1	2.3	2.0
K m.e. %	2.3	1.5	0.9	1.4	1.0	0.9	2.9	1.7	1.7
Na m.e. %	0.25	0.20	Trace	0.80	0.65	1.05	0.25	0.65	0.40

Field Designation	AUGER No. 9			AUGER No. 10	AUGER No. 11	AUGER No. 12		AUGER No. 13
Lab. No.	3027	3028	3026	3026	3025	3023	3024	3022
Depth (cm)	0-40	40-70	70-90	0-30	0-30	0-30	30-40	0-40

AVAILABLE NUTRIENTS

pH 1:1	6.5	6.7	6.9	5.4	5.7	6.4	5.8	6.7
Na m.e.%	0.06	0.10	0.18	0.14	0.82	0.34	0.28	0.21
K m.e.%	1.18	0.72	0.46	0.57	0.48	0.75	0.72	0.82
Ca m.e.%	6.2	4.8	4.8	3.8	6.4	3.0	2.0	8.0
Mg m.e.%	3.6	3.4	3.3	2.8	4.0	3.6	4.5	3.0
Mn m.e.%	0.76	0.76	0.57	1.10	0.90	1.16	1.83	1.02
ppm	19	18	20	14	20	15	16	28
N%	0.18	-	-	0.15	0.14	0.20	-	0.19
C%	0.98	-	-	1.41	0.65	1.55	-	1.47
Hp m.e.%	-	-	-	0.9	-	-	-	-

TEXTURE AND EXCHANGEABLE BASES

Sand %	27	29	29	39	43	51	45	53
Silt %	24	22	22	28	16	20	18	22
Clay %	49	49	49	33	41	29	37	25
Class	C	C	C	CL	C	CL	CL	SCL
C.E.C. m.e.%	25.4	21.4	20.0	21.4	20.0	19.6	21.4	21.4
Ca m.e.%	8.0	7.6	8.4	4.8	11.6	4.0	3.8	7.6
Mg, m.e.%	1.8	1.7	1.1	0.9	3.8	1.9	3.8	1.2
K m.e.%	1.9	1.3	0.9	1.0	1.1	1.3	1.1	1.5
Na m.e.%	0.80	0.55	0.55	0.49	1.0	0.80	1.45	1.14

Field Designation	AUGER No.14			AUGER No.15		AUGER No.16			
Lab. No.	3019	3020	3021	3017	3018	3015	3016		
Depth (cm)	0-30	30-60	60+	0-40	40-50	0-35	35-50		

AVAILABLE NUTRIENTS

pH 1:1	7.2	8.0	7.8	6.7	7.3	5.5	5.8		
Na m.e.%	0.22	0.16	0.12	0.12	0.14	Trace	0.06		
K m.e.%	1.44	1.08	1.30	1.56	1.32	0.34	0.22		
Ca m.e.%	10.6	9.4	3.4	10.8	6.0	1.2	1.4		
Mg m.e.%	4.6	4.5	3.8	4.0	2.6	0.6	1.9		
Mn m.e.%	1.03	0.40	0.36	0.94	0.86	1.00	1.25		
ppm	90	48	32	120	21	9.0	12.0		
N%	0.22	-	-	0.27	-	0.17	-		
C%	1.61	-	-	1.97	-	1.38	-		
Hp m.e.%	-	-	-	-	-	0.9			

TEXTURE AND EXCHANGEABLE BASES

Sand %	23	21	13	49	43	53	47		
Silt %	28	34	18	22	24	10	12		
Clay %	49	45	69	29	33	37	41		
Class	C	C	C	SCL	CL	SC	C		
C.E.C. m.e %	28.6	21.4	18.0	24.0	18.0	16.2	17.0		
Ca m.e. %	11.6	11.6	7.2	10.0	8.0	2.0	2.8		
Mg, m.e. %	3.2	3.7	2.7	1.8	1.3	0.7	0.6		
K m.e. %	2.5	1.9	2.2	2.6	2.2	0.8	0.5		
Na m.e. %	0.65	0.65	1.25	0.6	0.80	0.40	0.65		

Field Designation	AUGER No.17			AUGER No.18			AUGER No.19		
Lab. No.	3012	3013	3014	3009	3010	3011	3006	3007	3008
Depth (cm)	0-30	30-60	60-65	0-40	40-90	90+	0-20	20-60	60-70

AVAILABLE NUTRIENTS

pH 1:1	5.7	5.2	5.5	6.7	6.5	6.7	7.2	6.4	7.8
Na m.e. %	0.18	0.18	0.14	0.14	0.06	0.08	0.18	0.46	0.66
K m.e. %	0.84	0.54	0.28	1.42	0.74	0.69	0.80	0.45	0.34
Ca m.e. %	4.4	1.2	1.2	9.0	3.4	2.8	9.2	8.4	6.0
Mg m.e. %	2.6	2.0	2.2	3.6	2.3	2.4	3.6	5.1	4.3
Mn m.e. %	0.56	0.32	0.82	0.80	0.54	0.32	0.70	0.80	0.72
ppm	17	12	12	20	17	18	20	16	18
N%	0.19	-	-	0.23	-	-	0.19	-	-
C%	1.64	-	-	1.75	-	-	1.18	-	-
Hp m.e. %	-	0.5	1.3	-	-	-	-	-	-

TEXTURE AND EXCHANGEABLE BASES

Sand %	25	19	29	29	19	19	47	41	45
Silt %	18	16	34	22	16	16	28	14	26
Clay %	57	65	37	49	65	65	25	45	29
Class	C	C	CL	C	C	C	SCL	C	CL
C.E.C. m.e. %	22.8	19.0	19.0	29.4	20.8	18.0	28.6	36.2	16.6
Ca m.e. %	6.0	3.2	3.2	10.0	6.0	6.4	9.6	12.0	6.8
Mg, m.e. %	2.1	0.8	1.2	1.7	0.7	1.5	2.3	4.9	1.7
K m.e. %	1.5	1.1	0.7	2.2	1.4	1.2	1.1	0.9	0.5
Na m.e. %	0.55	0.65	0.80	0.55	0.80	0.09	0.80	1.05	1.34

Field Designation	AUGER No.20		AUGER No.21			AUGER No.22	AUGER No.23	
Lab. No.	3004	3005	3001	3002	3003	3000	2998	2999
Depth (cm)	0-30	30-50	0-30	30-50	50+	0-30	0-30	30-50

AVAILABLE NUTRIENTS

pH 1:1	6.8	6.7	5.5	5.5	6.9	6.6	6.6	6.0
Na m.e.%	0.22	0.21	0.46	0.73	1.26	0.14	0.14	0.21
K m.e.%	0.48	0.56	0.80	0.66	0.66	0.72	0.31	0.18
Ca m.e.%	5.6	3.8	7.2	8.4	10.4	3.6	4.0	5.2
Mg m.e.%	3.1	3.0	4.0	4.9	5.8	2.8	2.3	2.8
Mn m.e.%	0.60	1.00	0.66	0.50	0.25	0.88	0.88	0.72
ppm	13	14	12	14	24	14	10	13
N%	0.16	-	0.22	-	-	0.18	0.14	-
C%	1.78	-	1.72	-	-	1.61	1.04	-
Hp m.e.%	-	-	1.5	2.2	-	-	-	-

TEXTURE AND EXCHANGEABLE BASES

Sand %	47	49	31	27	29	53	39	37
Silt %	24	22	20	16	14	24	24	18
Clay %	29	29	49	57	57	24	37	45
Class	SCL	SCL	C	C	C	L	CL	C
C.E.C. m.e.%	16.2	18.0	38.2	41.1	45.6	15.2	21.4	24.0
Ca m.e.%	6.6	4.4	11.6	15.6	32.4	4.4	6.0	8.4
Mg, m.e.%	1.5	1.1	4.3	7.4	9.5	1.7	2.2	2.3
K m.e.%	0.8	0.8	1.2	1.2	1.5	0.9	0.3	0.2
Na m.e.%	0.25	0.65	0.60	1.00	1.45	0.49	0.25	0.25

Field Designation	AUGER No.24		AUGER No.25	AUGER NO.27	AUGER No.28			
Lab No.	2996	2997	2995	2994	3046	3047	3048	3049
Depth (cm)	0-30	30-60	0-8	0-30	0-30	30-60	60-100	100+

AVAILABLE NUTRIENTS

pH 1:1	5.6	5.9	5.4	6.4	7.6	7.9	8.5	8.7
Na m.e.%	0.35	0.42	0.20	0.28	0.18	0.12	0.14	0.14
K m.e.%	0.20	0.14	0.19	0.90	1.86	1.52	2.00	3.20
Ca m.e.%	0.8	0.4	0.8	6.60	8.4	5.2	9.2	9.2
Mg m.e.%	1.3	1.3	1.4	3.1	6.0	5.1	7.4	8.2
Mn m.e.%	0.90	0.68	1.50	1.02	0.96	0.85	0.96	1.66
ppm	8	9	9	16	26	26	28	27
N%	0.16	-	0.16	0.19	0.20	-	-	-
C%	1.24	-	1.55	1.69	1.75	-	-	-
Hp m.e.%	-	-	2.3	-	-	-	-	-

TEXTURE AND EXCHANGEABLE BASES

Sand%	37	45	37	37	27	21	19	19
Silt%	30	22	18	18	24	22	20	18
Clay%	33	33	45	45	49	57	61	63
Class	CL	CL	C	C	C	C	C	C
C.E.C. m.e.%	18.0	14.3	16.2	21.4	30.2	24.0	24.0	22.8
Ca m.e.%	2.0	1.6	6.0	6.8	12.8	12.0	16.8	17.4
Mg, m.e.%	0.2	0.5	Trace	1.9	3.5	1.6	3.5	6.1
K m.e.%	0.3	0.3	0.2	1.2	2.8	2.9	3.9	6.4
Na m.e.%	0.6	0.8	0.34	0.65	1.80	0.25	0.35	0.25

Field Designation	AUGER No.29			AUGER No.30	AUGER No.31		AUGER No.32		
Lab. No.	3050	3051	3052	3053	3054	3055	3056	3057	
Depth (cm)	0-30	30-60	60+	0-8	0-15	15-20	0-30	30-40	

AVAILABLE NUTRIENTS

pH 1:1	5.5	5.4	5.7	6.2	5.8	5.4	5.9	6.3	
Na m.e.%	0.86	1.20	1.34	0.14	0.08	0.12	0.08	0.12	
K m.e.%	0.60	0.28	0.18	0.68	0.28	0.12	0.24	0.34	
Ca m.e.%	9.6	10.0	10.0	2.4	4.4	1.2	3.6	3.0	
Mg m.e.%	4.6	4.9	4.7	2.8	2.0	0.9	2.5	2.8	
Mn m.e.%	0.54	0.20	0.15	1.09	1.03	1.06	0.81	1.36	
ppm	16	16	17	10	12	6	9	11	
N%	0.17	-	-	0.16	0.19	0.14	0.18	-	
C%	1.61	-	-	1.55	1.55	1.29	1.58	-	
Hp m.e.%	3.1	2.5	-	-	-	3.0	-	-	

TEXTURE AND EXCHANGEABLE BASES

Sand %	19	17	19	57	35	39	47	63	
Silt %	12	8	10	16	30	24	24	4	
Clay%	69	75	71	27	35	37	29	33	
Class	C	C	C	SCL	CL	SCL	SCL	SCL	
C.E.C. m.e. %	51.0	55.8	52.8	18.0	27.0	22.8	23.4	19.6	
Ca m.e. %	19.6	24.0	25.2	4.4	8.2	3.8	6.0	4.8	
Mg, m.e. %	5.5	5.7	7.2	0.8	2.1	Trace	1.4	0.8	
K m.e. %	1.5	1.2	0.9	1.5	0.9	0.4	0.8	0.9	
Na m.e. %	2.0	3.10	3.10	0.55	1.05	1.05	0.40	1.00	0.65

Field Designation	AUGER No. 34				AUGER No. 34a	AUGER No. 35			
Lab. No.	3059	3060	3061	3062	3058	3063	3064	3065	3066
Depth (cm)	0-30	30-80	80-120	120+	0-8	0-30	30-60	60-80	80+

AVAILABLE NUTRIENTS

pH 1:1	5.8	4.9	4.8	4.7	8.3	6.5	7.5	6.2	4.9
Na m.e.%	0.26	0.14	0.14	0.18	0.20	0.18	0.10	Trace	Trace
K m.e.%	0.68	0.54	0.36	0.22	0.42	1.08	0.80	0.61	0.14
Ca m.e.%	3.2	0.4	0.2	Trace	22.0	8.8	4.4	1.2	Trace
Mg m.e.%	2.8	1.3	1.1	1.3	6.6	4.4	3.3	2.3	1.6
Mn m.e.%	0.67	0.62	0.36	0.22	0.43	1.22	0.54	0.52	0.68
ppm	15	9	10	12	50	45	20	7	6
N%	0.15	-	-	-	0.30	0.21	-	-	-
C%	1.44	-	-	-	2.62	1.64	-	-	-
Hp m.e.%	-	2.9	2.8	2.7	-	-	-	-	2.0

TEXTURE AND EXCHANGEABLE BASES

Sand %	23	21	15	11	51	11	11	11	15
Silt %	14	12	12	12	26	28	18	10	6
Clay %	63	67	73	77	23	61	71	79	70
Class	C	C	C	C	SCL	C	C	C	C
C.E.C. m.e.%	27	22.0	20.0	19.6	25.5	34.2	23.4	18.0	18.0
Ca m.e.%	6.8	2.4	2.4	2.2	21.6	14.8	11.6	5.8	2.4
Mg, m.e.%	0.3	0.9	0.8	0.5	2.5	1.2	0.7	0.9	0.2
K m.e.%	1.7	1.4	1.1	0.7	1.2	2.7	2.0	1.4	0.5
Na m.e.%	1.05	0.40	0.40	0.49	0.94	1.00	0.80	0.25	0.20

Field Designation	AUGER No.36				AUGER No.37				
Lab. No.	3067	3068	3069	3070	3071	3072	3073	3074	
Depth (cm)	0-40	40-90	90-120	120+	0-30	30-60	60-80	80-100	

AVAILABLE NUTRIENTS

pH 1:1	6.7	7.4	6.6	5.1	6.6	7.4	6.5	5.2	
Na m.e.%	0.04	0.04	Trace	Trace	0.08	Trace	Trace	Trace	
K m.e.%	1.30	1.00	0.96	0.34	1.52	0.92	0.62	0.32	
Ca m.e.%	8.4	4.8	1.2	Trace	8.4	5.2	1.8	0.6	
Mg m.e.%	4.4	3.7	2.5	1.7	4.4	3.8	3.0	2.3	
Mn m.e.%	0.98	0.72	0.46	0.46	0.70	0.60	0.44	0.54	
ppm	40	14	8	6	58	16	7	6	
N%	0.23	-	-	-	0.22	-	-	-	
C%	1.72	-	-	-	1.89	-	-	-	
Hp m.e.%	-	-	-	1.9	-	-	2.7	0.7	

TEXTURE AND EXCHANGEABLE BASES

Sand %	15	11	11	19	15	11	11	11	
Silt %	24	34	20	4	26	20	12	8	
Clay %	61	55	79	77	59	69	77	81	
Class	C	C	C	C	C	C	C	C	
C.E.C. m.e.%	34.2	24.8	18.0	18.0	35.2	27.8	20.8	19.0	
Ca m.e.%	17.6	12.8	6.4	2.0	16.6	15.0	7.4	4.2	
Mg m.e.%	2.2	1.7	1.2	Trace	2.0	1.1	1.2	0.9	
K m.e.%	2.9	2.4	2.3	0.9	3.4	2.4	1.7	1.1	
Na m.e.%	0.25	0.80	0.20	0.15	0.94	1.05	0.25	0.75	

Field Designation	Auger No.38	AUGER No.39	AUGER No.40	AUGER No.41	AUGER		AUGER No.42		
Lab. No.	3075	3076	3077	3078	3079	3080	3081	3082	3083
Depth (cm)	0-30	0-8	0-30	0-30	30-90	90+	0-30	30-90	90+

AVAILABLE NUTRIENTS

pH 1:1	7.3	5.5	6.8	6.6	5.3	4.9	6.8	7.2	5.3
Na m.e.%	Trace	0.06	0.26	Trace	Trace	Trace	0.15	0.08	Trace
K m.e.%	0.90	0.36	0.96	1.22	0.64	0.25	1.14	1.00	0.50
Ca m.e.%	7.6	0.8	6.0	4.8	0.6	Trace	5.0	1.2	0.2
Mg m.e.%	5.8	1.8	3.4	3.5	1.6	1.7	4.7	3.5	1.8
Mn m.e.%	0.63	0.90	0.72	0.78	0.56	0.56	0.84	0.56	0.46
ppm	16	4	20	10	6	6	16	8	4
N%	0.24	0.14	0.20	0.19	-	-	0.21	-	-
P%	2.82	1.29	1.73	1.41	-	-	1.58	-	-
Hp m.e.%	-	0.7	-	-	0.4	1.0	-	-	1.1

TEXTURE AND EXCHANGEABLE BASES

Sand %	47	51	31	15	11	11	19	14	11
Silt %	20	28	24	28	12	8	24	8	8
Clay %	33	21	45	57	77	81	57	77	81
Class	SCL	SCL	C	C	C	C	C	C	C
C.E.C. m.e.%	28.6	18.0	27.0	24.0	18.6	16.2	26.2	20.8	17.0
Ca m.e.%	13.6	2.4	12.4	11.0	4.4	2.2	12.0	7.6	3.2
Mg m.e.%	2.7	1.3	0.7	Trace	Trace	0.9	0.7	0.4	0.2
K m.e.%	2.2	1.0	2.4	2.7	1.7	0.6	2.6	2.4	1.4
Na m.e.%	0.25	0.94	0.75	0.15	0.15	0.55	0.55	0.40	0.25

Field Designation	AUGER No.43			AUGER No.44	AUGER No.45			
Lab. No.	3084	3085	3086	3090	3091	3092		
Depth (cm)	0-40	40-60	60+	0-30	0-40	40-60		

AVAILABLE NUTRIENTS

pH 1:1	5.9	5.7	5.7	6.0	6.9	5.3		
Na m.e.%	0.22	1.16	1.52	Trace	0.06	Trace		
K m.e.%	0.40	0.08	0.08	0.04	0.82	0.24		
Ca m.e.%	4.8	8.0	8.4	3.4	6.0	0.4		
Mg m.e.%	3.7	4.7	4.6	1.9	4.6	1.8		
Mn m.e.%	0.90	0.24	0.12	1.10	0.93	0.61		
ppm	4	6	7	12	18	10		
N%	0.15	-	-	0.22	0.18	-		
C%	1.56	-	-	4.49	1.97	-		
Hp m.e.%	-	-	-	-	-	2.8		

TEXTURE AND EXCHANGEABLE BASES

Sand %	27	19	23	43	35	23		
Silt %	36	16	16	20	20	20		
Clay %	37	65	61	37	45	57		
Class	CL	C	C	CL	C	C		
C.E.C. m.e.%	27.0	46.8	52.8	21.4	28.6	17.0		
Ca m.e.%	10.4	23.4	26.4	19.8	12.6	3.2		
Mg m.e.%	6.5	9.5	1.5	2.4	1.2	0.7		
K m.e.%	1.0	0.4	0.5	0.9	1.9	0.7		
Na m.e.%	0.75	2.95	3.65	0.20	0.80	0.15		

Field Designation	Auger No.46			Auger No.47			Auger No.48	
Lab. No.	3093	3094	3095	3096	3097	3098	3100	3101
Depth (cm)	0-40	40-90	90+	0-30	30-60	60+	0-30	30-60

AVAILABLE NUTRIENTS

pH 1:1	6.9	7.7	7.6	7.8	5.8	5.9	6.8	5.4
Na m.e.%	0.08	Trace	0.06	0.04	0.04	0.04	0.08	Trace
K m.e.%	1.32	1.23	1.36	1.18	1.04	0.66	0.96	0.30
Ca m.e.%	8.4	3.8	1.6	12.4	1.4	0.6	7.8	0.8
Mg m.e.%	4.6	3.4	3.7	6.4	2.9	3.0	5.2	2.0
Mn m.e.%	0.96	0.62	0.50	0.88	1.00	1.03	0.86	0.79
ppm	32	21	21	26	14	15	18	9
N%	0.18	-	-	0.25	-	-	0.24	-
C%	1.50	-	-	2.33	-	-	2.88	-
Hp m.e.%	-	-	-	-	-	-	-	2.5

TEXTURE AND EXCHANGEABLE BASES

Sand %	23	19	14	31	23	43	35	35
Silt %	24	16	12	24	12	12	12	20
Clay %	53	65	73	45	65	45	37	45
Class	C	C	C	C	C	C	CL	C
C.E.C. m.e.%	29.4	21.4	20.8	35.2	26.2	21.4	34.2	23.4
Ca m.e.%	16.8	13.4	10.2	21.6	4.4	4.2	15.0	3.8
Mg, m.e.%	1.4	2.2	2.6	1.5	0.5	1.2	0.7	Trace
K m.e.%	2.9	2.9	3.3	2.7	2.6	1.7	2.4	0.8
Na m.e.%	0.40	1.05	0.25	0.40	0.65	0.35	0.40	0.15

Field Designation	AUGER No. 49			AUGER No. 50			AUGER No. 51
Lab. No.	3102	3103	3104	3105	3106	3107	3108
Depth (cm)	0-30	30-70	70+	0-30	30-70	70+	0-8

AVAILABLE NUTRIENTS

pH 1:1	5.4	5.6	5.9	5.7	5.9	5.9	5.3
Na m.e.%	0.40	1.08	0.62	0.50	0.14	0.08	0.12
K m.e.%	0.43	0.32	0.08	0.04	0.98	0.42	0.97
Ca m.e.%	1.6	4.4	34.0	36.0	8.8	2.4	4.0
Mg m.e.%	1.5	3.3	1.6	2.4	4.4	3.0	3.2
N m.e.%	0.27	0.37	0.01	0.01	1.14	0.81	1.14
ppm	12	16	23	21	25	12	29
N%	0.23	-	-	0.16	-	-	0.27
C%	2.51	-	-	1.30	-	-	2.74
Hp m.e.%	1.5	-	-	-	-	-	1.2

TEXTURE AND EXCHANGEABLE BASES

Sand %	31	29	25	23	23	27	21
Silt %	40	10	18	44	24	20	28
Clay %	29	61	57	33	53	53	51
Class	CL	C	C	CL	C	C	C
C.E.C. m.e.%	27	36.6	34.2	20.8	37.2	37.2	40.2
Ca m.e.%	4.8	15.6	11.4	5.4	13.8	14.4	10.6
Mg, m.e.%	2.2	1.0	0.4	1.2	2.6	2.2	1.4
K m.e.%	1.0	1.2	1.4	0.9	1.3	1.2	1.8
Na m.e.%	0.85	1.14	1.95	1.00	2.20	1.95	1.1

Field Designation	AUGER No. 51a		AUGER No. 52	AUGER No. 53	AUGER No. 54	AUGER No. 55		
Lab. No.	3109	3110	3111	3112	3113	3114	3115	3116
Depth (cm)	0-30	30-60	0-15	0-8	0-15	0-30	30-60	60+

AVAILABLE NUTRIENTS

pH 1:1	5.6	5.1	6.3	5.7	6.1	5.9	5.8	7.2
Na m.e.%	0.14	0.12	0.33	0.24	0.36	1.50	1.86	0.18
K m.e.%	0.24	0.10	0.50	0.08	0.18	0.16	0.20	0.62
Ca m.e.%	0.8	0.20	4.4	0.8	3.0	8.4	7.4	2.2
Mg m.e.%	3.0	1.5	3.1	2.1	2.5	3.6	4.4	2.9
Mn m.e.%	0.48	0.55	1.08	0.92	1.17	0.22	0.08	1.58
ppm	18	18	25	16	15	19	24	14
N%	0.26	-	0.29	0.26	0.19	0.22	-	-
C%	2.62	-	2.68	2.53	1.81	1.35	-	-
Hp m.e.%	-	2.1	-	-	-	-	-	-

TEXTURE AND EXCHANGEABLE BASES

Sand %	29	27	63	41	61	31	23	29
Silt %	18	28	12	22	18	28	16	16
Clay %	53	45	25	37	21	41	61	56
Class	C	C	SCL	CL	SCL	C	C	C
C.E.C. m.e.%	34.2	43.2	24.8	24.8	20.8	43.2	57	60.0
Ca m.e.%	9.0	16.0	9.2	4.2	3.8	15.6	30	34.8
Mg, m.e.%	4.7	0.5	0.7	0.7	2.7	6.1	7.1	7.5
K m.e.%	1.3	1.3	2.5	2.0	2.5	1.4	1.2	1.0
Na m.e.%	1.05	1.53	0.35	0.25	0.65	1.00	2.40	3.45

Field Designation	PIT 1			PIT 13		PIT 17a		
Lab. No.	3124	3125	3126	3127	3128	3129	3130	3131
Depth (cm)	0-10	10-50	50+	0-20	20-40	0-20	20-70	70-120

AVAILABLE NUTRIENTS

pH 1:1	6.2	7.2	7.6	6.6	6.4	5.6	6.8	7.3
Na m.e.%	0.08	0.12	0.15	0.24	0.20	0.28	0.24	0.08
K m.e.%	1.85	0.52	0.42	0.38	0.24	0.48	0.26	0.74
Ca m.e.%	2.4	3.8	4.4	3.4	3.6	3.4	3.2	2.4
Mg m.e.%	1.44	0.68	0.75	0.75	0.74	0.66	0.67	0.56
Mn m.e.%	18	43	41	29	31	30	36	15
ppm	0.12	-	-	0.16	-	0.19	-	-
N%	0.87	-	-	1.37	-	0.18	-	-
C%	-	-	-	-	-	-	-	-
Hp m.e.%								

TEXTURE AND EXCHANGEABLE BASES

Sand %	23	23	17	17	35	13	19	15
Silt %	40	20	22	38	28	22	32	10
Clay %	37	57	61	45	37	65	49	75
Class	CL	C	C	C	CL	C	C	C
C.E.C. m.e.%	47.7	50.4	47.7	20.8	19.7	14.2	20.8	15.9
Ca m.e.%	22.8	27.6	28.2	12.0	11.2	5.8	13.4	8.4
Mg, m.e.%	9.2	16.4	15.1	3.5	2.9	1.6	4.0	4.0
K m.e.%	1.3	1.0	1.1	1.6	1.0	0.3	2.4	1.4
Na m.e.%	1.25	2.65	3.40	0.52	0.35	0.55	0.29	0.22

Field Designation	PIT 26	PIT 33		PIT 34a			
Lab. No.	3135	3132	3133	3134	3136	3137	3138
Depth (cm)	0-30	0-20	20-50	50+	0-20	20-70	70-90

AVAILABLE NUTRIENTS

pH 1:1	6.1	5.4	5.5	5.8	8.0	8.3	8.4
Na m.e.%	0.12	0.10	0.04	0.12	0.15	0.98	0.54
K m.e.%	0.83	0.66	0.42	0.38	0.83	0.48	0.42
Ca m.e.%	1.6	2.2	2.0	2.0	2.0	3.8	2.0
Mg m.e.%	1.0	1.2	1.1	1.0	1.1	2.9	1.5
Mn m.e.%	0.52	0.52	0.48	0.46	0.52	0.70	0.52
ppm	23	14	20	16	14	18	14
N%	0.14	0.19	-	-	0.18	-	-
C%	0.79	1.64	-	-	1.08	-	-
Hp m.e.%	-	4.0	2.0	-	-	-	-

TEXTURE AND EXCHANGEABLE BASES

Sand %	35	23	15	19	23	23	35
Silt %	24	30	6	8	24	26	16
Clay %	41	47	79	73	53	51	49
Class	C	C	C	C	C	C	C
C.E.C. m.e.%	13.5	25.0	50.4	50.4	29.4	40.5	30.4
Ca m.e.%	3.0	6.8	22.2	27.6	25.2	50.4	46.8
Mg, m.e.%	1.7	2.8	8.8	14.4	2.5	2.1	1.9
K .m.e.%	0.8	0.3	0.5	0.6	1.3	0.4	0.3
Na m.e.%	0.65	0.75	2.30	2.90	0.47	0.80	0.60

Field Designation	PIT 39a		PIT 41			PIT 42	
Lab. No.	3139	3140	3141	3142	3143	3144	3145
Depth (cm)	0-20	20-40	0-35	35-110	110+	0-30	30-90

AVAILABLE NUTRIENTS

pH 1:1	6.8	5.5	6.3	5.6	4.7	6.2	5.2
Na m.e.%	1.00	0.95	0.44	0.48	0.69	0.12	0.08
K m.e.%	0.42	0.32	0.62	0.50	0.33	1.20	0.82
Ca m.e.%	5.2	5.0	5.2	4.8	7.2	6.8	2.2
Mg m.e.%	2.9	2.8	2.9	2.6	3.6	2.6	1.8
Mn m.e.%	0.72	0.40	0.28	0.63	0.66	1.20	0.72
ppm	15	13	17	12	15	13	8
N%	0.18	-	0.16	-	-	0.18	-
C%	1.14	-	1.70	-	-	1.64	-
H _p m.e.%	-	2.4	-	-	2.0	-	1.7

TEXTURE AND EXCHANGEABLE BASES

Sand %	43	45	15	11	15	23	15
Silt %	22	18	22	10	8	18	14
Clay %	35	39	63	79	77	59	71
Class	CL	CL	C	C	C	C	C
C.E.C. m.e.%	19.7	17.8	17.8	12.8	12.4	19.7	16.8
Ca m.e.%	12.0	10.4	6.4	7.4	4.8	11.6	7.2
Mg, m.e.%	3.4	3.5	2.4	1.4	3.0	1.9	1.8
K m.e.%	1.8	0.8	1.1	0.4	0.2	0.8	0.2
Na m.e.%	0.31	0.29	0.45	0.45	0.15	0.75	0.80

Field Designation	PIT 43			PIT 47a		PIT 50	
Lab. No.	3146	3147	3148	3149	3150	3151	3152
Depth (cm)	0-20	20-60	60+	0-20	20-44	0-20	20-40

AVAILABLE NUTRIENTS

pH 1:1	5.9	6.1	6.0	5.9	5.4	5.6	5.6
Na m.e.%	0.12	0.44	1.12	1.82	0.18	0.12	0.33
K m.e.%	0.92	0.46	0.28	0.22	0.26	1.75	0.18
Ca m.e.%	2.2	9.2	13.6	15.2	1.6	3.2	0.8
Mg m.e.%	1.9	3.5	3.5	3.6	1.3	2.1	1.4
Mn m.e.%	0.98	1.32	0.32	0.26	1.00	0.98	0.93
ppm	9	15	20	29	10	17	10
N%	0.13	-	-	0.18	-	0.26	-
C%	1.19	-	-	1.61	-	0.59	-
H _p m.e.%	-	-	-	-	1.4	-	-

TEXTURE AND EXCHANGEABLE BASES

Sand %	27	19	19	35	35	23	23
Silt %	32	14	14	36	20	24	30
Clay %	41	67	67	39	45	53	47
Class	C	C	C	CL	C	C	C
C.E.C. m.e.%	16.4	42.6	53.4	16.8	15.0	32.8	15.9
Ca m.e.%	12.2	18.4	26.4	5.6	3.0	10.6	6.4
Mg m.e.%	2.4	7.2	7.8	2.6	1.2	3.2	2.2
K m.e.%	0.4	0.4	0.7	1.2	0.4	1.2	0.7
Na m.e.%	0.60	2.00	3.40	0.40	0.40	0.70	0.55

Field Designation	PIT 53		PIT 56					
Lab. No.	3156	3157	3153	3154	3155			
Depth (cm)	0-10	10-40	0-20	20-80	80+			

AVAILABLE NUTRIENTS

pH 1:1	5.4	6.0	5.6	6.1	6.0			
Na m.e.%	0.26	0.18	0.18	0.08	0.08			
K m.e.%	0.38	0.24	0.36	0.47	0.38			
Ca m.e.%	20.00	1.2	2.0	8.0	2.8			
Mg m.e.%	2.7	1.0	1.1	3.0	1.2			
Mn m.e.%	0.66	0.86	1.86	0.71	1.02			
ppm	39	8	13	15	12			
N%	0.12	-	0.17	-	-			
C%	0.76	-	1.61	-	-			
Hp m.e.%	1.8	-	-	-	-			

TEXTURE AND EXCHANGEABLE BASES

Sand %	39	39	55	23	55			
Silt %	16	24	16	32	12			
Clay %	45	37	29	45	33			
Class	C	CL	SCL	C	SCL			
C.E.C. m.e.%	13.2	16.4	13.5	17.8	13.8			
Ca m.e.%	1.4	5.6	1.6	1.6	1.2			
Mg m.e.%	0.4	1.5	0.8	0.9	0.5			
K m.e.%	0.3	1.8	0.5	0.3	0.2			
Na m.e.%	0.45	0.40	0.45	0.52	0.35			

SOILS OF KURAIHA ESTATE - THIKA



Legend

Well drained soils

- 1** More than 90 cm of dark reddish brown clay over plinthite (Murrum)
- 2** 40 to 90 cm dark reddish brown clay loam over plinthite (Murrum); some termite mounds

Moderately well drained soils

- 3** Less than 40 cm of dark reddish brown clay loam over plinthite (Murrum); some termite mounds
- 3a** Like 3, but many termite mounds

Poorly drained soils

- 4** 30 to 80 cm of very dark grey brown clay over plinthite (Murrum); impeded drainage; few termite mounds
- 5** 40 to 80 cm of very dark grey brown clay over plinthite (Murrum); seasonally water logged

Addition

- Levelled area**

Miscellaneous

- 6** Rock Outcrop (Soft tuff)
- 7** Swamp and open water

Reference

- Soil boundary and boundary of addition
- Main road
- Track
- Railway
- Stream
- Observation point with number
- Boundary of Surveyed area
- Termite mound

SCALE 1:5,000

