

## Reference soil Kenya 1: Nitisol

### Description

Authors: Kenya Soil Survey (KSS), officers Rachilo and Michieka. Topography and landform: The area has an almost flat topography, the slope gradient increasing to the North and East to gently undulating, thus inducing a N-NE aspect of land. Situated on a broad interfluvium at an altitude of 1700 m the landform is characteristic for a large area East of the Rift Valley, which has been named "broad ridge topography" by Scott (1963), or as "volcanic ridge landscape". The ridge on which NAL is located is bordered to the South by the valley of the upper Nairobi river, which flows from West to East and to the North by a canalized stream following the same direction. Both streams contribute to the Athi river. Vegetation and land use: The original vegetation of bushy and wooded grassland with characteristically broad-leaved trees such as Combretum and Croton macrostachys with mostly evergreen shrubs made way a long time ago for arable cropping and exotic tree and bush species. Present cropping experiments on the station include plants like maize, sunflower, pulses, tomatoes, Irish potatoes and flowers. Prior to these coffee (Arabica) was grown. These and other crop trials may have influenced the fertility status of the (top)soils. Brief description of the profile: The typical soil at the NAL is described as well-drained, very deep, dark reddish brown to dark red, friable clay. Additional notes on profile description: Ah: in the upper 5 cm weak sealing occurs; AB: also many fine and few medium pores. In a thin section taken from the Bt2 at 110-120 cm micro-cutans are observed and occasionally clay filling occurs. There is also common soil fauna activity mainly by termites and millipeds, as evident from channels and agrotubules. Rooting is very deep, the bulk of roots is concentrated in the top 60 cm. Climatic data: mean monthly potential evaporation in mm; period 1921-1962 and 1965.



### Classification

#### WRB 2006:

Acric Nitisol (Humic Dystric Rhodic)

37-150 cm nitic horizon

#### WRB 1998:

Rhodi- Humic Nitisol (Dystric)

0-37 cm ochric horizon

37-150 cm nitic horizon

#### FAO-UNESCO-ISRIC 1988: FAO-UNESCO 1974:

Dystric- Rhodic Nitisol

0-37 cm ochric A horizon

37-150 cm argic B horizon

nitic properties

strongly humic

Humic Nitosol

0-37 cm ochric A horizon

37-150 cm argillic B horizon

high organic matter content in B horizon

## Site description

### General information:

Names of person(s) who described the profile : Rachilo & Michieka

General description of location of profile (e.g., town, province) : National Agricultural Laboratories (NAL), 7km W of Nairobi centre

Climate classification according to Köppen : Cfs

Date : October 1973

Latitude / Longitude : S -1.25° / E 36.6833°

### Physiography:

The altitude of the soil profile relative to mean sea level, specified in meters : 1700 m asl

Regional landform : plateau

Topography of the surrounding country : undulating

Physiographic Unit in the immediate surrounding of the site : volcanic ridge landscape

The slope refers to the inclination of the land : immediately surrounding the site. The measured or estimated slope angle is specified to the nearest per cent : 4 %

The physiographic position of the site where the profile is located : middle slope

Form of the slope surrounding the site :

Slope Aspect of the site : north-north-east

### Parent material:

The main parent rock/ material over which the soil has been formed (1st entry) : fine-grained intermediate igneous rock

Mode of Accumulation or deposition of parent material (1st entry) : residual material

Texture of parent material (1st entry) : clayey

Weathering status of solid rock (1st entry) : highly

Resistance against weathering (solid rock) (1st entry) : moderate

Depth1 of lithological boundary : cm

The main parent rock/ material over which the soil has been formed (2nd entry) :

Resistance against weathering (solid rock) (2nd entry) :

Soil Depth; depth to which roots can easily penetrate throughout the year : 180 cm

Remarks on Parent Materials : quartz trachyte

### Hydrology and drainage:

Depth of groundwater table : cm

Groundwater Top : cm

Groundwater Bottom : cm

Kind of groundwater table : no groundwater table observed

Top Stagnating Layer : cm

Bottom Stagnating Layer : cm

Runoff : medium

Flooding frequency : never

Estimated permeability (class) of least permeable part of the profile : high

Drainage Class : well

To Drainage Class :

Moisture conditions of the profile: dry from -to : 0-180 cm

Moisture conditions of the profile: moist from -to : cm

Wet From - To : cm

### Land use / vegetation:

Current land use at the site : high level arable farming

Major crops : maize

Main type of irrigation : no irrigation

Rotation scheme :

Vegetation Type;The natural vegetation at the site : woodland

### Erosion and aggradation:

Soil erosion type (1st entry) :

Occurrence of soil aggradation : absent

Slope Stability : stable

Status of vegetation : modified

Remarks on Land Use / Vegetation : VEGETETATION: The original vegetation of bushed and wooded grassland with characteristically broad-leaved trees such as Combretun and Croton macrostachys with mostly evergreen shrubs made way a long time ago for arable cropping and exotic tree and bush species. LANDUSE: Used for cropping experiments, and garden. Present cropping experiments include maize, sunflower, pulses, tomatoes, irish potatoes and flowers. Prior to these coffee (Arabica) was grown. These and other crop trials may have influenced the fertility status of the (top) soils.

## Surface characteristics:

Microrelief type: small-scale : differences in relief in the direct vicinity of the site

Microrelief Pattern : none

Microrelief Height :

Rockiness : none

Stoniness : none

Average size of stones :

Shape of stones (on average) :

Cracks : no cracks observed

Slaking of aggregates by tillage, rainfall or frost : surface partly slaked, round smooth aggregates

Evidence of salt : non-saline

Evidence of alkali : non-alkaline

## Nearest climate station:

Station : Muguga

Country : Kenya

WMO Code : 63.735

Distance : 6 km WNW (good )

Latitude / Longitude : S 1°13 / E 36°38

## Climate data\*:

dataType(Station)	: nrecord	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Precipitation (mm)(Muguga)	: 12	61	40	60	219	203	49	22	22	26	59	141	89	991
Mean temperature (°C)(Muguga)	: 9	17	17.2	17.6	17	15.8	14.3	13.3	14.1	15.2	16.5	16	16.2	15.9
Maximum temperature (°C)(Muguga)	: 9	22.6	23.2	23	21.3	19.8	19	18.2	19.2	20.8	21.8	20.2	21.1	20.9
Minimum temperature (°C)(Muguga)	: 9	11.2	11.2	12.2	12.7	11.7	9.6	8.5	9	9.6	11.2	11.7	11.3	10.8
Pot. evapotranspiration (mm)(Muguga)	: -	13	12.7	13.7	15	15	13.5	12.5	12.5	12.2	12.7	14	14	13.4
Epot. - Penman (mm)(Muguga)	: -	128	123	135	109	90	78	78	90	108	126	110	112	1287
Epot. - Frere, Popov (mm)(Muguga)	: -	129	124	136	108	87	76	75	88	108	127	108	111	1277
Bright sunshine (%) (Muguga)	: -	77	80	74	61	54	55	42	44	58	64	62	64	61.3
Total global radiation (MJ/m²)(Muguga)	: -	22.7	24.3	23.4	19.3	16.7	17.1	14.5	15.7	19.6	21.6	20.7	21.6	19.8
Estimated global radiation (MJ/m²)(Muguga)	: -	22.7	24.3	23.5	19.3	16.7	17.1	14.5	15.7	19.6	21.7	20.7	21.6	19.8
Windspeed (m/s, at 2m height)(Muguga)	: 10	3.4	3.4	3.5	3.2	2.4	2.1	2.1	2.4	3	3.5	3.6	3.4	3

\*Data are considered representative for site

## Profile description:

Ap 0-18 cm	: dark reddish brown (5YR 3/4, dry) dark reddish brown (5YR 3/3, moist), clay, moderate to strong fine subangular blocky and moderate to strong medium subangular blocky, hard firm sticky plastic, patchy thin clay cutans, non calcareous, gradual smooth boundary to,
AB 18-37 cm	: dark reddish brown (2.5YR 3/4, dry) dark reddish brown (2.5YR 3/4, moist), clay, strong medium subangular blocky and strong coarse subangular blocky, hard friable sticky plastic, broken moderately thick clay cutans, common micro pores and many pores, non calcareous, gradual smooth boundary to,
Bt1 37-66 cm	: dark red (2.5YR 3/6, dry) dark reddish brown (2.5YR 3/4, moist), clay, strong medium angular blocky and strong coarse angular blocky, hard friable sticky plastic, continuous thick clay cutans, many micro fine common medium pores, non calcareous, diffuse smooth boundary to,
Bt2 66-116 cm	: dark red (2.5YR 3/6, dry) dark reddish brown (2.5YR 3/4, moist), clay, strong medium angular blocky and strong coarse angular blocky, hard friable sticky plastic, broken thick clay cutans, many micro fine common medium pores, non calcareous, diffuse smooth boundary to,
Bt3 116-180 cm	: dark red (2.5YR 3/6, dry) dark reddish brown (2.5YR 3/4, moist), clay, strong medium angular blocky and strong fine angular blocky, firm, broken thick clay cutans, many micro fine common medium pores, non calcareous,

## Physical

### Particle size distribution:

Depth (cm)	Gravel (%)	Very Coarse Sand (%)	Coarse Sand (%)	Medium Sand (%)	Fine Sand (%)	Very Fine Sand (%)	Total Sand (%)	Coarse Silt (%)	Fine Silt (%)	Total Silt (%)	Clay (%)
0-15	-	0.1	0.6	1.7	2.4	1.4	6.2	7.1	16.5	23.6	70
15-30	-	0.0	0.6	1.6	2.6	1.5	6.3	6.4	12.7	19.1	74.6
30-60	-	0.1	0.4	1.0	1.7	1.1	4.3	5.2	9.0	14.2	81.5
65-100	-	0.0	0.5	0.8	1.4	1.0	3.7	3.8	8.7	12.5	83.8
100-150	-	0.1	0.4	0.7	1.6	1.2	4	2.1	8.8	10.9	85.1

### Other physical data

Depth (cm)	Bulk Density (kg/dm³)	Spec. Surf. Area (m²/g)	COLE (cm/cm)	Water Disp. Clay (%)	Clay (%)
0-15	-	-	-	14.7	70
15-30	-	-	-	13.1	74.6
30-60	-	-	-	14.8	81.5
65-100	-	-	-	4.2	83.8
100-150	-	-	-	0.0	85.1

### Chemical characteristics:

Depth (cm)	pH H2O	pH KCl	EC 1 : 2.5 (mS/cm)	CaCO3 (%)	Org. C (%)	Org. N (%)	C / N	Exch. Acid (cmol/kg)	Exch. Al (cmol/kg)	Ca (cmol/kg)	Mg (cmol/kg)	K (cmol/kg)	Na (cmol/kg)	Sum Cations (cmol/kg)
0-15	5.8	4.9	0.15	-	2.33	0.18	13	-	-	7.9	1.9	2.1	0.0	11.9
15-30	5.4	4.3	0.14	-	2.14	0.16	13	0.2	0.0	5.4	1.5	1.4	0.0	8.3
30-60	5.4	4.5	0.08	-	1.02	0.09	11	0.1	0.2	6.5	1.6	0.9	0.0	9
65-100	5.9	5.0	0.08	-	0.81	-	-	-	-	7.1	2.6	0.4	0.0	10.1
100-150	6.3	5.3	0.07	-	0.73	-	-	-	-	6.3	3.4	0.4	0.0	10.1

Depth (cm)	CEC Soil (cmol/kg)	CEC Clay (cmol/kg)	CEC Org (cmol/kg)	ECEC (cmol/kg)	Base sat. (%)	Al sat. (%)	ESP (%)
0-15	25.7	37	8.2	-	46	-	0
15-30	24.8	33	7.5	-	33	0	0
30-60	22.7	28	3.6	-	40	1	0
65-100	23.7	28	2.8	-	43	-	-
100-150	18.5	22	2.6	-	55	-	0

Depth (cm)	pH NaF	P Retention (%)	ODOE	Melanin Index	Fe o (wt%)	Al o (wt%)	Si o (wt%)	Fe d (wt%)	Al d (wt%)	Fe p (wt%)	Al p (wt%)	C p (wt%)
0-15	-	-	-	-	0.4	0.3	0.0	7.2	0.3	-	-	-
15-30	-	-	-	-	0.4	0.3	0.0	7.6	0.3	-	-	-
30-60	-	-	-	-	0.4	0.3	0.0	7.1	0.2	-	-	-
65-100	-	-	-	-	0.4	0.3	0.1	7.2	0.3	-	-	-
100-150	-	-	-	-	0.4	0.3	0.0	7.7	0.3	-	-	-

## Clay mineralogy:

Depth (cm)	Kaolinite	Mica / illite	Vermiculite	Chlorite	Smec	Halloysite	Mixed layer	Quar	Feldspar	Gibbsite	Goethite	Hematite
0-15	weak to medium	-	-	-	-	-	weak	very weak to weak	very weak to weak	-	very weak to weak	-
15-30	weak to medium	-	-	-	-	-	weak	very weak to weak	very weak to weak	-	very weak to weak	-
30-60	weak to medium	very weak	-	-	-	-	weak	very weak to weak	weak	-	very weak to weak	-
65-100	weak to medium	very weak	-	-	-	-	weak	very weak to weak	weak	-	very weak to weak	-
100-150	weak to medium	very weak to weak	-	-	-	-	weak	very weak to weak	weak	-	very weak to weak	-

## Source of analyzing procedures:

Laboratory Attribute	Description	Proc. ref
ISRIC Al d	Al; Atomic Absorption Spectrometry	<a href="#">12.1-1.2</a>
ISRIC Al o	Al; Atomic Absorption Spectrometry	<a href="#">12-2</a>
ISRIC Al sat.	Calculation; Exchangeable Al / ( exchangeable bases+Al+H) or Al / CEC	<a href="#">11.1.4-1.4.3</a>
ISRIC Base sat.	Calculation; Sum of Exchangeable Cations (Na, K, Ca, Mg) / CEC soil	<a href="#">labmanual</a>
ISRIC C / N	Calculation; Organic Carbon / Organic Nitrogen	<a href="#">labmanual</a>
ISRIC Ca	Exchangeable bases with 1 M ammonium acetate at pH 7; Ca by atomic absorption spectrometry	<a href="#">9-4 and 9-5.3</a>
ISRIC CEC Clay	Calculation; ((CEC soil - CEC org.m.)/ clay %)*100	<a href="#">9-6.3</a>
ISRIC CEC Org	CEC organic matter; expert estimate for charge per unit C	<a href="#">9-6.3</a>
ISRIC CEC Soil	CEC; with index cation in buffered solution pH7	<a href="#">9-4 and 9-5.3.3</a>
ISRIC Clay; < 0.002 mm	Fraction by Pipette analysis; after removal CaCO <sub>3</sub> and organic matter, dispersion and sedimentation	<a href="#">3-4.7</a>
ISRIC EC 1 : 2.5	Electro Conductivity of a soil / water (1:2.5) suspension	<a href="#">4-1.4 and 13-4</a>
ISRIC ESP	Calculation; (Exchangeable Na / CEC soil) * 100	<a href="#">9-6.3</a>
ISRIC Exch. Acid	Extraction by 1 M KCl; titration with NaOH	<a href="#">11.1.4-1.4.2</a>
ISRIC Exch. Al	Extraction by 1 M KCl; Al by atomic absorption spectrometry	<a href="#">11.1.4-1.4.3</a>
ISRIC Fe d	Fe; Atomic Absorption Spectrometry	<a href="#">12-1.2</a>
ISRIC Fe o	Fe; Atomic Absorption Spectrometry	<a href="#">12-2</a>
ISRIC Feldspar	Feldspar; relative abundance scale 0 - 7	<a href="#">16-1</a>
ISRIC Goethite	Goethite; relative abundance scale 0 - 7	<a href="#">16-1</a>
ISRIC K	Exchangeable bases with 1 M ammonium acetate at pH 7; K by flame atomic emission spectrometry	<a href="#">9-6.1</a>
ISRIC Kaolinite	Kaolinite; relative abundance scale 0 - 7	<a href="#">16-1</a>
ISRIC Mg	Exchangeable bases with 1 M ammonium acetate at pH 7; Mg by atomic absorption spectrometry	<a href="#">9-4 and 9-5.3</a>

ISRIC	Mica / Illite	Mica / ilite; relative abundance scale 0 - 7	<a href="#">16-1</a>
ISRIC	Mixed-layer	Mixed layer minerals; relative abundance scale 0 - 7	<a href="#">16-1</a>
ISRIC	Na	Exchangeable bases with 1 M ammonium acetate at pH 7; Na by flame atomic emission spectrometry	<a href="#">9-4 and 9-5.3</a>
ISRIC	Organic Carbon	Wet combustion of organic matter by potassium dichromate and sulphuric acid at about 125 degrees Celcius. Residual dichromate is back titrated against ferrous sulphate. To compensate for incomplete destruction an empirical correction factor of 1.3 is applied	<a href="#">5</a>
ISRIC	Organic Nitrogen	Organic Matter is digested in sulphuric acid (and hydrogen peroxide) with selenium as catalyst. Nitrogen is converted to ammonium sulphate. The solution is made alkaline and ammonia is distilled off. The evolved ammonia is trapped in boric acid and titrated with standardized acid solution	<a href="#">6</a>
ISRIC	pH H2O	pH electrode; in supernatant suspension	<a href="#">4-1</a>
ISRIC	pH KCl	In supernatant suspension; potentiometrically	<a href="#">4-1</a>
ISRIC	Quartz	Quartz; relative abundance scale 0 -7	<a href="#">16-1</a>
ISRIC	Sand; 0.10 - 0.05 mm	Fraction by sieving; after removal CaCO3 and organic matter	<a href="#">3-4.6</a>
ISRIC	Sand; 0.25 - 0.10 mm	Fraction by sieving; after removal CaCO3 and organic matter	<a href="#">3-4.6</a>
ISRIC	Sand; 0.5 - 0.25 mm	Fraction by sieving; after removal CaCO3 and organic matter	<a href="#">3-4.6</a>
ISRIC	Sand; 1.0 - 0.5 mm	Fraction by sieving; after removal CaCO3 and organic matter	<a href="#">3-4.6</a>
ISRIC	Sand; 2.0 - 0.05 mm	Total sand fractions by sieving; after removal CaCO3 and organic matter	<a href="#">3-5</a>
ISRIC	Sand; 2.0 - 1.0 mm	Fraction by sieving; after removal CaCO3 and organic matter	<a href="#">3-4.6</a>
ISRIC	Si o	Si; Atomic Absorption Spectrometry	<a href="#">12-2</a>
ISRIC	Silt; 0.02 - 0.002 mm	Fraction by Pipette analysis ; after removal CaCO3 and organic matter, dispersion and sedimentation	<a href="#">3-4.7</a>
ISRIC	Silt; 0.05 - 0.002 mm	Calculation; Sum fractions Silt 0.05 - 0.02 mm	<a href="#">3-4.7</a>
ISRIC	Silt; 0.05 - 0.02 mm	Fraction by Pipette analysis ; after removal CaCO3 and organic matter, dispersion and sedimentation	<a href="#">3-4.7</a>
ISRIC	Sum cations	Sum of Exchangeable Cations (Ca, Mg, Na, K) with 1 M ammonium acetate at pH 7	<a href="#">9-</a>
ISRIC	Water Dispersable Clay	Fraction by Pipette analysis; without any pretreatment	<a href="#">3-8</a>

\*ref: no labmanual available, link to presumable used analytical methode

## Other classification

USDA-NRCS (1999) : Rhodic Paleustalf

USDA-SCS (1975) : Rhodic Paleustalf clayey kaolinitic isohyperthermic

## Classification (other)

FAO-Unesco (1974): ferric properties (CEC < 24 meq/100 g clay) occur below 100 cm, therefore soil does not classify as Nitosol. FAO-Unesco (1988):topsoil meets all requirements for umbric horizon except for colour (dry colours 5YR 3/4 and 2.5Ydoes not use

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