

## Reference soil Zimbabwe 11: Plinthosol

### Description

(1) Natural vegetation consists predominantly of medium-sized open woodland of trees and shrubs. *Brachystegia spiciformis* and *Julbernardia globiflora* trees and shrubs dominate, but there are common *Terminalia sericea* and *Parinari curatellifolia* trees and shrubs. A detailed listing of natural vegetation types is available. (2) Only a few grasses and arable weeds were observed in the immediate vicinity of the pit. (3) The land has been cleared and stumped to accommodate the ICRAF Agroforestry Trials. The upper part of the Block where the pit is sited was cleared in 1990. Agroforestry shrubs were planted in December 1990. The land was ploughed at the time of establishment. At the time of planting, all agroforestry shrubs were watered every 2 weeks with 10 litres of water for a two-month period. Thereafter, no water beyond the annual rainfall was applied. During the 1990/91 season, 251 mms of rainfall were received, but during the 1991/92 season, only 151 mms were received. No pretreatments or fertilisations have taken place. In contrast to the ICRAF Trials at Domboshawa, each shrub was surrounded with a low depression well. Plantings occur about 5 metres from the pit. (4) A variety of agroforestry species have been planted in blocks. They include *Acacia augustisma*, *Calliandra calliothrus*, *Flemingia conjesta*, *Gliditsia triacant*, *Grincidia sepium*, *Sesbania sesban*, *Leucaena leucocephala*, *Cajanus cajan* and *Flemingia macrophila*. (5) Occasional, broad, round termite mounds occur within the Block, about 80-100 metres apart and up to 2 metres in height. These mounds would normally support tree and/or shrub growth, but this vegetation cover has been removed. (6) The location of the pit relative to the landscape is difficult to assess. It occupies a crestal, but midslope position on a long, gradually sloping (<2%), west-facing and convex spur of ground that lies between two drainage lines. The slope in the immediate vicinity of the pit is flat. (7) Lister (1986, p99) indicates that the dominant landform of the area consists of regularly jointed granite koppies with intermediate flat pediments. (8) This particular pit is very slightly higher (50 cms) in position than ZW12, but about 6 metres higher than ZW13. (9) The soil horization is very variable within the pit. On the sampled and described face, the dense gravel horizon occurs at about 100 cms from the surface, and is underlain by heavily mottled red/yellow plinthic material, which sets hard on exposure. On the other side of the pit, the dense gravel horizon tapers down to 200 cms from the surface, and above it is a moist, heavily mottled sand, which is not as strongly mottled as the plinthite. (10) Roots observed in the profile are mostly tree roots of varying dimensions. (11) Mottle concentrations vary from about 2% in the 2nd horizon, 5% in the 3rd to 10% in the 4th. The concentrations of mottles in the 5th and 6th horizons is difficult to determine. The 7th horizon is dominantly mottled. (12) Mottle colours in the 5th, 6th and 7th horizons also include 7.5YR hues ,

### Classification

#### WRB 2006:

Acri Fractipetric Plinthosol (Albic Dystric Arenic)

27-71 cm albic horizon

71-228 cm argic horizon

97-162 cm plinthic horizon

#### FAO-UNESCO-ISRIC 1988:

Acri-Albic Plinthosol

0-27 cm ochric A horizon

27-71 cm albic E horizon

71-228 cm argic B horizon

plinthite

#### FAO-UNESCO 1974:

Plinthic Acrisol

0-27 cm ochric A horizon

27-71 cm albic E horizon

71-228 cm argillic B horizon

plinthite

## Site description

### General information:

Names of person(s) who described the profile : Spurway JKR  
General description of location of profile (e.g., town, province) : Makoholi Research Station in ICRAF Agroforestry Trial Block  
Climate classification according to Köppen : Cw  
Date : June 1992  
Latitude / Longitude : S -19.8° / E 31.75°

### Physiography:

The altitude of the soil profile relative to mean sea level, specified in meters : 1220 m asl  
Regional landform : pediment  
Topography of the surrounding country : flat or almost flat  
Physiographic Unit in the immediate surrounding of the site : long interfluve  
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 : 0 %  
The physiographic position of the site where the profile is located : crest  
Form of the slope surrounding the site : convex  
Slope Aspect of the site : West

### Parent material:

The main parent rock/ material over which the soil has been formed (1st entry) : coarse-grained acid igneous rock  
Mode of Accumulation or deposition of parent material (1st entry) : residual material  
Texture of parent material (1st entry) : sandy  
Weathering status of solid rock (1st entry) : slightly  
Resistance against weathering (solid rock) (1st entry) : high  
Depth1 of lithological boundary : 97 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 : 97 cm  
Remarks on Parent Materials : granodiorite

### 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 : 97 cm  
Bottom Stagnating Layer : 162 cm  
Runoff : very slow  
Flooding frequency : never  
Estimated permeability (class) of least permeable part of the profile : slow  
Drainage Class : excessive  
To Drainage Class :  
Moisture conditions of the profile: dry from -to : 0-162 cm  
Moisture conditions of the profile: moist from -to : 162-228 cm  
Wet From - To : cm

### Land use / vegetation:

Current land use at the site : agro-forestry  
Major crops : crops (unspecified)  
Main type of irrigation : no irrigation  
Rotation scheme : crop rotation scheme not relevant  
Vegetation Type;The natural vegetation at the site : deciduous woodland  
Status of vegetation : primary  
Remarks on Land Use / Vegetation : LANDUSE: The land has been cleared and stumped to accomodate agro-forestry trials. Species p;lanted: Acacia augustisma, Calliandra calliothrus, Flemingia conjesta, Gliditsia triacant, Grincidia sepium, Sesbania seban, leucaena leucocephala, Cajanus cajan and Flemingia macrophila. VEGETATION: Natural vegetation consists predominantly of medium-sized open woodland of trees and shrubs. Brachystegia spiciformis and Julbernardia globiflora trees and shrubs dominate, but there are common Terminalia sericea and Parinari curatellifolia trees and shrubs. Only a few grasses and arable weeds were observed in the immediate vicinity.

### Erosion and aggradation:

Soil erosion type (1st : sheet entry)  
Intensity of the soil erosion type (1st entry) : slight  
Occurrence of soil aggradation : not apparent  
Slope Stability : stable

### Surface characteristics:

Microrelief type: small-scale differences in relief in the direct vicinity of the site : termite/ant mounds  
Microrelief Pattern : isolated  
Microrelief Height : 250  
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 : no surface slaking/crusting observed  
Evidence of salt : non-saline  
Evidence of alkali : non-alkaline

### Nearest climate station:

Station : Makoholi  
Country : Zimbabwe  
WMO Code : 67.889  
Distance : 10 km S (good )  
Latitude / Longitude : S 19°50 / E 30°47

## Climate data\*:

data	Type(Station)	nrecord	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Precipitation (mm)(Makoholi)	: 30		144	128	68	26	6	5	1	2	5	23	88	154	650
Number of rain days(Makoholi)	: 35		11	11	7	6	2	2	1	1	2	4	9	12	68
Mean temperature (°C)(Makoholi)	: 12		21.8	21	20.2	18.4	15.7	13.2	13.4	16	19.1	21.2	21.3	21.5	18.6
Maximum temperature (°C)(Makoholi)	: 12		27.9	27	26.4	25.1	23.2	20.8	21.1	23.9	27.2	28.6	27.9	27.6	25.6
Minimum temperature (°C)(Makoholi)	: 12		16.8	16.1	15	12.8	9.3	6.6	6.2	8.4	10.9	14.2	15.5	16.6	12.4
Relative humidity (%) (Makoholi)	: 22		69	73	70	66	61	59	57	50	46	51	59	68	60.8
Pot. evapotranspiration (mm)(Makoholi)	: 12		18.2	18.3	16.7	14.1	11	8.9	8.6	9.1	9.5	12.3	14.9	17.1	13.2
Epot. - Frere, Popov (mm)(Makoholi)	: -		138	113	115	93	75	62	71	106	151	168	143	136	1371
Act. evaporation - Class A pan (mm)(Makoholi)	: 22		182	147	157	134	120	96	113	155	200	223	194	174	1895
Bright sunshine (%) (Makoholi)	: 12		62	60	64	68	77	76	79	80	82	71	58	53	69.2
Bright sunshine (hours/day)(Makoholi)	: 22		8.2	7.6	7.8	8.2	8.7	8.4	8.6	9.3	9.4	8.7	7.7	7.2	8.3
Estimated global radiation (MJ/m <sup>2</sup> )(Makoholi)	: -		22.1	20.8	19.7	17.5	16	14.4	15.3	17.7	21.1	21.8	21	20.6	19
Windspeed (m/s, at 2m height)(Makoholi)	: 12		1.8	1.8	1.9	1.8	1.6	1.6	1.7	2	2.3	2.5	2.2	1.9	1.9

\*Data are considered representative for site

## Profile description:

- Ah 0-27 cm : very pale brown (10YR 7/3, dry) brown (10YR 5/3, moist), coarse sand, single grain, soft non sticky non plastic, no cutans, few very fine discontinuous expd interstitial random pores highly porous (>60 vol%), many fine and common coarse roots, no inclusions, no fragments, no, non calcareous, clear smooth boundary to,
- E1 27-52 cm : very pale brown (10YR 8/3, dry) (2.5Y 6/3, moist), coarse sand, single grain, soft non sticky non plastic, fine faint clear 10YR5/6 (yellowish brown) mottles and few (2-5%) fine faint clear mottles 10YR5/8 (yellowish brown), no cutans, common very fine discontinuous expd interstitial random pores, common fine and common coarse roots, no inclusions, no fragments, no, non calcareous, clear smooth boundary to,
- E2 52-71 cm : (2.5Y 8/3, dry) (2.5Y 6/3, moist), coarse sand, weakly coherent massive, soft slightly sticky non plastic, few (2-5%) fine faint clear mottles, 10YR5/6 (yellowish brown) and 10YR5/8 (yellowish brown), no cutans, common very fine discontinuous expd interstitial random pores, few fine few and coarse roots, no inclusions, no fragments, no, non calcareous, non calcareous, gradual smooth boundary to,
- Bt 71-97 cm : (2.5Y 7/3, dry) light yellowish brown (2.5Y 6/4, moist), coarse sand, moderately coherent massive, slightly hard slightly sticky slightly plastic, common fine distinct clear mottles (10YR 5/6) and common fine distinct mottles (10YR 5/8), broken moderately thick clay cutans between sand grains, many very fine discontinuous expd interstitial random pores and common very fine discontinuous expd tubular random pores moderately porous (40-60 vo, few fine and few coarse roots, no inclusions, few fine gravel weathered quartz fragments, no, non calcareous, abrupt wavy boundary to,
- Btv 97-162 cm : white (2.5Y 8/2, dry) (2.5Y 7/3, moist), coarse sand gravel, strongly coherent massive, many (15-40%) medium prominent sharp mottles, 10YR5/6 (yellowish brown) and 7.5YR5/8 (strong brown), broken thick clay cutans between sand grains, few fine roots, dominant medium and large spherical hard ferruginous concretions, many medium and coarse gravel weathered quartz fragments, no, discontinuous nodular strongly cemented plinthite pans, non calcareous, gradual irregular boundary to,
- BC 162-199 cm : white (2.5Y 8/2, dry) (2.5Y 7/3, moist), very gravelly coarse sand, moderately coherent massive, many (15-40%) medium distinct clear mottles, 10YR5/6 (yellowish brown) and 7.5YR5/8 (strong brown), no cutans, few fine roots, few medium spherical hard ferruginous concretions, dominant fine gravel weathered quartz fragments, no, non calcareous, gradual irregular boundary to,
- Cg 199-228 cm : light grey (10YR 7/1, moist), coarse sandy loam stony, moderately coherent massive, friable slightly sticky slightly plastic, many (15-40%) medium prominent sharp mottles 10YR5/6 (yellowish brown) and many (15-40%) coarse prominent sharp 7.5YR5/8 (strong brown) mottles, no cutans, few fine roots, few medium spherical ferruginous soft segregations, few fine gravel weathered quartz fragments, no, 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 (%)
0-27	: 2	9.0	20.4	20.6	21.9	11.9	83.8	8.4	2.7	11.1	5.2
27-52	: 2	9.5	18.8	21.0	23.1	9.7	82.1	7.8	2.9	10.7	7.2
52-71	: 2	4.6	12.5	18.3	18.9	10.1	64.4	25.3	3.7	29	6.6
71-97	: 5	10.0	19.3	20.9	18.6	7.8	76.6	8.1	2.1	10.2	13.2
97-162	: -	-	-	-	-	-	-	-	-	-	-
162-199	: -	-	-	-	-	-	-	-	-	-	-
199-220	: 20	10.4	20.0	15.9	11.6	12.0	69.9	6.4	8.7	15.1	15.0

## Other physical data

Depth (cm)	Bulk Density (kg/dm <sup>3</sup> )	Spec. Surf. Area (m <sup>2</sup> /g)	COLE (cm/cm)	Water Disp. Clay (%)	Clay (%)
0-27	:	-	-	1.9	5.2
27-52	:	-	-	1.4	7.2
52-71	:	-	-	4.6	6.6
71-97	:	-	-	2.5	13.2
97-162	:	-	-	-	-
162-199	:	-	-	-	-
199-220	:	-	-	5.6	15.0

## 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)
0-27	:	4.7	4.1	0.08	-	0.44	0.03	15	0.4	0.0	0.6	0.0	0.1	0.0	0.7
27-52	:	4.2	4.1	0.18	-	0.14	0.01	14	0.5	0.2	0.2	0.3	0.1	0.2	0.8
52-71	:	4.2	3.9	0.11	-	0.12	0.01	12	0.6	0.2	0.0	0.3	0.1	0.2	0.6
71-97	:	4.1	3.8	0.12	-	0.05	0.03	2	1.0	0.4	0.0	0.3	0.1	0.2	0.6
97-162	:	-	-	-	-	-	-	-	-	-	-	-	-	-	-
162-199	:	-	-	-	-	-	-	-	-	-	-	-	-	-	-
199-220	:	4.6	4.0	0.03	-	0.06	0.01	6	0.8	0.5	0.2	0.3	0.1	0.4	1

Depth (cm)		CEC Soil (cmol/kg)	CEC Clay (cmol/kg)	CEC Org (cmol/kg)	ECEC (cmol/kg)	Base sat. (%)	Al sat. (%)	ESP (%)
0-27	:	1.9	37	1.5	-	37	0	0
27-52	:	1.2	17	0.5	-	67	17	17
52-71	:	1.9	29	0.4	-	32	11	11
71-97	:	1.9	14	0.2	-	32	21	11
97-162	:	-	-	-	-	-	-	-
162-199	:	-	-	-	-	-	-	-
199-220	:	2.1	14	0.2	-	48	24	19

## Clay mineralogy:

Depth (cm)	Kaolinite	Mica / illite	Vermiculite	Chlorite	Sme c	Halloysite	Mixed layer	Quartz	Feldspar	Gibbsite	Goethite	Hematite
0-27	:	strong to very strong	weak	-	-	-	-	very weak	very weak	-	-	-
27-52	:	strong to very strong	weak	-	-	-	-	very weak	very weak	-	-	-
52-71	:	very strong	weak	-	-	-	-	very weak	very weak	-	-	-
71-97	:	very strong	weak	-	-	-	-	-	very weak	-	-	-
97-162	:	-	-	-	-	-	-	-	-	-	-	-
162-199	:	-	-	-	-	-	-	-	-	-	-	-
199-220	:	very strong	weak	-	-	-	-	-	very weak	-	-	-

## Source of analyzing procedures:

Laboratory	Attribute	Description	Proc. ref
ISRIC	Al sat.	Calculation; Exchangeable Al / ( exchangeable bases+Al+H) or Al / CEC	11.1.4-1.4.3
ISRIC	Base sat.	Calculation; Sum of Exchangeable Cations (Na, K, Ca, Mg) / CEC soil	labmanual
ISRIC	C / N	Calculation; Organic Carbon / Organic Nitrogen	labmanual
ISRIC	Ca	Exchangeable bases with 1 M ammonium acetate at pH 7; Ca by atomic absorption spectrometry	9-4 and 9-5.3
ISRIC	CEC Clay	Calculation; ((CEC soil - CEC org.m.)/ clay %)*100	9-6.3
ISRIC	CEC Org	CEC organic matter; expert estimate for charge per unit C	9-6.3
ISRIC	CEC Soil	CEC; with index cation in buffered solution pH7	9-4 and 9-5.3.3
ISRIC	Clay; < 0.002 mm	Fraction by Pipette analysis; after removal CaCO <sub>3</sub> and organic matter, dispersion and sedimentation	3-4.7
ISRIC	EC 1 : 2.5	Electro Conductivity of a soil / water (1:2.5) suspension	4-1.4 and 13-4
ISRIC	ESP	Calculation; (Exchangeable Na / CEC soil) * 100	9-6.3
ISRIC	Exch. Acid	Extraction by 1 M KCl; titration with NaOH	11.1.4-1.4.2
ISRIC	Exch. Al	Extraction by 1 M KCl; Al by atomic absorption spectrometry	11.1.4-1.4.3
ISRIC	Feldspar	Feldspar; relative abundance scale 0 - 7	16-1
ISRIC	K	Exchangeable bases with 1 M ammonium acetate at pH 7; K by flame atomic emission spectrometry	9-6.1
ISRIC	Kaolinite	Kaolinite; relative abundance scale 0 - 7	16-1
ISRIC	Mg	Exchangeable bases with 1 M ammonium acetate at pH 7; Mg by atomic absorption spectrometry	9-4 and 9-5.3
ISRIC	Mica / Illite	Mica / illite; relative abundance scale 0 - 7	16-1
ISRIC	Na	Exchangeable bases with 1 M ammonium acetate at pH 7; Na by flame atomic emission spectrometry	9-4 and 9-5.3
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 emprical correction factor of 1.3 is applied	5
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	6
ISRIC	pH H <sub>2</sub> O	pH electrode; in supernatant suspension	4-1
ISRIC	pH KCl	In supernatant suspension; potentiometrically	4-1
ISRIC	Quartz	Quartz; relative abundance scale 0 -7	16-1
ISRIC	Sand; 0.10 - 0.05 mm	Fraction by sieving; after removal CaCO <sub>3</sub> and organic matter	3-4.6
ISRIC	Sand; 0.25 - 0.10 mm	Fraction by sieving; after removal CaCO <sub>3</sub> and organic matter	3-4.6
ISRIC	Sand; 0.5 - 0.25 mm	Fraction by sieving; after removal CaCO <sub>3</sub> and organic matter	3-4.6
ISRIC	Sand; 1.0 - 0.5 mm	Fraction by sieving; after removal CaCO <sub>3</sub> and organic matter	3-4.6
ISRIC	Sand; 2.0 - 0.05 mm	Total sand fractions by sieving; after removal CaCO <sub>3</sub> and organic matter	3-5
ISRIC	Sand; 2.0 - 1.0 mm	Fraction by sieving; after removal CaCO <sub>3</sub> and organic matter	3-4.6
ISRIC	Silt; 0.02 - 0.002 mm	Fraction by Pipette analysis ; after removal CaCO <sub>3</sub> and organic matter, dispersion and sedimentation	3-4.7
ISRIC	Silt; 0.05 - 0.002 mm	Calculation; Sum fractions Silt 0.05 - 0.02 mm	3-4.7
ISRIC	Silt; 0.05 - 0.02 mm	Fraction by Pipette analysis ; after removal CaCO <sub>3</sub> and organic matter, dispersion and sedimentation	3-4.7
ISRIC	Sum cations	Sum of Exchangeable Cations (Ca, Mg, Na, K) with 1 M ammonium acetate at pH 7	9-
ISRIC	Water Dispersable Clay	Fraction by Pipette analysis; without any pretreatment	3-8
CSRI	Gravel	Fraction from field sample, after drying, crushing, sieving	*ref

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

Other classification

USDA-NRCS (1999) : Typic Plinthustult  
USDA-SCS (1975) : Typic Plinthustult coarse-loamy siliceous hyperthermic  
Classification (other) :  
Makoholi 5G.3 Series