Soil Brief *Cuba 4*

CUBA

Hydromorphic reference soils

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International Soil Reference and Information Centre

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ISRIC Soil Monoliths:

Number	*FAO-Unesco*	*Soil Taxonomy*
CU 1	Eutric Gleysol	Ustic Endoaquert
CU 4	Eutric Gleysol	Typic Tropaquept
CU 13	Eutric Gleysol	Ustic Epiaquept

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CONTENTS

FOREWORD

The objective of this Soil Brief is to summarize geological, geomorphological, chemical and physical characteristics of hydromorphic reference soils in Cuba, with emphasis on their qualities for crop production, in particular for sugarcane. Target user groups for Soil Brief are soil specialists and non-soil specialists.

A joint cooperation project of INICA and ISRIC was initiated in 1990. The project operated in the framework of ISRIC's National Soil Reference Collection and Database (NASREC) programme. The NASREC goals are to support the establishment of soil expositions, databases and accompanying publications. In Cuba, it aims to describe and sample a series of reference soils, representative for the sugarcane areas. The soils were collected for the national soil collection of Cuba in Villa Clara and for the world soil collection of ISRIC in Wageningen, The Netherlands.

This Soil Brief was compiled in cooperation with ISRIC staff: M.B.B.J. Clabaut (text processing), L.P. van Reeuwijk (laboratory), R.A. Smaal (diagrams), T. de Meester and A.E. Hartemink (editing). In the fieldwork, O. Lezcano had an important participation, and J. Luís Rodríguez and N. Milanés (CU 1); E. Pineda, I. Fernández, I. Rodríguez, R. Díaz, R. Más and M.E. Sánchez (CU 4 and 13), from Sugarcane Experiment Station of Habana and Villa Clara provinces also participated in the fieldwork.

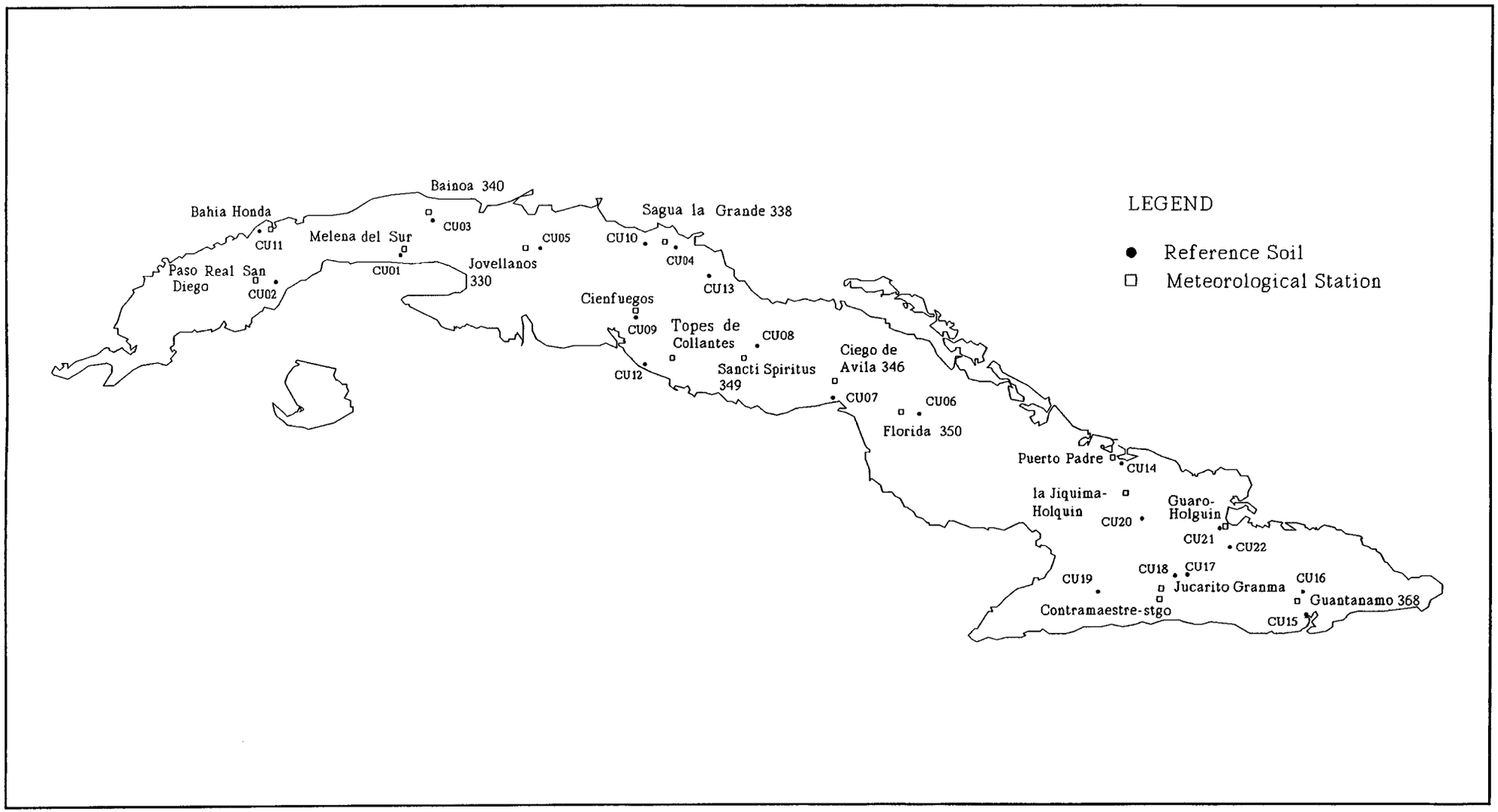

Figure 1 Geographical location of the reference sites.

1 THE REFERENCE SOILS

1.1 Introduction

The reference soils presented in this Soil Brief are hydromorphic soils, which are characterized by the presence of iron reduction or local segregation phenomena due to temporal or permanent saturation with water, provoking a deficit of oxygen (Duchaufour, 1984). Such soils could be found in any climate and are mainly the result of poor internal or external drainage. The specific moisture regime of such soils results in the formation of characteristics which differ very much from soil profiles developed in a well drained environment.
In Cuba, hydromorphic soils are mainly found in the low coastal plains and sometimes in the central zones of the eastern region of Cuba. They are cultivated with rice, pastures and sugarcane. In addition to the waterlogging, these soils may have salt problems, which negatively affect their productivity.

1.2 Areas location and distribution

The reference soils are located in the provinces of Havana (CU 1) and Villa Clara (CU 4 and CU 13) in the west and central regions of the country, respectively. CU 1 is located near the sugar mill "Gregorio Arlee Mañalich", municipality of Melena del Sur (22°58'N, 82°02' W) at 8 m altitude. CU 13 is located at the sugar mill "Batalla de Santa Clara", in the Camajuaní municipality, (22°35' N, 79°45' W) at 8 m altitude (Fig. 1).
The soils which are characterized by the reference soils CU 1 and CU 4 cover approximately 5% of the sugarcane area and are distributed in the coastal lowlands. Associations of well drained red soils derived from limestone are common in this region (Ascanio and Sulroca, 1986).
CU 13 represents about 9% of the sugarcane area. Its geographic distribution is associated with Vertisols (see Soil Brief *Cuba 8*), which covers extensive areas in the country.

1.3 Geology, relief and vegetation

The parent material of CU 1, CU 4 and CU 13 originates from geological processes that took place in the Pleistocene. It includes clay, sand and gravel deposits (Academy of Sciences, 1989).
The general landscape of the sites (see photograph) is that of abrasive marine and accumulative plains. The relief at the sites is flat or almost flat with a slope gradient < 2%.
The original vegetation of the sites CU 1 and CU 4 consisted of associations of mangrove with marsh grassland; for CU 13 it was a typic mesophyll vegetation (Academy of Sciences, 1989). The anthropogenic influence can be clearly observed and agricultural crops such as rice, pastures and sugarcane are widely grown.

1.4 Climate

The analysis of the climate, according to the Köppen classification, shows that maritime tropical conditions with a seasonal distribution of the rainfall prevail. Based on a dynamic analysis (Allison) two subregions are distinguished in Cuba:
- Western Caribbean
- Eastern Caribbean

The reference sites belong to the first subregion and, according to Díaz Cisneros (1989), are located in the region of plains with a relatively stable seasonal moisture regime, high evaporation and high temperatures.
There are two well defined seasons: a dry one from November to April, and the rainy season from May to October. This is the case for CU 1. However, for CU 4 and CU 13 two important rainfall peaks are observed in May and October with a marked decrease of rainfall in the July-August period (Figures 2 and 3). The latter shows a water deficit during a long period of the year. Figures 4, 5 and 6 show temperature regimes at the sites, with a general mean of 24°C, a minimum of 19°C and average maximum about 30°C.
The climate (Aveladze, 1989) is favourable for sugarcane cultivation.

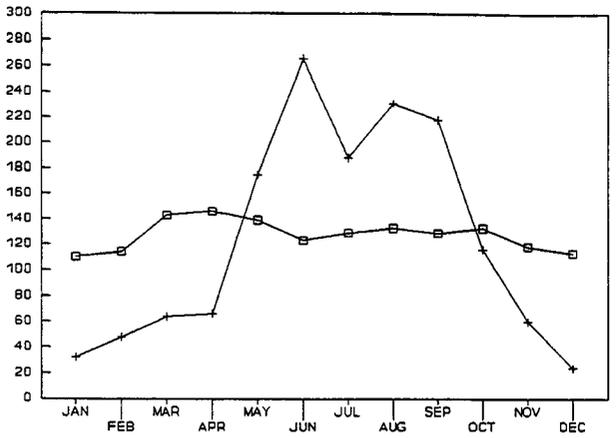

Figure 2 Precipitation (+) and evapotranspiration (□) in mm at Melena del Sur meteorological station (CU 1 site).

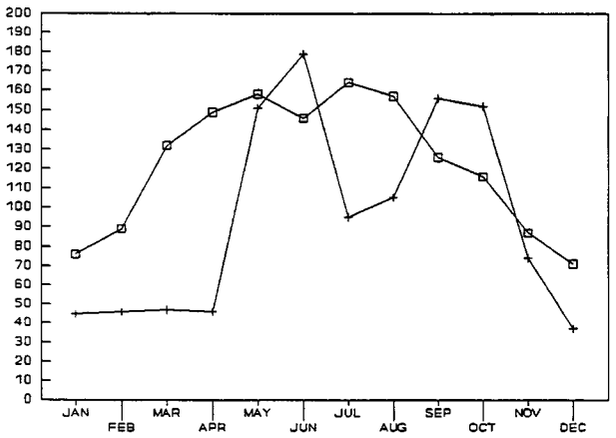

Figure 3 Precipitation (+) and evapotranspiration (□) in mm at the Sagua La Grande meteorological station (CU 4 and CU 13 sites).

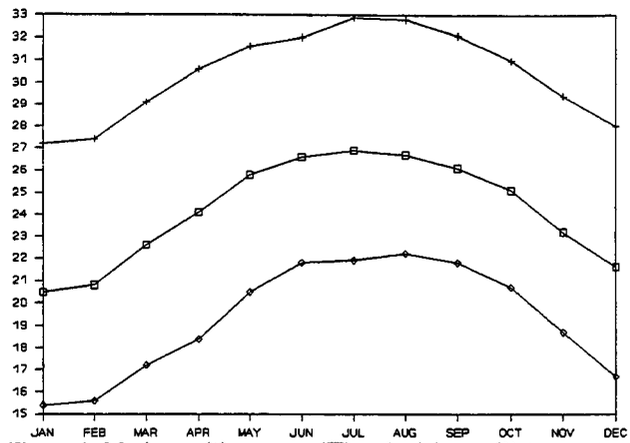

Figure 4 Maximum (+), average (□) and minimum (◊) temperature in °C at Melena del Sur meteorological station (CU 1 site).

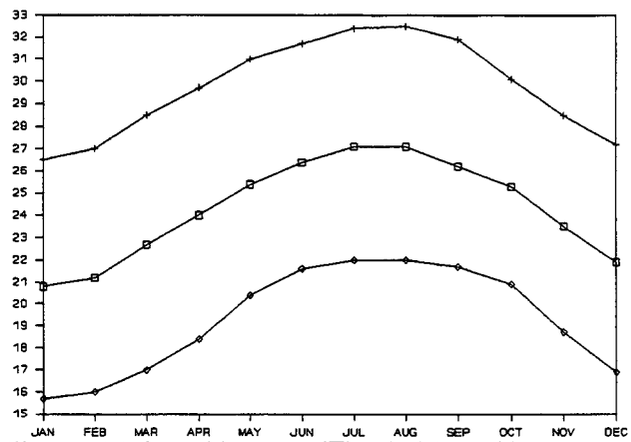

Figure 5 Maximum (+), average (□) and minimum (◊) temperature in °C at the Sagua La Grande meteorological station (CU 4 and CU 13 sites).

2 SOIL CHARACTERIZATION

2.1 Short field description

CU 1 is a deep, poorly to imperfectly drained, grey clay. The subsoil is strongly mottled and has a wedge-shaped angular blocky structure and slickensides (see photographs).
CU 4 is a deep, imperfectly drained, light greyish brown clay. The subsoil is strongly mottled and has a strong prismatic structure and slickensides.
CU 13 is a deep, poorly drained, grey clay. The subsoil has blackish mottles, a strong prismatic structure and slickensides (see photographs).

Summarizing, the reference soils CU 1, CU 4 and CU 13 have reduced subsoil horizons (gley) and marked hydromorphic properties, corresponding with the fluctuation of the water table. Red mottling presence may be sometimes weakly concretioned. Their characteristics coincide with those quoted by Blume (1968) and Duchaufour (1977), describing the main morphological characteristics of a typical gley profile. After drying, the soil pit wall shows an angular blocky structure and slickensides, but the soil does not have large open cracks. However, it is assumed that when dry years occur, cracks will open into the deeper subsoil.
Detailed descriptions of the soils with their different horizons, according to the Guidelines for Soil Profiles Description (FAO, 1990) is presented in the Annexes.

2.2 Analytical characterization

Soil samples were analyzed according to the ISRIC procedures (Van Reeuwijk, 1992) at the ISRIC and INICA laboratories and all analytical data are presented in the Annexes. Table 1 presents some soil characteristics.
Reference profiles CU 1 and CU 4, located in similar geographical positions in the South and North coast, have similar characteristics. Sodium, which accumulates in the hydromorphic horizons causes alkalinity, which increases with depth. This results in Fe and Al precipitation and the flocculent action of Calcium, mainly in CU 4 (Fig. 6 and 7), as reported by Lossaint (1959).
CU 13 presents similar characteristics to CU 1 and CU 4, but is only slightly alkaline and has a high content of organic carbon. All soils have smectite as dominant clay mineral. However, there is a substantial amount of kaolinite. The latter possibly originates from the surrounding zones of higher elevation with soils high in kaolinite clay.
In all soils a high percentage of clay is present throughout the profile (Fig. 8, 9 and 10).
The soils have a low to very low air capacity and a high to very high moisture availability.

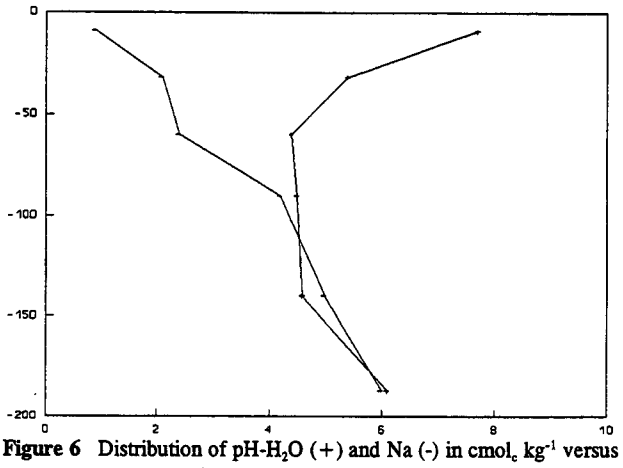

Figure 6 Distribution of pH-H_2O (+) and Na (-) in $cmol_c\ kg^{-1}$ versus depth (cm) in profile CU 1 (Eutric Gleysol).

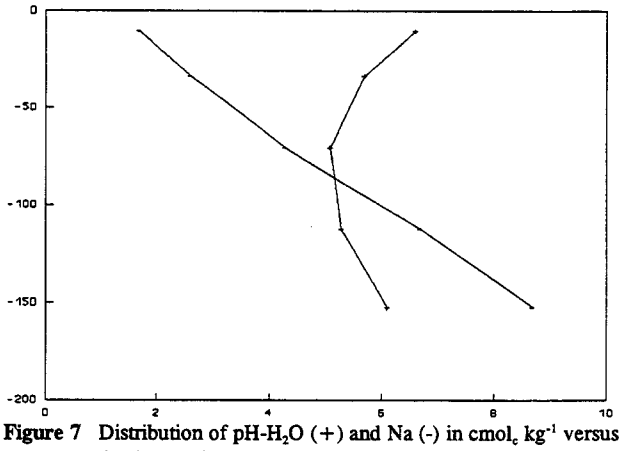

Figure 7 Distribution of pH-H_2O (+) and Na (-) in $cmol_c\ kg^{-1}$ versus depth (cm) in profile CU 4 (Eutric Gleysol).

2.3 Soil classification

FAO-UNESCO (1988)
The reference soils CU 1, CU 4 and CU 13 are all classified as Eutric Gleysol as they have gleying properties in the first 50 cm depth and a base saturation of more than 50%. At the third level, the presence of weak fluvic and vertic properties could be included.

USDA Soil Taxonomy (1992)
All soils have to a certain extent vertic properties, such as wedge-shaped structure elements intersecting slickensides and a high montmorillonitic clay content. However, the large cracks required for Vertisols are lacking. It is assumed that the vertic properties are relatively the strongest in CU 1 and it is therefore classified as Endoaquert. For CU 4 and CU12, the vertic properties are less expressed and because of the presence of an ochric and cambic horizons and aquic conditions, the soils are classified as Typic Tropaquept (CU 4) and Ustic Epiaquept (CU 13).

Table 1 Some characteristics of CU 1, CU 4 and CU 13.

	CU 1	CU 4	CU 13
Texture	Clay throughout the profile	Clay throughout the profile	Clay throughout the profile
Organic C	Low to medium	Low to medium	High or very high
pH	Strongly acid	Acid	Alkaline
CEC	High	Very high	Very high
Sum of Bases	Very high	Very high	Very high
Mineralogy	Smectite and kaolinite	Smectite	Smectite and mixture of kaolinite and feldspar

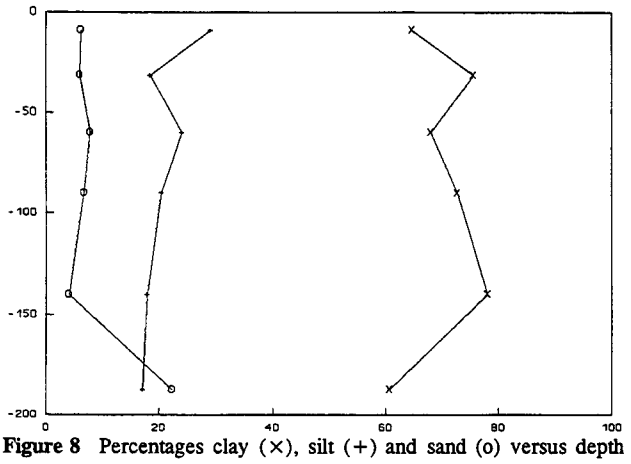

Figure 8 Percentages clay (×), silt (+) and sand (o) versus depth (cm) in profile CU 1.

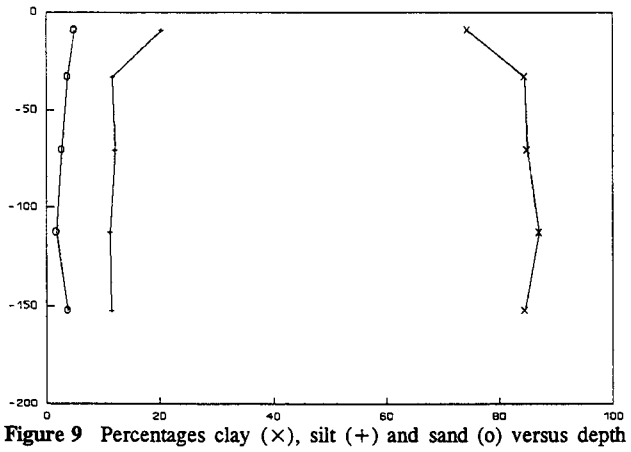

Figure 9 Percentages clay (×), silt (+) and sand (o) versus depth (cm) in profile CU 4.

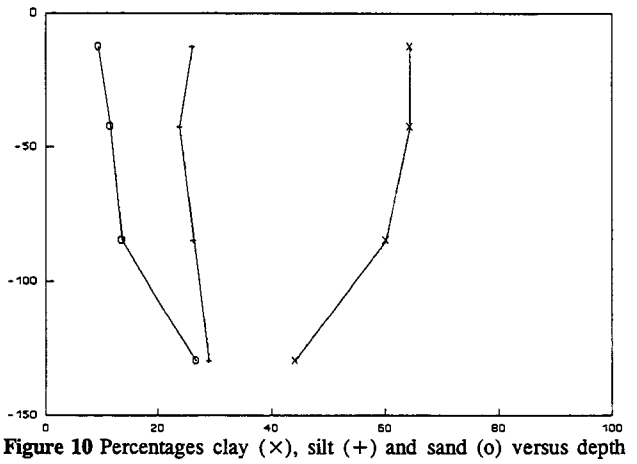

Figure 10 Percentages clay (×), silt (+) and sand (o) versus depth (cm) in profile CU 13.

2da Clasificación Genética de los Suelos de Cuba (1975)

CU 1 is classified as Gley Ferralítico Típico and CU 4 and CU 13 as Gley Húmico Típico. CU 13 is developed over transported materials from areas with ferralitic soils. Its exchange capacity is higher than usually reported for this type of soils.

Although CU 1 has some vertic properties in the subsoil, it does not have the structure and cracking conditions for the classification as Vertisol.

The profiles CU 4 and CU 13 are classified as Gley Húmico Típico although the organic matter content is low due to prolonged cultivation of sugar cane.

3 LAND EVALUATION

Detailed studies on sugarcane cultivation in these soils are scarce in Cuba. However, specific criteria related to sugarcane management in hydromorphic soils have been reported by Reporte Annual (1982; 1984; 1990; 1991). A general soil qualities evaluation of the sites according to FAO (1983) and ISRIC (1994) is presented in Annex 2.

Soil CU 1

The imperfect to poor drainage conditions and the high clay percentage strongly affect soil management. It may have negative effects on sugarcane germination. After the crop is established, the water regime is favourable. Nutrients availability is medium, no response to nitrogen has been observed. The phosphorus and potassium levels are low and gifts of 25 kg/ha of phosphorus and 80 kg/ha potassium are usually required to correct deficiencies. Similar zones in the Coastal Plains of the south and east of Havana-Matanzas (Arcia *et al.*, 1993) are able to yield 124 t ha^{-1}. Under conditions of extensive production the productivity is about 65 t ha^{-1}.

Soil CU 4

The imperfect to poor drainage conditions have a negative influence on the management of this soil.
CU 4 is located in the Coastal Plain at the North of the Central Region of Cuba. According to the Agro-ecological Scheme Related to Sugarcane Cultivation in Cuba (Arcia *et al.*, 1993) the soil is able to produce potentially about 134 t ha^{-1} sugarcane. Under extensive production conditions it reaches about 53 t ha^{-1}.

Soil CU 13

Similar comments as for CU 4.

The reference soils discussed here present serious limitations under natural conditions. Agronomic management should focus on the improvement of the drainage conditions. Nutritional deficiencies are mainly phosphorus and potassium, which can easily be corrected, as is shown in Table 2 (especially for the CU 13 site). This table also shows a yield reduction in the ratoons probably due to deterioration of physical properties. Improvement of these soils should be directed to the establishment of (surface) drainage systems and adequate application of chemical and organic fertilizers (Arcia *et al.*, 1993).

Table 3 shows a summary of experiments on hydromorphic soils by Vidal Díaz *et al.* (1992), presenting the variation of sugarcane yields when soil drainage is improved. It shows the beneficial effect of surface and deep drainage (mole-drainage). This removes the excess moisture in less than 72 hours, allowing mechanical harvest within 15 days after strong rainfall.

Table 2 Influence of mineral fertilizers (N,P,K) on sugarcane yields (t ha^{-1}) (Reporte Anual, 1990, 1991).

Doses	Plant Cane	1st Ratoon	2nd Ratoon	3rd Ratoon
0 kg N ha^{-1}	254	107	166	88
50 kg N ha^{-1}	269	111	149	88
100 kg N ha^{-1}	269	111	168	88
0 kg P ha^{-1}	227	84	137	90
50 kg P ha^{-1}	223	117	157	97
100 kg P ha^{-1}	231	109	147	100
150 kg P ha^{-1}	218	123	163	98
0 kg K ha^{-1}	208	109	157	85
80 kg K ha^{-1}	198	124	165	89
160 kg K ha^{-1}	214	126	166	85

Table 3 Influence of surface and deep drainage on sugarcane yields (t ha^{-1})in the North Coast of the Central Region of Cuba (Vidal Díaz *et al.*).

	Without drainage (only natural)	Only surface drainage	Surface and deep drainage (buried)
Plant cane (spring planting)	83	77	120
Winter planting	48	51	141
Ratoons (12 months)	42	46	100

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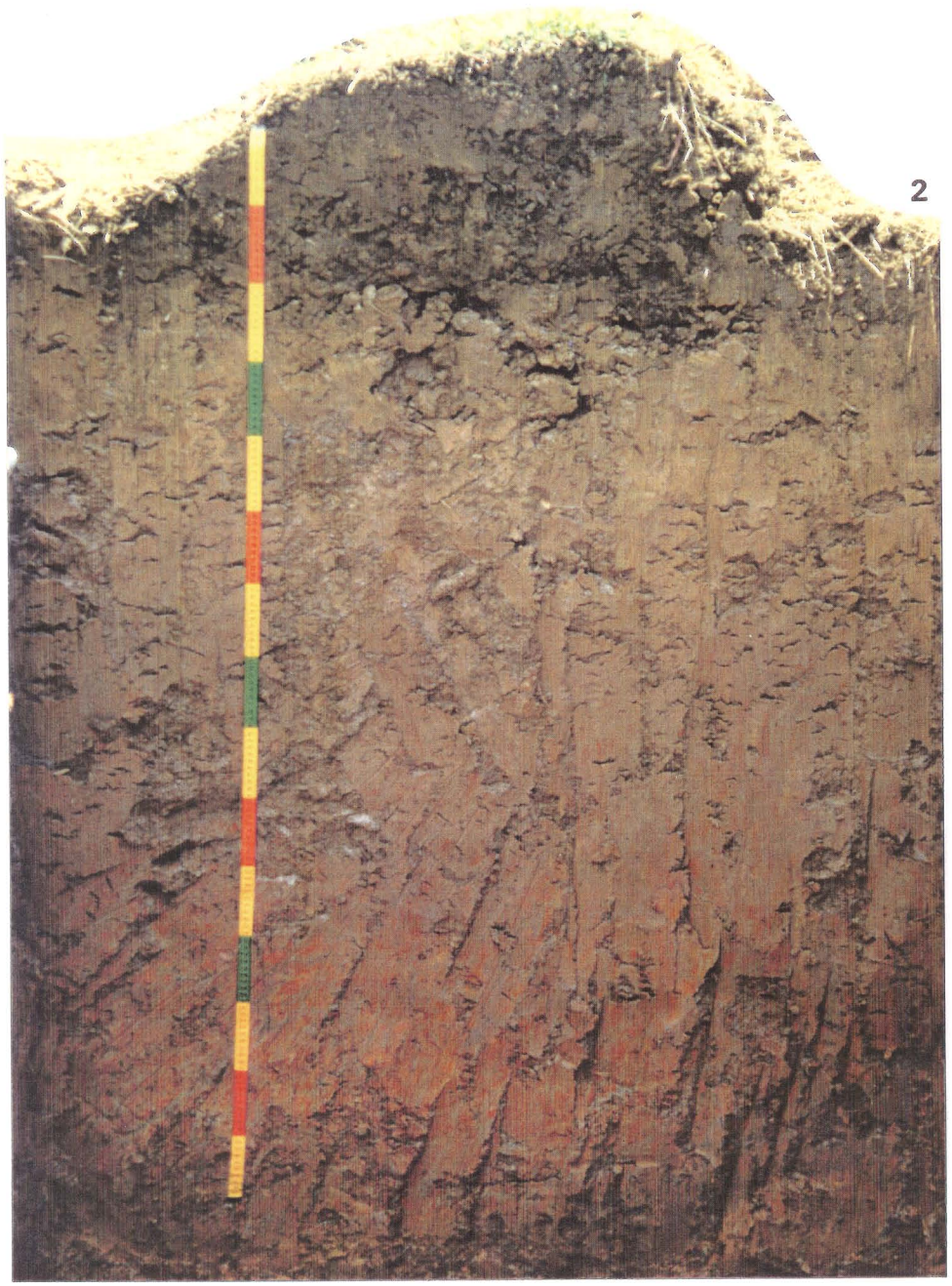


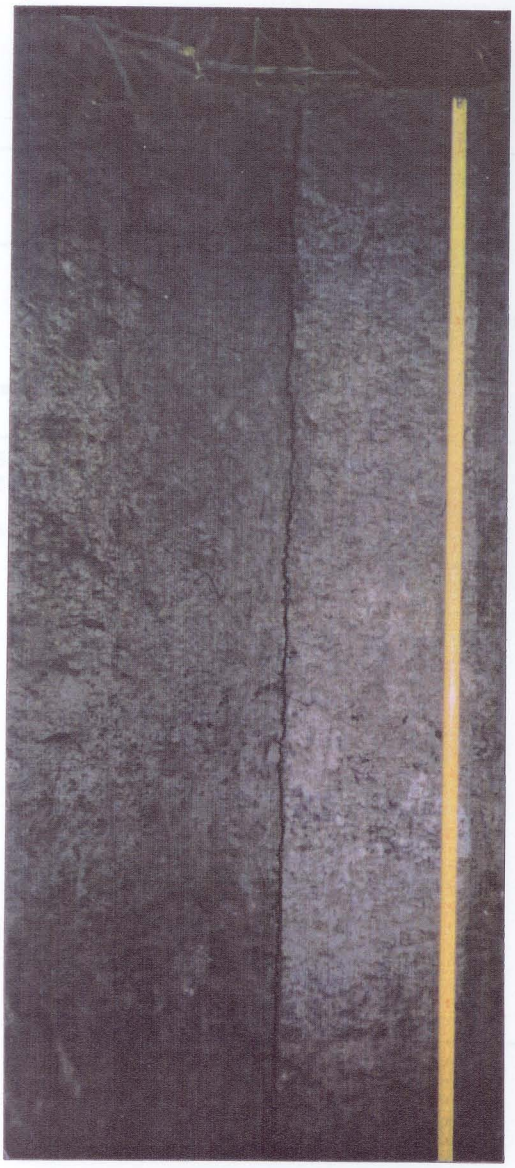
2

1. Landscape CU 1
2. Profile CU 1

1

2

3



1. Landscape CU 13
2. Top soil CU 13
3. Profile CU 13

Annex 1A ISIS Data Sheet CU 1

Reference soil CU 1, CUBA

Print date: 31 August 1995

FAO/UNESCO (1988) : Fluvi-Eutric Gleysol
(1974) : Eutric Gleysol
USDA/SCS SOIL TAXONOMY (1992) : Ustic Endoaquert, clayey, montmorrilonitic, isohyperthermic
(1975) : Typic Tropaquept
LOCAL CLASSIFICATION : Gley Ferralitico

DIAGNOSTIC CRITERIA FAO (1988) : ochric A, cambic B, gleyic properties
USDA/SCS (1992) : ochric epipedon, cambic horizon, slickensides
Soil moisture regime : aquic
Soil temperature regime : isohyperthermic

LOCATION : Cuba Habana Melena del Sur CAI G.A. Manalich Bloque 41 Campo 4006
Latitude / Longitude : 22°44'0"N / 82°10'0"W Altitude : 8 m a.s.l.
AUTHOR(S) : Kauffman/Villegas Date : April 1990

GENERAL LANDFORM : marine terrace Topography : flat or almost flat
PHYSIOGRAPHIC UNIT : flat or almost flat
SLOPE Gradient, Form : 0%, straight, Position of site : flat
MICRO RELIEF Kind :
SURFACE CHAR. Rock outcrop : nil Cracking : small cracks
Stoniness : nil
Slaking/crusting : nil
SLOPE PROCESSES Soil erosion : no

PARENT MATERIAL 1 type, texture : marine sediments derived from claystone, clayey
Remarks :

EFFECTIVE SOIL DEPTH : 100 cm
WATER TABLE Kind, Depth : groundwater table, 300 cm
DRAINAGE : poorly to imperfectly
PERMEABILITY : No slowly permeable layer observed
FLOODING Frequency : irregular Run off : slow

MOISTURE CONDITIONS PROFILE : 0-200 cm moist

LAND USE : high level arable farming (sugar cane), seasonal irrigated, not relevant
Improvements : none
VEGETATION Type : dwarf shrub Status : secondary

CLIMATE Köppen : Aw
MET. STATIONS Name, Location : MELENA DEL SUR, 22°46'N / 82°8'W, 25 m a.s.l
Distance to site (relevance) : MELENA DEL SUR lays 10 km NE of the site (very good)

		No. years of record	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
MELENA DEL SUR															
EA class A pan	mm	11	128	139	185	205	193	175	171	159	149	140	122	119	1890
EP Penman	mm	14	110	114	143	146	139	123	129	133	129	133	118	113	1535
relative humidity	%	21	81	79	78	75	79	83	82	83	84	83	82	81	81
precipitation	mm	15	32	48	64	66	175	266	188	231	218	116	60	24	1493
tot.glob.rad.	MJ m^{-1}	13	13.8	16.9	20.2	22.4	21.7	20.4	20.2	19.7	17.5	15.0	13.0	12.7	17.8
T max	°C	21	27.2	27.4	29.1	30.6	31.6	32.0	32.9	32.8	32.1	31.0	29.4	28.0	30.4
T min	°C	21	15.4	15.6	17.2	18.4	20.5	21.8	21.9	22.2	21.8	20.7	18.7	16.7	19.2
windspeed(at 2m)	m s^{-1}	5	2.9	3.5	3.9	3.8	3.4	2.8	2.7	2.5	2.2	3.4	3.1	3.0	3.1
bright sunshine	h d^{-1}	14	6.9	7.7	8.3	8.8	8.0	7.4	7.3	7.3	7.2	6.9	6.9	6.8	7.4

PROFILE DESCRIPTION :

Ap	0 - 18 cm	dark grayish brown (10YR 4/2, moist) clay; moderate coarse angular blocky and moderate medium crumb; very sticky, very plastic; no mottles; no cutans; common fine pores; moderately porous; many fine roots and many medium roots; no inclusions; no fragments; frequent channels; non calcareous (10% HCL) throughout; clear smooth boundary to
Bw	18 - 45 cm	grayish brown (10YR 5/2, moist) clay; strong medium angular blocky;; many fine distinct diffuse mottles (7.5YR 5.0/6.0); no cutans; common fine roots; very few small spherical hard ferrigenous concretions; no fragments; frequent channels; gradual smooth boundary to
Cg1	45 - 105 cm	gray (10YR 5/1, moist) clay; strong coarse wedge-shaped angular blocky;; common medium prominent clear mottles (10R 4.0/6.0); continuous thin slickensides cutans; few fine pores; common fine roots; no inclusions; no fragments; few channels; diffuse smooth boundary to
Cg2	105 - 175 cm	grayish brown (10YR 5/1.5, moist) clay; moderate very coarse wedge-shaped angular blocky;, very plastic; many coarse prominent clear mottles (2.5YR 4.0/8.0); continuous thin slickensides cutans; few fine pores; few fine roots; no inclusions; no fragments; gradual smooth boundary to
CG	175 - 200 cm	strong brown (7.5YR 4/6, moist) clay; moderate very coarse wedge-shaped angular blocky; very sticky, very plastic; many coarse prominent clear mottles (10YR 5.0/1.0); continuous thin slickensides cutans; few fine pores; slightly porous; few fine roots throughout; no inclusions; no fragments; non calcareous (10% HCL) throughout;

ADDITIONAL REMARKS

Short field description
Deep, poorly to imperfectly drained, grayish brown clay. The subsoil is strongly mottled, a wedge-shaped angular blocky structure and slickensides.
Water table is present during the rainy season at a depth of about 50 to 100 cm (verbal communications).
Geology: Quaternary Era, Pleistocene; Guevarra Formation: Clays and sandy clay.
Geomorphology: marine plain and terrace, abrasive and accumulative abrasive, slightly ondulating.
The poor drainage is somewhat compensated by the cultivation of sugarcane on machine prepared large ridges with a height of 40 to 50 cm.

ANALYTICAL DATA:

				PARTICLE SIZE DISTRIBUTION (µm)																		
			>2	2000	1000	500	250	100	TOT	50	20	TOT		WDIS	BULK	pF						
Hor.	Top	Bot.	mm	1000	500	250	100	50	SAND	20	2	SILT	<2	CLAY	DENS	0.0	1.0	1.5	2.0	2.3	2.7	3.4	4.2
Ap	0	18	-	1	1	1	1	3	6	8	22	29	65	44.3	-	-	-	-	-	-	-	-	-
Bw	18	45	-	1	1	1	1	2	6	7	12	19	76	49.2	-	-	-	-	-	-	-	-	-
Cg1	45	75	-	1	2	1	2	3	8	12	12	24	68	45.4	-	-	-	-	-	-	-	-	-
	75	105	-	1	1	1	2	2	7	11	9	21	73	35.9	-	-	-	-	-	-	-	-	-
Cg2	105	175	-	0	1	1	1	2	4	7	11	18	78	1.1	-	-	-	-	-	-	-	-	-
CG	175	200	-	0	1	11	9	3	22	6	11	17	61	57.9	-	-	-	-	-	-	-	-	-

	pH	pH		ORG. MATTER		EXCHANGEABLE CATIONS					EXCH. ACID.		CEC	CEC	CEC		BASE	AL		
Hor.	H2O	KCl	CaCO3	C	N	Ca	Mg	K	Na	sum	H+Al	Al	soil	clay	OrgC	ECEC	SAT	SAT	EC2.5	ESP
Ap	7.7	6.8	2.9	1.0	0.12	28.9	12.4	0.2	0.9	42.4	-	-	38.3	59	3.6	42.4	100	-	0.54	
Bw	5.4	4.3	-	0.6	0.07	23.6	10.5	0.2	2.1	36.4	0.4	0.2	35.7	47	1.9	36.4	100	-	0.52	
Cg1	4.4	3.3	-	0.4	-	17.8	8.8	0.2	2.4	29.2	5.7	4.2	34.3	50	1.5	29.2	85	-	0.57	
	4.5	3.4	-	0.4	-	18.4	9.9	0.3	4.2	32.8	4.3	3.1	38.4	53	1.5	32.8	85	-	0.62	
Cg2	4.6	3.4	-	0.4	-	21.0	12.4	0.2	5.0	38.6	3.9	2.4	42.3	54	1.4	38.6	91	-	0.69	
CG	6.1	4.8	-	0.1	-	22.8	14.4	0.2	6.0	43.4	-	-	41.7	69	0.5	43.4	100	-	0.79	

CLAY MINERALOGY (1 = very weak .. 8 = very strong)

Hor.	MI	VE	CH	SM	KA	HA	ML	QU	FE	GI	GO	HE
Ap	0	0	0	8	5	0	0	3	0	0	3	0
Bw	0	0	0	8	5	0	0	2	0	0	3	0
Cg1	0	0	0	8	6	0	0	1	0	0	0	0
Cg1	0	0	0	8	5	0	0	1	0	0	0	0
Cg2	0	0	0	8	5	0	0	1	0	0	1	0
CG	0	0	0	8	4	0	0	1	0	0	2	0

EXTRACTABLE Fe, Al, Si, Mn by amm. oxal.(o), Na dith(d) & pyroph.(p)

Hor.	Fe(o)	Al(o)	Si(o)	Fe(d)	Al(d)	Fe(p)	Al(p)	Pret	pHNaF
Ap	0.6	0.2	0.1	4.3	0.3	-	-	-	-
Bw	0.3	0.2	0.0	3.8	0.3	-	-	-	-
Cg1	0.2	0.2	0.0	3.6	0.2	-	-	-	-
Cg1	0.3	0.2	0.0	3.4	0.2	-	-	-	-
Cg2	0.3	0.2	0.0	2.9	0.3	-	-	-	-
CG	0.2	0.2	0.1	2.2	0.2	-	-	-	-

Annex 1B ISIS Data Sheet CU 4

Reference soil CU 4, CUBA — Print date: 31 August 1995

FAO/UNESCO (1988) : Verti-Eutric Gleysol
(1974) : Eutric Gleysol
USDA/SCS SOIL TAXONOMY (1992) : Typic Tropaquept, clayey, montmorrilonitic, isothermic
(1975) : -do-
LOCAL CLASSIFICATION : Gley ferralitico

DIAGNOSTIC CRITERIA FAO (1988) : ochric A, cambic B, gleyic properties, vertic properties
USDA/SCS (1992) : ochric epipedon, cambic horizon, aquic conditions, slickensides
Soil moisture regime : aquic
Soil temperature regime : isothermic

LOCATION : Cuba, Villa Clara, Sagua La Grande, CAI Antonio Finalet, Bloque 50
Latitude / Longitude : 22°48'50"N / 80°5'0"W — Altitude : 8 m a.s.l.
AUTHOR(S) : Marin/Regla/Balmas. — Date : May 1991

GENERAL LANDFORM : plain — Topography : flat or almost flat
PHYSIOGRAPHIC UNIT : flat or almost flat
SLOPE Gradient, Form : 1%, straight, — Position of site : flat
MICRO RELIEF Kind :
SURFACE CHAR. Rock outcrop : nil — Cracking : nil
Stoniness : nil
Slaking/crusting : nil
SLOPE PROCESSES Soil erosion : no

PARENT MATERIAL 1 type, texture : marine sediments derived from claystone, clayey
Remarks :

EFFECTIVE SOIL DEPTH : 95 cm
WATER TABLE Kind, Depth : groundwater table, 300 cm
DRAINAGE : imperfectly to moderately well
PERMEABILITY : No slowly permeable layer observed
FLOODING Frequency : irregular, fresh water — Run off : slow

MOISTURE CONDITIONS PROFILE : 0-20 cm dry, 20-175 cm moist

LAND USE : high level arable farming (sugar cane), seasonal irrigated
VEGETATION Type : dwarf shrub — Status : degraded

CLIMATE Köppen : Aw
MET. STATIONS Name, Location : SAGUA LA GRANDE 338, 22°49'N / 80°5'W, 22 m a.s.l
Distance to site (relevance) : SAGUA LA GRANDE 338 lays 4 km SW of the site (very good)

SAGUA LA GRANDE 338		No. years of record	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
act. evapotransp.	mm	21	130	137	191	215	208	180	210	200	162	145	120	118	2021
EP Penman	mm	21	76	89	132	149	158	146	164	157	126	116	87	71	1476
relative humidity	%	21	82	79	77	75	79	82	80	81	83	84	84	83	81
precipitation	mm	21	45	46	47	46	151	179	95	105	156	152	74	37	1139
tot.glob.rad.	MJ m^{-1}	10	412.3	465.0	629.0	690.0	682.0	648.0	703.7	675.8	534.0	489.0	399.0	384.4	6711.5
T mean	°C	21	20.8	21.2	22.7	24.0	25.4	26.4	27.1	27.1	26.2	25.3	23.5	21.9	24.3
T max	°C	21	26.5	27.0	28.5	29.7	31.0	31.7	32.4	32.5	31.9	30.1	28.5	27.2	29.7
T min	°C	21	15.7	16.0	17.0	18.4	20.4	21.6	22.0	22.0	21.7	20.9	18.7	16.9	19.3
windspeed(at 2m)	m s^{-1}	4	2.9	3.5	4.5	3.7	3.8	3.1	3.3	2.9	2.5	2.9	3.1	2.6	
bright sunshine	h d^{-1}	10	6.6	7.4	8.3	9.3	8.6	7.9	8.9	8.7	7.4	7.8	7.1	6.7	7.8

.2

PROFILE DESCRIPTION :

Ap	0 - 20 cm	very dark grayish brown (10YR 3/2, moist) clay; moderate medium angular blocky; slightly sticky, slightly plastic, very hard; no mottles; no cutans; common fine pores and few medium pores; moderately porous; many fine roots throughout; few medium spherical hard manganiferous concretions; no fragments; few worm channels; non calcareous (HCL) throughout; abrupt wavy boundary to
BA	20 - 47 cm	light gray (10YR 7/2, moist) clay; strong coarse prismatic and moderate medium angular blocky; slightly sticky, plastic, firm; few medium distinct clear mottles (2.5YR 5.0/8.0); patchy thin slickensides cutans on horizontal pedfaces; few fine pores and few medium pores; few fine roots; very few small spherical soft manganiferous concretions; no fragments; non calcareous (HCL); gradual smooth boundary to
Bg	47 - 95 cm	light brownish gray (10YR 6/2, moist) clay; strong fine to medium prismatic; slightly sticky, plastic, firm; common coarse distinct clear mottles (10R 4.0/6.0); continuous moderately thick slickensides cutans on horizontal pedfaces; few fine pores and few medium pores; few very fine roots; very few small spherical soft manganiferous concretions; no fragments; non calcareous (HCL); clear irregular boundary to
BCg	95 - 130 cm	light brownish gray (2.5Y 6/2, moist) clay; strong fine to medium prismatic; slightly sticky, plastic, firm; many coarse prominent clear mottles (10R 4.0/6.0); continuous moderately thick slickensides cutans on horizontal pedfaces; few very fine pores;; no inclusions; no fragments; non calcareous (HCL); gradual smooth boundary to
Cg	130 - 175 cm	brown (7.5YR 5/4, moist) clay; moderate medium to coarse subangular blocky parting to moderate fine to medium prismatic; slightly sticky, plastic, friable; many coarse prominent clear mottles (2.5Y 2.0/0.0) and common medium distinct diffuse mottles (2.5Y 5.0/2.0); no cutans; few very fine pores;; no inclusions; no fragments; non calcareous (HCL);

ADDITIONAL REMARKS

Short field description
Deep, poorly to imperfectly drained, brownish grey, clay. The subsoil is strongly mottled, has a strong prismatic structure and slickensides.
Geology: Quarternary Era, Higher Pleistocene. Camacho Formation: grey-green and brown clays and sandy clay, sometimes with gravels and small 'guijarros'.
Geomorphology: fluvio-marine deltaic plain, very flat.

ANALYTICAL DATA:

				PARTICLE SIZE DISTRIBUTION (µm)												pF							
			>2	2000	1000	500	250	100	TOT	50	20	TOT		WDIS	BULK								
Hor.	Top	Bot.	mm	1000	500	250	100	50	SAND	20	2	SILT	<2	CLAY	DENS	0.0	1.0	1.5	2.0	2.3	2.7	3.4	4.2
Ap	0 -	20	-	1	1	1	2	1	5	1	20	20	74	50.1	-	-	-	-	-	-	-	-	-
BA	20 -	47	-	1	1	1	1	1	4	1	11	12	85	65.2	-	-	-	-	-	-	-	-	-
Bg	47 -	95	-	0	0	0	1	1	3	2	10	12	85	60.5	-	-	-	-	-	-	-	-	-
BCg	95 -	130	-	0	0	0	1	1	2	1	10	11	87	67.2	-	-	-	-	-	-	-	-	-
Cg	130 -	175	-	0	0	1	1	1	4	2	10	12	85	65.8	-	-	-	-	-	-	-	-	-

	pH	pH		ORG. MATTER		EXCHANGEABLE CATIONS					EXCH. ACID.		CEC	CEC	CEC		BASE	AL		
Hor.	H2O	KCl	CaCO3	C	N	Ca	Mg	K	Na	sum	H+Al	Al	soil	clay	OrgC	ECEC	SAT	SAT	EC2.5	ESP
Ap	6.6	5.1	3.0	1.4	0.10	29.9	12.2	0.2	1.7	44.0	-	-	46.3	62	5.0	44.0	95	-	0.19	
BA	5.7	4.0	-	0.4	0.06	34.5	14.7	0.2	2.6	52.0	-	-	48.3	57	1.5	52.0	100	-	0.18	
Bg	5.1	3.6	-	0.2	-	30.3	14.7	0.3	4.3	49.6	-	-	52.2	61	0.6	49.6	95	-	0.28	
BCg	5.3	3.8	-	0.1	-	36.3	18.8	0.3	6.7	62.1	-	-	65.2	75	0.4	62.1	95	-	0.38	
Cg	6.1	4.4	-	0.0	-	38.6	21.3	0.4	8.7	69.0	-	-	69.2	82	0.1	69.0	100	-	0.50	

CLAY MINERALOGY (1 = very weak .. 8 = very strong)

Hor.	MI	VE	CH	SM	KA	HA	ML	QU	FE	GI	GO	HE
Ap	0	0	0	8	2	0	3	4	0	0	0	0
BA	0	0	0	8	2	0	3	4	0	0	0	0
Bg	0	0	0	8	2	0	3	3	0	0	0	0
BCg	0	0	0	8	2	0	3	3	0	0	0	0
Cg	0	0	0	8	5	0	2	3	0	0	0	0

EXTRACTABLE Fe, Al, Si, Mn by amm. oxal.(o), Na dith(d) & pyroph.(p)

Hor.	Fe(o)	Al(o)	Si(o)	Fe(d)	Al(d)	Fe(p)	Al(p)	Pret	pHNaF
Ap	0.3	0.2	0.1	2.0	0.1	-	-	-	-
BA	0.6	0.2	0.1	0.9	0.2	-	-	-	-
Bg	0.3	0.2	0.1	1.5	0.1	-	-	-	-
BCg	0.2	0.2	0.1	1.4	0.2	-	-	-	-
Cg	0.2	0.3	0.1	0.9	0.1	-	-	-	-

Annex 1C ISIS Data Sheet CU 13

Reference soil CU 13, CUBA — Print date: 31 August 1995

FAO/UNESCO (1988) : Verti-Eutric Gleysol
(1974) : Eutric Gleysol
USDA/SCS SOIL TAXONOMY (1992) : Ustic Epiaquept, clayey, montmorrilonitic, isohyperthermic
(1975) : Typic Haplaquoll
LOCAL CLASSIFICATION : Gley humico

DIAGNOSTIC CRITERIA FAO (1988) : ochric A, gleyic properties, vertic properties
USDA/SCS (1992) : ochric epipedon, aquic conditions, slickensides
Soil moisture regime : ustic
Soil temperature regime : isohyperthermic

LOCATION : Cuba Prov. Villa Clara, Camajuani CAI Batalla de Sta Clara Bloque Exp.
Latitude / Longitude : 22°35'0"N / 79°45'0"W Altitude : 8 m a.s.l.
AUTHOR(S) : MARIN/REGLA/BALMAS. Date : December 1991

GENERAL LANDFORM : coastal plain Topography : flat or almost flat
PHYSIOGRAPHIC UNIT : flat or almost flat
SLOPE Gradient, Form : 0%, straight, Position of site : flat
MICRO RELIEF Kind :
SURFACE CHAR. Rock outcrop : Cracking : small cracks
Slaking/crusting :
SLOPE PROCESSES Soil erosion :

PARENT MATERIAL 1 type, texture : marine sediments derived from claystone
Remarks :

EFFECTIVE SOIL DEPTH : 60 cm
WATER TABLE Kind, Depth : groundwater table, 120 cm Estimated high/low level : 100 cm / 200 cm
DRAINAGE : imperfectly
PERMEABILITY : slow, slowly permeable layer from 25 to 40 cm
FLOODING Frequency : irregular, fresh water Run off : slow

MOISTURE CONDITIONS PROFILE : 0-150 cm moist

LAND USE : high level arable farming (sugar cane), no irrigation
VEGETATION Type : semi deciduous woodland Status : secondary

CLIMATE Köppen : Aw
MET. STATIONS Name, Location : SAGUA LA GRANDE 338, 22°49'N / 80°5'W, 22 m a.s.l
Distance to site (relevance) : SAGUA LA GRANDE 338 lays 45 km NW of the site (moderate)

		No. years of record	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
SAGUA LA GRANDE 338															
act. evapotransp.	mm	21	130	137	191	215	208	180	210	200	162	145	120	118	2021
EP Penman	mm	21	76	89	132	149	158	146	164	157	126	116	87	71	1476
relative humidity	%	21	82	79	77	75	79	82	80	81	83	84	84	83	81
precipitation	mm	21	45	46	47	46	151	179	95	105	156	152	74	37	1139
tot.glob.rad.	MJ m^{-1}	10	412.3	465.0	629.0	690.0	682.0	648.0	703.7	675.8	534.0	489.0	399.0	384.4	6711.5
T mean	°C	21	20.8	21.2	22.7	24.0	25.4	26.4	27.1	27.1	26.2	25.3	23.5	21.9	24.3
T max	°C	21	26.5	27.0	28.5	29.7	31.0	31.7	32.4	32.5	31.9	30.1	28.5	27.2	29.7
T min	°C	21	15.7	16.0	17.0	18.4	20.4	21.6	22.0	22.0	21.7	20.9	18.7	16.9	19.3
windspeed(at 2m)	m s^{-1}	4	2.9	3.5	4.5	3.7	3.8	3.1	3.3	2.9	2.5	2.9	3.1	2.6	3.2
bright sunshine	h d^{-1}	10	6.6	7.4	8.3	9.3	8.6	7.9	8.9	8.7	7.4	7.8	7.1	6.7	7.8

PROFILE DESCRIPTION :

Ap	0 - 25 cm	very dark gray (10YR 3/1, moist) clay; strong coarse prismatic; sticky, plastic, hard; no mottles; no cutans; few very fine pores and common coarse pores; highly porous; many coarse roots throughout; no inclusions; no fragments; frequent worm channels and channels; non calcareous (10% HCL) throughout; clear irregular boundary to
Cg1	25 - 60 cm	light gray (10YR 7/2, moist) clay; strong medium to coarse prismatic; sticky, plastic, slightly hard; many coarse prominent clear mottles (10YR 4.0/4.0); broken moderately thick slickensides cutans throughout; few very fine pores and common coarse pores; moderately porous; common coarse roots throughout; no inclusions; no fragments; frequent worm channels; non calcareous (10% HCL); gradual irregular boundary to
Cg2	60 - 110 cm	grayish brown (10YR 5/2, moist) clay loam; moderate fine to medium prismatic; slightly sticky, slightly plastic, slightly hard; common medium prominent clear mottles (10YR 4.0/4.0) and common coarse prominent clear mottles (10YR 3.0/2.0); broken thick slickensides cutans throughout; few very fine pores and few fine pores; slightly porous; few medium roots throughout; no inclusions; no fragments; non calcareous (10% HCL) throughout; gradual smooth boundary to
Ck3	110 - 150 cm	dark brown (10YR 4/3, moist) massive; slightly sticky, slightly plastic, slightly hard; no mottles; no cutans; common very fine pores and many fine pores; slightly porous; no roots; few large irregular hard calcareous nodules; no fragments; calcareous (10% HCL) throughout;

ADDITIONAL REMARKS

Short field description
Deep, poorly drained, grey clay. The subsoil has blackish mottles, a strong prismatic structure and slickensides.
Geomorphology:fluvio-marine terrace, deltaic, flat to slightly undulating.
Geology: Pleistocene, clays, gravels.

ANALYTICAL DATA:

			PARTICLE SIZE DISTRIBUTION (µm)													pF							
Hor.	Top	Bot.	>2 mm	2000 1000	1000 500	500 250	250 100	100 50	TOT SAND	50 20	20 2	TOT SILT	<2	WDIS CLAY	BULK DENS	0.0	1.0	1.5	2.0	2.3	2.7	3.4	4.2
Ap	0	25	-	0	0	1	4	4	9	7	20	26	65	44.1	1.09	58	57	57	56	56	55	47	39
Cg1	25	60	-	0	0	1	5	4	12	6	18	24	65	50.0	-	-	-	-	-	-	-	-	-
	25	30	-	-	-	-	-	-	-	-	-	-	-	-	1.18	59	58	58	57	57	55	45	36
	45	50	-	-	-	-	-	-	-	-	-	-	-	-	1.19	58	57	57	56	56	55	45	36
Cg2	60	110	-	0	0	1	7	5	14	7	19	26	60	40.3	-	-	-	-	-	-	-	-	-
Ck3	110	150	-	0	0	4	14	8	27	11	18	29	44	30.1	-	-	-	-	-	-	-	-	-

	pH	pH		ORG. MATTER		EXCHANGEABLE CATIONS					EXCH. ACID.		CEC	CEC	CEC		BASE	AL		
Hor.	H2O	KCl	CaCO3	C	N	Ca	Mg	K	Na	sum	H+Al	Al	soil	clay	OrgC	ECEC	SAT	SAT	EC2.5	ESP
Ap	6.4	5.3	2.4	1.3	0.15	35.3	28.0	0.2	0.6	64.1	-	-	60.2	93	4.5	64.1	100	-	0.13	
Cg1	7.7	6.6	3.8	0.2	0.03	51.2	26.2	0.2	0.9	78.5	-	-	52.6	82	0.6	78.5	100	-	0.28	
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Cg2	8.3	6.9	9.4	0.1	0.01	61.9	27.5	0.2	0.7	90.3	-	-	45.3	75	0.3	90.3	*	-	0.22	
Ck3	8.4	7.0	7.6	0.1	0.01	48.3	22.4	0.2	1.0	71.9	-	-	38.3	86	0.2	71.9	*	-	0.20	

CLAY MINERALOGY (1 = very weak .. 8 = very strong)

Hor.	MI	VE	CH	SM	KA	HA	ML	QU	FE	GI	GO	HE
Ap	0	0	0	8	4	0	0	4	3	0	0	0
Cg1	0	0	0	8	4	0	0	4	3	0	0	0
Cg1	-	-	-	-	-	-	-	-	-	-	-	-
Cg1	-	-	-	-	-	-	-	-	-	-	-	-
Cg2	0	0	0	8	4	0	0	4	3	0	0	0
Ck3	0	0	0	8	4	0	0	3	3	0	0	0

EXTRACTABLE Fe, Al, Si, Mn by amm. oxal.(o), Na dith(d) & pyroph.(p)

Hor.	Fe(o)	Al(o)	Si(o)	Fe(d)	Al(d)	Fe(p)	Al(p)	Pret	pHNaF
Ap	-	-	-	-	-	-	-	-	-
Cg1	-	-	-	-	-	-	-	-	-
Cg1	-	-	-	-	-	-	-	-	-
Cg1	-	-	-	-	-	-	-	-	-
Cg2	-	-	-	-	-	-	-	-	-
Ck3	-	-	-	-	-	-	-	-	-

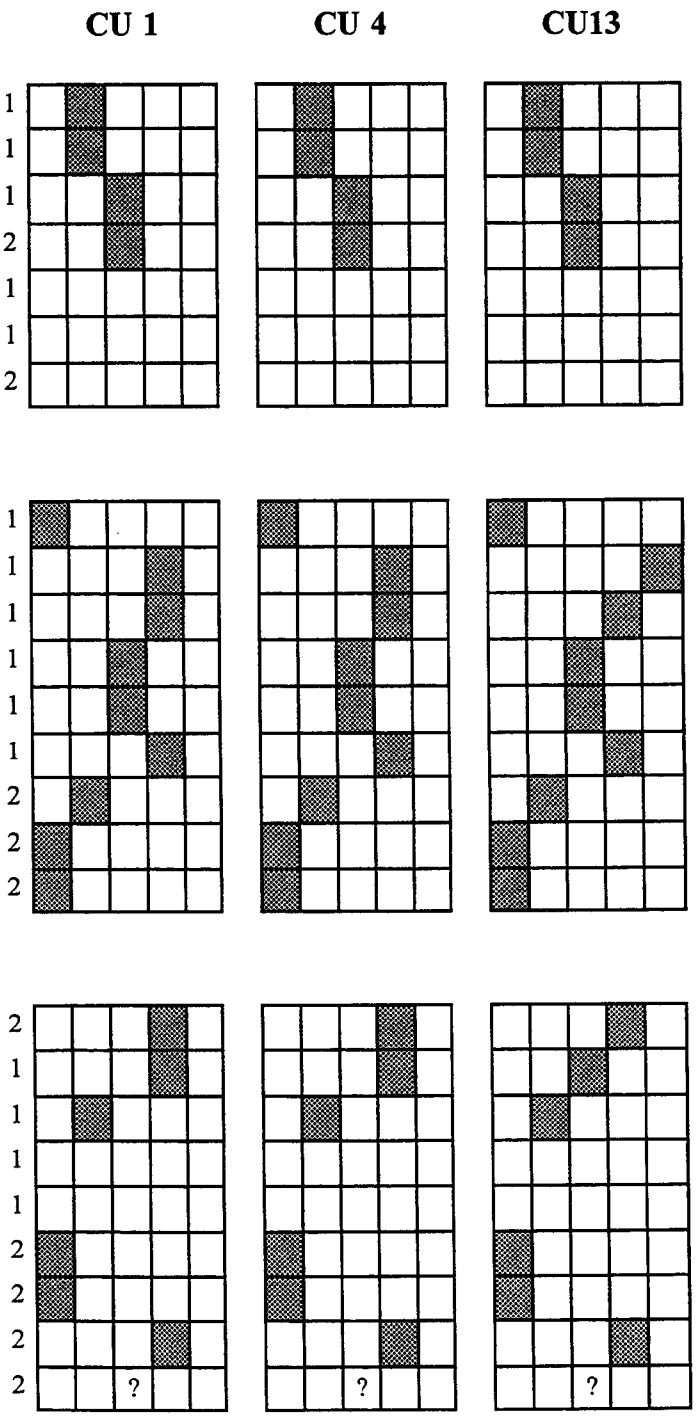
Annex 2 Evaluation of land qualities of the CU 1, CU 4 and CU 13 soils

LAND QUALITY Availability (1) | vh | h | m | l | vl |

vh = very high h = high m = moderate l = low vl = very low

Hazard/Limitation (2) | n | w | m | s | vs |

n = not present w = weak m = moderate s = serious vs = very serious



COMMENTS

Annex 3 Methods of Soil Analysis

Preparation	Each sample is air-dried, cleaned, crushed (not ground), passed through 2 mm sieve, homogenized. Moisture content is determined at 105° C.
pH H_2O	(1:2.5): 20 g of soil is shaken with 50 ml of deionised water for 2 hours, electrode in upper part of suspension.
pH-KCl	likewise but shaken with 1 *M* KCl.
EC	(1:2.5): Conductivity of pH-H_2O suspension.
Particle-size distribution	Soil is treated with 15% hydrogen peroxide overnight in the cold, then on waterbath at about 80°C. Then boiled on hot plate for 1 hour. Washings until dispersion. Dispersing agent is added (20 ml solution of 4% Na-hexametaphosphate and 1% soda) and suspension shaken overnight. Suspension sieved through 50 μm sieve. Sand fraction remaining on sieve dried and weighed. Clay and silt determined by pipetting from sedimentation cylinder.
Exchangeable bases and CEC	Percolation with 1*M* ammonium acetate pH7 using automatic extractor. (If EC>0.5mS pre-leaching with ethanol 80%). Cations are determined in the leachate by AAS. CEC: saturation with sodium acetate 1M pH7; washed with ethanol 80% and then leached with ammonium acetate 1*M* pH7. Na determined by FES.
Exchangeable acidity and Aluminium	The sample is extracted with *1 M* KCl solution and the exchange acidity (H+Al) titrated with NaOH. Al is measured by AAS.
Carbonate	Piper's procedure. Sample is treated with dilute acidand the residual acid is titrated.
Organic carbon	Walkley-Black procedure. The sample is treated with a mixture of potassium dichromate and sulphuric acid at about 125°C. The residual dichromate is titrated with ferrous sulphate. The result expressed in % carbon (because of incomplete oxidation a correction factor of 1.3 is applied).
Total nitrogen	Micro-Kjeldahl. Digested in H_2SO_4 with Se as catalyst. Then ammonia is distilled, trapped in boric acid and titrated with standard acid.
Extractable Iron, Aluminium, Manganese and Silicon	All determinations by AAS. 1 "Free" (Fe, Al, Mn): Holmgren Shaken with sodium citrate (17%) + sodium dithionite (1.7%) solution for 16 hours. 2 "Active" (Fe, Al, Si): Shaken with acid ammonium acetate 0.2 *M* pH 3 for 4 hours in the dark. 3 "Organically bound" (Fe, Al): Shaken with sodium pyrophosphate 0.1 *M* for 16 hours.
Clay mineralogy	Clay is separated as indicated for particle-size analysis. about 10-20 mg of clay is brought on porous ceramic tile by suction and analyzed using a Philips diffractometer.
Soluble salts	Measuring pH, EC, cations and anions in water extracts. 1 1:5 extract. Shaking 30 g of fine earth + 150 ml of water for 2 hours. 2 saturation extract. Adding to 200-1000 g fine earth just enough water to saturate the sample. Standing overnight. After filtration Ca, Mg, Na, K are measured by AAS. Cl with the Chlorocounter and SO_4 turbidimetrically.
Gypsum	To 10 g of fine earth 100 ml of water is added, shaken overnight and centrifuged. Precipitation by adding acetone. Precipitate redissolved in water and determination of Ca by AAS.
Elemental composition	The fine earth is dried, ignited and fused with lithium tetraborate. The formed bead is analyzed by X-ray fluorescence spectroscopy.
Moisture retention	Moisture determinations on undisturbed core samples in silt box (pF1.0;1.5;2.0) and kaolinite box (pF2.3;2.7) respectivily and on disturbed samples in high pressure pan (pF3.4;4.2). Bulk density obtained from dry weight of core sample.

Annex 4 Units, Glossary, Classes and Acronyms

UNITS

$cmol_c\ kg^{-1}$	centimol charge per kilogram (formerly meq/100 g; 1 meq/100 g = 1 $cmol_c\ kg^{-1}$)
μm	micro-metre: $1/1000^{th}$ of a millimetre.
$mg\ kg^{-1}$	milligram per kilogram (formerly parts per million (ppm))
$mS\ cm^{-1}$	milliSiemens per cm at 25 °C (formerly $mmho\ cm^{-1}$)
MJ	Megajoules (formerly kcal; 1 MJ = 4186.8 kcal)

GLOSSARY

Air capacity	Amount of pore space filled with air 2 or 3 days after soil has been wetted. It is calculated from the difference between amount of water under almost saturated conditions (pF 0.0) and moisture retained at "field capacity" (pF 2.0), and expressed as volume percentage.
Al saturation	Ratio of exchangeable aluminium to the CEC, expressed as percentage.
Available soil moisture	Amount of moisture retained between "field capacity" (pF 2.0) and "wilting point" (pF 4.2), expressed as volume percentage (also called "available water capacity"). It is indicative of the amount of moisture available for plant growth.
Base saturation	Ratio of the sum of bases to the CEC, expressed as percentage.
Bulk density	Weight of an undisturbed soil sample divided by its volume.
CEC	Cation exchange capacity, indicative of the potential nutrient retention capacity of the soil.
Clay mineralogy	Type of clay-sized (< 2μm) particles.
kaolinite	Clay mineral with a low nutrient retention capacity, common in soils from (sub)tropical regions.
smectite	Silica-rich clay mineral with a high nutrient retention capacity and the ability to absorb water, resulting in swelling of the clay particles.
illite	Potassium-rich clay mineral with a moderately high nutrient retention capacity, common in soils from temperate regions and in alluvial soils.
montmorillonite	Clay mineral with a high nutrient retention capacity and strong potassium-fixation.
chlorite	Aluminium-rich clay mineral with a moderately high nutrient retention capacity, occurring in variable quantities in soils rich in aluminium.
halloysite	Clay mineral with a moderately high nutrient retention capacity, common in soils derived from volcanic ashes.
quartz	Residual silica, resistant to weathering.
feldspar	Residual primary mineral, unstable in soil environments and, if present, indicative of a slight to moderate degree of weathering.
hematite	Reddish coloured iron oxide, common in well drained soils of tropical regions.
goethite	Yellowish coloured hydrated iron oxide, common in soils of temperate regions.
gibbsite	Aluminium hydroxide, indicative of a high degree of weathering.
Consistence	Refers to the degree and kind of cohesion and adhesion of the soil material, or to the resistance to deformation or rupture.
ECEC	Effective cation exchange capacity. It is calculated by addition of the sum of bases and exchangeable acidity, and reflects the actual nutrient retention capacity of the soil.
Exchangeable acidity	Sum of exchangeable hydrogen and aluminium.
Fine earth fraction	Part of the soil material with a particle-size of 2 mm or less (nearly all analyses are carried out on this soil fraction).
Horizon	Layer of soil or soil material approximately parallel to the earth's surface.
Land characteristic	Measurable property of land (e.g. texture).
Land quality	Set of interacting land characteristics which has a distinct influence on land suitability for a specified use (e.g. erosion hazard, which is a.o. influenced by slope, rainfall intensity, soil cover, infiltration rate, soil surface characteristics, texture).
Leaching	Downward or lateral movement of soil materials in solution or suspension.
Mottle	Spot or blotch differing in colour from its surroundings, usually indicative of poor soil drainage.
Organic carbon	Content of organic carbon as determined in the laboratory (% org. C x 1.72 = % org. matter)
Parent material	The unconsolidated mineral or organic material from which the soil is presumed to have been developed by pedogenetic processes.
pF value	Measure for soil moisture tension.
Soil reaction (pH)	Expression of the degree of acidity or alkalinity of the soil.
Soil structure	Aggregates of primary soil particles (sand, silt, clay) called peds, described according to grade, size and type.
Sum of bases	Total of exchangeable calcium (Ca^{++}), magnesium (Mg^{++}), potassium (K^{+}) and sodium (Na^{+}).
Texture	Refers to the particle-size distribution in a soil mass. The field description gives an estimate of the textural class (e.g. sandy loam, silty clay loam, clay); the analytical data represent the percentages sand, silt and clay measured in the laboratory.

CLASSES OF SOME ANALYTICAL SOIL PROPERTIES

Organic Carbon - C (%)

< 0.3	very low
0.3 - 1.0	low
1.0 - 2.0	medium
2.0 - 5.0	high
> 5.0	very high

Acidity pH-H_2O

< 4.0	extremely acid
4.0 - 5.0	strongly acid
5.0 - 5.5	acid
5.5 - 6.0	slightly acid
6.0 - 7.5	neutral
7.5 - 8.0	slightly alkaline
8.0 - 9.0	alkaline
> 9.0	strongly alkaline

Available phosphorus (mg kg^{-1})	**Olsen**	**Bray**
low	< 5	< 15
medium	5 - 15	15 - 50
high	> 15	> 50

CEC [pH7] ($cmol_c$ kg^{-1} soil)

< 4	very low
04 - 10	low
10 - 20	medium
20 - 40	high
> 40	very high

Sum of bases ($cmol_c$ kg^{-1} soil)

< 1	very low
1 - 4	low
4 - 8	medium
08 - 16	high
> 16	very high

Base saturation - BS [CEC pH7] (%)

< 10	very low
10 - 20	low
20 - 50	medium
50 - 80	high
> 80	very high

Aluminium saturation (%)

< 5	very low
05 - 30	low
30 - 60	moderate
60 - 85	high
> 85	very high

Exchangeable sodium percentage - ESP (%)

Soil structure		*Crops*
< 5	very low	< 2
05 - 10	low	02 - 20
10 - 15	medium	20 - 40
15 - 25	high	40 - 60
> 25	very high	> 60

Bulk density (kg dm^{-3})

< 0.9	very low
0.9 - 1.1	low
1.1 - 1.5	medium
1.5 - 1.7	high
> 1.7	very high

ACRONYMS

FAO	Food and Agriculture Organization of the United Nations
ISIS	ISRIC Soil Information System
INICA	Instituto Nacional de Investigaciones de la Caña de Azúcar
ISRIC	International Soil Reference and Information Centre
Unesco	United Nations Educational, Scientific and Cultural Organization

Soil Briefs of Cuba

(ISSN: 1381-6950)

No.	Title	No. of soils*
Cuba 1	Reference Soil of the Central Valley, derived from Alluvium	1
Cuba 2	Salt-Affected Reference Soil of the Guantánamo Valley	1
Cuba 3	Strongly weathered Reference Soils of the Central and Northeastern Regions	4
Cuba 4	Hydromorphic Reference Soils	3
Cuba 5	Brown Calcareous Reference Soils derived from Limestone	4
Cuba 6	Brown Reference Soils	2
Cuba 7	Humus-rich Calcareous Reference Soil	1
Cuba 8	Cracking Heavy Clay Reference Soils (Vertisols)	3

Country Reports

(ISSN: 1381-5571)

No.	Country	No. of soils*	No.	Country	No. of soils*
1	Cuba	22	15	Gabon	6
2	P.R. of China	51	16	Ghana	in prep.
3	Turkey	15	17	Philippines	6
4	Côte d'Ivoire	7	18	Zimbabwe	13
5	Thailand	13	19	Spain	20
6	Colombia	18	20	Italy	17
7	Indonesia	48	21	Greece	in prep.
8	Ecuador	in prep.	22	India	in prep.
9	Brazil	28	23	Kenya	in prep.
10	Peru	21	24	Mali	in prep.
11	Nicaragua	11	25	Nigeria	in prep.
12	Costa Rica	12	26	Mozambique	in prep.
13	Zambia	11	27	Botswana	in prep.
14	Uruguay	10			

* State of reference collections as of January 1995