Soil Brief *Cuba 1*

CUBA

Reference Soil of the Central Valley, derived from Alluvium

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International Soil Reference and Information Centre

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ISRIC Soil Monolith:

Number	*FAO-Unesco*	*Soil Taxonomy*
CU 18	Verti-Haplic Phaeozem	Vertic Haplustoll

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CONTENTS

FOREWORD

The present Soil Brief includes a representative profile of the Alluvial soils in the Central Valley region which extends from the Guantánamo province to the Contramaestre municipality, Santiago de Cuba, bordering to the Granma province in the west.

The objective of this Soil Brief is to provide a description of a reference soil in its ecological setting. The Soil Brief is written for soil specialists and non-soil specialists.

A joint cooperation project of the Instituto Nacional de Investigaciones de la Caña de Azúcar and the International Soil Reference and Information Centre was initiated in 1990. The project operates 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, and databases, with accompanying publications. In Cuba, it aims to describe and sample a series of reference soils representative for the sugarcane areas. 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), J.H. Kauffman, T. de Meester and A.E. Hartemink (editing). All diagrams were made with the programme SOLGRAPH. In the fieldwork, participation of G. Reynosa from the Sugarcane Experiment Station of Santiago de Cuba province is acknowledged.

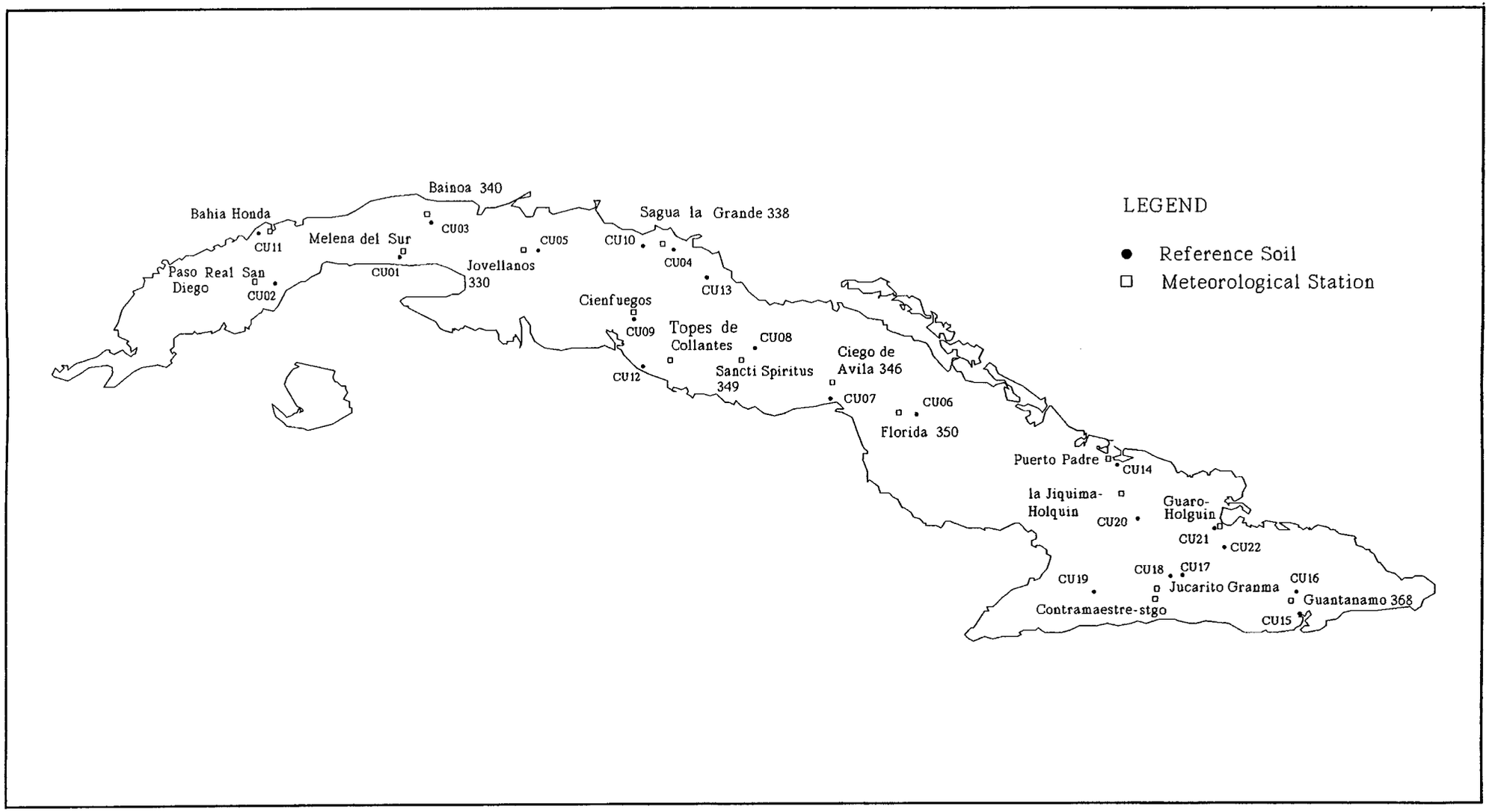

Figure 1 Cuba: Geographical location of the Reference profiles.

1 AREA LOCATION AND DISTRIBUTION

Alluvial soils are characterized by their geomorphological position, sediments and water regime.
The soils constitute the more or less recent deposits of the valleys where they occupy frequently flooded floodplains of rivers.
Alluvial soils are distributed in small areas throughout Cuba, although they are more extensive in the eastern part where they cover about 10300 ha of arable soil cultivated with sugarcane (Ascanio and Sulroca, 1986). Also bananas, tubers and vegetables are cultivated on these soils.
Reference profile CU 18 was sampled in a sugarcane plantation belonging to the mill América Libre, at 20°20' N and 76°10' W and at 100 m altitude, Santiago de Cuba province. Fig. 1 shows its geographical location.

1.1 Climate

The climate is influenced by the high plains with a stable seasonal moisture regime, high evaporation and high temperatures, which is typical for this region of the Central Valley (Academia de Ciencias, 1989).
Fig. 2 shows the alternation of moisture deficit and excess periods. The air humidity decreases during July and August, which is related to the high temperatures (Fig. 3), and the marked rainfall decrease in these months although this is the rainy season of the year. Other climatic parameters are given in Annex 1.

All diagrams in this Soil Brief were made with the programme SOLGRAPH (Brunt & Kauffman, 1995)

1.2 Geology and Geomorphology

Reference soil CU 18 is a young soil, formed in loamy-clay Holocene sediments. Two different landscapes are distinguished, a pre-mountain region consisting of blocks slightly dipping towards the south, and a region of high plains and terraces (Academia de Ciencias, 1989) (see photograph).

1.3 Vegetation and Land use

The forest vegetation has a great variability of the principal timber-yielding species of the country. The original vegetation consists of residues of the tropical forests, Subperennifolia (typical Mesophyll) in the Central Valley. In the mountains residues of the Submountain Mesophyll vegetation is found with species such as Cedar (*Cedrela odorata*), West Indian Mahogany (*Switenia mahogany*), Barma (*Coedia gerascanthus*) and Mastic tree (*Bursira semaruba*).

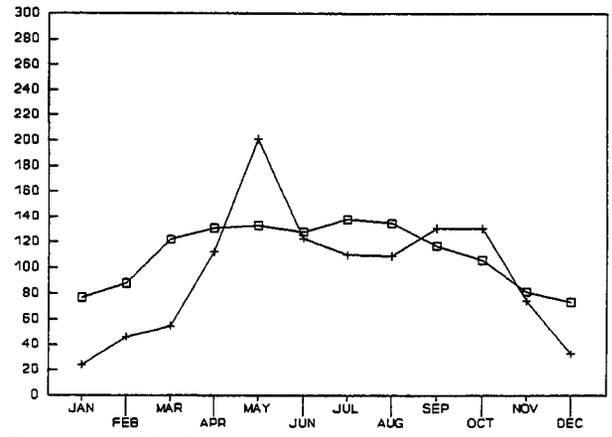

Figure 2 Precipitation (+) and evapotranspiration (□) in mm at the Contramaestre-STGO meteorological station.

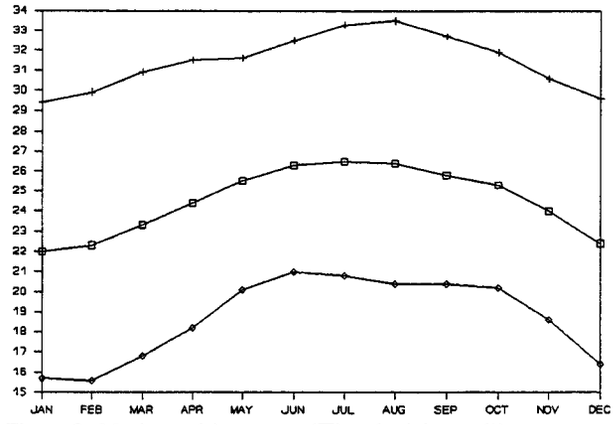

Figure 3 Maximum (+), average (□) and minimum (◊) temperature in °C of Contramaestre-STGO meteorological station.

In the Central Valley crops as sugarcane, rice, vegetables and citrus are cultivated, and coffee and cacao mainly in the mountain area.

1.4 Landscape and Soils

Soil formation as result of relief is well known in Cuba. According to studies carried out for the Cuban soil Map 1:250 000 (Instituto de Suelos, 1973) and the works carried out by Dirección General de Suelos y Fertilizantes (1984) a well defined sequence of soils occurs (Table 1).

Table 1 Soil type in relation to landform.

Landform	Type of Soil (Inst. de Suelos, Cuba/1975)	Classification (FAO/1974)	Classification (Soil Survey Staff/1975)
Mountains	Red Ferralitic soils	Ferralsols	Hapludox
Hills	Brown soils	Phaeozems, Cambisols	Haplustoll, Eutrochrept
Plains (Valleys)	Alluvial soils, Vertisols	Fluvisols, Vertisols	Ustifluvent, Pellustert

2 THE REFERENCE SOIL

2.1 Brief field description

Very deep, moderately to well drained, dark yellowish brown, clay, derived from alluvium. Small slickensides are observed in the subsoil (see photograph). A detailed description according to the guidelines for profile description of FAO (1977, 1983) is presented in Annex 1.

2.2 Brief analytical characterization of the profile

Soil samples were analysed at the ISRIC laboratory according to procedures described by Van Reeuwijk (1992).

Texture:	Clay with a slight increase with depth
Organic Carbon:	Medium, 1.5% in the upper 25 cm
Acidity:	Neutral to 80 cm depth
Sum of bases:	Very high (30-50 cmol (+)/kg soil)
Cation exchange capacity:	High throughout
Clay mineralogy:	Smectite dominant, kaolinite sub-dominant
Air capacity:	Very low
Available soil moisture:	Medium to high (13-16%)

Particle size distribution of the profile is shown in Fig. 4. The soil has a high clay content. The decrease at 100 cm depth is probably a result of sedimentation.
Organic Carbon, pH-H_2O, pH-KCl and sum of bases versus depth are shown in Figure 5.
Organic Carbon markedly decreases from 45 cm depth. The pH remains neutral until 80 cm depth and increases downward because of presence of calcium carbonate.
The sum of bases is high throughout the profile; this is related to the prevalence of smectite. A slight decrease is present in the subsoil, where particularly calcium values decrease. The low air capacity of these soils and the increase of the available soil moisture with depth are remarkable (Fig. 6).

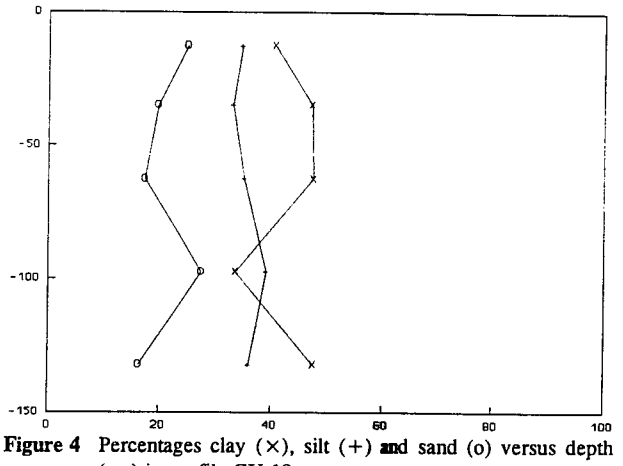

Figure 4 Percentages clay (×), silt (+) and sand (o) versus depth (cm) in profile CU 18.

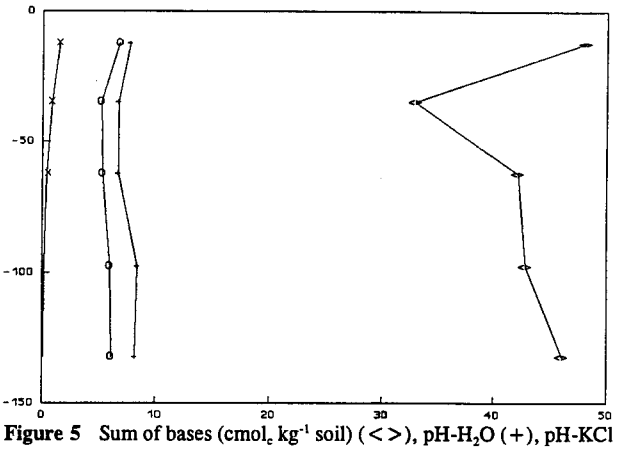

Figure 5 Sum of bases ($cmol_c\ kg^{-1}$ soil) (<>), pH-H_2O (+), pH-KCl (o) and organic carbon (×) versus depth (cm) in profile CU 18.

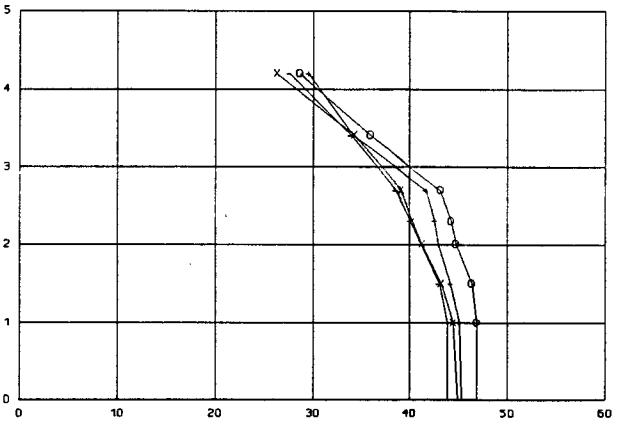

Figure 6 pF or moisture retention curves (water content in vol % versus suction) at depth 0-25 cm (×), 24-45 cm (+), 45-80 cm (o) and 80-115 cm (-) in profile CU 18.

1

2

1. Landscape CU 18
2. Profile CU 18

3 SOIL CLASSIFICATION

FAO-Unesco 1988
The soil has no clear sedimentation layers because of intensive bio-homogenisation. There is a mollic horizon overlying the thick cambic horizon, and the soil classifies therefore as Phaeozem. Because of weakly expressed vertic properties, it is a Verti-Haplic Phaeozem.

USDA, Soil Taxonomy (Soil Survey Staff, 1992)
The soil classifies as Mollisol because of the presence of mollic and cambic horizons. Due to the ustic moisture regime and the presence of slickensides it is a Vertic Haplustoll.

2nd Genetic classification of Cuban soils (Instituto de Suelos, 1975)
The soil classifies as Alluvial Differentiated because of its absence of clearly differentiated genetic horizons, their ample limits for a series of soil properties such as pH, bases saturation, carbonate content, exchange capacity, all determined by the sediments origin and sedimentation conditions.

4 SOIL MANAGEMENT

Potential and limitations for cultivation

These soils have been used for intense agricultural exploitation since many years because of their high natural fertility and suitable physical properties. They are, however, frequently flooded and have a moderate to poor drainage, which are the main restrictions. Table 2 shows the fertilizer recommendations for sugarcane. These soils are seasonly irrigated. An evaluation of land qualities according to the FAO methodology is presented in Annex 2 (FAO, 1983 and ISRIC, in prep.).

Alluvial soils suitable for sugarcane in Cuba have a potential production about 80 and 90 t/ha for plant cane under extensive production conditions (Roldós *et al.*, 1993). In experimental areas where factors reducing yield are under control, the soils achieve 137 t/ha in plant cane of 19 months and 109 t/ha in ratoons.

In the area where the CU 18 profile was sampled yields are between 60 and 70 t/ha, which is low to the production potential estimated for the region which is about 107 t/ha, according to the Agroecological Scheme, related to sugarcane cultivation (Arcia *et al.*, 1993).

Improved management of these soils should be directed to the construction of drainage systems.

Table 2 Mineral fertilization recommendations for sugarcane in soils with similar characteristics to CU 18 (Villegas *et al.*, 1986)

	NITROGEN (kg N ha^{-1})								PHOSPHORUS (kg P_2O_5 ha^{-1})					POTASSIUM (kg K_2O ha^{-1})			
	Expected yield (t/ha)								P_2O_5 content in soil (mg/100g)					K_2O content in soil (mg/100g)			
	<40	40-60	61-80	81-100	101-120	121-140	141-160	>160	>6.0	4.6-6.0	3.0-4.5	1.5-2.9	<1.5	>30.0	20.0-	10.0-	<10.0
Planting of:																	
Spring	25	25	25	35	35	35	35	35	0	0	25	35	50	0	0	100	100
Winter	40	40	40	50	50	60	60	60	0	0	25	35	50	0	0	100	100
1st Ratoon	50	50	50	60	60	75	75	75	0	0	25	35	50	0	0	150	160
2nd Ratoon	65	70	75	90	125	125	125	125	0	0	25	35	50	0	0	150	160
3rd Ratoon or further	75	85	90	110	130	150	180	200	0	0	25	35	50	70	70	160	160

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Annex 1 ISIS Data Sheet CU 18

Reference soil CU 18, CUBA — Print date: 28 June 1995

FAO/UNESCO (1988) : Verti-Haplic Phaeozem
(1974) : Haplic Phaeozem
USDA/SCS SOIL TAXONOMY (1992) : fine, montmorrilonitic, isohyperthermic
(1975) : Vertic Haplustoll
LOCAL CLASSIFICATION : Aluvial diferenciado

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

LOCATION : Cuba Prov. Stgo de Cuba Mun. Contramaestre CAI America Libre Bloque124
Latitude / Longitude : 20°20'0"N / 76°10'0"W — Altitude : 100 m a.s.l.
AUTHOR(S) : MARIN/REGLA/REYNOSA — Date : December 1991

GENERAL LANDFORM : stagnant alluvial 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 : nil — Cracking : small cracks
Stoniness : nil
Slaking/crusting :
SLOPE PROCESSES Soil erosion : no

PARENT MATERIAL 1 type, texture : alluvium derived from mixed lithology
Remarks :

EFFECTIVE SOIL DEPTH : 150 cm
WATER TABLE Kind, Depth : no watertable observed, -
DRAINAGE : moderately well
PERMEABILITY : No slowly permeable layer(s) cm
FLOODING Frequency : irregular, fresh water — Run off : medium

MOISTURE CONDITIONS PROFILE : 0-25 cm dry, 25-150 cm moist

LAND USE : high level arable farming (sugar cane), seasonal irrigated
VEGETATION Type : semi deciduous shrub — Status : secondary

CLIMATE Köppen : Aw
MET. STATIONS Name, Location : CONTRAMAESTRE-STGO, 20°17' / 76°15', 100 m a.s.l
Distance to site (relevance) : CONTRAMAESTRE-STGO lays 6 km SW of the site (good)

	No. years of record	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
CONTRAMAESTRE-STGO														
act. evapotransp. mm	13	129	144	195	209	179	183	188	189	155	142	117	110	1943
EP Penman mm	13	77	88	122	131	133	128	138	135	117	106	82	74	1331
relative humidity %	13	76	74	72	73	77	78	79	78	81	80	81	79	77
precipitation mm	13	24	46	55	112	201	123	110	109	131	131	75	33	1156
tot.glob.rad. MJ m^{-2}	13	449.0	476.1	651.0	657.0	641.7	606.2	657.2	635.9	552.0	517.0	432.0	430.0	6709.3
T mean °C	13	22.0	22.3	23.3	24.4	25.5	26.3	26.5	26.4	25.8	25.3	24.0	22.4	24.5
T max °C	13	29.4	29.9	30.9	31.5	31.6	32.5	33.3	33.5	32.7	31.9	30.6	29.6	31.4
T min °C	13	15.7	15.6	16.8	18.2	20.1	21.0	20.8	20.4	20.4	20.2	18.6	16.4	18.7
windspeed(at 2m) m s^{-1}	13	0.7	0.9	1.1	1.0	0.7	0.5	0.5	0.5	0.5	0.4	0.4	0.5	0.6
bright sunshine h d^{-1}	13	6.9	7.2	8.5	8.4	7.5	7.2	7.9	7.8	7.3	7.4	7.1	7.3	7.5

PROFILE DESCRIPTION :

Ap	0 - 25 cm	very dark grayish brown (10YR 3.0/2.0, moist) clay loam; strong medium subangular blocky slightly sticky, non plastic, slightly hard; no mottles; continuous thin humus cutans throughout; common fine pores and few medium pores; highly porous; many fine roots throughout and many medium roots throughout; no inclusions; no fragments; few worm channels and channels; slightly calcareous (10% HCL) throughout; gradual irregular boundary to
AB	25 - 45 cm	dark grayish brown (10YR 4.0/2.0, moist) clay loam; moderate medium to coarse subangular blocky slightly sticky, slightly plastic, firm; no mottles; patchy thin slickensides cutans throughout; common fine pores and few medium pores; highly porous; common fine roots throughout and common medium roots throughout; no inclusions; no fragments; few worm channels and channels; slightly calcareous (10% HCL) throughout; clear irregular boundary to
Bw1	45 - 80 cm	dark yellowish brown (10YR 4.0/4.0, moist) clay loam; moderate medium wedge-shaped angular blocky to moderate fine to medium crumb slightly sticky, slightly plastic, friable; no mottles; patchy thin slickensides cutans throughout; common fine pores; moderately porous; few fine roots throughout and few medium roots throughout; no inclusions; no fragments; slightly calcareous (10% HCL) throughout; gradual smooth boundary to
Bw2	80 - 115 cm	dark yellowish brown (10YR 4.0/4.0, moist) loam; moderate medium subangular blocky sticky, plastic , friable; no mottles; continuous moderately thick slickensides cutans throughout; common medium pores and common fine pores; moderately porous; few fine roots throughout; no inclusions; no fragments; slightly calcareous (10% HCL) throughout; gradual smooth boundary to
BC	115 - 150 cm	dark yellowish brown (10YR 3.0/4.0, moist) clay; moderate fine to medium subangular blocky sticky, plastic, firm; no mottles; no cutans; few fine pores; slightly porous; no roots; no inclusions; no fragments; slightly calcareous (10% HCL) throughout;

ADDITIONAL REMARKS

Short field description:
Very deep, moderately well to well drained, dark yellowish brown clay derived from alluvium. Small slickensides are present in the subsoil.
Geology: Holocene silty clay and alluvials sands.
Geomorphology: alluvial plain and terrace, eroded and hilly.

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	25	-	1	1	2	12	10	25	13	22	35	41	10.3	1.45	45	45	43	41	40	39	34	26
AB	25	45	-	0	0	1	10	9	20	17	17	33	47	18.9	1.43	45	45	44	43	43	42	34	30
Bw1	45	80	-	0	0	0	7	10	17	14	21	35	48	28.2	1.52	47	47	46	45	44	43	36	29
Bw2	80	115	-	0	0	1	14	13	28	16	23	39	34	13.9	1.57	44	44	43	41	40	39	34	28
BC	115	150	-	0	1	2	7	7	16	11	25	36	48	26.4	-	-	-	-	-	-	-	-	-

	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	4.0	1.5	0.03	41.5	5.6	0.7	0.4	48.2	-	-	32.4	80	5.4	48.2	149	-	0.22	
AB	6.7	5.2	2.4	0.9	0.11	26.1	6.0	0.5	0.6	33.2	-	-	31.8	67	3.0	33.2	104	-	0.10	
Bw1	6.7	5.3	3.6	0.4	0.06	33.2	7.5	0.4	1.1	42.2	-	-	38.9	82	1.2	42.2	108	-	0.14	
Bw2	8.4	6.0	3.0	0.2	0.04	33.5	7.4	0.4	1.6	42.9	-	-	37.0	110	0.6	42.9	116	-	0.21	
BC	8.2	6.1	4.6	0.1	0.04	33.6	9.6	0.6	2.3	46.1	-	-	40.2	84	0.2	46.1	115	-	0.21	

CLAY MINERALOGY (1 = very weak .. 8 = very strong)												EXTRACTABLE Fe, Al, Si, Mn by amm. oxal.(o), Na dith(d) & pyroph.(p)								
Hor.	MI	VE	CH	SM	KA	HA	ML	QU	FE	GI	GO	HE	Fe(o)	Al(o)	Si(o)	Fe(d)	Al(d)	Fe(p)	Al(p)	Pret	pHNaF
Ap	2	·	·	8	4	·	·	1	2	·	·	·	-	-	-	-	-	-	-	-	-
AB	2	·	·	8	4	·	·	·	1	·	·	·	-	-	-	-	-	-	-	-	-
Bw1	2	·	·	8	4	·	·	·	2	·	·	·	-	-	-	-	-	-	-	-	-
Bw2	2	·	·	8	4	·	·	·	1	·	·	·	-	-	-	-	-	-	-	-	-
BC	2	·	·	8	4	·	·	1	1	·	·	·	-	-	-	-	-	-	-	-	-

Annex 2 Evaluation of Soil/Land Qualities of CU 18

LAND QUALITY Availability (1)

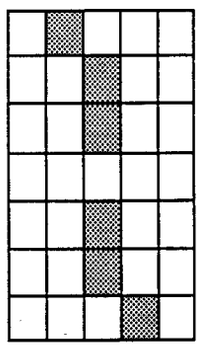
Hazard/Limitation (2)

vh	h	m	l	vl
n	w	m	s	vs

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

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

CU 18



CLIMATE		
Radiation regime	- total radiation	1
	- day length	1
Temperature regime		1
Climatic hazards (hailstorm, wind, frost)		2
Conditions for ripening		1
Length growing season		1
Drought hazard during growing season		2
SOIL		
Potential total soil moisture		1
Oxygen availability		1
Nutrient availability		1
Nutrient retention capacity		1
Rooting conditions		1
Conditions affecting germination		1
Excess of salts	- salinity	2
	- sodicity	2
Soil toxicities (e.g. high Al sat.)		2
LAND MANAGEMENT		
Initial land preparation		2
Workability		1
Potential for mechanization		1
Accessibility	- existing	1
	- potential	1
Erosion hazard	- wind	2
	- water	2
Flood hazard		2
Pests and diseases		2

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 1*M* 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: 1/1000th 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.
vermiculite	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.
ESP	Exchangeable sodium percentage, ratio of exchangeable sodium to the CEC, expressed as percentage.
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.
SAR	Sodium adsorption ratio of the soil solution, indicative of sodication hazard.
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.
Water soluble salts	Salts more soluble in water than gypsum.

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
SCS	Soil Conservation Service
UNESCO	United Nations Educational, Scientific and Cultural Organization
USDA	United States Department of Agriculture

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