Soil Brief *Cuba 7*

CUBA

Organic matter-rich calcareous reference soil

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ISRIC

INICA

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ISRIC Soil Monolith:

Number	*FAO-Unesco*	*Soil Taxonomy*
CU 10	Calcaric Phaeozem	Entic Haplustoll

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CONTENTS

FOREWORD

The main objective of the Soil Brief is to present a short characterization of a reference soil, to discuss selected properties, and to provide a qualitative assessment of the soil, climate and management qualities.

This Soil Brief presents a Calcaric Phaeozem. These soils are distributed throughout Cuba and cover an area of about 2200 km^2 (Ascanio, 1984), they are used for different crops, mainly sugarcane and pasture land.

It should be stressed that the origin of this soil allow its separation from the Brown calcareous soils, although they form part of the same soil class according to the FAO-Unesco soil classification system.

A joint cooperation project of INICA and ISRIC 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 national soil expositions, databases and accompanying publications. In Cuba it aims to describe and sample a series of reference soils, representative for the sugarcane areas of Cuba. Duplicates of these 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). During fieldwork, I. Rodríguez, I. Fernández, E. Pineda, R. Díaz and M.E. Sánchez from Sugarcane Experiment Station of Villa Clara province made important contributions.

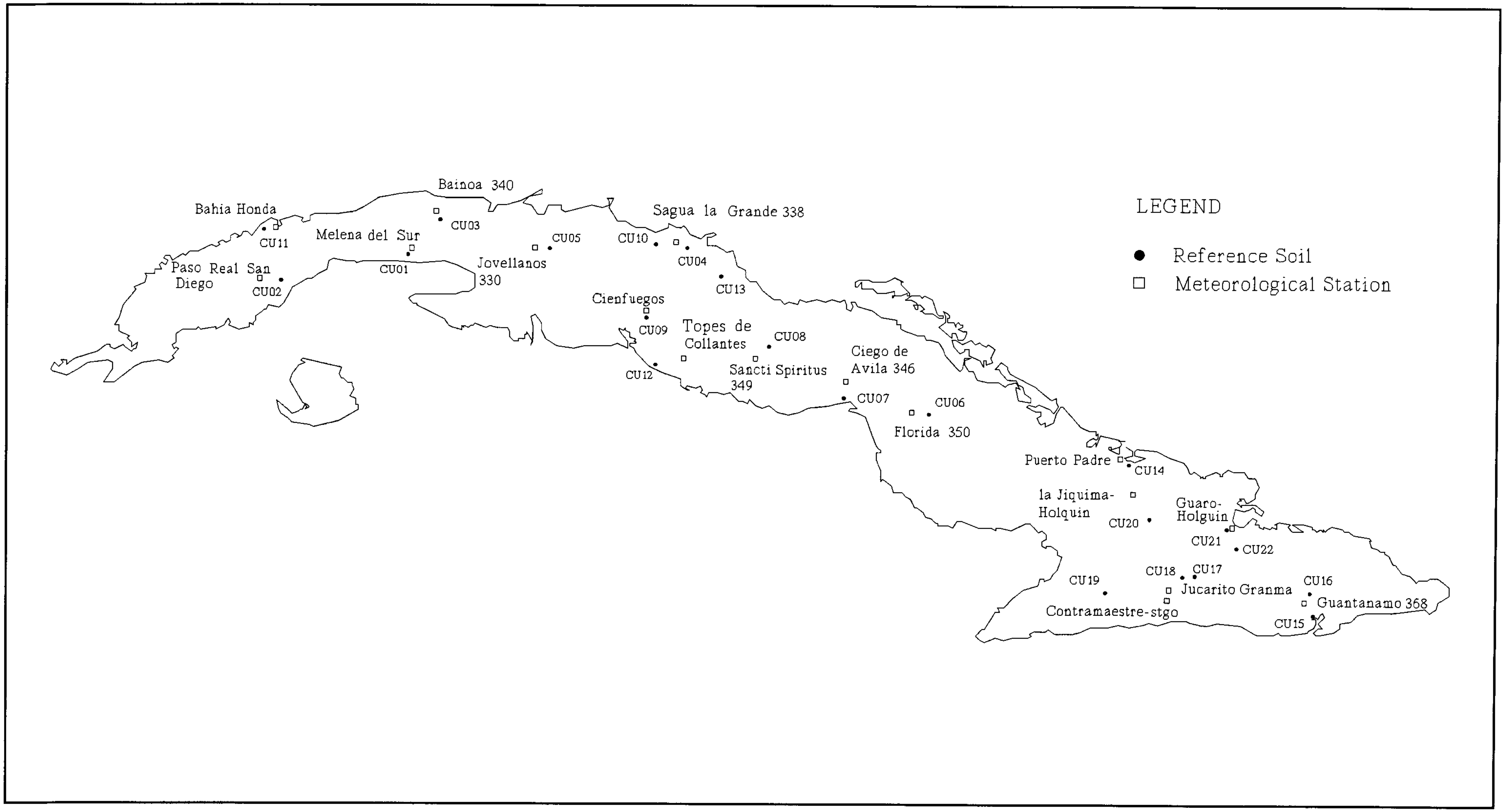

Figure 1 Geographical location of the reference sites.

1 LOCATION AND DISTRIBUTION

Reference Soil CU 10 is located in the North of the Central region of Cuba, in the Villa Clara province (Figure 1). The profile was selected in an area used for sugarcane cultivation at the "Panchito Gómez Toro" mill, municipality of Quemado de Güines, at 22°49' and 80°15'. Altitude was 50 m.a.s.l.

These soils are distributed throughout the country occurring in different topographic conditions, from mountainous to plain zones. Topography influences the degree of carbonate leaching, soil depth and its association to other soil units.

1.1 Climate

The climate of the region where the Reference Soil is located is considered tropical with relatively humid summers (Aw). Such climate is prevailing in almost all the country (Díaz Cisneros, 1989).

Climatic data taken from the Sagua la Grande meteorological station are representative for the reference site. Figure 2 shows a marked dry period from November to April and also during the rainy season there are two relatively dry months. These moisture deficits reduce crop production. The dry winter, together with the lower temperatures (Figure 3) during that season favours crop ripening, especially for sugarcane.

The diagrams were made with Solgraph (Brunt and Kauffman, 1995).

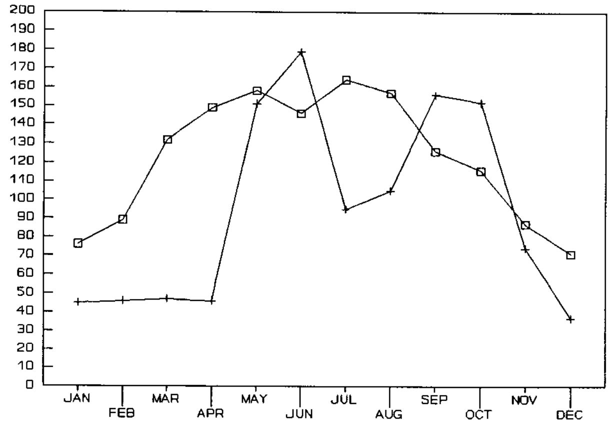

Figure 2 Precipitation (+) and evapotranspiration (□) in mm at the CU10 site.

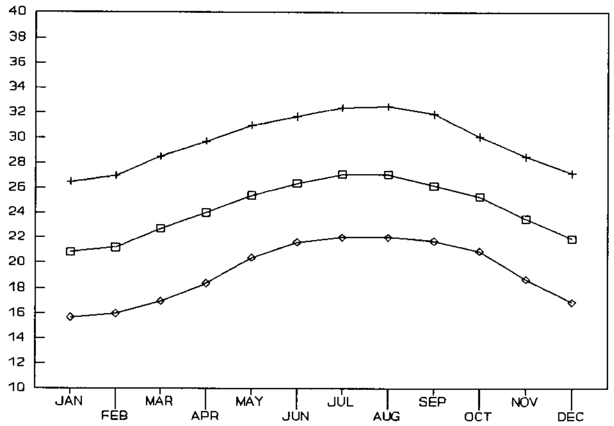

Figure 3 Maximum (+), average (□) and minimum (◊) temperature in °C at the CU10 site.

1.2 Landscapes and Soils

Phaeozems (humus rich calcareous) soils occur in Cuba in different landscapes ranging from mountains to plains. With an undulating relief, slopes between 5 and 10%, these soils are generally associated with Cambisols (Brown calcareous soils). In mountainous regions with slopes up to 20% the soils are associated with ferralsols and Cambisols. In zones comparable to the reference site, with a (slightly undulating to almost plain) relief (slopes less than 5%), they are usually associated to Vertic Cambisols and Vertisols.

1.3 Geology and Geomorphology

Reference Soil CU 10 and comparable ones are formed in geological strata consisting of clay, loam, limestone and sandstone, mainly belonging to the Inferior-medium Miocene and Eocene.

The reference site CU 10 is located in an abrasive plain and hilly marine terrace (Cuban National Atlas, 1989).

1.4 Vegetation and Land Use

The original vegetation of the area was a "latifolia" tropical forest, semi-deciduous. Some residual species are: Royal Palm (*Reystonea regia*), Cedar (*Cedrela mexicana*), Mahogany (*Swietenia mahogany*), and Baria (*Coedia gerascanthus*). As a result of deforestation at the beginning of the twentieth century, most of these areas are at present used for agricultural crops like grains, vegetables, sugarcane and pasture, the two latter with high input.

2 SOIL CHARACTERIZATION

2.1 Brief analytical characterization of the profile

CU 10 is a shallow, moderately well-drained, dark greyish brown clay soil. The soil has a subangular blocky structure and contains small calcareous nodules and gravels.

Soil samples were analyzed at the ISRIC soil laboratory according to the procedures described by van Reeuwijk (1992).

Texture: Clay strongly decreasing with depth
Organic Carbon: High (2.4%) in the first 34 cm
Acidity: Slightly alkaline in the upper 46 cm
Sum of Bases*: Very high (83 cmol (+)/kg soil)
Cation Exchange Capacity: Very high (49 cmol(+)/kg soil) in the upper 46 cm
Bulk density: Medium in the upper 46 cm
Air capacity: Low to very low (6-3%)
Available soil moisture: Medium
Clay mineralogy: Smectite dominant with medium kaolinite and mixed minerals

*) Although the sum of bases is always very high in these soils, it is overestimated here probably due to the extraction method utilized (a part of the calcium carbonate in the soil is measured as exchangeable Ca^{2+} cation).

Figure 4 shows the texture profile characterized by a clay A horizon with an abrupt change in texture towards the weathered limestone substratum (45-50 cm). The 2:1 clay type (montmorillonite group) is dominant, with an increase of mixed minerals and kaolinite in the weathered limestone rock (Annex 1).

Figure 5 shows the organic carbon, pH and the sum of bases versus depth.

Humus-rich horizons are the result of humus accumulation, being one of the dominant soil forming processes in these soils. This process is strengthened by a seasonal moisture regime, and a high calcium and clay content as a result of sialitization inherited from the carbonated rock (Ascanio, 1984).

In a comparative study of 30 Phaeozems a significative correlation between organic matter, total Nitrogen and Munsell Soil Value (color) was found (Table 1).

Soil reaction is slightly alkaline to alkaline with a close correlation between pH and calcium carbonate content. The sum of bases is high throughout the profile.

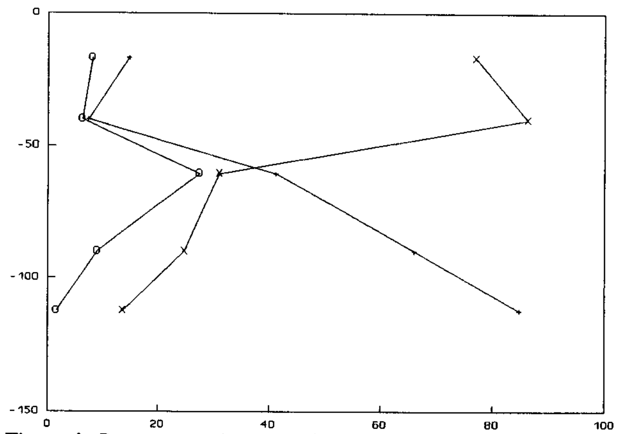

Figure 4 Percentages clay (×), silt (+) and sand (o) versus depth (cm) in profile CU 10.

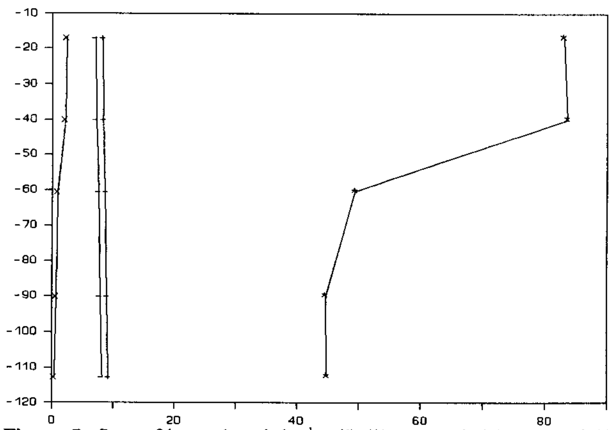

Figure 5 Sum of bases ($cmol_c$ kg^{-1} soil) (*), pH-H_2O (+), pH-KCl (-) and organic carbon (x) versus depth (cm) in profile CU 10.

Table 1 Correlation of Organic Matter, Total Nitrogen versus soil color (After Marín *et al.*, 1968).

	Correlation Coefficient		
	Total-N	Value	Chroma
O.M	0.52	0.35	0.23
Total-N	-	0.15	0.21
Value	-	-	0.07

2.2 Soil classification

FAO-UNESCO (1988)
The soil has a mollic A horion. It is assumed that there is no calcic horizon. Therefore it classifies as Hyper-Calcaric Phaeozem. If a calcic horizon was present, the soil is classified as Chernozem.

USDA Soil Taxonomy (1990)
The soil classifies as a Entic Haplustoll because of the mollic horizon and the ustic moisture regime, and the assumed absence of a calcic horizon.

2nd Cuban Soils Genetic Classification
It classifies as "Humic Carbonated", due to the Organic Matter content, the type of humus, the presence of high active calcium carbonate content and the presence of a humified A horizon with more than 50% clay (Montmorillonite) and the subangular blocky structure.

3 SOIL MANAGEMENT

These soils have been submitted to an intensive agricultural exploitation for a very long time, because of their high natural fertility and appropriate physical conditions. There are some slight constraints reducing the productivity, such as effective depth, stoniness, medium moisture reserves and high active carbonate content. The latter could lead to a pH over 8, causing insolubility of some plant nutrients. A qualitative evaluation of the soil and the reference site according to FAO (1983) and ISRIC (1994) methodology is presented in Annex 2.

Experience has shown that with high input some of the limitations can be alleviated, resulting in good yields. In studies carried out by Roldós *et al.* (1993) in similar soils of the same region under long term sugarcane cultivation, yields varies between 70 and 80 t ha^{-1}.

It has been proved that in improved conditions these soils give yields up to 190 t ha^{-1} in plant cane of 19 months age. Yields obtained in experimental areas on these soils are shown in Table 2.

Table 2 Sugarcane yields obtained in experimental areas on these soils.

	Yields	
Crop cycle	Cane t ha^{-1}	Pol t ha^{-1}
Plant Cane	171	26
1st Ratoon	140	17
2nd Ratoon	117	20

The management of these soils should be focused on:
- Shallow ploughing
- Complementary irrigation to satisfy the crop water requirements in view of the limited cm effective soil-depth.
- Fertilization

Annex 1 ISIS Data Sheet CU 10

Reference soil CU 10, CUBA — Print date: 3 July 1995

FAO/UNESCO (1988) : Calcaric Phaeozem
(1974) : Rendzinas
USDA/SCS SOIL TAXONOMY (1992) : Entic Haplustoll, clayey over fine-silty, montmorrilonitic (calc.), isohyperthermic
(1975) : -do-
LOCAL CLASSIFICATION : Humico carbonatico

DIAGNOSTIC CRITERIA FAO (1988) : mollic A
USDA/SCS (1992) : mollic epipedon
Soil moisture regime : ustic
Soil temperature regime : isohyperthermic

LOCATION : Cuba Prov. V. Clara Mun. Q.de Guines CAI P.G.Toro Bloque 37 Campo 19
Latitude / Longitude : 22°49'0"N / 80°15'0"W — Altitude : 50 m a.s.l.
AUTHOR(S) : Marin/Regla/Balmas. — Date : July 1991

GENERAL LANDFORM : valley — Topography : undulating
PHYSIOGRAPHIC UNIT : undulated
SLOPE Gradient, Form : 2%, undulating, — Position of site : middle slope
MICRO RELIEF Kind : termite mounds
SURFACE CHAR. Rock outcrop : nil — Cracking : nil
Stoniness, Size, Form : very few stones, 10 cm, , angular irregular
Slaking/crusting : capped
SLOPE PROCESSES Soil erosion : no

PARENT MATERIAL 1 type, texture : marine sediments, clayey
Remarks :

EFFECTIVE SOIL DEPTH : 100 cm
WATER TABLE Kind, Depth : apparent, 140 cm
DRAINAGE : well
PERMEABILITY : No slowly permeable layer observed
FLOODING Frequency : nil — Run off : medium

MOISTURE CONDITIONS PROFILE : 0-120 cm moist

LAND USE : high level arable farming (sugar cane), no irrigation

CLIMATE Köppen : Aw
MET. STATIONS Name, Location : SAGUA LA GRANDE 338, 22°49' / 80°5', 22 m a.s.l
Distance to site (relevance) : SAGUA LA GRANDE 338 lays 29 km NE of the site (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/m²	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	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	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 - 34 cm very dark gray (10YR 3.0/1.0, moist) clay; strong medium to coarse subangular blocky; slightly sticky, slightly plastic, friable; no mottles; no cutans; few fine pores; slightly porous; many medium roots throughout and many fine roots throughout; few medium spherical hard calcareous unspec. inclusions; no fragments; very frequent worm channels and channels; calcareous (10% HCL) throughout; diffuse smooth boundary to

AC 34 - 46 cm dark grayish brown (10YR 4.0/2.0, moist) clay; strong medium to coarse subangular blocky; slightly sticky, slightly plastic, friable; no mottles; no cutans; few fine pores; slightly porous; many medium roots throughout and many fine roots throughout; few medium spherical hard calcareous inclusions; no fragments; very frequent worm channels and channels; calcareous (10% HCL) throughout; clear irregular boundary to

CA	46 - 75 cm	very pale brown (10YR 8.0/3.0, moist) slightly gravelly silt; moderately coherent; non sticky, non plastic, firm; no mottles; no cutans; common fine pores; moderately porous; few fine roots throughout; few medium spherical hard calcareous inclusions; no fragments; few worm channels and channels; strongly calcareous (10% HCL) throughout; diffuse smooth boundary to
Ck	75 - 105 cm	white (10YR 8.0/2.0, moist) slightly gravelly silt; structureless; non sticky, non plastic, firm; few medium distinct clear mottles (10YR 7.0/8.0); no cutans; common fine pores; moderately porous; few fine roots throughout; no inclusions; no fragments; few channels and worm channels; strongly calcareous (10% HCL) throughout; diffuse smooth boundary to
R	105 - 120 cm	white (10YR 8.0/1.0, moist) structureless; non sticky, non plastic, firm; common coarse prominent clear mottles (10YR 7.0/8.0); no cutans; few fine pores; slightly porous; no roots; no inclusions; no fragments; strongly calcareous (10% HCL) throughout;

ADDITIONAL REMARKS

Short field description:
Shallow, moderaley well drained, dark greyish brown clay. The soil has a subangular blocky structure and contains small calcareous nodules and gravels.
Geology: Neogene Era, mid-lower Miocene. Arabos formation: clays, marls, sandstone, limestone and aleurolitas.
Geomorphology: abrasive, erosive, undulatimg marine plains.

ANALYTICAL DATA:

Hor.	Top	Bot.	>2 mm	PARTICLE SIZE DISTRIBUTION (µm) 2000 1000	1000 500	500 250	250 100	100 50	TOT SAND	50 20	20 2	TOT SILT	<2	WDIS CLAY	BULK DENS	pF 0.0	1.0	1.5	2.0	2.3	2.7	3.4	4.2
Ap	0	34	-	1	1	1	2	3	8	7	8	15	77	-	1.27	56	54	54	50	49	47	44	37
AC	34	46	-	0	1	2	1	2	6	7	0	7	86	-	1.14	60	60	60	57	56	55	54	47
CA	46	75	-	11	8	4	3	2	28	5	36	41	31	-	-	-	-	-	-	-	-	-	-
Ck	75	105	-	2	2	1	1	2	9	11	55	66	25	-	-	-	-	-	-	-	-	-	-
R	105	120	-	0	0	0	0	1	2	4	81	85	14	-	-	-	-	-	-	-	-	-	-

Hor.	pH H2O	pH KCl	CaCO3	ORG. MATTER C	N	EXCHANGEABLE CATIONS Ca	Mg	K	Na	sum	EXCH. ACID. H+Al	Al	CEC soil	CEC clay	CEC OrgC	ECEC	BASE SAT	AL SAT	EC2.5	ESP
Ap	8.2	7.1	36.6	-	0.31	74.4	7.9	0.5	0.2	83.0	-	-	49.3	64	-	83.0	*	-	0.38	
AC	8.3	7.2	32.6	-	-	74.0	8.7	0.6	0.3	83.6	-	-	49.0	57	-	83.6	*	-	0.38	
CA	8.7	7.6	75.7	-	-	44.6	4.4	0.1	0.3	49.4	-	-	14.7	47	-	49.4	*	-	0.20	
Ck	9.0	7.9	85.2	-	-	39.3	5.0	0.1	0.3	44.7	-	-	8.7	35	-	44.7	*	-	0.17	
R	9.2	8.2	90.2	-	-	36.5	8.0	0.1	0.3	44.9	-	-	5.3	39	-	44.9	*	-	0.14	

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	3	0	2	3	2	0	0	0
AC	0	0	0	7	3	0	3	3	2	0	0	0
CA	0	0	0	6	3	0	4	1	1	0	0	0
Ck	0	0	0	6	3	0	5	0	1	0	0	0
R	0	0	0	6	4	0	6	0	1	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	0.2	0.4	0.1	-	-	-	-	-	-
AC	0.2	0.4	0.1	-	-	-	-	-	-
CA	0.0	0.1	0.1	-	-	-	-	-	-
Ck	0.0	0.0	0.1	-	-	-	-	-	-
R	0.1	0.0	0.0	-	-	-	-	-	-

Annex 2 Evaluation of Soil/Land Qualities of CU 10

LAND QUALITY Availability (1)

Hazard/Limitation (2)

vh	h	m	l	vl
n	w	m	s	vs

vh = very high n = not present
h = high w = weak
m = moderate m = moderate
l = low s = serious
vl = very low vs = very serious

CU 10

↓

CLIMATE

Land quality		vh / n	h / w	m / m	l / s	vl / vs
Radiation regime - total radiation	1			X		
- day length	1			X		
Temperature regime	1			X		
Climatic hazards (hailstorm, wind, frost)	2					
Conditions for ripening	1		X			
Length growing season	1			X		
Drought hazard during growing season	2		X			

SOIL

Land quality		vh / n	h / w	m / m	l / s	vl / vs
Potential total soil moisture	1			X		
Oxygen availability	1		X			
Nutrient availability	1		X			
Nutrient retention capacity	1					
Rooting conditions	1			X		
Conditions affecting germination	1		X			
Excess of salts - salinity	2	X				
- sodicity	2	X				
Soil toxicities (e.g. high Al sat.)	2	X				

LAND MANAGEMENT

Land quality		vh / n	h / w	m / m	l / s	vl / vs
Initial land preparation	2			X		
Workability	1		X			
Potential for mechanization	1		X			
Accessibility - existing	1		X			
- potential	1					
Erosion hazard - wind	2	X				
- water	2				X	
Flood hazard	2		X			
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

Chinese weights and measures	SI equivalent
1 mu	0.067 ha
1 jin	0.5 kg
1 jin/mu	0.133 kg ha^{-1}

Other 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.
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 Agricultural 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

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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	Organic matter-rich Calcareous Reference Soil	1
Cuba 8	Cracking Heavy Clay Reference Soils (Vertisols)	3

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5	Thailand	13
6	Colombia	18
7	Indonesia	48
8	Ecuador	in prep.
9	Brazil	28
10	Peru	21
11	Nicaragua	11
12	Costa Rica	12
13	Zambia	11
14	Uruguay	10
15	Gabon	6
16	Ghana	in prep.
17	Philippines	6
18	Zimbabwe	13
19	Spain	20
20	Italy	17
21	Greece	in prep.
22	India	in prep.
23	Kenya	in prep.
24	Mali	in prep.
25	Nigeria	in prep.
26	Mozambique	in prep.
27	Botswana	in prep.

* State of reference collections as of January 1995