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SOIL PROFILE DESCRIPTIONS FOR AGROFORESTRY RESEARCH SITES IN HAITI

by
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Carine Bernard and Marguerite Blemur

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EXECUTIVE SUMMARY

SOIL PROFILE DESCRIPTIONS FOR RESEARCH SITES IN HAITI.

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Reliable recommendations for the development of agroforestry systems require accurate descriptions of the environment. Information on the properties of soils in selected sites is needed to expand agroforestry in regions with similar conditions. The information generated from this report is useful in transfering the technologies which have been validated on research sites representing the major agro-ecological zones in Haiti. Five profiles are described, one on each of the research sites utilized by Haiti PLUS for agroforestry adaptive research. This report documents the soil resources of the agroforestry trial sites representing different agro-ecological zones. Organizations engaged in implementing agroforestry efforts can greatly benefit from these data because they then can predict with some confidence the potential output of particular interventions in different areas of the country as they compare their sites with the sites included in the trials.

The major limitations of the soils described and characterized in this report are low fertility and nutrient imbalance, resulting from high pH and low phosphorus. At the Titanyen site, the problem of nutrient imbalance is compounded by inadequate moisture. The soils at Fort Jacques, Bergeau, Saint Georges, and Bois Greffin are typical of the soils at many of the locations where hedgerow technologies are likely to be applied by CARE and PADF (Guthrie, *et al,* 1990). The soils at all of these sites have low available phosphorus, but only the soil at Fort Jacques is likely to respond to phosphate fertilizer because it has a near-neutral pH in the surface soil. High pH and saturation with calcium and/or magnesium render the other soils unlikely to respond to any fertilizer other than massive applications of acid-forming amendments.

One property of all soils, except for the Saint Georges site, that is highly favorable for the production of hedgerows is high organic matter. Preservation of organic matter should take precedence over other soil conservation measures because of the beneficial effects of organic matter on nutrient availability and moisture conservation.

REZIME

DESKRIPSYON SOL KOTE ESE ETABLI AN AYITI

Se

Richard L. Guthrie, Lionel Isaac, Gerard Alexis,
Carine Bernard ak Marguerite Blemur
ki fè travay sa-a

Pou fè rekòmandasyon valab pou devlope sistèm agwoforestye, sa mande pou dekri ak presizyon kote rechèch yo fèt. Enfòmasyon sou kalite tè enpòtan pou aplike rezilta ki jwenn nan lòt kote ki sanble ak kote esè yo etabli. Enfòmasyon ki nan rapò sa-a nesesè pou konnen si teknik yo jwenn ki valab nan sit kote esè yo fèt e ki reprezante zòn ki pi enpòtan yo an Ayiti, kapab aplike lòt kote. Senk (5) pwofil sòl dekri nan rapò sa-a, youn pou chak sit kote PLUS mete esè sou rechèch agroforestye adapte. Rapò sa-a bay enfòmasyon sou kalite sòl kote esè agwoforestye SECID/PLUS yo etabli e ki reprezante pliziè kalite zòn nan peyi Dayiti. Enfòmasyon sa yo kapab ede anpil òganizasyon k'ap travay nan agwoforestri paske yo kapab plis ou mwen asire lè yo prevwa ki sa yo kapab jwenn lè yo aplike yon teknik nan diferan zòn nan peyi-a, lè yo konpare kote yo travay ak kote esè sa yo etabli.

Pi gwo pwoblèm tout tè nou te etidye nan rapò sa-a, se tè ki yon jan pòv e pa genyen ekilib nan eleman nitritif (manje) yo. Sa bay kòm rezilta, yon "pH" ki wo ak fòsfò ki yon jan ba. Nan Titanyen, pwoblèm manke ekilib sa-a soti nan pwoblèm pa gen ase dlo. Sòl nan Fò Jak, Bèjo, Sen Jòj ak Bwa Grefen sanble ak sòl ki rankontre anpil kote CARE ak PADF ap travay, kote yo kapab etabli ranp vivan (Guthrie, *et al,* 1990). Sòl tout kote sa yo pa gen ase fòsfò plant yo ka jwenn nan tè-a, men sèl sòl ki nan Fò Jak kapab bay yon rezilta si yo mete angrè ki genyen fòsfò paske sòl ki anlè tè-a gen "pH" net (nan zòn pH = 7). Lòt sòl yo genyen yon "pH" ki wo ak anpil kalsyum ak/ou byen mayezium, sa ki fè yo pap bay anyen menm si yo aplike nenpòt ki angrè. Sèl amandman ak asid pou netralize baz sa yo kapab bay yon bagay.

Yon bagay ki valab pou tout sòl yo, eksepte Sen Jòj, tout genyen anpil matyè òganik ki bon anpil pou aplike teknik ranp vivan. Konsève matyè òganik nan tè sa yo ta dwe pi enpòtan pase aplike estrikti konsèvasyon sòl, paske matye òganik pèmèt plant yo jwenn manje (eleman nitritif) e li kenben dlo tou.

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INTRODUCTION.

Research data must be examined in relation to accurate descriptions of the environment to provide for consistent interpretation and to make sound recommendations for specific sites. Current Haiti Productive Land Use Systems (PLUS) field data forms for hedgerow, tree and crop yield measurements allow for the physical description of fields in terms of slope, aspect, altitude, field sizes, natural vegetation, crop association, and other characteristics. This information needs to be expanded, however, to include a complete soil profile description and classification for each research site. The information provided here can be used as a reference to characterize soils for the Agroforestry Adaptive Trial sites. It can also be useful for the grantees, PADF and CARE, and the Centre de Recherche et de Documentation Agricoles (CRDA) in their implementation of agroforestry efforts in specific locations when used in conjunction with species suitability data collected in the Agroforestry Adaptive Trials. Selection of the most suitable species and application of the most appropriate conservation practices will help to ensure sustainable, highly productive hedgerows.

In 1991, three Agroforestry Adaptive Trials were established to support CARE and PADF's effort to establish hedgerows in different regions of Haiti. Agroforestry Trial I, or AGRO 1, was designed to identify the appropriate tree species to use in alley cropping under different agro-ecological environments in Haiti. Although leucaena (*Leucaena leucocephala*) and several other species were being extended to farmers within the project, no systematic testing had been conducted to determine which species was best suited for hedgerows. There are areas within the country (high elevation and basaltic soils) where questions had been raised as to the appropriateness of leucaena. The Fort Jacques site was selected to represent mid to high elevation sites, Saint Georges was selected to represent low elevation basaltic soils, Bergeau was selected to represent low elevation calcareous soils and Titanyen was selected to represent semi-arid conditions. Between 16 and 20 tree species were planted at each site, with a total of 35 tree species for the entire trial.

AGRO 2 was designed to develop recommendations on appropriate management of the hedgerows for sustainable crop production, while AGRO 3 was designed to compare various soil conservation practices including alley cropping with leucaena hedgerows, grass rows, rock walls, and contour canals. Because these two trials required more intensive management, they were located at Pernier, a central location which is intermediate in rainfall conditions between the wetter South and the drier Northwest.

The soil descriptions and site information included in this report may be used to relate the results of the Agroforestry Adaptive Trials to PLUS Project implementation areas in Haiti.

Currently, two reports have been published on AGRO 1 (Shannon and Isaac, 1993; Isaac *et al.*, 1994) one on AGRO 2 (Isaac *et al.*, 1995) and one on AGRO 3 is in preparation. The SECID/Auburn Agroforestry Report No. 16 (Guthrie *et al.*, 1990) provides soil descriptions from a number of sites throughout Haiti. By comparing soil and rainfall conditions in implementation areas with conditions at the trial sites, it will be possible to anticipate hedgerow performance based upon similarities and differences between the trial sites and the implementation sites. Although this does not eliminate the need for verification within local areas, the combination of better site information with actual trial results provides a more favorable basis on which to promote of agroforestry interventions.

METHODS

Field Procedures

The soils examined were described using soil description sheets from the Natural Resources Conservation Service of the U.S. Department of Agriculture. This form was adapted to fit the conditions in Haiti. Some of the items that were irrelevant were eliminated while other information was added. For example, because information on soil type is not available, we replaced it with data from the geological map units taken from the OAS Geology Map for Haiti (Geologie, Republique d'Haiti, 1972). For area, we indicated the name of a major town or village, followed by the Department name. The date the soil was described was recorded. A preliminary classification of the soil was made in the field. Soil samples were taken by horizon for physical and chemical analyses. In a few instances, the tentative soil classification made in the field was revised according to the results of the laboratory analyses. Location includes the locality where the field is located and the distance from a known landmark. Natural vegetation, crops and crop association were described. The parent material refers to the geological material from which the soil developed. If parent material is known, it is often possible to have an indication of the fertility constraints that are present or which may occur. The following physiographic data were recorded: description of landform, slope, altitude and aspect. Slope is important in predicting the intensity of the runoff. Aspect indicates the direction the slope faces and is a measure of how exposed or protected the landform is from solar radiation, dominant winds and rain. These last two factors are important when evaluating risks for erosion. A photograph of each site was taken and is included below with the data relating to each site.

Relevant information regarding soil properties specific for each site are also given. Drainage, moisture, and permeability will be used to assess the soil moisture regime. Stoniness and soil texture of the surface, as well as root distribution and the depth of the soil to a root restrictive soil layer are used to identify constraints to land preparation and cultivation. An estimate of the degree of soil erosion is also given and will help assess the urgency of needed soil conservation measures.

After the general site description was completed, a soil profile description by horizon was made from a soil pit. Pits were dug one meter deep or until the parent material or the bedrock was reached. A photograph of each pit accompanies the technical data for each site. The horizons were named using the standard horizon nomenclature and their depth measured. The color is defined as being either "dry" or "moist" using the Munsell soil color chart. The Munsell system includes three variables, the hue, value and chroma. The hue indicates the relation of the color to red, yellow, green, blue, and purple (Munsell color chart manual) and is generally linked to the form of the iron in the soil. Within each hue, the value indicates its lightness and the chroma its strength. For practical purposes, the lower the chroma and the value, the higher the organic matter content. The texture (particle size distribution) is estimated in the field, but soil samples taken in the field were also analyzed in the laboratory for their content of clay, silt and sand. Based on these results the exact textural classes can be defined. Structure is described by grade, or distinctness, size and type of soil aggregates. Consistence is a measure of the ability of a soil to adhere or cohere, that is, to resist deformation or rupture. These last three properties combined provide a good estimate of the soil moisture regime which is very important when considering plant resistance to moisture stress and drought. Structure and consistence also affect root penetration, which will affect tree establishment and growth as well as efficiency in conserving soil.

The reaction of the soil to hydrochloric acid tests the presence of calcium carbonates. This is a very important aspect of site specific tree selection. Some plants are extremely sensitive to calcium carbonates and others are tolerant. This test is very simple and can be performed in the field by extension personnel.

Laboratory Procedures

Particle size distribution was determined by the pipette method and dry sieving (Soil Survey Staff, 1991). Cation exchange capacity (CEC) of whole soil (<2mm) was determined by extraction with pH 7.0, 1 *M* NH_4OAc, replacement with 1 *M* KCl and titration (Soil Survey Staff, 1991). Soil solutions were obtained by extraction with the Mississippi solution and analyzed for P, K, Ca, and Mg according to standard procedures of the Auburn University Soil Testing Laboratory (Hue and Evans, 1986). Organic matter was determined by the Walkley and Black method (Black, C.A., et al, 1965). X-ray diffraction analyses were used to identify the mineralogical basis for the high CEC values at Fort Jacques, Saint Georges and Pernier. X-ray diffraction results are provided in the Appendix.

Presented below are the analyses for each site. These data will be used in relation to production data in the future. This analysis will provide generalizations about the best soil and tree species combinations.

AGROFORESTRY ADAPTIVE TRIAL 1

High Elevation Site: Fort Jacques

SITE DESCRIPTION

Soil Series: Fort Jacques

Map Unit, Symbol: Omc Name: Formations Madame Joie et La Crete

Classification: Typic Hapludalfs, clayey-skeletal, kaolinitic, isohyperthermic

Area: Fort Jacques - Departement de L'Ouest

Location: Greffin - 3.7 miles from Baptist Mission, Fermathe

Latitude: 18° 29'N Longitude: 72°15'W

Climate: Humid Tropical

Use and Vegetation: Low elevation mountain humid forest; PLUS Project hedgerow species trials

Parent Material: Colluvium from siliceous limestones and argillaceous shales

Landform: Mountain

Topography, Percent Slope: Very steep; 30 - 45% slopes

Elevation: 1150-1200 meters Aspect: North

Drainage: Well drained Permeability: Moderate

Moisture: Udic Stoniness: Class 0

Depth to Root Restrictive Layer: 125 cm

Degree of Erosion: Very severe

Sampled and Described by: Richard Guthrie, Gerard Alexis, Lionel Isaac, Marguerite Blemur, Carine Bernard.

Date: 3/8/95

Comments: PLUS Project alley-cropping research site. In the year before the trials, this site was planted to beans, cassava, and sweet potatoes. Annual rainfall is estimated to be about 1200 mm.

PROFILE DESCRIPTION

Ap1 - 0 to 17 cm; dark reddish brown (5YR 3/2) clay; moderate fine granular structure; friable; common fine roots; less than 15% coarse fragments; neutral; abrupt smooth boundary.

Ap2 - 17 to 28 cm; dark red (2.5YR 3/6) clay; strong fine subangular blocky structure; friable; common fine roots; less than 15% coarse fragments; mildly alkaline; abrupt smooth boundary.

Bt1 - 28 to 42 cm; dark red (2.5YR 3/6) gravelly clay; strong fine subangular blocky structure; friable; many coarse roots; 25% coarse fragments <7.5 cm in diameter; neutral; abrupt wavy boundary.

Bt2 - 42 to 64 cm; red (2.5YR 4/8) very gravelly clay; strong fine subangular blocky structure; friable; common fine roots; 40% coarse fragments <7.5 cm in diameter; moderately alkaline; abrupt wavy boundary.

Bt3 - 64 to 125 cm; red (2.5YR 4/8) very gravelly clay; moderate fine subangular blocky structure; friable; 50% coarse fragments <7.5 cm in diameter; moderately alkaline.

PARTICLE SIZE ANALYSIS

Horizon	---- Particle Size ----			Textural Class	H_2O Avail.
	Sand	Silt	Clay		
	-------	---------- % ----------			cm/cm
Ap1	11.25	33.75	55.00	Clay	0.22
Ap2	6.25	26.25	67.50	Clay	0.23
Bt1	3.75	18.75	77.50	Clay	0.24
Bt2	8.75	6.25	85.00	Clay	0.22
Bt3	25.00	7.50	67.50	Clay	0.18

SOIL TEST RESULTS[1]

Horizon	pH	Phosphorus	Potassium	Magnesium	Calcium	CEC	O.M.
		---------- Mg ha^{-1} ----------				$cmol_c$ kg^{-1}	-- % --
Ap1	6.8	.0146	.2324	.4872	14.3248	49.03	8.9
Ap2	6.8	.0090	.1859	.2106	9.3968	37.73	5.0
Bt1	7.0	.0056	.2106	.1187	9.8000	37.63	3.6
Bt2	7.7	.0045	.2815	.0974	19.4272	39.83	2.5
Bt3	8.0	.0090	.2531	.1322	15.0528	29.93	2.1

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[1] Previous reports (Guthrie et al., 1990) reported cations in parts/million (ppm). To convert ppm to tonnes per hectare (Mg ha^{-1}), multiply by 0.00224.

To convert cations to $cmol_c$ kg^{-1}:
Ca: divide Mg ha^{-1} by 0.224
Mg: divide Mg ha^{-1} by 0.134
K: divide Mg ha^{-1} by 0.437

The difference between the sum of K, Mg, and Ca and the CEC is largely due to free Ca in the form of $CaCO_3$. Approximate values for exchangeable Ca may be obtained by differences.

General View, High Elevation Site: Fort Jacques

Soil Pit, High Elevation Site: Fort Jacques

Calcareous Site: Bergeau

SITE DESCRIPTION

Soil Series: Bergeau

Map Unit, Symbol: Te Name: Eocene-Calcaires massiff

Classification: Typic Troporthents, loamy, mixed (calcareous), iso-hyperthermic

Area: Cayes - Departement du Sud

Location: About 4.5 miles East of Les Cayes

Latitude: 18°13'N Longitude: 73°W

Climate: Humid Tropical

Use and Vegetation: Low Elevation Humid Mountain Forest; PLUS hedgerow species trials

Parent Material: Limestone

Landform: Upland

Topography, Percent Slope: Steep - 32%

Elevation: 70 meters Aspect: East

Drainage: Well drained Permeability: Moderately slow

Moisture: Udic Stoniness: Class 0

Depth to Root Restrictive Layer: 22 cm

Degree of Erosion: Severe

Sampled and Described by: Richard Guthrie, Lionel Isaac, Gerard Alexis, Carine Bernard.

Date: 5/9/95

Comments: Site was in umimproved pasture for the previous four or five years. Previous to that, sorghum was cultivated in rotation with maize and beans. Average annual temperature is 26.5°C and mean annual rainfall is 1800 mm.

PROFILE DESCRIPTION

Ap1 - 0 to 7 cm; dark brown (10YR 3/3) clay loam; moderate very fine subangular blocky structure; friable; common fine roots; less than 15 % coarse fragments; moderately alkaline; abrupt smooth boundary.

Ap2 - 7 to 22 cm; dark grayish brown (10YR 4/2) clay loam; moderate fine subangular blocky structure; friable; common fine roots; less than 15 % coarse fragments; moderately alkaline; abrupt wavy boundary.

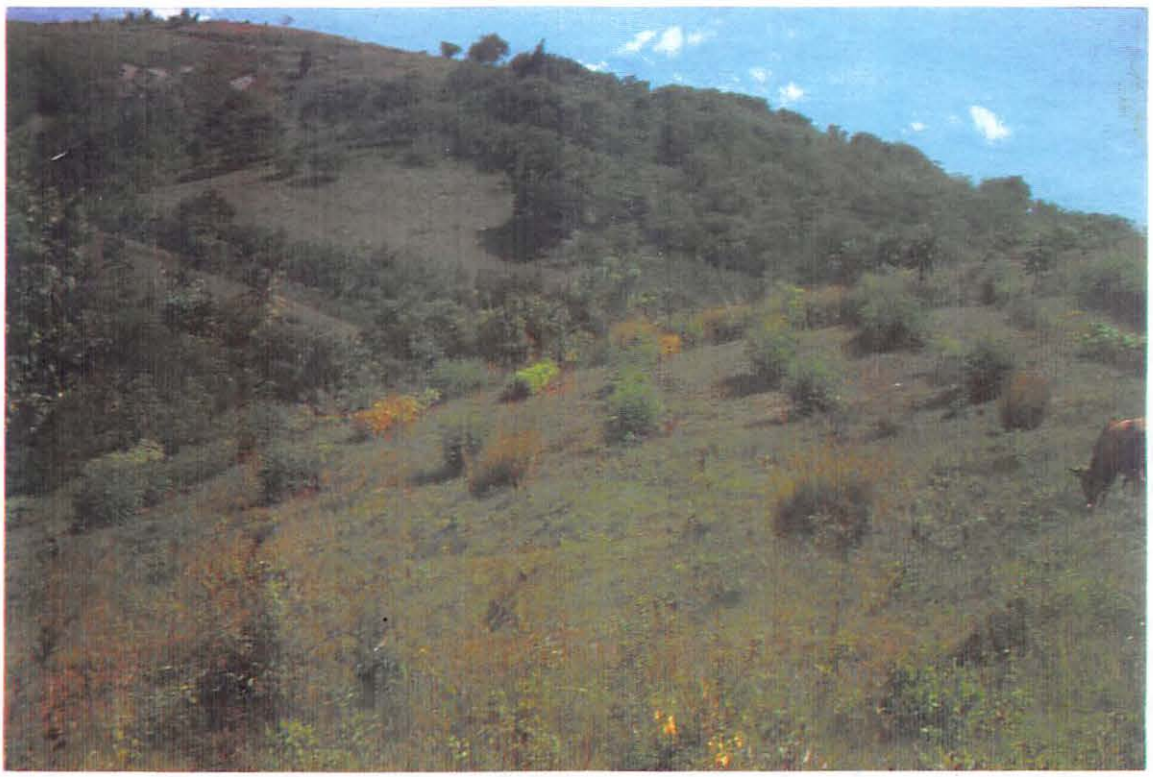
C - 22 to 72 cm; very pale brown (10YR 8/3); structureless massive; very firm; soft limestone; moderately alkaline.

PARTICLE SIZE ANALYSIS

Horizon	---- Particle Size ----			Textural	H_2O
	Sand	Silt	Clay	Class	Avail.
	------- ---------- % ----------				cm/cm
Ap1	33.75	48.75	17.50	Loam	0.16
Ap2	28.75	51.25	20.00	Silt loam	0.17
C	30.00	47.50	22.50	Loam	0.17

SOIL TEST RESULTS

Horizon	pH	Phosphorus	Potassium	Magnesium	Calcium	CEC	O.M.
		---------- Mg ha^{-1} ----------			--------	$cmol_c\ kg^{-1}$	-- % --
Ap1	8.0	.0224	.1859	.4637	17.5728	21.09	6.8
Ap2	8.1	.0202	.1422	.3382	17.8864	20.31	5.5
C	8.3	.0134	.0515	.1277	111.9888	6.20	1.9



General View, Calcareous Site: Bergeau

Soil Pit, Calcareous Site: Bergeau

Basaltic Site: Saint Georges

SITE DESCRIPTION

Soil Series: Saint Georges

Map Unit, Symbol: Cb Name: Basaltes, Dolerites et Roches Basique metamorphisees, Cretacee

Classification: Typic Hapludalfs, fine, mixed, isohyperthermic

Area: Cayes - Departement du Sud

Location: 26.7 miles East of Les Cayes

Latitude: 18°15'N Longitude: 73°W

Climate: Humid Tropical

Use and Vegetation: Low Elevation Humid Mountain Forest, PLUS hedgerow species trials

Parent Material: Basalt

Landform: Mountain

Topography, Percent Slope: Steep - 53%

Elevation: 80 meters Aspect: North

Drainage: Well drained Permeability: Moderately slow

Moisture: Udic Stoniness: Class 0

Depth to Root Restrictive Layer: 90 cm

Degree of Erosion: Very severe

Sampled and Described by: Richard Guthrie, Lionel Isaac, Gerard Alexis, Carine Bernard.

Date: 5/10/95

Comments: The site was previously in pasture into which had been planted hedgerows of *Erythrina indica* and *L. leucocephala*. Average annual temperature is 26°C and average annual rainfall is about 1600 mm.

PROFILE DESCRIPTION

Ap - 0 to 13 cm; dark brown (7.5YR 4/2) clay loam; moderate very fine subangular blocky structure; friable; many fine roots; few stones; neutral; abrupt wavy boundary.

Bt1 - 13 to 38 cm; very dark grayish brown (10YR 3/2) clay; moderate fine subangular blocky structure; friable; common fine roots; neutral; abrupt irregular boundary.

Bt2 - 38 to 59 cm; dark reddish brown (5YR 3/4) gravelly clay; weak fine subangular blocky structure; friable; more than 15% coarse fragments; more than 50% weathered basalt; neutral; abrupt irregular boundary.

Bt3 - 59 to 90 cm; dark brown (10YR 4/3) clay loam; weak very fine subangular blocky structure; friable; neutral; abrupt wavy boundary.

R - 90+ cm; Basalt rock.

PARTICLE SIZE ANALYSIS

Horizon	---- Particle Size ----			Textural	H_2O
	Sand	Silt	Clay	Class	Avail.
	-------	---------- % ----------			cm/cm
Ap	68.75	23.75	7.50	Sandy loam	0.07
Bt1	71.25	18.75	10.00	Sandy loam	0.07
Bt2	76.25	18.75	5.00	Loamy sand	0.05
Bt3	51.25	36.25	12.50	Loam	0.12
R	-----	-----	-----	-----	----

SOIL TEST RESULTS

Horizon	pH	Phosphorus	Potassium	Magnesium	Calcium	CEC	O.M.
		----------	Mg ha^{-1}	----------	----------	$cmol_c\ kg^{-1}$	-- % --
Ap	7.3	.0034	.1534	10.8102	7.2910	30.44	1.4
Bt1	7.2	.0034	.0515	10.9581	7.4700	37.96	1.5
Bt2	7.3	.0034	.0302	11.1765	6.8100	33.58	0.7
Bt3	7.2	.0022	.0280	11.0880	8.1540	40.26	0.6
R	-----	-----	-----	-----	-----	------	-----

General View, Basaltic Site: Saint Georges

Soil Pit, Basaltic Site: Saint Georges

Semi-Arid Site: Titanyen

SITE DESCRIPTION

Soil Series: Titanyen

Map Unit, Symbol: Tm Name: Miocene; sables, gres, conglomerates,

Classification: Lithic Petrocalcic Calciustolls, loamy, mixed, isohyperthermic

Area: Port au Prince - Departement de L'Ouest

Location: On the grounds of the Baptist mission camp, near Minoterie d'Haiti

Latitude: 18°41'N N Longitude: 73°W

Climate: Semiarid Tropical

Use and Vegetation: Native grasses and shrubs; PLUS Project hedgerow species trials

Parent Material: Limestone colluvium

Landform: Allluvial terrace

Topography, Percent Slope: Gently sloping - 10 %

Elevation: 87 meters Aspect: West

Drainage: Well drained Permeability: Moderate

Moisture: Moist Stoniness: Class 0

Depth to Root Restrictive Layer: 40 cm

Degree of Erosion: Slight

Sampled and Described by: Richard Guthrie, Lionel Isaac, Gerard Alexis, Carine Bernard

Date: 5/7/95

Comments: The site has not been cultivated in recent history and had a sparse cover of shrubs and grasses. Average annual temperature is estimated to be 28.5°C and average annual rainfall is estimated to be 780 mm.

PROFILE DESCRIPTION

A1 - 0 to 8 cm; very dark gray (10YR 3/1) loam; weak very fine granular structure; very friable;common coarse roots; many fine roots; few pebbles; moderately alkaline; abrupt smooth boundary.

A2 - 8 to 40 cm; very dark brown (10YR 2/2) loam; weak very fine granular structure; very friable; Many fine roots; more than 35% coarse fragments <7.5 cm in diameter; moderately alkaline; abrupt wavy boundary.

Bkm - 40 to 60 cm; white (10YR 8/1); massive structure; very hard; fragments are coated with secondary carbonates; cemented; strongly alkaline.

PARTICLE SIZE ANALYSIS

Horizon	---- Particle Size ----			Textural	H_2O
	Sand	Silt	Clay	Class	Avail.
	-------	---------- % ----------			cm/cm
A1	33.75	41.25	25.00	Loam	0.16
A2	35.00	37.50	27.50	Clay loam	0.16
Bkm	-----	-----	-----	-----	----

SOIL TEST RESULTS

Horizon	pH	Phosphorus	Potassium	Magnesium	Calcium	CEC	O.M.
		----------	Mg ha^{-1}	----------		$cmol_c\ kg^{-1}$	-- % --
A1	8.1	.0538	.5163	.9867	111.9888	28.04	9.0
A2	8.1	.0403	.3170	.8411	111.7648	28.63	8.6
Bkm	-----	-----	-----	-----	-----	-----	-----

General View, Semi-Arid Site: Titanyen

Soil Pit, Semi-Arid Site: Titanyen

AGROFORESTRY TRIALS 2 & 3

Bois Greffin, Pernier

SITE DESCRIPTION

Soil Series: Bois Greffin Pernier

Map Unit, Symbol: Tm Name: Miocene, sables, gres, conglomerates

Classification: Lithic Eutropepts, fine, mixed, isohyperthermic

Area: Departement de Port-au-Prince

Location: 4.9 miles northeast of Petionville

Latitude: 18°N Longitude: 72°30'W

Climate: Humid Tropical

Use and Vegetation: Low Elevation Mountain Forest; PLUS Project soil conservation trials

Parent Material: Limestone

Landform: Mountain

Topography, Percent Slope: Steep - 25%

Elevation: 250 meters Aspect: North

Drainage: Well drained Permeability: Moderate

Moisture: Udic Stoniness: Class 0

Depth to Root Restrictive Layer: 40 cm

Degree of Erosion: Severe

Sampled and Described by: Richard Guthrie, Lionel Isaac, Gerard Alexis, Carine Bernard

Date: 5/11/95

Comments: During the last three years prior to establishing the trials, carrots and lima bean had

been planted in the second rainy season followed by a fallow period with pasture. Mean annual temperature is 27.5°C and mean annual rainfall is about 1100 mm.

PROFILE DESCRIPTION

Ap - 0 to 24 cm; dark brown (7.5YR 3/2) gravelly clay; weak fine granular structure; very friable; more than 15% coarse fragments; many fine roots; moderately alkaline; abrupt wavy boundary.

B - 24 to 40 cm; dusky red (2.5YR 3/2) gravelly clay; weak very fine subangular blocky structure; friable; more than 15% coarse fragments >7.5 cm in diameter; common fine roots; moderately alkaline; abrupt wavy boundary.

R - 40+ cm; white (10YR 8/1).

PARTICLE SIZE ANALYSIS

Horizon	---- Particle Size ----			Textural	H_2O
	Sand	Silt	Clay	Class	Avail.
	------- ---------- % ----------				cm/cm
Ap	22.50	37.50	40.00	Clay loam	0.19
B	28.75	26.25	45.00	Clay	0.17
R	-----	-----	-----	-----	----

SOIL TEST RESULTS

Horizon	pH	Phosphorus	Potassium	Magnesium	Calcium	CEC	O.M.
		---------- Mg ha^{-1} ----------				$cmol_c\ kg^{-1}$	-- % --
Ap	8.0	.0157	.5163	.8411	111.9888	58.05	10
B	8.1	.0157	.4514	.6037	17.3376	45.17	7.7
R	-----	-----	-----	-----	-----	----	-----

General View, Agroforestry Trials 2 & 3 Site: Bois Greffin, Pernier

Soil Pit, Bois Greffin, Pernier

CONCLUSIONS AND RECOMMENDATIONS

The major limitations for the soils described in this report are low fertility, poor physical properties and low available water. Also the fact that most of them are on very steep slopes makes most land preparation, cultural practices and mechanization difficult.

Four of the five soils described developed from calcareous material and have a high pH, near pH 8 or more, which very often leads to induced low soil fertility through nutrient imbalance. In particular, phosphorus and micronutrients are locked into insoluble forms and thus not available to plants. Low available phosphorus prevents adequate growth and micronutrient deficiencies often affect photosynthetic and physiological activity and are indicated by chloroses. In addition, the amount of available magnesium and potassium, even though they may be in adequate supply, are in imbalance compared to the very large amounts of calcium.

Three sites, Fort Jacques, Saint Georges and Pernier, have exceptionally high CEC values. X-ray diffraction reveals a high proportion of 2:1 clay minerals. This indicates a high capacity to retain nutrients (see figures in Appendix).

Heavy fertilizer inputs would be required to achieve maximum production on these soils. However, they have other major constraints, some of which are impossible to overcome. They are usually shallow and have poor moisture regimes. The introduction of intensive cropping techniques is impossible in most of the sites studied because of steep slopes or inadequate moisture.

Fertilization of crops or trees is not recommended in most of the sites studied, because it will likely be uneconomical. However, improved well-adapted crop varieties and improved cropping practices can increase food production. The planting of well-developed and healthy tree seedlings will result in a better survival rate. The use of phosphorus-based fertilizers in nurseries is encouraged because phosphate fertilizer promotes root growth and increases overall physiological activity in young plants.

The soil developed from basalt at Saint Georges is generally chemically better balanced than the other soils, with the exception of the soil at Fort Jacques. Available phosphorus is very low, available potassium is low and magnesium is high. In addition to phosphorus, a response to potassium can be expected because of the inadequate balance between calcium, magnesium and potassium.

The soil at Fort Jacques also has a near-neutral pH and very low available phosphorus, but medium available potassium. This soil is less likely than the soils at Titanyen, Bergeau and Bois Greffin to have micronutrient deficiencies and is more likely to respond to phosphate fertilizer.

The soils at Bergeau, Titanyen and Bois Greffin have calcareous surface horizons, very

low available phosphorus and low available potassium. All are likely to have micronutrient deficiencies and to be unresponsive to phosphate fertilizer. Also, all three are shallow, resulting in low available water. In addition, the Titanyen site receives little rainfall and is, therefore, unsuited for food crop and tree production without supplemental irrigation.

As a general conclusion of this study, both chemical and physical limitations are affecting yields and tree production. Special attention needs to be given to the introduction of high pH tolerant tree species or crop varieties. This is certainly not new information, but hopefully, this report provides a better understanding of the extent of the constraints to adequate tree planting. Similarly, regarding resolving the food production shortages in Haiti, the introduction of improved varieties that are tolerant to high pH also needs to be focused on the better land that has the best potential. The relatively high percentages of organic matter in all soils should be given special emphasis in order to minimize nutrient imbalance and enhance moisture retention.

A previous study (Guthrie *et al*, 1990) presented descriptions and data for soils in PADF and CARE areas. Utilizing the taxonomic classification and comparing the properties of soils in this and the previous study, the transfer of technologies from research sites to extension and on-farm research sites should be improved.

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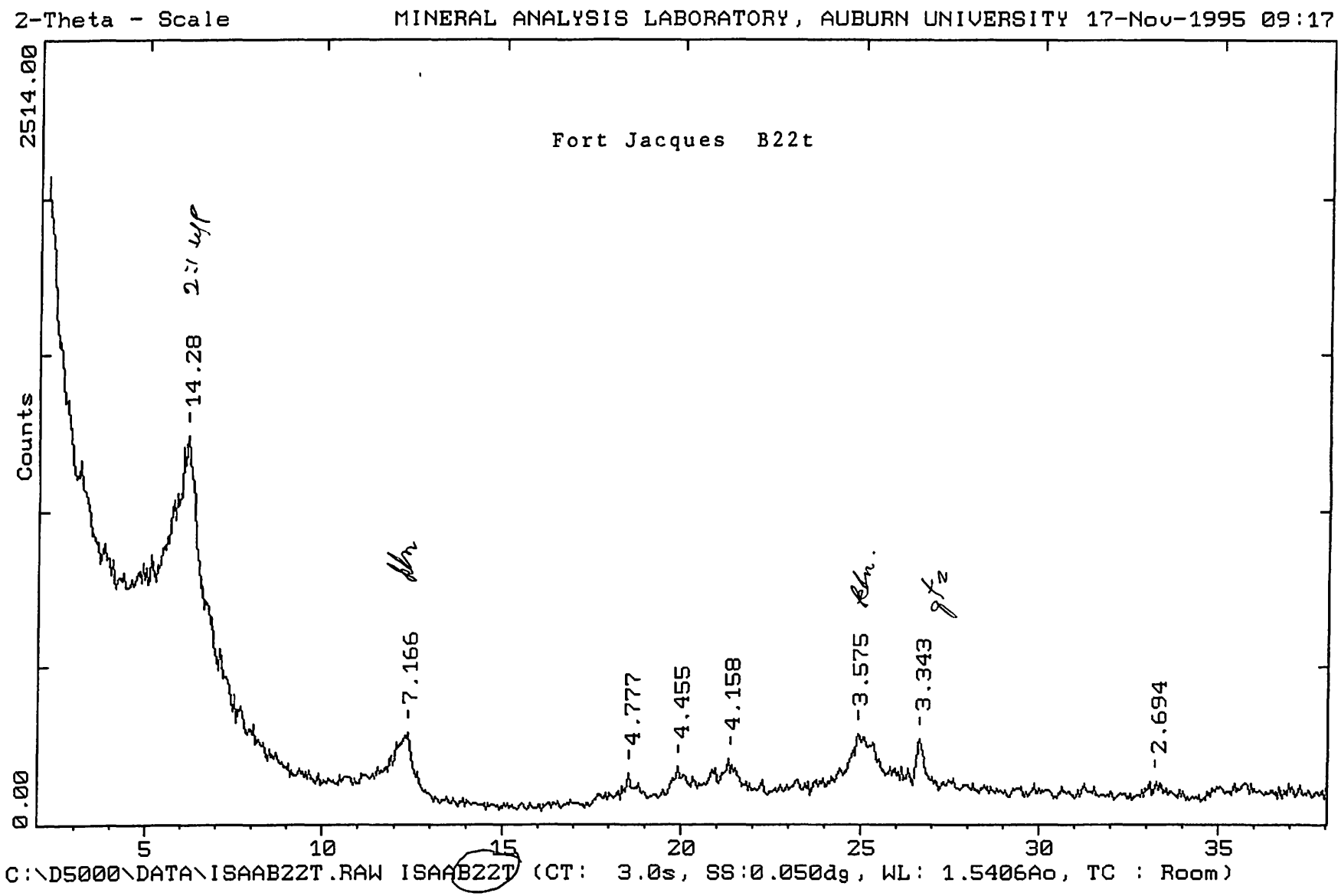
APPENDIX: X-RAY DIFFRACTION RESULTS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Fort Jacques B22t
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0.00
Counts
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-4.777
-4.455
-4.158
-3.575
-3.343
-2.694
5
10
15
20
25
30
35
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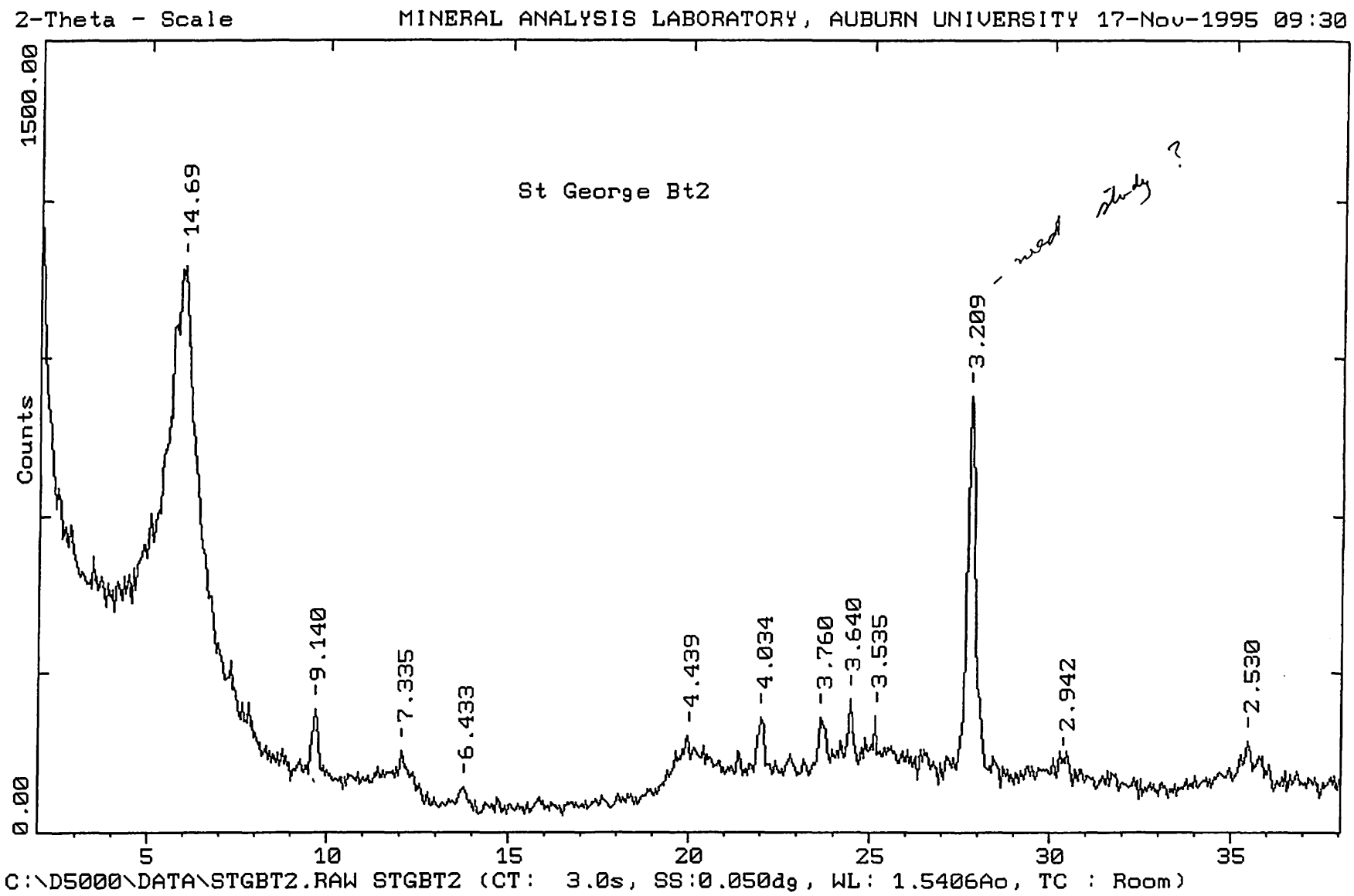
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St George Bt2
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-2.942
-2.530
5
10
15
20
25
30
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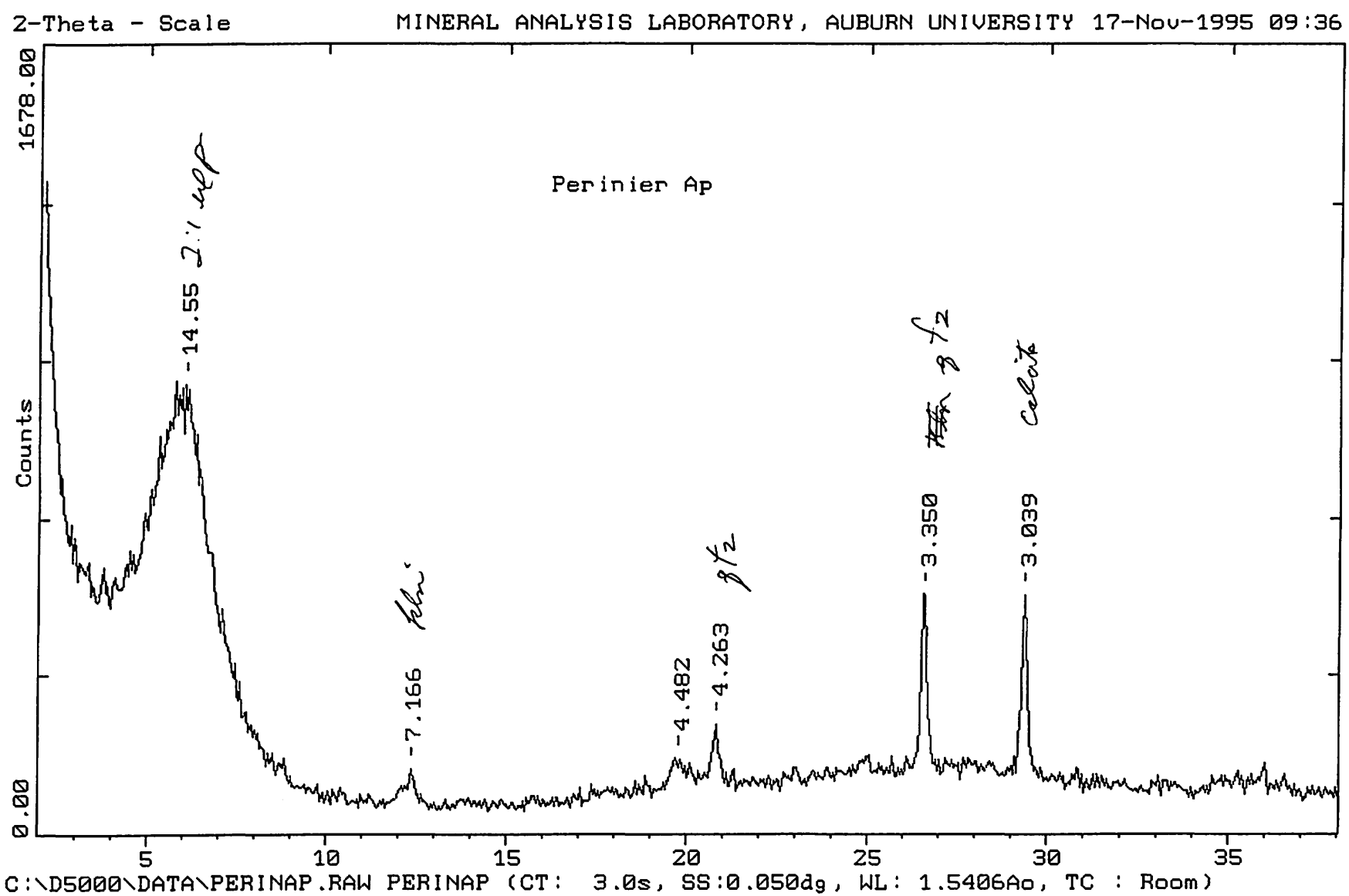
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Perinier Ap
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35
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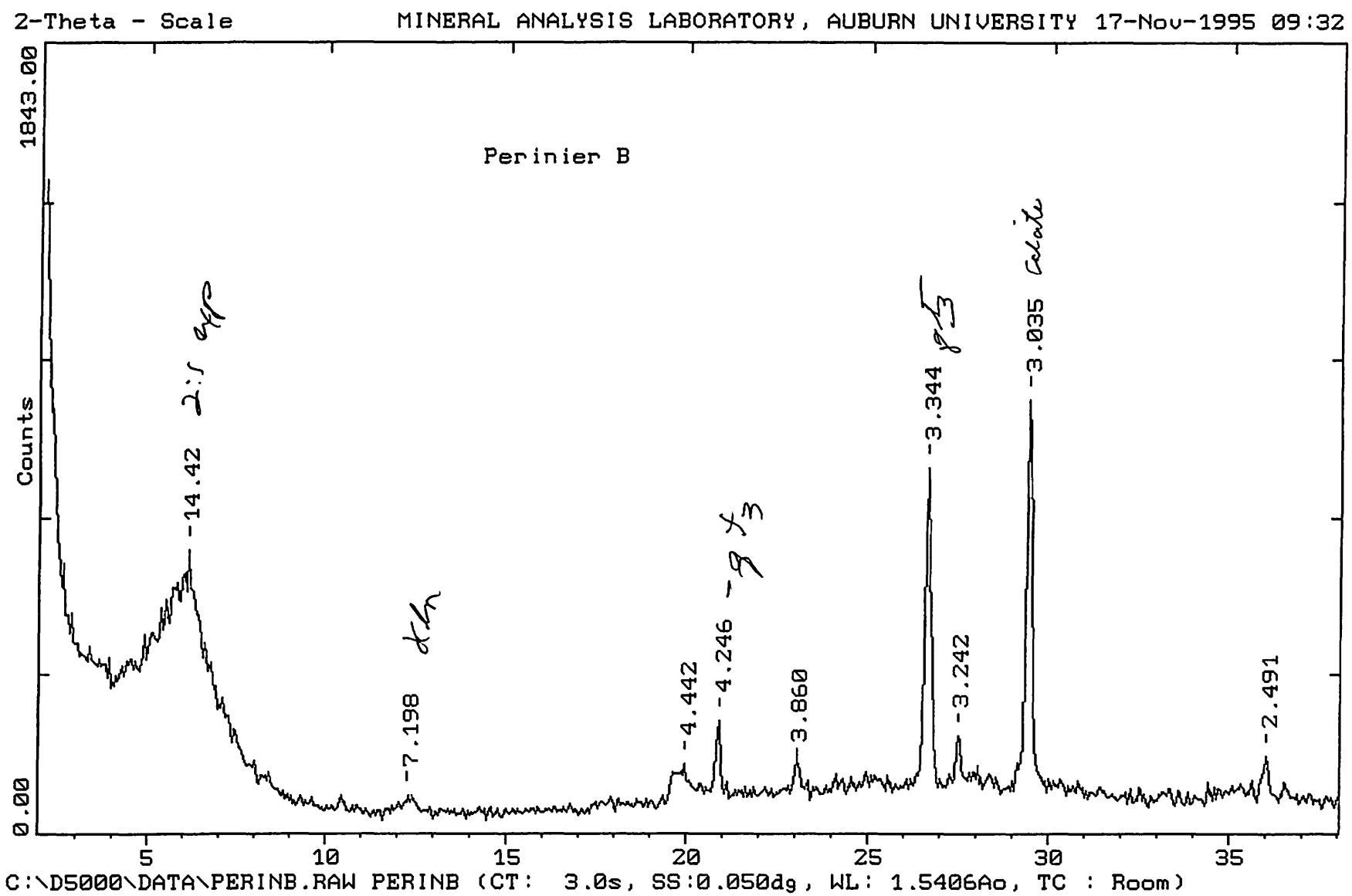
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5
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15
20
25
30
35
C:\D5000\DATA\PERINB.RAW PERINB (CT: 3.0s, SS:0.050dg, WL: 1.5406Ao, TC : Room)