United States Department of Agriculture

NEON Site-Level Plot Summary
Lajas Experimental Station (LAJA)

Document Information

Date
November 2018

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Site Background

The Lajas Experiment Station site covers approximately 1,093 acres within the Semiarid Coastal Plains Major Land Resource Area (MLRA 273) of southwest Puerto Rico. Lajas is one of the six experimental stations operated by the University of Puerto Rico with active agriculture taking place across the property.

Site Information

Elevation ranges from approximately 40 to 175 feet (12 to 53 meters) above sea level. The relief is flat to rolling.

Mean annual air temperature is 75 degrees F.

The parent materials at the LAJA site include marine and alluvial deposits in level, low-relief areas and colluvium adjacent to valley walls.

Land use is predominately agriculture use such as pineapple, fruit trees, various row crops and some pasture.

Plant communities are dominated by oak-hickory forest. Several plots contained Japanese stilt grass.

In general, soils on the site have high clay content (~ 55%), which is dominated by expandable layer silicates or vertic properties (high shrink-swell).

Major soil series on the site are predominately Cartagena and Fraternidad. Both are dark gray to black colored Vertisols. These soils are active, have a high shrink-swell potential, and are typically considered well suited for agriculture, but not recommended for building sites due to the potential for cracking foundations.

Analysis of Plots for Sampling

The initial plot selection goal was to capture soil variability, while maintaining a comparable plot number to soil map-unit acreage ratio for all soil map units. A total of 15 soil map units occur within the LAJA site. The designated plots, however, occur on only 4 of the 15 soil map units, which accounts for only 27% of the site. Eleven (11) map units contain no plots. Thirty-one (31) of the 34 plots occur within the Fraternidid clay, 0 to 2 percent slope (FrA) or the Cartagena clay, 0 to 2 percent slope (CeA) map units (91% of the plots are within these two soil map units). Plot selection employed professional judgment while using topographic, hill shade, color infrared, and digital orthoimagery to select plots that match the dominant landscape characteristics within a map unit. Once a sufficient number of plots within a map unit had been selected, it was felt that adequate coverage had been obtained and additional plots would have diminishing value. For example, the Fraternidid map unit (FrA) occurs on 19 plots (56%) and the Cartagena map unit (CeA) occurs on 12 plots (35%). Eleven (11) plots were selected in the Fraternidid map unit (11 of the 19 plots = 58%) and 6 plots were selected in the Cartegna map unit (6 of the 19 plots = 32%) for sampling. These plot numbers should adequately characterize the map units. Three (3) of 4 plots on the Mariana gravelly clay loam, 12 to 20 percent slopes (MiD) and San German-Duey complex, 5 to 20 percent slopes (SdD) map units were also sampled.

The four tower plots were not selected for sampling due to both map unit redundancy and because these plots are limited to sampling by hand-auger. Plots with similar soils that could be described and sampled via pit were preferred.

In total, 20 of the 34 NEON distributed plots were selected for sampling via pit with 7 being selected as back up or alternate plots. The alternate plots (LAJA_010, LAJA_013, LAJA_019, LAJA_021, LAJA_024, LAJA_006, and LAJA_023) would only be sampled when excavation difficulty, site access issues, or surface conditions (such as ponded water) prevented sampling of a primary site.

Field sampling resulted in 19 plots being sampled. Due to current agriculture activities being conducted on plot LAJA_007, plot LAJA_010 was selected as a replacement and was sampled. Plot LAJA_026 was rejected since the entire area was covered with construction debris (mainly concrete and wood). No alternate was available; however, this soil type was sampled at another plot (LAJA_015).

Approximately 15% of the LAJA site area (74% of the site's total map units) was covered by map units that were not sampled. These include:

Map unit symbol	Map Unit Name	% Total site area
AkA	Aguirre clay, occasionally ponded	3
FrB	Fraternidad clay, 2 to 5 percent slopes	1
JaB	Jacana clay, 0 to 5 percent slopes	1
JaC	Jacana clay, 5 to 12 percent slopes	1
OrA	Olivares muck, ponded	1
PaA	Palmarejo loam, 0 to 2 percent slopes	0
PgA	Parguera clay, 0 to 2 percent slopes	0
ScA	San Anton clay loam, 0 to 2 percent slopes, occasionally flooded	5
SdF	San German cobbly clay loam, 20 to 60 percent slopes	1
SiA	Santa Isabel clay, 0 to 2 percent slopes	2

Ua	Urban land	0
	Total	**15**

Sampled units represent approximately 85% of the LAJA site area (26% of the site's total mapunits):

Map unit symbol	Map Unit Name	% Total site area
CeA	Cartagena clay, 0 to 2 percent slopes	48
FrA	Fraternidad clay, 0 to 2 percent slopes	34
MiD	Mariana gravelly clay loam, 12 to 20 percent slopes	1
SdD	San German cobbly clay loam, 5 to 20 percent slopes	1
	Total	**85**

Rationale for plot selection

Plots not sampled:

LAJA_003 and LAJA_008 – These plots were evaluated and rejected during the pre-analysis phase of the project. The plots were located near a map unit delineation boundary and were deemed not necessary since numerous other plots in the same soil map unit had been selected and were in better locations.

LAJA_006 and LAJA_013 – These plots were selected as alternate sites based on preliminary analyses because of redundancy. They were listed as alternates to other plots in the CeA map unit. During on-site sampling these plots were again ranked as not needed.

LAJA_007 – This plot was originally selected for sampling. However, upon starting work we noticed that this plot was currently being cultivated and worked by the experimental farm. This prevented our team from sampling this plot. As we took borings and further investigated, it was determined by the local experts that plot LAJA_010 was a good alternate. Therefore, this plot was chosen as an alternate.

LAJA_018 – This plot was evaluated and rejected based on analyses of the site prior to field work. The plot was deemed redundant and therefore not necessary since numerous other plots in the same soil conditions had been selected.

LAJA_019, LAJA_021, LAJA_023, and LAJA_024 – These plots were selected as alternate sites based on preliminary analyses because of redundancy. They were listed as alternates to other plots in the FrA map unit. During on-site sampling these plots were again ranked as not needed.

LAJA_026 – This plot was initially selected for sampling based on preliminary analyses of the site prior to field work. However, in visiting the site for sampling, we discovered the area to be covered in discarded construction debris. The covering was so dense that sampling was impossible and therefore rejected. Plot LAJA_015 was nearby and within the same soil map unit and it was sufficient for capturing the soil variability for this map unit.

LAJA_042, LAJA_044, LAJA_046, and LAJA_051 – These plots were evaluated and rejected based on preliminary analyses of the site. These plots were deemed redundant and therefore not necessary since numerous other plots in the same soil map unit had been selected. Also, these plots were located at the NEON tower and sampling was restricted to auger borings.

Plots chosen for sampling:

LAJA_001, LAJA_002, LAJA_004, LAJA_005, LAJA_009, LAJA_011, LAJA_012, LAJA_014, LAJA_015, LAJA_016, LAJA_017, LAJA_020, LAJA_022, LAJA_025, LAJA_027, LAJA_028, LAJA_029 and LAJA_030 – These plots were selected for sampling due to their location within the soil map unit delineations and their potential to capture the variability of the soil conditions at the Lajas Experimental Farm.

LAJA_010 – This plot was selected as an alternate plot for LAJA_007 sampling based on preliminary analyses.

Plot Findings

The 19 pedons sampled represent four soil map units. The major named components are Cartagena, Fraternidad, Mariana, and San German soils. Field sampling and observation sometimes yielded different results than indicated by the soil map that was used for selecting sampling locations. Table 1 below provides the named map unit (Map Unit Name) and the soil series that was observed for each plot. An explanation of the differences is included. The table also provides cover kind and landform position.

Map Unit Symbol	Map Unit Name	Plot ID	Cover Kind	Observed soil type from field observations	Reasoning for not finding named major component
CeA	Cartagena clay, 0 to 2 percent slope	LAJA_001	Grass or herbaceous cover	Cartagena	N/A
FrA	Fraternidad clay, 0 to 2 percent slopes	LAJA_002	Grass or herbaceous cover	Santa Isabel	Santa Isabel is a minor component (5%) in the Fraternidad map unit and finding this soil is expected. Santa Isabel soils are very similar to Fraternidad. Difference: Santa Isabel does not have secondary calcium carbonates in the lower soil horizons.
CeA	Cartagena clay, 0 to 2 percent slope	LAJA_004	Grass or herbaceous cover	Cartagena	N/A
CeA	Cartagena clay, 0 to 2 percent slope	LAJA_005	Grass or herbaceous cover	Cartagena	N/A
FrA	Fraternidad clay, 0 to 2 percent slopes	LAJA_009	Grass or herbaceous cover	Fraternidad	N/A

Map Unit Symbol	Map Unit Name	Plot ID	Cover Kind	Observed soil type from field observations	Reasoning for not finding named major component
CeA	Cartagena clay, 0 to 2 percent slope	LAJA_010	Grass or herbaceous cover	Fraternidad	Difference: Fraternidad has a deeper seasonal water table and slightly differing clay mineralogy. Fraternidad is not a listed minor component in the map unit, but its presence is reasonable, and the sample point is probably on a slightly higher rise (micro-relief) within the delineation. Cartagena is a minor component (5%) in the Fraternidad map unit and is an associated soil.
CeA	Cartagena clay, 0 to 2 percent slope	LAJA_011	Grass or herbaceous cover	Cartagena	N/A
CeA	Cartagena clay, 0 to 2 percent slope	LAJA_012	Grass or herbaceous cover	Fraternidad	Same as LAJA_010
FrA	Fraternidad clay, 0 to 2 percent slopes	LAJA_014	Grass or herbaceous cover	Cartagena	Similar to LAJA_010, Fraternidad may be found in a Cartagena map unit. Cartagena is a minor component (~5%) of the FrA unit and its presence is reasonable. This plot was probably in a micro-low where a seasonal-high water table was slightly higher in the pedon.
MiD	Mariana gravelly clay loam, 12 to 20 percent slopes	LAJA_015	Grass or herbaceous cover	Mariana	N/A
FrA	Fraternidad clay, 0 to 2 percent slopes	LAJA_016	Grass or herbaceous cover	Fraternidad	N/A
FrA	Fraternidad clay, 0 to 2 percent slopes	LAJA_017	Grass or herbaceous cover	Cartagena	Same as LAJA_014
FrA	Fraternidad clay, 0 to 2 percent slopes	LAJA_020	Grass or herbaceous cover	Fraternidad	N/A
FrA	Fraternidad clay, 0 to 2 percent slopes	LAJA_022	Grass or herbaceous cover	Fraternidad	N/A
FrA	Fraternidad clay, 0 to 2 percent slopes	LAJA_025	Grass or herbaceous cover	Cartagena	Same as LAJA_014

Map Unit Symbol	Map Unit Name	Plot ID	Cover Kind	Observed soil type from field observations	Reasoning for not finding named major component
FrA	Fraternidad clay, 0 to 2 percent slopes	LAJA_027	Grass or herbaceous cover	Fraternidad	N/A
FrA	Fraternidad clay, 0 to 2 percent slopes	LAJA_028	Grass or herbaceous cover	Jacana	Difference: Jacana typically has highly weathered, rippable, and semi-consolidated volcanic rock between 20 and 40 inches deep. Although not a named component of the Fraternidad map unit, Fraternidad is a minor component in a neighboring Jacana unit. The two are associated soils.
CeA	Cartagena clay, 0 to 2 percent slope	LAJA_029	Tree cover	Jacana	This appears to be a soil line placement issue. About 100 feet to the southeast is a Jacana map unit (JaC). Due to the soil survey scale line, work may be imprecise and/or map compilation was imprecise.
SdD	San German/ Fraternidad	LAJA_030	Tree cover	San German	N/A

Table 1. Soil survey Map Unit distribution and field observations of soil types at the LAJA site.

Summary of Soils

The two plots sampled under tree cover did not have significant organic matter accumulation as the plants overhead were small and young. For this reason, no O horizon was present.

Of the 19 plots sampled, 7 were Cartagena and 7 were Fraternidad (Table 1). Cartagena and Fraternidad are very similar. Cartagena soil is somewhat poorly drained and has a mixed mineralogy and the Fraternidad soil is moderately well drained and has smectitic mineralogy (has a little more clay in the subsoil than Cartagena). Cartagena is found on lower landforms than Fraternidad where water and minerals tend to collect. This differing landform position explains the mixed mineralogy (mixing of minerals) and somewhat poorly drained class.

Both soils are dark-colored with very high clay content (55%+ clay). This high amount of clay allows the soil to hold nutrients, making them well suited for farming. These soils also have higher pH values that collectively range from 6.8 to 8.5 (neutral to moderately alkaline). These higher pH ranges allow nutrients to be more available for plants to use and therefore make these soils more productive for farming. The combination of these properties contributes to both soils being classified as prime farmland, where irrigated.

Both Fraternidad and Cartagena soils are formed from clayey marine sediments that weathered from volcanic rock and limestone. Both soils are Vertisols. This means the soil contains “active” clay that will shrink and swell with wetting and drying therefore creating cracks in the soil. This movement is captured in the soil's physical appearance by the presence of slickensides. Slickensides are smooth areas within the soil profile that results from soil peds rubbing together. This movement makes these soils limited for construction because this cracking can cause damage to foundations, roads, basements, and other structures in or on the soil.

Another similar soil was Santa Isabel (plot LAJA_002). Santa Isabel soil only differs from Fraternidad soil in that it does not contain secondary carbonates in the lower subsoil.

San German (LAJA_030) and Jacana (LAJA_028 & LAJA_029) soils are both Mollisols and are found adjacent to one another. Mollisols are soils that have a base saturation of more than 50%, usually resulting in a higher pH, and have a dark surface that is at least 10 inches (25 cm) thick.

San German is weathered from limestone bedrock, well drained, and found on ridgetops, summits, and side slopes. Depth to limestone bedrock ranges from 10 to 20 inches. This shallow depth to rock is the primary limitation and for this soil and makes it less suited for agriculture use.

Jacana soil is found "down the hill" from San German soil and is mapped on fans and footslopes. The volcanic bedrock encountered is more weathered than San German and ranges in depth from 20 to 40 inches. Because of the lower landform positions for the Jacana series, this soil occupies a "receiving position" where water movement has caused the soil to be more weathered. This results in lower pH ranges (5.6 to 7.8) when compared to San German (pH range of 7.5 to 8.4). Similar to the San German series, Jacana is more limited for agriculture due to depth to weathered bedrock. Both have active clays, with Jacana also having vertic properties and shrink swell issues. When combined with the shallow depth to bedrock, these soils become limited for use with construction activities as well.

The other soil encountered during sampling at the Lajas site was Mariana (LAJA_015). Mariana soil is well drained and found on summit and side slope positions of hills. This soil formed from colluvium and residuum that was weathered from basalt lava and tuff. Mariana is an Ultisol. This means that it is a soil that has been highly weathered, and the pH and base saturation will be lower (less fertile). This was the only Ultisol encountered at the Lajas site.

Although Mariana contains a high amount of clay, similar to Cartagena, Fraternidad, and San German, the severe weathering has caused the soil to oxidize more. The oxidation process has resulted in more brown to red colors and a lower pH than the Vertisols and Mollisols. The pH range for Mariana is 3.5 to 5.0, causing these soils to have the potential to be extremely acidic. The lower pH usually restricts its suitability for some plants, however, this property makes it desirable for crops like pineapple, which prefer more acidic soils. Therefore, Mariana is considered a soil of statewide importance due to its significance for pineapple production in Puerto Rico.