THE EFFECTS OF PRESCRIBED BURNING ON SOIL INFILTRATION RATES AND OTHER SELECT SOIL PHYSICAL AND CHEMICAL PROPERTIES IN EAST TEXAS

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ABSTRACT

This study focuses on prescribed burning effects on soil infiltration and other soil properties. Sampling will occur before the burn (pre-burn), one month after the burn (post-burn), and three months after the burn (green-up) to determine the effects of prescribed fire on soil infiltration rates, soil pH, bulk density, particle density, pore space, soil strength, O-horizon weight and depth (organic matter), water stable aggregates, and soil nutritional status. There are 46 total sampling locations, 2 are located on The National Forests and Grasslands of Texas (NFGT) of the United States Forest Service, 20 are on The Nature Conservancy's (TNC) Roy E. Larsen Sandylands Sanctuary, and 24 are located at the Winston 8 Land and Cattle Ltd. Tree Farm. Sites were chosen to assess a variety of vegetation stand types. The study is aimed at developing an understanding of any correlation between the soil physical and chemical properties among the soil types and the affects prescribed burning has on them.

GOAL AND OBJECTIVES

The overall goal is to determine if prescribed burning impacts soil infiltration rates and soil physical and chemical properties of forest soils in deep East Texas.
Objectives:
• Test the effects of soil infiltration rates as influenced by prescribed fire in Deep East Texas.
• Evaluate the effects of various soil physical properties influenced by prescribed fire in Deep East Texas.

SITE DESCRIPTIONS

All the sites were chosen based on availability and the likelihood of them being burned. NFGT and TNC plots were previously established. The Winston 8 plots were not pre-existing and were randomly selected within the projected burn area of a planted Longleaf Pine stand. Figure 1
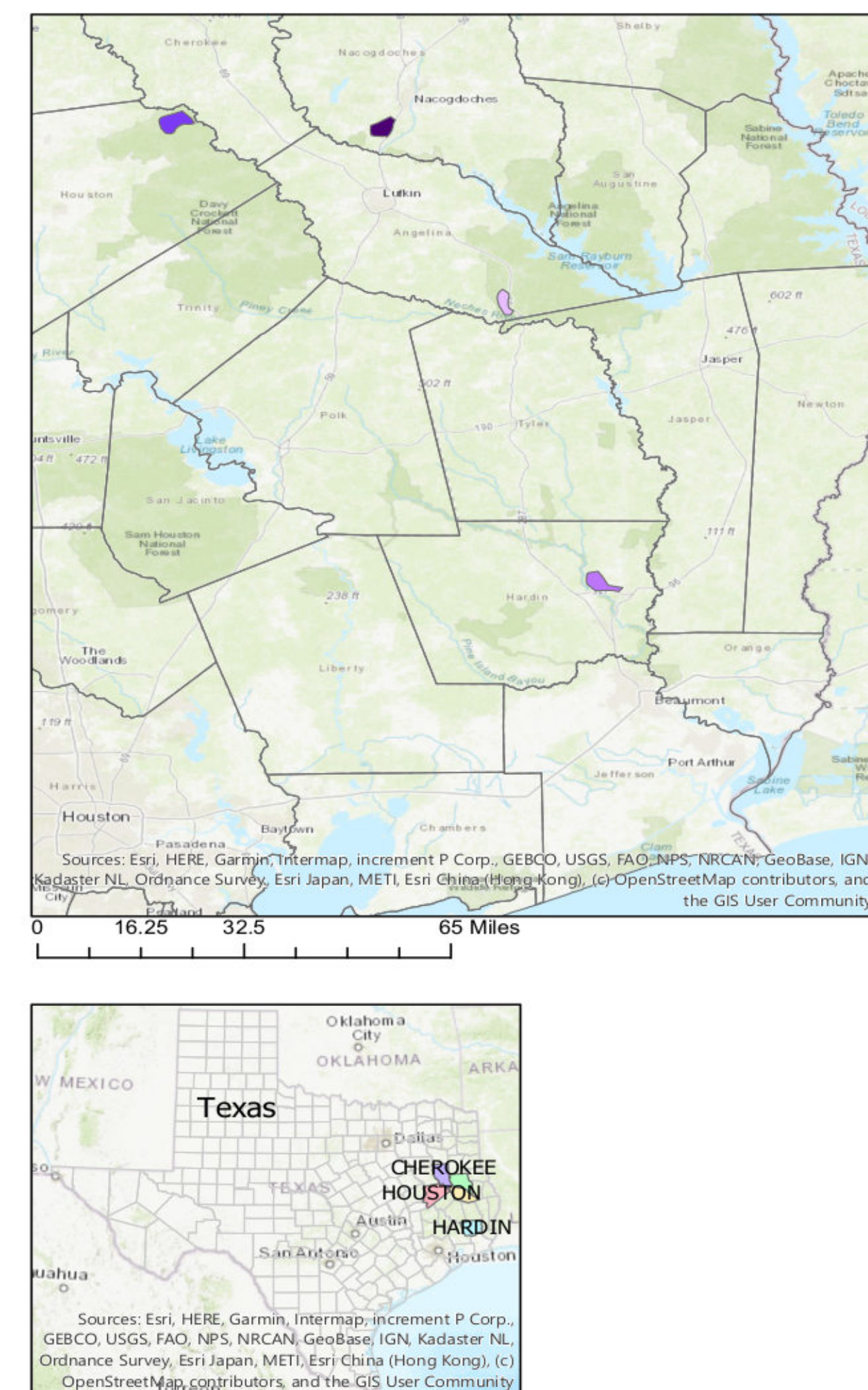
STATISTICS

SAS was used to run a paired t-test and ANOVA. The paired t-test was used to show general differences over time (pre-burn to post-burn, post-burn to green-up, and pre-burn to green-up). ANOVA will be used to show more direct differences when comparing burning frequency and soil map unit type.

SELECTED RESULTS AND DISCUSSION

A paired t-test was run in the statistical program SAS. In this test the pre-burn was compared to the post-burn, post-burn compared to green-up and finally, pre-burn compared to green-up. The alpha value used was 0.1. Soil textured was determined and results can be seen in Figure 4.

INFILTRATION: No statistical differences were observed.
PH: Statistical difference was observed in the post-burn to green-up and the pre-burn to green-up comparisons.
SOIL BULK DENSITY: Statistical differences were observed in the post-burn to green-up and the pre-burn to green-up comparisons.
PORE SPACE: Statistical differences were observed in the post-burn to green-up and the pre-burn to green-up comparisons.
PARTICLE DENSITY: No statistical differences were observed.
PARTICLE VOLUME: No statistical differences were observed.

FIGURE 1: SITE LOCATION MAP

Locations
Forest_Name
Angelina National Forest
Davey Crockett National Forest
Roy E. Larsen Sandylands
Winston 8 Land and Cattle LLC.
<all other values>
tx_county

Texas

This map shows the locations of the forests in which the sampling locations are located. Sampling plots are in Nacogdoches, Hardin, Angelina, and Houston Counties in east Texas. These plots are located on the Angelina and Davey Crockett National Forests, Winston 8 Land and Cattle LLC. Tree Farm, and Roy E. Larsen Sandylands Sanctuary.

FIELD SAMPLING METHODS

See Figure 2.

GPS COORDINATES: GPS coordinates were taken at each sampling location using a Garmin Montana 680.
RANDOM DIRECTION AND DISTANCE: A random number generator was used to determine the sampling location
SOIL SERIES CONFIRMATION: The Web Soil App (UC Davis and Natural Resources Conservation Service), was used to determine the soil type at each plot. A soil auger was used to a maximum depth of 1.5 meters to confirm the soil type.
SOIL BULK DENSITY: The Excavation Method was used in the field. A small hole was dug to a depth of 15cm, all the soil was collected from the hole and then lined with cling wrap plastic, a known quantity of water was poured into the hole filling it to the top.
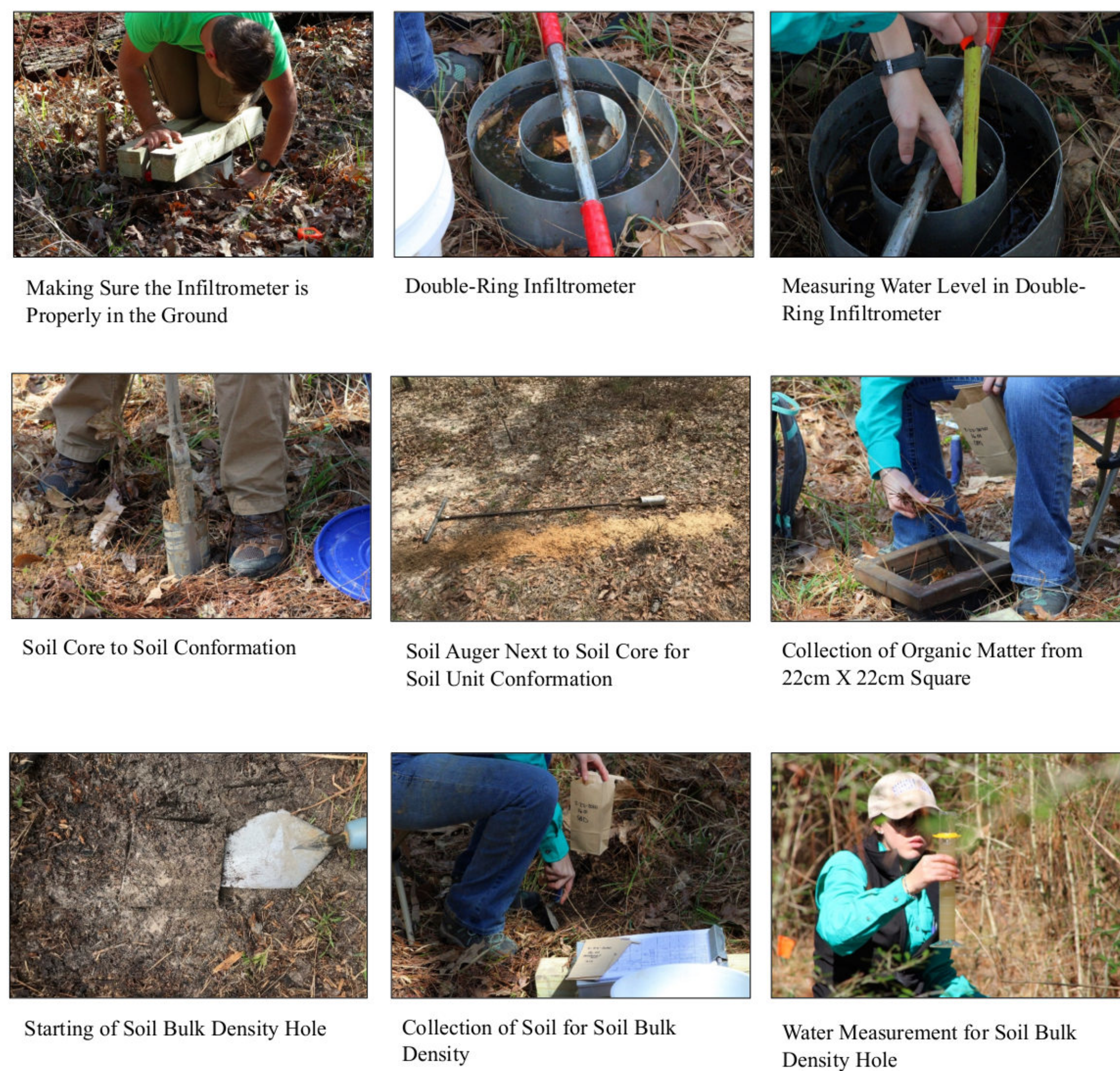**MINERAL SOIL SAMPLES**: Two bags of mineral soil samples were collected from each plot. One bag was sent to the SFASU Soil and Water Analysis Lab to determine soil fertility. The other bag was used in determining the wet pH of the soil, the soil texture, and percentage of water stable aggregates.
O-HORIZON DEPTH AND WEIGHT: A 22cm X 22cm square was utilized to collect the organic matter.
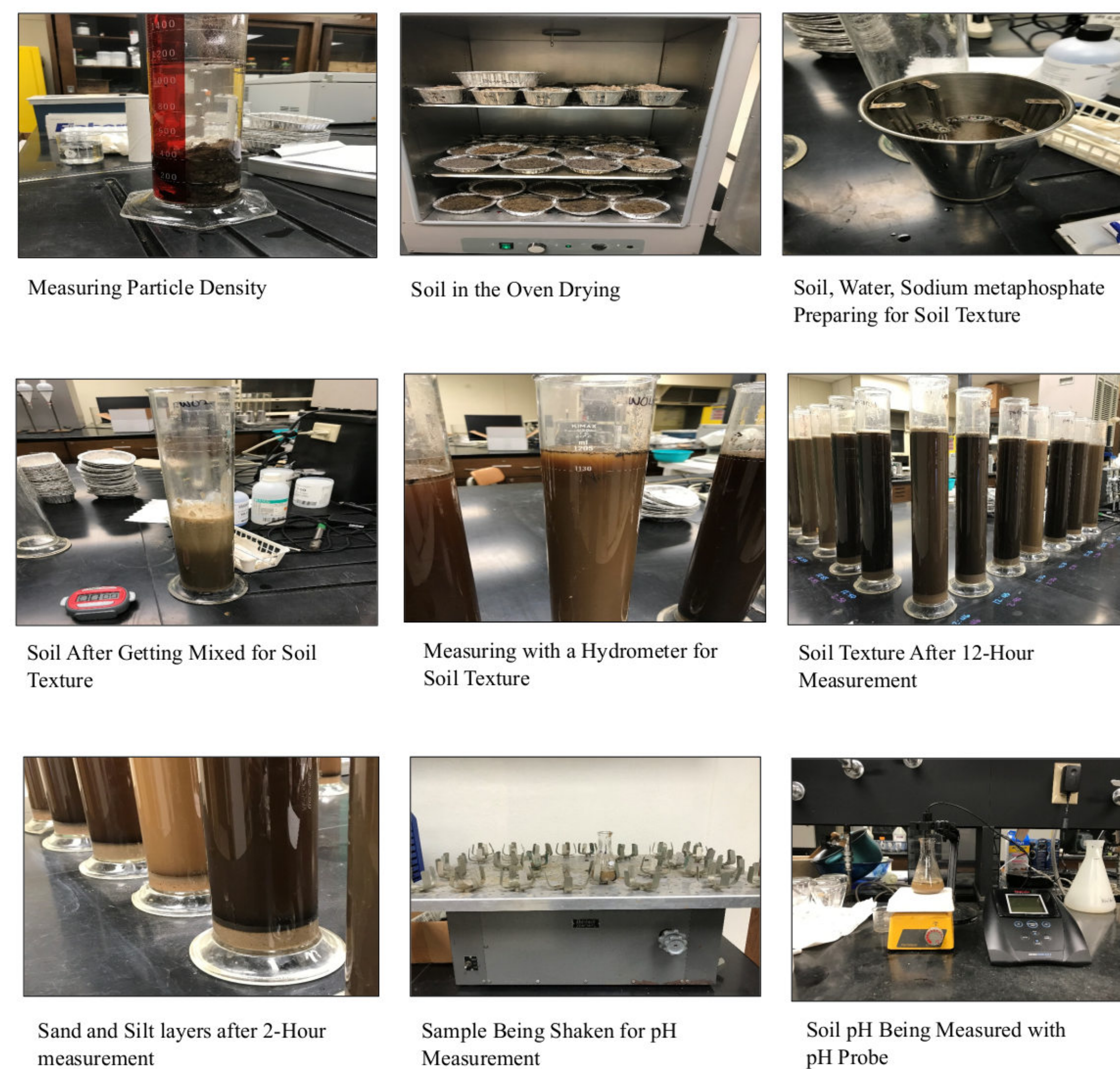**SOIL STRENGTH**: A cone penetrometer of 19.05 mm (¾ inch) was used to determine the soil strength in PSI up to a depth of 127 mm (5 inches).
SOIL INFILTRATION: A double-ring cylindrical infiltrometer was used and measurements occurred until a steady rate was reached in the inner ring.

LAB SAMPLING METHODS

See Figure 3.

SOIL TEXTURE: 100 grams of dry soil was placed in a milkshake blender cup with 100 mL of Sodium Metaphosphate, filled halfway with water and mixed for 10 minutes, poured into a cylinder and a hydrometer is placed into the mixture and water was added. Measurements were taken at the 40-second and 2-hour time marks to determine the percentage of Sand, Silt, and Clay.
SOIL BULK DENSITY: Soil was weighed wet and then after reaching a constant dry weight at a temperature of 105 degrees Celsius.
PARTICLE DENSITY: Water displacement of the soil bulk density sample was taken by filling a graduated cylinder with 1000mL of water and dry soil added, the dry weight was then divided by the volumetric difference.
SOIL PH: 20g of soil was placed in an Erlenmeyer Flask, 40mL of deionized water added, and then placed on a shaker for 15 minutes and measured using a calibrated pH probe.
WATER STABLE AGGREGATES: The percentage of water stable aggregates was determined using 200g of mineral soil. The wet soil was put though a nest of sieves, sized at 5 mm, 2 mm, 1 mm, 0.5 mm, and 0.25 mm. Aggregates on each sieve were weighed wet and then placed in an oven at 105 degrees Celsius until a constant weight is reached. Percentages of water stable aggregates on each sieve were then calculated.
WATER CONTENT OF SOIL: The water content was measured from the soil bulk density sample in MWC and VMC.
WATER CONTENT OF ORGANIC MATTER: The organic matter was measured wet and then dried at 60 degrees Celsius for at least 48 hours or until the weight remained constant.
SOIL FERTILITY: A separate bag of soil mineral sample was sent to the SFASU Soil and Water Analysis Lab to measure the total organic carbon content, total Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, and Sulfur.

FIGURE 2: FIELD SAMPLING METHODS

Making Sure the Infiltrometer is Properly in the Ground

Double-Ring Infiltrometer

Measuring Water Level in Double-Ring Infiltrometer

Soil Core to Soil Conformation

Soil Auger Next to Soil Core for Soil Unit Conformation

Collection of Organic Matter from 22cm X 22cm Square

Starting of Soil Bulk Density Hole

Collection of Soil for Soil Bulk Density

Water Measurement for Soil Bulk Density Hole

FIGURE 3: LAB SAMPLING METHODS

Measuring Particle Density

Soil in the Oven Drying

Soil, Water, Sodium metaphosphate Preparing for Soil Texture

Soil After Getting Mixed for Soil Texture

Measuring with a Hydrometer for Soil Texture

Soil Texture After 12-Hour Measurement

Sand and Silt layers after 2-Hour measurement

Sample Being Shaken for pH Measurement

Soil pH Being Measured with pH Probe

FIGURE 4: SOIL TEXTURE