BES 316 2010

**SOIL LABORATORY ANALYSIS**

Goals for Today

1. To learn about selected approaches in the lab analysis of soils
2. To understand equipment applications & limitations
3. To explore properties of soils from contrasting field sites
4. To understand ecological implications of various soil properties

***SCHEDULE for MAY 11, 2010***

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| **Time Period** | **Activity** |
| 11:00 – 11:30 | Introduction to techniques  |
| 11:30 – 12:30 | Soil processing and analyses |
| 12:30 – 1:05 | Discussion of microclimate lab results |

**TASKS FOR TODAY**

As a team, you will begin your lab analyses on soils collected at St Edward State Park. The majority of the lab analyses will be done on Thursday, but today you will (1) complete the soil moisture analyses and calculations and (2) begin the soil organic matter analyses.

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| **Lab analyses on soil today** |
| Soil organic matter concentration |
| Soil moisture / bulk density |

# Detailed Procedures

**1. Soil moisture content**

To assess the moisture content of soils we are using a simple gravimetric method. This involves weighing the soil when it is moist (field conditions) and weighing it after the water has been removed following oven-drying (48 hours at 105 °C). It should be noted that the determination of soil moisture content using this method is common, but not a good reflection of the “availability” of water to plants. Better methods for this purpose measure “soil water potential”, a reflection of the chemical activity state of water in a medium. Plants take water up along a water potential gradient, and water potential provides a better measure of how available water in a soil matrix truly is for plants. Soil water potential measurements are commonly made with techniques such as psychometric dew point analysis, time domain reflectrometry, and neutron scattering. Such approaches are highly specialized and will not be covered in this class.

You have taken six readings from each site for this purpose (6 readings / site x 2 sites = 12 moisture readings). You have already measured the wet weight and dry weight of your St Edward samples (and possibly your campus samples as well). Today, you should measure the weight of each of your soil tins when empty:

* Empty the soil from each tin into a temporary container. Brush out the tin so it is clean of soil.
* Weigh the empty tin (including lid) to the nearest milligram.

 Below are the calculations you should use to determine and express soil moisture content:

Soil moisture content is traditionally calculated **based upon DRY weight** of the sample (**CAREFUL -** **this is NOT intuitive!**). With this equation it’s possible to get a % moisture that is greater than 100%!

Soil Wet Weight – Soil Dry Weight

 % Soil Moisture =

x 100

Soil Dry Weight

Soil Wet Weight = (Weight of Wet Soil in Tin) - (Tin Weight)

Soil Dry Weight = (Weight of Dry Soil in Tin) - (Tin Weight)

Be sure that the lid of the tin is included in all weights! All weights should be expressed to .001 grams.

**2. Soil Bulk Density**

No additional measurements are needed in order to calculate soil bulk density, as it is simply the dry weight of soil per unit volume. The volume of soil that was collected into each soil tin is 68.67 cm3. Simply divide the dry weight of the soil in that tin (without the weight of the tin itself) by the volume to get bulk density. Bulk density is typically expressed in units of g/cm3.

**3. Soil organic matter**

To assess the organic matter (OM) content of soils we are using a method that weighs soil samples before and after organic matter is removed through burning. This method is known as the “loss-on-ignition” approach. It has the benefit of being relatively simple, rapid, and comparable (commonly reported in the literature). It is an inexact measure of the true OM content, as often inorganic forms of constituents such as N, P, and S are also driven off during the burn. Furthermore, investigators often wish to know the carbon content of soils (e.g., for understanding the role of soil carbon sequestration in global carbon balance and climate). Organic matter can be correlated with carbon content but the exact relationship is variable. Loss-on-ignition is not a good method in these cases, as much more than carbon is burned off. Techniques involving elemental analyzers (e.g., C-H-N analyzers) are used more commonly for those instances.

You have taken 6 tins of soil for soil moisture readings from each site. You should take one subsample of oven-dried soil from each tin (after completing soil moisture determinations outlined in part 1 above) for determination of soil organic matter concentration:

* 1 subsamples per tin x 6 tins per site = 6 soil OM readings per site
* 6 soil OM readings per site x 2 sites = 12 soil OM readings total

The organic matter procedures will be done in your instructor’s research lab – UW2-231. After weighing your soil moisture tins, transport the sealed tins to this lab in UW2 where we will have equipment for you to initiate the soil organic matter procedure:

Soil OM Procedure:

* For each soil tin, sieve all of the soil through a 2 mm mesh sieve to remove coarse fragments. Place the material that passes through the sieve back into the soil tin.
* Weigh 12 empty ceramic crucibles with their lids (to .0001 g), recording the weights with the crucible numbers. This will require the use of an **analytical balance**. If you are not familiar with how this works – ask BEFORE you use it!
* Take one small sample of sieved soil from each soil tin and fill the 12 ceramic crucibles about 3/4 full with oven-dried soil (leave the rest of the soil in each tin). Place the ceramic lid on each crucible immediately after filling it with soil to minimize moisture getting into the sample.
* **For each sample, be sure to record both the crucible number and the soil tin number** the sample came from (and eventually note its position in the muffle furnace).
* Weigh each full crucible and lid (to .0001 g) on the same **analytical balance.**
* When you are done filling and weighing all crucibles, place all of them in the muffle furnace with the lids off (lids should be placed on a marked sheet of paper so you know which lid goes with which crucible for reweighing later). The furnace will be turned on by your instructor for 8 hours at 450 °C on Wednesday, May 12 to burn the OM off. After the burn is complete I will turn the furnace off and cover the crucibles (so they do not absorb atmospheric moisture as they cool).
* On Thursday, May 13 (as part of the regular lab period) you will need to reweigh the crucibles. With the cover, weigh each crucible with the soil sample on same **analytical balance** as before (to .0001 grams).
* Be sure the weight makes sense – check the numbers! The burned soil plus crucible weight should be less than the original soil plus crucible weight.
* Once you are done with all of the weights and they make sense (step above), discard the soil samples into receptacles provided, rinse out each crucible with tap water, and leave them upside down on a piece of paper towel to dry.

Calculating Soil Organic Matter Content

Oven-dry Weight – Furnace-dry Weight

 % Organic Matter =

x 100

Oven-dry Weight

 Oven Dry Wt = (Weight of Oven-dried soil and crucible+lid) - (Weight of empty crucible+lid)

 Furnace Dry Wt = (Weight of Furnace-dried soil and crucible+lid) - (Weight of empty crucible+lid)

**All weight should be expressed to .0001 grams.**