SOIL ANALYSIS LAB

BACKGROUND

Soil is one of the earth's most important, yet least appreciated, resources. It performs a valuable role in land ecosystems. In order for a community of producers and consumers to become established on land, soil must be present. Furthermore, soil quality is often a limiting factor for population growth in such systems. Soil is a complex mixture of inorganic materials, organic materials, microorganisms, water and air. Its formation begins with the weathering of bedrock or the transport of sediments from another area. These small grains of rock accumulate as a layer on the surface of the earth. There they become mixed with organic matter called humus, which results from the decomposition of the waste products and dead tissue of living organisms. The soil formation process is very slow (hundreds to thousands of years), so it can be very detrimental to a community if the soil is lost through erosion or its quality degraded in any way. Soil contains important primary plant nutrients such as nitrogen, potassium and phosphorus. Water and air are also trapped in its pore spaces. These are all necessary ingredients for the growth of plants. In this lab activity you will determine textural and compositional characteristics of a soil sample.

OBJECTIVES

- To determine the soil texture, a measure of the proportions of sand, silt, and clay in the soil.
- To determine soil carbonate level
- To determine soil fertility (pH, nitrogen, phosphorus, potassium)
- To determine water retention, permeability, porosity, and percolation rate.
- To determine the soil consistency.
- Using the analysis, write a letter to a farmer whose soil you have just tested, reporting the results and making recommendations on how he or she can improve the farmland.

MATERIALS

Soil Sample	Tray	Stereoscope	pH testing kit
Magnifying glass	Soil Texture Kit	NKP testing kit	oven/incubator
Vinegar	Petri dish	Balance, scale	Soil tube
Graduated cylinder	screen		

PROCEDURE

PART ONE: GENERAL OBSERVATIONS

Take your wet soil samples and carefully dump them onto your observation tray. Make sure that your soil does not spill onto the counter top or the floor. Now take a look at your soil. What do you see? Perhaps you will see some organic matter, worms, or insects. Probably you will see some rocks and roots. Observe the various particle sizes in your soil. Are most of the particles large or small?

Take a hand magnifier and look more closely. What do you see now that you did not see before?

When you are done with the hand magnifier, take a petri dish and put some soil in it. Observe this soil under a stereomicroscope. What can you see now that you couldn't see before?

Record your observations under the DATA section of your lab notebook. Your observations should include distinguishing abiotic and biotic components as well as general comments.

PART TWO: CARBONATE ANALYSIS

1. Add a few drops of vinegar to the soil sample in the petri dish. If this creates a lot of bubbling, you have a high level of free carbonates in your soil. A little bubbling means a moderate to low level of free carbonates in the soil. No bubbling means no free carbonates in the soil.
2. Record the level of free carbonates in your soil as "low, medium or high".

PART THREE: SOIL FERTILITY ANALYSIS

Using the soil test kit, test your soil for all four factors (pH, nitrogen, phosphorus, potassium) and record the results.

PART FOUR: SOIL TEXTURE

Soil is made of mineral particles belonging to three size categories: clay, silt, and sand. Determine the percentage of clay, silt, and sand that your soil contains by using the soil texture kits. Record your results.

PART FIVE: SOIL WATER CONTENT

In this part of the lab you will be determining the amount of water in your soil. Obtain a petri dish and weight it empty. Then put several spoonfuls of soil into the petri dish and weight it again.

Now it is time to dry the soil in the petri dish. Place your petri dish with soil into the incubator oven over night. After the soil has dried, take it out of the oven and let it cool to room temperature before you try to weigh it. Weigh the petri dish with dry soil in it and use all your measurements to determine the percent content of water in your soil. Record ALL of your data and show calculations to determine soil water content.

A. *Mass of petri dish=*
B. *Mass of petri dish with moist soil=*
C. *Mass of petri dish with dry soil=*

B – C = Mass of water in soil

C – A = Mass of dry soil

B – A = Mass of moist soil

$$\frac{\text{Mass of water in soil}}{\text{Mass of moist soil}} \times 100 = \text{\% of water in your soil}$$

$$\frac{\text{Mass of water in soil}}{\text{Mass of dry soil}} = \text{water holding capacity of your soil}$$

The water holding capacity of your soil will be a number that can be used to compare the water holding capacity of your soil to other types of soil. The higher the number, the greater the capacity of your soil to hold water. You would expect clay soils to have a higher number than sandy soils because clay has a greater water holding capacity than does sand.

PART SIX: DRY PERMEABILITY RATE (INFILTRATION) ***USE DRY SOIL***

Now it is time to dry your soil out so you can perform the following test procedures. To dry your soil out, spread it evenly over the drying tray. It may take a day or two for the soil to dry out adequately depending on the humidity level in the room.

The dry permeability rate is the rate at which water will flow down through dry soil. Fill the soil tube with 125 ml (cm^3) of your dry soil sample. Fill a graduate cylinder to the 100 ml mark with water. Now slowly pour the water onto the soil in the soil tube and time how long it takes the water to reach the bottom of the soil tube. Continue to pour water into the soil tube until it just starts to pool on the soil surface. Note how much water is left in the graduated cylinder. (This information will be used later on to determine porosity and water retention ability.) To determine permeability take the reciprocal of the infiltration time (the time it took the water to go from the top of the soil to the bottom of the tube). For example, if the infiltration time (also called the wetting time) is 25 seconds then the permeability is 1/25 or 0.04.
The permeability of my soil sample is: _______________

PART SEVEN: SOIL POROSITY

Porosity is the amount of air space in your soil. Porosity is important because germinating seeds and roots need oxygen. The creation of aquifers is dependent upon the pore spaces in soil and rocks.
To determine the porosity of your soil, see how much water it took to fill up the soil (from part six when you determined permeability) by subtracting the amount of water left in the graduated cylinder from 100. Divide the amount of water poured into the soil by 125 and then multiply by 100 to determine the percent of air space or porosity in your soil.

The porosity (percent pore space) in my soil sample is: ____________________

PART EIGHT: WATER RETENTION ABILITY OF THE SOIL

The ability of the soil to hold water is important. To determine the water holding capacity of your soil sample, pipet off the water at the top of your soil tube and combine that with the water that percolated through your sample. Measure this. Subtract this sample from the amount of water that was poured into your soil sample in part six. Now you know the amount of water retained by your soil sample. Divide this by the amount poured in during part six and multiply by 100 to get the percent of water retained by your soil.

The percent of water retained by my soil sample is: _______________

PART NINE: PERCOLATION RATE

Percolation is the rate at which water will flow through already saturated soil. For this part, use the same tube and soil that you used for part six. Carefully remove the plastic cap on the bottom of the tube and rubber band a piece of screen over the end of the tube. If you can turn the tube upside down before removing the clear plastic cap, you will be less likely to spill soil out the bottom of the tube. After the screen is in place, pour water down the tube again, but this time determine how long it takes for 100ml of water to flow through the tube starting with the first drop out the bottom. If the water drips out the bottom of the tube very slowly, you don't have to wait for a full 100ml to go into the beaker. Instead, time how long it takes to produce 10ml and then multiply the time by 10.

The soil surface area inside your plastic tube is the amount of soil you measured in cm^3 which means that you have to multiply the time that you got by that figure to determine how long it would take for just one square centimeter of soil to pass 100ml of water.

100ml permeability rate per cm^3 of your soil = _____minutes _____seconds

PART TEN: SOIL CONSISTENCY

Determine which of the following is closest to your soil and circle the number.

1. Loose --- soil flows easily through one's hand like sand
2. Friable --- soil does not flow, but it does crumble easily between one's fingers
3. Firm---soil resists crumbling and it takes effort to brake it into pieces
4. Extremely firm ---soil is cement-like and feels like it might need a hammer to break it into pieces