1.1) EVALUATING SOIL TEXTURE

Objective: This laboratory exercise shows you how to measure infiltration, water-holding capacity, and workability of different soils. **Video instructions:** https://vimeo.com/70065208

Introduction: When soil is described as "rich," most people think about its nutrient content, not its texture. Texture helps determine some of the most important soil quality variables that are conducive to life. These include infiltration rate, water-holding capacity, and workability. In the absence of organic matter some of these qualities can exist only at the expense of others. For example, soils that have a high sand content are good at absorbing the rain and resisting compaction, but they are poor in their capacity to hold water and retain nutrient content. Soils with high clay content have a slower infiltration rate and therefore are more likely to cause runoff, which leads to erosion. The best loam has a ratio of sand, silt, and clay that strikes a balance between these variables.

Unlike sand, silt, and clay, humus is unique in that it can enhance all of three of these texture-dependent parameters at the same time. Humus is made up of degraded organic matter and is responsible for the dark color that characterizes topsoil. Consequently, it is also rich in recycled nutrients. These chemical and physical properties of topsoil are highly interdependent. Nutrient content of soil depends mostly on the constant addition of decaying vegetation, which, in turn, depends on the soil's physical ability to supply water to the plants that provide the dead leaves.

High workability of topsoil not only allows the penetration of roots; it also makes it easier for earthworms to aerate the soil and break down the detritus, thereby further enhancing the chemical and physical qualities that benefit both earthworm and plant. The importance of earthworms for maintaining soil texture became tragically evident in Scotland following invasion by the New Zealand flatworm. This predator's voracious appetite for earthworms resulted in waterlogged soils that drain poorly and have higher run-off. This has significantly reduced the productivity of affected farms and increased flooding (*1*).

Literature Cited:

1. Haria, A. H. 1995. *Hydrological and environmental impact of earthworm depletion by the New Zealand flatworm* (*Artioposthia triangulata*). J. Hydrol. 171(1-2), 1-3.

Procedure A: Infiltration and Water-Holding Capacity

1) Place the sieve on top of the 1-liter beaker and completely line the inside with the handkerchief as indicated in Fig. 1 & Fig. 2.
2) Weigh out 200 grams of soil sample (sand, clay, topsoil, or loam) and place it inside the cloth. Arrange the soil in the sieve so that it has the structure of a shallow bowl (Fig. 3).
3) Add 50 mL of water to the center of the "bowl" (Fig. 4).
4) Count how much time it takes for the soil to absorb the water completely (Fig. 5 to Fig. 6). This will be your "infiltration" measurement.
5) After all of the water has been absorbed, slowly add 150 mL of water to the soil, making sure that none of the water spills over the top edges of the soil. When all of the water is absorbed, measure the amount of water that has managed to percolate throughout the soil and into the beaker (in the case of clay, the water will be absorbed so slowly that you will have to come back at the end of the day to make this measurement). If all of the water is absorbed and there is no percolation, then add 100 mL more water (300 mL total). The amount of water that does not percolate will approximate the "water holding capacity" of your soil sample.


Fig. 1

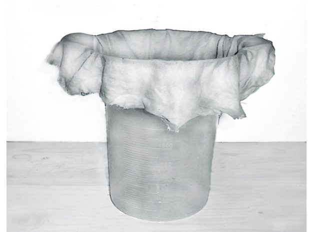
Fig. 2


Fig. 3


Fig. 4


Fig. 5


Fig. 6

Procedure B: Soil Strength/Workability

1) To measure workability, take the wet sample and shape out 2-3 balls of approximately one inch in diameter. Make sure balls are similar in size. Place them in a drying oven overnight or dry them at room temperature for about one week.
2) After drying, test how much weight is needed to crush the balls (*Note: more strength = less workability*). Place the ball on a stable surface and add increasing amounts of weight to the ball (Fig. 7).
3) If you need more weight, place the ball on a bathroom scale and cover it with a brick. While reading the scale, slowly push down on the ball until it is crushed (Fig 8).


Fig. 7


Fig.

Procedure C: Presenting the Data

Organize data into a table. Use a <u>bar graph</u> for comparing <u>qualitative</u> differences (topsoil vs clay/sand mixtures) and a <u>line graph</u> for comparing <u>quantitative</u> differences (sand/clay mixtures):

Sample format for comparing sand/clay mixtures provided in class

	Strength (g)	Infiltration (s)	Water-holding (mL)
0 % Clay			
25 % Clay			
50 % Clay			
75 % Clay			
100 % Clay			
Top soil			

Soil Texture Pre-lab Questions (based on video clip and reading):

1. Number the following soil types in the order of their infiltration rates based on your experience (fastest to slowest): sand ______________ clay ______________ topsoil _____________
2. Number the following soil types in the order of their ability to hold water based on your experience (highest to lowest): sand ______________ clay ______________ topsoil _____________
3. Number the following soil types in the order of weight-bearing strength based on your experience (highest to lowest): sand ______________ clay ______________ topsoil _____________
4. What effect do soils with fast infiltration have on groundwater recharging?
5. What effect do soils with fast infiltration have on run-off?
6. What are two problems associated with run-off?
7. How do soils with low water-holding capacity affect plants?
8. What effect do soils with high weight-bearing strength have on the ability of Earthworms to burrow through the soil?
9. How do Earthworms affect runoff? *Hint: Re-read the introduction.*

Soil Texture Post-lab Questions:

1. What is an advantage of sand as a soil component in agriculture?
2. What is a disadvantage of sand as a soil component in agriculture?
3. What is an advantage of clay as a soil component in agriculture?
4. What is a disadvantage of clay as a soil component in agriculture?
5. Are the qualities you measured of the clay/sand mixtures intermediate between those of sand and clay? What aspect(s) of its physical properties support your conclusion?
6. Are the qualities you measured of the topsoil intermediate between those of sand and clay? What aspect(s) of its physical properties support your conclusion?
7. Which sample (sand, clay, topsoil, or silt-loam) gives the best textural qualities for growing plants? Why?

Assignment Checklist:

1. Did you answer all the questions (pre & post lab)?
2. Did you graph the data (infiltration, water holding capacity, and weight-bearing strength)?
3. Do all three graphs have titles, axis labels, and captions?
4. Are the graphs hand-drawn?