Soil I - Texture

Introduction

Soil texture is based on the percentage of sand, silt and clay particles in the soil. The largest particles are classified as sand, intermediate particles are classified as silt and the smallest particles as clay. Soil texture influences the amount of pore space, which in turn influences the amount of water and air in the soil. Soil texture also influences the nutrient holding capacity and the pH or acidity of the soil. Soils with high percentage of clay have smaller pore spaces, and hold water and nutrients more tightly than sandy soils.

This factsheet focuses on the physical properties of soils. Soil morphology and structure will be covered in following lessons on soil.

Learning Objectives

Female extension educators will learn about soil components and its classification. They will be introduced to basic concepts and observations of different soil textures, as well as practical methods to characterize soils.

Learning Outcomes

- Students will be familiar with basic concepts of soil texture and will be able to identify soil types based on observations.
- Students will perform some practical methods to characterize soils
- Students will suggest testing methods that can be easily implemented.

Materials and Preparation

- flipchart or blackboard
- chalk or markers
- samples of different soils (dry)
- sand
- mist bottle
- water
- jars with samples of different soils in water (wet)
- clear empty glass jars (same shape and volume)
- ruler

Preparation (1): One or two days in advance, take samples of soil from three (or more) different locations. Try to obtain substantially different types of soil. Fill three (or more) clear glass containers (canning jars work well) with clean water 2/3 full. Add the soil samples - one type of soil per container
- until the container is almost full, leaving some air space to the top. Cap the containers and shake them well to break up clumps.
Leave the containers to settle undisturbed until the class demonstration. Avoid disturbing the jars when handling them.

**Preparation (2):** At the Model Teaching Farm, dig a hole 15 cm in diameter and 30 cm deep for the drainage test.

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**Lecture Notes and Lesson Plan**

*Show different samples of soils and have the students describe them.*

How are soils formed? Where do they come from? For most soils the **parent materials** are either the bedrock underneath or sediments deposited thousands of years ago. These parent materials determine:

- the texture of the soil (its physical composition and characteristics, i.e. whether the soil is sandy, silty or clay)
- the pH of the soil - acidic or basic
- whether it is naturally rich in nutrients

**Climate** is another factor, together with **time**. Temperature, rains, ice and snow acted for millions of years on the parent materials to form soil. These processes are continuing, but they are so slow they are hardly noticeable.

**Landscape** and **topography** contribute to soil formation. The configurations of a surface and its man-made and natural features (exposure, slope, mountains, rivers, lakes, etc.) have a strong influence on soils.

Finally, all the **organisms** present, below and above the ground, contribute to the soil’s texture. Plant covers stabilize soil during its development and prevent erosion. Microorganisms produce substances that weaken and break rocks. Plant roots, besides releasing acids able to dissolve minerals, can break rocks by sheer mechanical force of penetration, opening the way to water, which is a powerful soil forming agent. Repeated cycles of freezing and thawing will crack the rock and form smaller and smaller particles.

*Invite the students to observe and feel the texture with their fingers using the dry soil samples. Then sprinkle a few drops of water on the samples and have them repeat the visual and tactile assay.*

**Texture** refers to the physical components of the soil and the particles that compose it.

- **Sand:** large (0.05 ÷ 2.00 mm) - feels grainy, gritty
- **Silt:** medium (0.002 ÷ 0.05 mm) - feels smooth and powdery
- **Clay:** very small (<0.002 mm) - feels sticky

Gravel and stones are not considered soil components.

**Squeeze test**

*Wet a good amount of soil from each sample and have the students squeeze a handful as tight as they can. Release the pressure and open the hand:*
• If the clump of soil breaks and falls apart, the soil is **sandy**
• If it stays together, use a stick or pencil to poke at it
• If when poked the clump opens and crumbles apart, the soil is **loamy**. It has equal amounts of sand, silt and clay.
• If when poked the clump does not break, the soil is rich in **clay**.

To put things in perspective, this picture defines the relative sizes of each particle.

Different ratios of each component will give different soils their own characteristics. Soils can be classified based on their sand, silt and clay content. Soils may also be described as **coarse** or **fine**.

- **Coarse-textured soil** = more sand
- **Fine-textured soil** = more clay and silt
- A soil with similar sand, silt, and clay content is called a **loam** or loamy soil.

These classifications have very practical implications.¹

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**Jar test**

*Show the glass jars prepared in advance with soil samples. The students should mark with a line each sediment layer and measure the thickness of each.*

1. The bottom layer, the first to sediment due to its dimension, is sand.
2. On top of the sand there is silt.
3. The third layer, which requires longer (hours to days) to settle is clay.²

**Equation for the percent of each component:**

\[
\text{Thickness of selected component} \times 100 = \% \text{ of component} \\
\text{Total thickness}
\]

*The students should be able to roughly classify the soil samples based on equation and wet test (see Soil Texture Pyramid, Appendix I).*

The texture of a soil is directly related to its **fertility**, which is its ability to absorb and retain water, to retain and release plant nutrients, and ability of roots to develop. Soils with a lot of clay are “heavy” and tend to hold a lot of water. The water moves slowly and does not drain well. Soils rich in sand are considered “light” soil. They tend to hold very little water, unless they also contain a lot of organic matter. Water infiltration in sandy soils is very rapid, so it dries very quickly.
Drainage test and soil comparison
To test drainage, go with the students where you prepared the hole. Fill it with water and allow it to drain completely. Immediately refill the pit and measure the depth of the water with a ruler. Measure again the water level after 15 minutes, and multiply by 4 to calculate how much water drains in one hour.

- < 3 cm/hour = poor drainage (water infiltration is too slow)
- 3 to 15 cm/hour = good drainage
- > 15 cm/hour = poor drainage (water infiltration is too fast)

While waiting for the drainage test, have the students partially fill empty identical glass jars with more soil samples (dry) from different locations on farm, plus one jar with sand. Using another set of jars, mix more of the same dry soil samples with some compost and/or sand, in different proportion.

- Mark the jars to be able to compare each sample with its mixed counterpart.
- Tap the jars so that the samples will settle. The jars should be evenly filled.
- Gradually, pour the same amount of water into each jar (1/3 – 1/2 of the depth of the soil) and observe the water infiltration rate in each sample, comparing it with the sand jar.

Discuss the results with the students. They should be able to draw conclusions about the type of soils and about the effect of adding sand or compost to the mix.

Follow up activities (optional)
During the tour of the farm have the students dig holes of about 15 cm in several different locations and get a clump of soil for a squeeze test. The soil should be neither too wet or to dry.

Ask your students to assess the soil in their home gardens with the jar method and to report their results the following week at training. They should also keep record of their findings.

Assessment questions
1) Describe how soil is formed
2) What are the physical components of soil?
3) What is a loamy soil?
4) How do climate and time influence soil formation?
5) What are the draining properties of sandy soil compared to soil that is heavy clay?

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1 http://www.ext.colostate.edu
2 http://singtree.com/