What is Soil Moisture?

In this lesson, students will be able to:

- Measure and record the current soil moisture (% volume) using a soil moisture sensor
- Determine the soil texture using Web Soil Survey or ribboning
- Discuss the soil moisture content for the determined soil texture
- Analyze the plant water needs and the impact of current soil water on the effective growing of plants
- Optional – use University of Nebraska CropWatch ET Monitor to determine water loss from the plants

Materials Needed:

Activity 1
Kitchen Sponge
Water
Timer
Wire or plastic mesh
Beaker with volumetric measurements

Activity 2
Complete the following activity in urban soil that is bare, covered in turf, or covered in mulch.

Soil moisture sensor. One can be purchased on Amazon for greenhouse use and will be about $20-$30

Time to Complete

Activity – Part 1 = 60 minutes

Activity – Part 2 = 30 minutes

Introduction

Soil moisture is a measure of the water as a percentage (% volume) or as a volume of water per volume of soil (usually mL/m^3). Soil moisture is a measure of "how much" water is stored in the soil profile in the areas where plants can use that water. Each plant or crop has a different root depth. Additionally, soil texture plays a role in how easily plants can pull water into their roots and how much maximum water that soil can hold.

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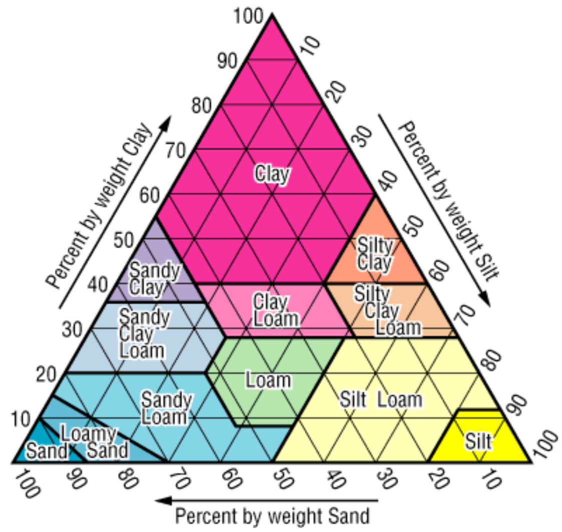
Field soil is traditionally made up of various percentages of sand, silt, and clay. In many cases, field soil also contains **organic matter.** However, urban soils can have other components such as concrete, mulch, and other debris that can affect how well the soil holds water, drains water away, and maintains healthy root systems for plants. The particles, along with the pore spaces in between the particles make up the soil. These pore spaces can hold water or air. As the percentage of water increases, the percent of air decreases and vice versa.

Soil Texture

Soil texture is determined by the percentages of sand, silt, and clay in a soil. This soil texture triangle is often used to determine the soil texture. This process can be done by ribboning the soil or by using a soil settling experiment to determine the soil texture. Additionally, the Web Soil Survey (https://websoilsurvey.nrcs.usda.gov/app/) can be used to get precise and detailed data about the soil based on the exact location from which it was collected/studied.



https://earthobservatory.nasa.gov/

Soil Moisture Content

Soil moisture content is the volume of water in a volume of soil. This is not constant as water is constantly flowing through the soil profile, being used by plants, or evaporating from the soil surface. Soil moisture content is affected by the soil texture and by the amount of pore spaces (**porosity**) of the soil. For example, sandy soils drain very easily due to large pore spaces while clay soils hold water for long periods of time in very small pore spaces that are not accessible to plants.

The following terms are used to describe soil moisture content:
Saturation: When a soil is considered saturated, all the pore spaces fill with water – no air is left in the pores. Saturation is dangerous for plants as their roots need access to oxygen to survive. However, water flows with the force of gravity and saturated soils usually resolve quickly. In the diagram, saturation is referred to as "gravity water".

Field Capacity: After a short time, gravity drains much of the water out of a soil profile. Once that gravitational water has stopped flowing, the soil moisture content is referred to as being at field capacity. At this stage, some of the pores in the soil contain air and the soil is considered ideal for growing plants.

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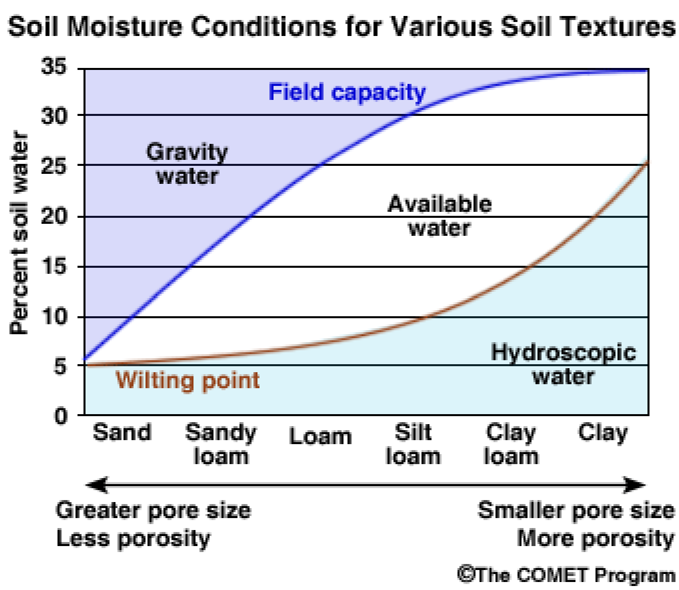
Available Water: This is a term that describes water stored in soil pores that is readily available for uptake by plant roots. This water is primarily stored in macropores (large pores) in the soil.

Wilting Point: At wilting point, all the available water in the soil profile has been used up. Water is only stored in micropores (small pores) and is difficult for plant roots to uptake. At wilting point, plants will show noticeable plant stress in the form of wilting.

Permanent Wilting Point: This term describes a very dry soil in which most of the soil moisture content has been eliminated. At permanent wilting point, there is still water in the soil. However, it is stored in only very small micropores, and it clings so tightly to soil particles that plant roots cannot access it. Plants will show significant stress and once the plant reaches permanent wilting point it will show irreversible injury or death.

The stages of soil moisture content can affect different species of plants in different ways. Additionally, the depth of the plant roots impacts the ability of the plant to reach available water at different soil profile depths. For instance, turfgrass roots are often in the top two to six inches of soil while prairie grass roots can reach depths of 30 ft.



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Activity – Part 1

This activity will use a kitchen sponge to illustrate the soil moisture content.

Directions: Observe the kitchen sponge, notice the holes (pores) and the material that absorbs and holds the water (soil particles). Set up the beaker with the mesh on top. Soak the kitchen sponge in water until it is saturated. Then set the sponge on top of the mesh and allow it to drain freely into the beaker. Use the timer to observe how long it takes before the sponge stops dripping.

After the sponge stops dripping pour the water out of the beaker. Once the beaker is empty and the sponge is full but not dripping, squeeze the sponge into the beaker. Ensure all the water has been squeezed out. Observe the amount of water in the beaker. The sponge will now be relatively dry. If time allows, let the sponge sit for one week and revisit the look and feel of the sponge.

When does the sponge represent “saturation”? ______________________________

When does the sponge represent “field capacity”? ____________________________

When does the sponge represent “wilting point”? ____________________________

What represented “available water” in the demonstration? ___________________________________

When does the sponge represent “permanent wilting point”? ___________________

Reflection

What did you already know when we started this activity? ____________________________________

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What did you learn from this activity? ____

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How will this activity help you grow plants? ____

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Activity – Part 2

Record the soil moisture readings using the provided moisture probe. With these probes, you will be writing down a value of 1-10. Use the blank space here to make your observations on the maps you see on the screen.

Plant #1: ______

Plant #2: ______

Plant #3: ______

Plant #4: ______

Plant #5: ______

Discussion:

Why is it valuable for us to understand soil moisture levels? ______________________________________

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Reflection

What did you already know when we started this activity? ______________________________________

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What did you learn from this activity? ____

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How will this activity help you grow plants? ____

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Activity – Part 3

Assemble the puzzle to stitch our imagery together. Once it is completed, use this space to make 3-5 observations about the field. Remember, green is the area of the field that has the best plant health, then yellow, orange, and red is the worst plant health in that field.

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What do you recommend we do for this field?

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How would you define precision agriculture? And what is an example of precision agriculture?

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