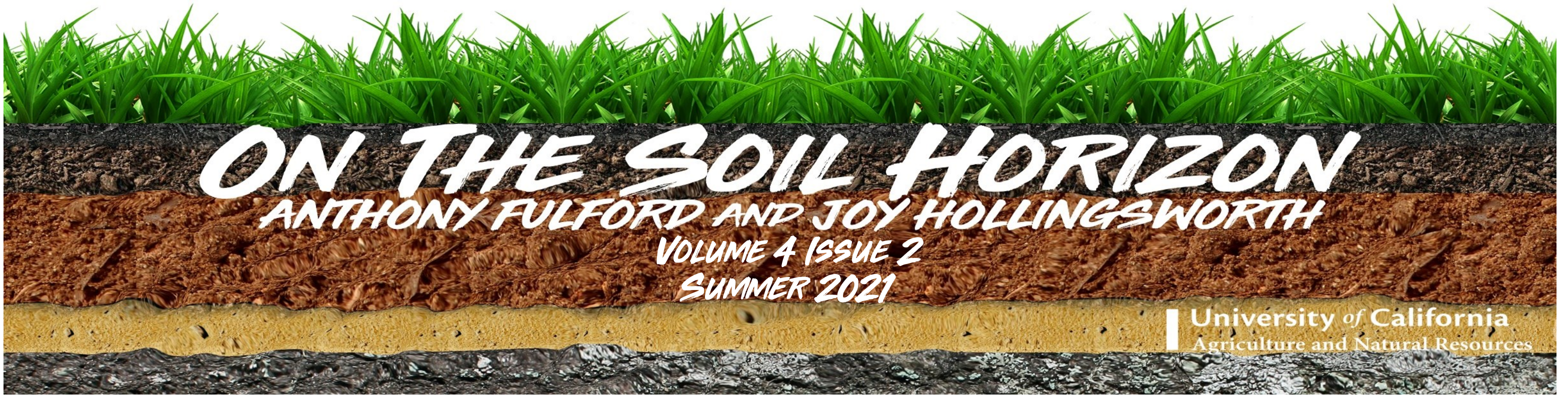

Clay Soils

Joy Hollingsworth, Farm Advisor, Nutrient Management/Soil Quality
UCCE Fresno, Madera, Kings, and Tulare Counties

In the Spring edition of ***On the Soil Horizon*** (https://ucanr.edu/sites/Soils_and_Nutrients/Newsletters_710/?newsletteritem=89158), I wrote about sandy soils, which have large particle sizes and pore spaces. These allow for good aeration and drainage of soils, but poor water and nutrient holding capacity. Clay soils are on the opposite end of the spectrum. Clay has the smallest particle sizes (less than 0.002 mm) and correspondingly smaller pore spaces. Smaller pore spaces do not necessarily mean that they hold less water, it's just that water is held tighter, and it's more difficult for the roots to access. Water will drain more slowly, increasing the time that it will be available for crop uptake which means you can wait longer between irrigation sets. Clay soils have a high Cation Exchange Capacity (CEC) which means that positively charged ions such as calcium, magnesium, and sodium will bind tightly to the soils. This is good for nutrient retention, but not good if you're trying to leach salts.

So, how do you manage clay soils? As I said in the previous article, it's not possible to change the texture of soil, but there are things you can do to improve your situation. Irrigation on clay soils should be gradual. Because of the tight particle structure, water infiltrates slowly, and putting too much water on puts you at risk of causing runoff and erosion. Also, be careful not to irrigate too frequently. Because the water drains slowly, frequent irrigation can cause waterlogged soils. When soils are waterlogged, the pores are taken up by water instead of air. This can cause either hypoxia (a partial lack of oxygen) or anoxia (a total lack of oxygen), both of which can damage your plants. To improve soil aeration, you can add organic matter, such as cover crops, composts, or mulch to your soil. Deep tillage is another practice that is beneficial in some situations, especially if you need to break up a hardpan.

If you are interested in applying organic matter to your land or trying another practice that can help you conserve resources, contact the USDA Natural Resource Conservation Service (NRCS) and ask about their cost-share programs. They operate in every county and you can find your local office at this link: **https://www.farmers.gov/service-center-locator.**

In This Issue

Anthony Fulford, PhD
UCCE Advisor
amfulford@ucanr.edu
(209) 525-6825
3800 Cornucopia Way
Suite A
Modesto, CA 95358

Joy Hollingsworth
UCCE Advisor
joyhollingsworth@ucanr.edu
(559) 241-7527
550 E. Shaw Avenue
Suite 210-B

Interpreting Soil Water Content

Anthony Fulford, Farm Advisor, Nutrient Management/Soil Quality
UCCE Stanislaus, San Joaquin, and Merced Counties

Currently, we are in the middle of a second consecutive dry year in California and the U.S. Drought Monitor indicates that 52% of the state falls into the 'Extreme Drought' category and 33% of the state is in the 'Exceptional Drought' category. Understanding soil water content is especially important during the hot and dry conditions of a seasonal or prolonged drought. However, regardless of weather conditions, soil texture will influence the amount of water that can be held in soil and available for plant use, as discussed specifically for clay soils in the above article. In this article, I will discuss ways to categorize and interpret soil water content.

Three categories that define the water content of soils are the permanent wilting point, field capacity, and plant-available water. The permanent wilting point is reached when soil dries out and crop roots cannot extract enough water to support plant growth. Field capacity is typically reached after a substantial rain or irrigation set when soils are saturated but leaching or flooding has not occurred. Plant-available water is a range that occurs between field capacity and permanent wilting point. The soil's water content at permanent wilting point and at field capacity is different for sandy, silt loam, and clayey soils, therefore, the amount of plant-available water is influenced by soil texture. This is why it is important to monitor plant-available water on a field-by-field or site-by-site basis. There are several tools and methods that can be used to evaluate the soil's water content. One of these tools, a capacitance probe, is able to monitor water content from several different depths within the crop's rooting zone **(Photo 1)**. By monitoring soil water content following an irrigation set with soil water sensors, it is possible to estimate when soil in that field has reached field capacity. To obtain a better understanding of water content as soils continue to dry out, it is necessary to use a tool which directly measures soil water content at or below field capacity and additional tools are required to take measurements when soil is close to the permanent wilting point.

The diagram in **(Figure 1)** shows that the amount of plant-available water changes with the soil's clay content. The amount of plant-available water is relatively low for sandy soils with low clay content and large pore spaces but increases and achieves a maximum near the mid-point of the graph, corresponding to conditions seen for silt loam soils with a mixture of particle sizes that produce small and large pore spaces. As clay-size particles in the soil continue to increase and pore sizes become smaller, the amount of plant-available water decreases for high clay soils. The general relationship shown in the diagram has several implications for interpreting soil water content, but one key takeaway is that sandier soils have lower water storage capacity and a lower amount of plant-available water compared to silt loam soils. This is why sandy soils typically require frequent irrigations. On the other hand, clayey soils have a higher water content, but also tend to have less plant-available water compared to silt loam soils. Overall, this relationship demonstrates how silt loam soils have a capacity to hold more water which is readily plant-available compared to sandy and clayey soils.

Photo 1. Installation of capacitance soil probe water sensors at a depth of 12, 18, and 24 inches in a clay soil near Stockton, CA.

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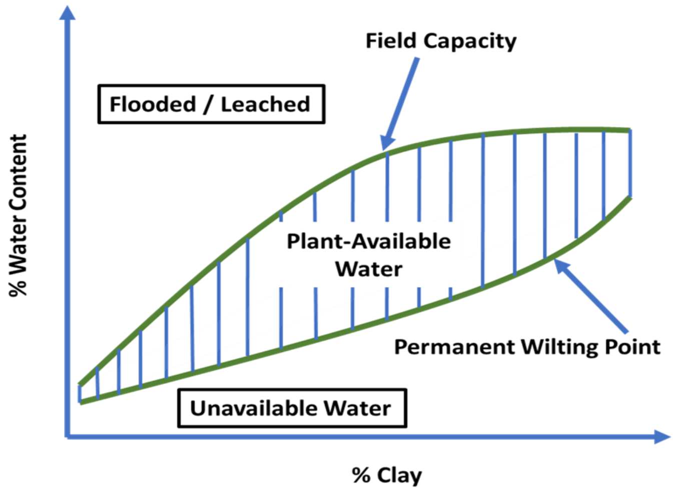


Figure 1. Diagram of plant-available water content in soil. Water content above field capacity (top green line) is the amount of water present during active leaching or flooding, while the water content below the permanent wilting point (bottom green line) is the amount of water retained by soil and unavailable for plant use.

Resources

Miller, R.W. and Gardiner, D.T. (1998). *Soils in Our Environment* (8th ed.). Prentice Hall.

Recorded Webinars

Check out these links for previously recorded cover crop webinar presentations:

Cover Cropping in the San Joaquin Valley presented by UC ANR/USDA ARS on May 18th 2021.

https://www.youtube.com/watch?v=tGd_9cL1jZw

Two videos from Cover Cropping in the San Joaquin Valley presented by UC ANR/USDA ARS on April 20th 2021

Cover Cropping in a Raisin Vineyard with Steven Cardoza

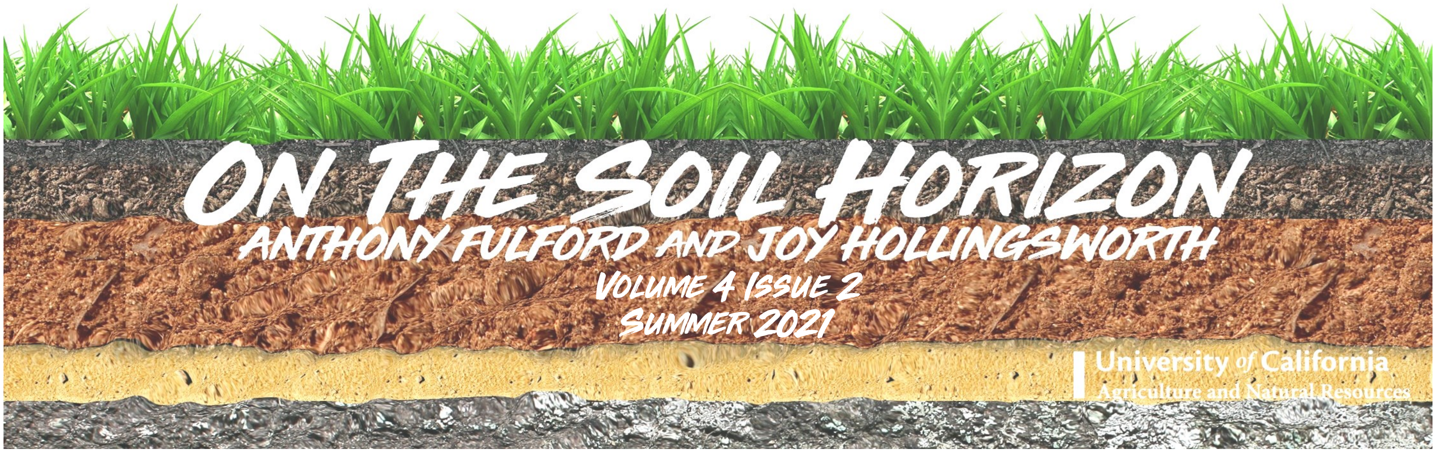
https://www.youtube.com/watch?v=XahMVXkEb2Y

Learn about a grower who is implementing innovative farming practices to improve the soil health of his vineyard!

Cover Crops in Perennials in the San Joaquin Valley

https://www.youtube.com/watch?v=pXvDmuv-8X0

This video covers research on water dynamics while a new table grape vineyard was established with cover crops in the San Joaquin Valley. There are two cover crop treatments, one with native plant species and another with introduced plant species. The native mixture was dominated by Tansy Phacelia and the introduced mix was dominantly Merced Rye. Both cover crops are known to contribute to soil health and the Phacelia had early positive impacts on the soil biota and soil water content.



Joy

Joy Hollingsworth
Nutrient Management
and Soil Quality Advisor
UCCE Fresno County

University of California
Cooperative Extension
550 E Shaw Ave, Suite 210-B
Fresno, CA 93710