Maximizing the use of soil moisture sensors

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Citrus trees require water to be able to carry on the natural processes of growth, making food and developing fruit and juice. To get the water from the soil, the fibrous roots do the extra work of absorbing the water and carrying it via the transport stream (the water highway) to the leaves.

The water in the soil is made available through either irrigation or rainfall. This article focuses on how to use soil moisture sensors to determine how much water to apply and how to use sensors for irrigation management.

SENSOR TYPES

Improved irrigation scheduling techniques that use moisture sensors to control irrigation events can greatly increase water-use efficiency. There are several types of soil moisture sensors that are commercially available.

Soil moisture sensors are classified into two categories: volumetric or tensiometric. Volumetric sensors provide soil moisture as a volume of water per volume of soil, while the tensiometric sensors give water content as a unit of suction or water potential.

There are at least seven different operating principles used by various brands of electronic soil water sensors: time domain reflectometry, time-domain transmission (TDT), frequency domain reflectometry, amplitude domain reflectometry, capacitance domain reflectometry, and resistance granular matrix sensors. The suitability of each sensor depends on the cost, accuracy, response time, installation, need for calibration, and soil type.

For Florida sandy soils, sensors that require minimal soil disturbance are preferred. TDR and TDT sensors are more ideal due to low maintenance requirements, high degree of accuracy and low need for calibration.

SENSOR INSTALLATION TIPS

When installing sensors in the root zone, it is important to place them within 1 to 1.5 feet of the irrigated zone to make sure the sensor is reporting accurate information. When the sensor is installed outside the irrigated zone, one can overestimate the need for irrigation by assuming the soil is dry and needs to be replenished.

For proper irrigation planning, it is always good to install sensors in the active root zone, which is typically within the top 12-inch soil depth. To ensure nutrients are not being leached beyond the root zone, it is highly important to install one or more sensors at 18 or 20 inch depths.

Elevated soil moisture below 18 inches suggests that the soil is wet enough to support the growth of the roots. Sensors are typically operated by battery power, and some also utilize solar panels. When deciding the location for a sensor, it is beneficial to determine the amount of rainfall in a particular area and the precipitation frequency. The change in soil moisture, especially in sandy soils, may be negligible for a short period of time.

Some sensors may have a built-in rain gauge, and others also have a built-in rain gauge. When deciding on a location, one should consider the area with adequate light coverage. If using solar-operated sensors, you do not have a weather station in close proximity to your grove, and the sensors are available through several manufacturers. Each company has a unique format for displaying the data from one sensor or multiple sensors.

Graphs can be displayed in various formats. In many cases, the user can elect which data to view, allowing for the comparison of data from one sensor or multiple sensors.
increased potential for nutrient leaching and thus the need to optimize the irrigation rate. It is preferred to install the sensors after a rain event or in a well-watered soil to reduce the influence of air gaps. Check the graphical trends over a week to assess where the soil is at the maximum saturation point (see https://edis.ifas.ufl.edu/publication/AE551).

**READING THE DATA**

Soil moisture data provides an indirect measurement of the water that a soil can hold. For sandy soils, the soil water-holding capacity is represented by a small range (based on the soil moisture characteristic curve that relates volumetric soil moisture and soil matric potential, Figure 1) that indicates a need for frequent short-time irrigations.

The volumetric sensor provides soil moisture as volume of water per volume of soil recorded across time (Figure 2). If the data provided is in bars or other energy units, the user might be dealing with tensiometric sensors. These sensors provide soil moisture as suction or matric potential due to capillarity.

**TROUBLE SHOOTING**

Sometimes sensors fail in the field as a result of poor connection, wild animals or damage from herbicides or spray equipment. Thus, it is a good idea to keep an eye on sensors from time to time to make sure the information is being provided in a timely fashion.

If a cable is damaged, order a replacement cable from the sensor provider. If a data logger is wet due to heavy rain, repair the unit and secure it carefully when installed. Marking the ends of the rows where sensors are located can serve as a visual reminder for equipment operators to use caution.

**SUMMARY**

Using soil moisture sensors can aid in decision making regarding irrigation management. Sensors that are easy to calibrate or need no calibration, are easy to maintain, and can be used for irrigation and fertigation management on Florida sandy soils are preferred. These tools will help growers judiciously use their water resources.

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