Soil moisture sensor Q&A

By Sandra Guzman

Understanding how to obtain and interpret data from soil moisture sensor (SMS) systems is crucial for efficient irrigation management. These systems help create an efficient and informed irrigation schedule based on soil moisture readings collected from the field.

Below are answers to some common questions about managing SMS systems, including how to view SMS data on a computer, what kind of electronics support data transfer from the field to the computer, and the best position for locating sensors in the field. Also discussed is CropMonitor, software created by the University of Florida (UF) for irrigation scheduling using SMS and weather data.

Q: How do I tell if my SMS system can automatically transmit readings to my computer/cellphone?

A: There are two types of SMS systems available: with and without telemetry (Figure 1).

Systems with telemetry allow the data to be transferred wirelessly using a cellphone connection. Soil moisture readings are collected and stored using dataloggers, then transmitted through radio or cellular modems enabled with antennas, solar panels, batteries and enclosures. Readings can be viewed on a computer or cellphone through the use of SMS company-owned software and cellphone apps.

Systems without telemetry only allow collecting and storing data with dataloggers or SMS readers. There is not a graphical visualization feature in these systems.

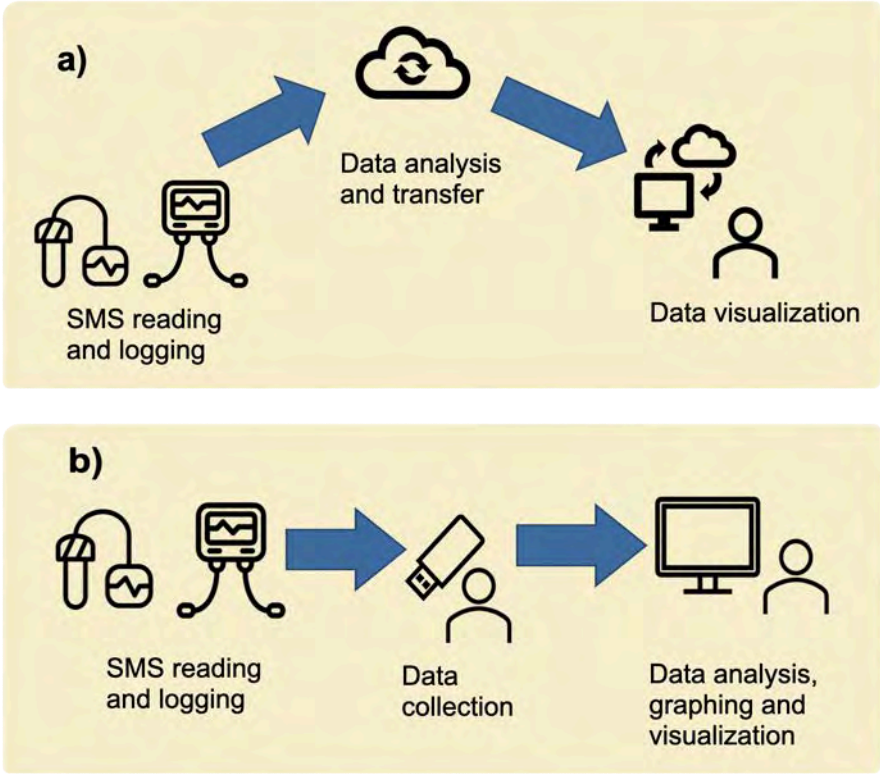

Figure 1. Soil moisture sensor systems with (a) and without (b) telemetry. The person icon indicates the level of manual work required.

The best rule of thumb for identifying if the SMS includes telemetry is to verify if the user has a cellular modem and access to graphical visualization software. If the user has a cellular modem but cannot view the data, they should contact the SMS system company and request assistance in data visualization. The most common solution is purchasing a subscription for visualization software.

Many companies offer multiple packages that range from soil moisture and datalogger to sensor, datalogger, software and technical assistance. Usually, users purchase an annual subscription to be able to visualize the data. Although the initial cost of SMS systems without telemetry is lower, they require more manual labor. The user needs to retrieve the data, manage it and graph it to view the daily changes in soil moisture. Because

managing the data is not as intuitive as it should be, the user risks not managing the system properly.

When purchasing a new SMS system, it is important to verify that the data can be viewed easily. It is recommended to purchase systems equipped with telemetry and a data visualization subscription.

Some companies do not offer graphical visualization software. CropMonitor (Figure 2) was developed at the UF Indian River Research and Education Center (IRREC) for these cases. With CropMonitor, the user can see the data coming from soil moisture and other sensors in the field. The software allows the user to manage and personalize weekly irrigation schedules.

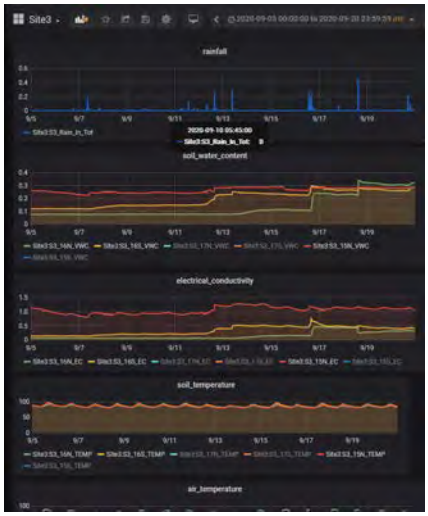

Figure 2. Data visualization with the University of Florida CropMonitor software

Q: What is the best way to install an SMS?

A: This depends on the SMS selected. The installation process is straightforward for SMS probes if the users take the soil variability and root depth into account. For example, the main roots for flatwood soils are located in the first 7 inches, and the SMSs inside a probe are usually located every 4 inches. In this scenario, a probe with 12 inches of depth should be enough to manage irrigation. Deeper SMSs (12 inches and below) might not be necessary for irrigation management, but rather for water table rise monitoring.

In the installation, it is important to take into account the shallow hardpan, which is usually near 12 inches for most flatwood soils. Longer probes

might be difficult to install under those conditions.

Although the installation of handheld SMSs is more difficult, the user can arrange the sensors according to individual field conditions. The method of installation depends on the sensor type. For more information about sensor installation, check the SMS manuals and the following Citrus Industry articles:

- Understanding Soil Moisture Sensor Data (CitrusIndustry.net/2017/07/10/understanding-soil-moisture-sensor-data)
- Irrigation Management Advice for HLB Trees (CitrusIndustry.net/2020/04/09/irrigation-management-advice-for-hlb-trees)

In terms of location, handheld SMSs can be installed both horizontally and vertically. However, for citrus under drip irrigation, a vertical installation with the SMS located in the wet bulb of the dripper (around 8 inches from the dripper, based on dripper flow conditions) is recommended. It is important to check for rocks or other materials that could interfere with an adequate reading when installing an SMS.

Both soil moisture probes and handheld SMSs can provide accurate readings in Florida conditions. Either of those SMS options is appropriate if it comes with telemetry and graphical visualization software.

Other factors that influence an SMS location include cellphone or radio range to the remote station, the length of the sensor cables, and power sources. SMSs with cable lengths higher than 300 feet are more likely to be compromised by lightning events or connectivity issues. Make a layout of the radio and cable pathway before purchasing and installing an SMS system.

Q: What is the minimum number of SMSs per site and how do I know if the readings are accurate?

A: When deciding on the minimum number of SMSs to use per site, it is common to assume that one handheld SMS installed vertically is enough to capture the movement of water across the soil layers. However, it is recommended to have at least two SMSs; one at the depth of the major roots and the other below the roots. The first SMS will show the trends of water movement across the root system, and the second will show how much the water table rises or if there is overirrigation. There should be at least one SMS installed per soil layer if there is more than one layer across the main root depth.

A soil moisture sensor is installed vertically.

Although irrigation can be managed based on the weekly moisture trends from the graphical visualization, many questions have been raised from growers about identifying an accurate SMS reading. Volumetric SMS readings can be direct or relative.

Direct measurements show values from 0 to 1 or 0% to 100%, where 100% is the moisture reading of water. For example, the Florida field capacity for sandy soils (or the upper threshold of irrigation) is around 0.15 (or 15%). Values higher than 15% might indicate saturation due to a rain event or overirrigation. If there is a constant trend of values higher than 30%, this might be due to reading inaccuracies.

For SMSs with relative measurements, 100% might be related to field capacity or another relative threshold. For more information on relative SMS measures, contact the SMS manufacturing company.

SUMMARY

SMS systems with telemetry and volumetric SMSs with direct measurements are the most practical way to manage and schedule irrigation. For growers that already have an SMS system with handheld sensors and cellular modems but not data visualization software, CropMonitor software developed by the Smart Irrigation and Hydrology lab at the IRREC is a solution to easily manage and personalize weekly irrigation schedules.

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