Current considerations for citrus irrigation management

Growers can use these tips and tools for trees impacted by HLB and Hurricane Irma.

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Water is a limiting factor in Florida citrus production during the majority of the year. This is because of the low water-holding capacity of sandy soils resulting from low clay and organic matter content and the non-uniform distribution of rainfall.

In Florida, the major portion of rainfall occurs from June through September. However, rainfall is scarce during the dry period from February through May, which coincides with the critical stages of bloom, leaf expansion, fruit set and fruit enlargement. Irrigation provides water when rainfall is not sufficient or timely to meet crop needs.

Adequate irrigation management is key to optimize water use, increase crop yield and improve fruit quality. Several weather-, soil- and plant-based methods are available for irrigation management. The most used methods rely on weather stations to calculate evapotranspiration (ET), the combination of water lost by plant transpiration and soil evaporation.

ALLOWABLE SOIL WATER DEPLETION

As soil dries out, water becomes increasingly difficult for trees to obtain, which can eventually cause water stress. Tree health and yield will suffer if the soil is too dry. To provide adequate water for flowering, fruit set and vegetative growth, maximum soil water depletion should not exceed 25 to 33 percent of available water from February to June. The percentage of available water can be measured with commercially available soil moisture sensors.

Once the rainy season starts, the maximum depletion can be increased to 50 to 66 percent of available water. This additional allowable depletion increases the capacity of the soil to hold rainfall without leaching nutrients or any applied chemicals. The same depletion in the fall and winter months will save water without reduction in yield.

IRRIGATION SCHEDULING

Increased water-use efficiency is achieved by selecting a proper irrigation scheduling method and application timing. Proper irrigation scheduling supplies water to a citrus grove at the appropriate time based on tree need, soil properties and weather conditions. With proper irrigation scheduling, yield will not be limited by water stress. Successful irrigation management maintains sufficient water and nutrients in the root zone to maximize tree performance and health.

Growers who focus on improving water- and nutrient-use efficiency will also reduce nutrient losses and negative environmental impacts. While some nutrient loss is unavoidable due to excess rainfall, loss due to management decisions can be minimized. The commonly used methods of irrigation management include soil moisture measurement, water budgeting and smartphone apps.

Soil Moisture Measurement

Experience or the calendar method can provide a reasonably good

irrigation schedule, but these methods are not accurate enough to maximize water-use efficiency and prevent nutrient leaching. Using soil moisture sensors (Figure 1) improves accuracy because they quantitatively measure changes in soil water status.

Tensiometers and electrical resistance blocks have been used to monitor soil moisture for decades. However, these sensors are not as accurate as new electronic sensors and typically require more maintenance to obtain the most accurate measurements.

Current electronic sensors may be fixed in one location, portable or hand-held, and can be connected wirelessly to computer systems. These advanced sensors may also measure soil moisture at one depth or at multiple depths. General categories include time domain reflectometry and capacitance probes.

Considerations when using soil moisture sensors to schedule irrigation include:

- Knowing the soil water-holding capacity and tree root-zone depth
- Placing sensors where the majority of roots are located (typically in the top 12 inches), such as at the dripline of the tree in the area watered by the irrigation system
- Using multiple sensors, both across the grove and with depth, to fully characterize the tree's root zone
- Moving sensors to follow root growth as the tree canopy expands for growing young citrus trees
- Basing irrigation on the soil depth containing the greatest root density
- Managing root-zone soil water content between field capacity and the maximum allowable water depletion (one-fourth to one-third depletion, depending on time of the year)

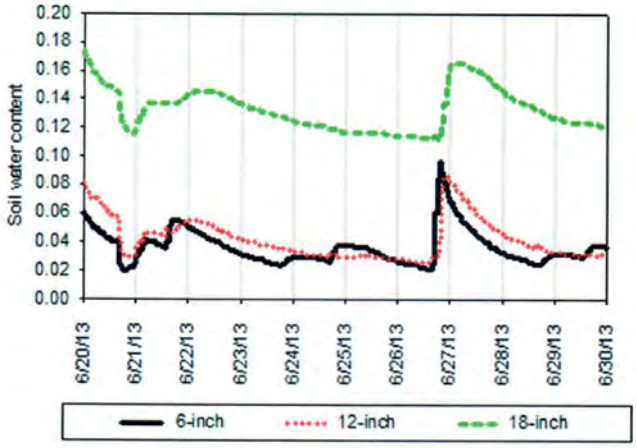

Figure 1. Continuous monitoring of soil moisture at 6, 12 and 18-inch depths in the soil by a multi-level capacitance probe installed in the root zone of a mature citrus tree.

Water Budgeting

An alternative method to schedule irrigation uses a computer program that estimates tree water consumption, also known as ET, from weather data. Reference ET and convenient irrigation scheduling management tools for all Florida citrus production regions can be found on the Florida Automated Weather Network (FAWN) website (http://fawn.ifas.ufl.edu).

Smartphone Apps

Mobile smart devices (e.g., smart phones and tablets) have become popular because of their convenience and ease of use, making them ideal for disseminating information on a regular basis with real-time data. Tools developed for use on mobile smart devices are typically called "apps" and are available for a variety of functions.

An app has been developed by the University of Florida Institute of Food and Agricultural Sciences that uses FAWN weather data for iPhone and Android platforms that allows users to view data from grower-owned weather stations. The goal is to provide users with an easy-to-use mobile app to access information that would improve irrigation scheduling for a wide range of crops, including citrus. By using the app instead of a set time-based schedule for irrigation, accurate irrigation is provided. Using the app to modify the irrigation schedule has the potential of reducing water and fertilizer use, resulting in reduced irrigation and fertilizer costs and the potential of further reducing nutrient leaching. The citrus irrigation app is available to download in the App Store and Play Store at no cost (smartirrigationapps.org).

REDUCE NUTRIENT LEACHING

Developing an irrigation strategy to reduce nutrient leaching has the objective of not applying more irrigation water than the root zone can hold. Considering the low water-holding capacity of citrus grove soils, this objective is very difficult to accomplish even for the most experienced and diligent irrigation manager. If the grove manager operates the irrigation system too long and applies more water than the soil can hold, water will move beneath citrus tree roots. If

water-soluble nutrients like nitrate or potassium are present in the irrigated zone during the irrigation period, a portion will leach.

CONSIDERATIONS FOR HLB-AFFECTED TREES

With HLB, irrigation scheduling is becoming more critical. Growers cannot afford water stress or water excess. Any degree of water stress or imbalance can produce a deleterious change in physiological activity, growth and production of citrus trees. With water stress, the number of fruit, fruit size and tree canopy are reduced, and premature fruit drop is increased. Growth in shoots and roots and leaf expansion are all negatively impacted by water stress. Benefits of proper irrigation scheduling include reduced loss of nutrients from leaching as a result of excess water applications and reduced pollution of groundwater or surface water from the leaching of nutrients.

Based on recent studies conducted in Florida on HLB-affected trees, researchers recommend that irrigation frequency should increase and irrigation amounts should decrease to ensure optimal water availability in the root zone at all times. These recommendations allow trees with reduced root density from HLB to minimize water stress or application of excess water.

Data can be downloaded from soil moisture sensors to help growers make better irrigation decisions.

It is recommended that growers maintain soil moisture in the root zone (top 3 feet for ridge and 18 inches for flatwoods soils) using soil moisture sensors or irrigation apps. If the irrigation scheduling app is used, the irrigation time should be reduced by

10 to 20 percent. For example, if the app suggests an irrigation time of 1 hour, this time could be reduced by 6 to 12 minutes for HLB-affected trees.

POST-IRMA TREE CARE

In Hurricane Irma, some citrus-producing regions experienced severe waterlogging, fertilizer leaching, trees tipping over, leaf loss, broken branches and high incidences of leaf and fruit drop. Where leaf loss was severe and root systems were compromised due to flooding and loss of tree canopy, it is recommended that irrigation frequency should increase and irrigation amounts should decrease.

Good drainage is very critical for successful citrus production. There is an urgent need to consider cleaning, repairing or redesigning drainage canals and swales (depending on the grove situation) where drainage is a problem, particularly in the southwestern and southeastern parts of Florida where citrus is grown on flatwoods.

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FOR FURTHER READING

- "Irrigation Management of Citrus Trees," 2017–2018 Florida Citrus Production Guide, pages 49–52
- "Understanding Soil-Moisture Sensor Data," July 2017 Citrus Industry, citrusindustry.net/2017/07/10/understanding-soil-moisture-sensor-data

Call for Proposals Is Coming Soon!

The mission of the Citrus Research and Development Foundation (CRDF) is to advance disease and production research and product development activities to ensure the survival and competitiveness of Florida's citrus industry through innovation. Since the inception of CRDF, the majority of investment has focused on HLB, while still addressing strategic topics in other diseases.

On a regular basis, CRDF has refreshed the portfolio of research projects. CRDF staff members facilitate and coordinate the work of the committees and reviewers, while the board has the responsibility to make the final funding decisions. Even before the open call for pre-proposals goes out, the staff and committee members are determining a schedule, finalizing templates and reviewing instructions to applicants.

But how is the list of topics to be funded generated for the call for proposals? CRDF begins the process by listening to our stakeholders — the citrus growers, processors and researchers. CRDF held public listening sessions focused on eliciting ideas for research priorities that are most important to the growers, production managers and processors. In order to receive input from researchers, CRDF asked Michael Rogers, the director of the University of Florida Institute of Food and Agricultural Sciences Citrus Research and Education Center, and Brian Scully, director of the U.S. Department of Agriculture Agricultural Research Service Horticultural Research Laboratory, to work with the research community to provide feedback to CRDF regarding those questions and ideas that researchers feel would most benefit the industry.

In addition, CRDF is looking forward to a report from the National Academy of Sciences that is the culmination of months of review and input from both the growers and the scientific community nationwide. This report should detail strategic directives for CRDF and HLB research. All of this input will be compiled by CRDF staff for review by the technical committees, which will make recommendations on the research priorities. The board of directors considers these recommendations and makes the final decision.

CRDF has a Research Management Committee (RMC) and a Commercial Product Delivery Committee (CPDC). This year, the call for pre-proposals will encompass both committees with a separate set of priorities for each. Both committees will review pre-proposals and make recommendations to the board for decisions regarding invitations for full proposals. The parallel process should provide a mechanism to fund experimental research that contributes to durable solutions through the RMC, and delivery projects designed to lead to practical applications in the near term through the CPDC.

Even though CRDF has had many calls for proposals over the years, this year will be slightly different as we will be putting into place a call for proposals for both RMC and CPDC. Vincent Van Gogh once said, "Great things are done by a series of small things brought together." With the challenges the citrus industry faces, we are all looking forward to the next round of project proposals to do great things.

Prepared by the CRDF project management team

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