Determining Water Use Efficiency

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During the California Avocado Commission's (CAC) recent grower meetings in April, some questions were asked regarding equipment that assists growers in determining water use efficiency. Specifically, what types of equipment and which manufacturers would we recommend for determining and improving water use efficiency?

Although we cannot recommend one brand of equipment over another, we decided it may be helpful to provide a sampling of what some growers have found beneficial in their farming operations. I spoke with several growers, from smaller scale (5-10 acres) to very large-scale (up to 400 acres) operations, to learn about their utilization of irrigation efficiency equipment, tools and resources. This article is not intended to be an all-inclusive list of options that exist, but hopefully will serve as a general overview and provide a good starting point for those growers who are looking for some direction.

Why is Water Use Efficiency Important?

Water use efficiency is a percentage value that indicates how much of the applied water in a grove is utilized by the trees. Factors such as runoff, deep percolation, irrigation system leaks, and soil evaporation reduce water use efficiency below 100 percent. By understanding the factors that affect water use efficiency, properly maintaining and repairing irrigation systems and applying water properly for maximum tree uptake, water use efficiency in an avocado grove can reach 85 percent. In addition, efficient application of water improves tree water status, which can increase tree productivity and potentially result in overall lower water use.

Determining Evapotranspiration (ET)

The first step in properly irrigating a grove is to determine the ET requirements. As I'm sure you all know, ET is the loss of water to the atmosphere by the combined processes of evaporation (from soil) and transpiration (from plant tissues). ET is also an indicator of how much water avocado trees need for healthy growth and productivity. Determining an accurate ET for each grove is essential for scheduling irrigation.

All of the growers I talked with had a system intended to "zero in" on their individual groves' ET requirements. The California Irrigation Management Information System (CIMIS) is a program in the California Department of Water Resources that manages a network of more than 120 automated weather stations in the state of California (http://www.cimis.water.ca.gov). CIMIS station data is provided to assist California's irrigators in efficiently managing their

A base station determines ET by tracking variables like temperature, humidity, wind speed, wind direction and rain.

water resources by estimating crop water use for irrigation scheduling. CIMIS can be a good starting point, but may not provide precise enough information for your grove. For example, if the nearest CIMIS station is five miles away, weather conditions could be significantly different from your grove and therefore your ET for that day may vary. In addition, other factors like soil type will have a direct impact on your irrigation requirements and scheduling.

One farm manager discussed a system they utilize that includes weather stations on some of their properties. Each property has one main base station and nodes that wirelessly transmit data to the base. The base stations cost around $4,500 each and determine ET by tracking variables like temperature, humidity, wind speed, wind direction and rain. The node equipment varies by ranch, but the most common setup is to have temperature, wind speed, and soil moisture sensors connected. Each node costs approximately $1,000, with temperature and humidity sensors at $425 and soil moisture probes running about $1,000 each. So, depending on equipment add-ons, each node setup will cost another $2,000-$3,000. There is a monthly fee for each system — $65 for the base station and $5 for each node. Another option is the cell node, a stand-alone system that is used when you only need data from one location. The advantage of the cell node is that it is smaller and less expensive, with start-up equipment costs of around $2,000 and monthly service at about $30.

A graph showing one month of soil moisture probe data (Figure 1) allows the user to see the spikes (when there is an irrigation set) and then see soil moisture levels decrease as water is used. A web-based system provides the user with a dashboard of their account, providing specific results updated every 15-30 minutes (Figure 2). One challenge is that you either need an ATT or Verizon cell signal for the systems to work, which for this grove manager hasn't been an issue in Ventura County, but it has been problematic in parts of Riverside and San Diego counties. Frost alerting is another available feature of this system. A low temperature threshold is entered into the online program and when that temperature is reached the system will call or text you.

Figure 2

Although the options discussed thus far require fairly significant start-up costs, there are less expensive options too. In the last issue of *From the Grove*, Dr. Tim Spann discussed the importance of soil moisture monitoring in an article entitled "Coping with Drought". He reported the results of a recent survey conducted by UC Riverside researchers which found that "60 percent of California avocado growers never monitor soil moisture. And of those who do monitor soil moisture, the majority does it by feel." Other growers I talked with use very inexpensive tensiometers (around $30) that they monitor manually in their groves. There is a YouTube video from Dr. Gary Bender, UC Farm Advisor, explaining how a tensiometer works and how to install one in an avocado grove (www.youtube.com/watch?v=UHVlvAO5NDQ).

Also, once the ET is determined for your grove, an irrigation calculator such as the one available on AvocadoSource.com (www.avocadosource.com/tools/IrrigationCalculator.asp) is a great resource.

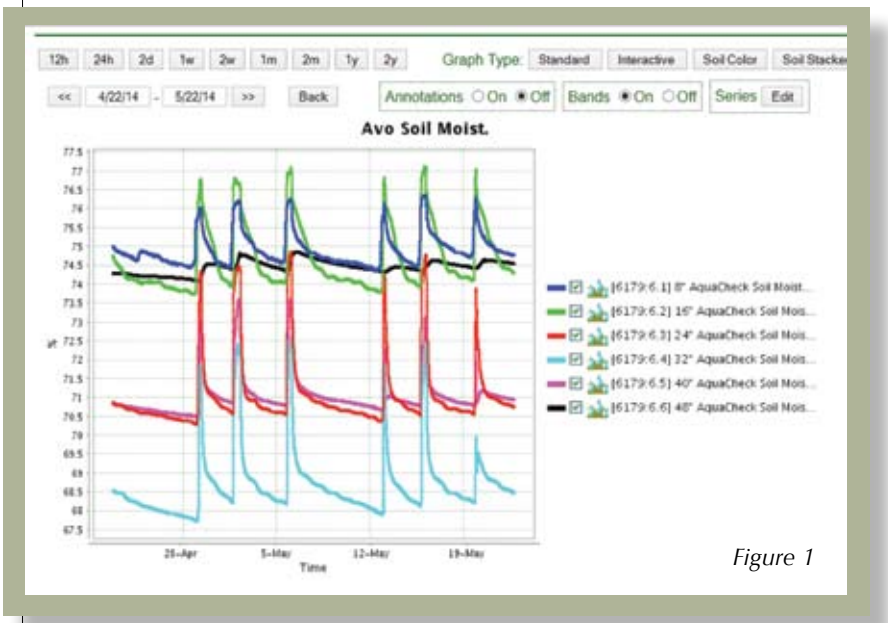

Figure 1

System Design

Unfortunately, there is not a "one size fits all" solution as groves have individual characteristics such as soil type, slope, irrigation system uniformity, etc. So it's important to develop a system that works in your grove. If your grove falls within the lower Santa Marga-

Avocado grower Gene Bianchi manually reads a tensiometer.

rita and middle and lower San Luis Rey watersheds, Mission Resource Conservation District offers local landowners and stakeholders free irrigation system evaluations to help growers assess the irrigation schedule and uniformity of the irrigation systems (www.missionrcd.org/).

Additionally, the Rancho California Water District offers Agricultural Water Use Efficiency Programs to assist farmers in determining their system's water efficiency, and in some instances, provides incentives towards equipment (www.ranchowater.com/index.aspx?nid=190). You may want to contact your local water agency to determine if they offer similar assistance or can provide other alternatives.

Quite a few options have been presented, ranging from relatively inexpensive to more costly alternatives. As the drought emergency continues, and overall challenges to our water supply and affordability increase, any improvements in water efficiency — big or small — are valuable. If you haven't yet taken steps to ensure your irrigation system and practices are efficient, I would encourage you to consider starting soon. If you have any questions feel free to contact the Commission at cac.iaf@avocado.org.