Using the FAWN Citrus Microsprinkler Irrigation Scheduler to maximize irrigation effectiveness

By Kelly T. Morgan and Rick Lusher

The competition for water is increasing throughout Florida. Increasing demands from residential and commercial users are often met at the expense of agricultural water permits. One way that citrus producers can address this trend is by improving their water use efficiency (the amount of water used per box of fruit produced). Irrigation managers can reduce grove water consumption while avoiding tree damage or fruit yield/quality loss due to insufficient irrigation. The key to improving water management is to include soil characteristics and weather factors in irrigation scheduling decisions. An easy-to-use, web-based, water-balance irrigation-scheduling tool is available at the Florida Automated Weather Network (FAWN) website (http://fawn.ifas.ufl.edu/). This tool assists growers in determining irrigation schedules that can improve water-use efficiency and reduce nutrient leaching.

Grove managers may have several objectives in mind when scheduling irrigation. Increased profit through the effective use of irrigation to produce high-quality citrus is the overall goal. Irrigation scheduling in combination with fertilizer best management practices (BMPs) will provide *maximum nutrient uptake efficiency* by increasing the amount of fertilizer taken up by the tree. The objective of maximum nutrient uptake efficiency is to hold nutrients — especially mobile nutrients such as nitrate-nitrogen — in the root zone, and to avoid the leaching of nutrients out of the root zone, which can be caused by excessive irrigation.

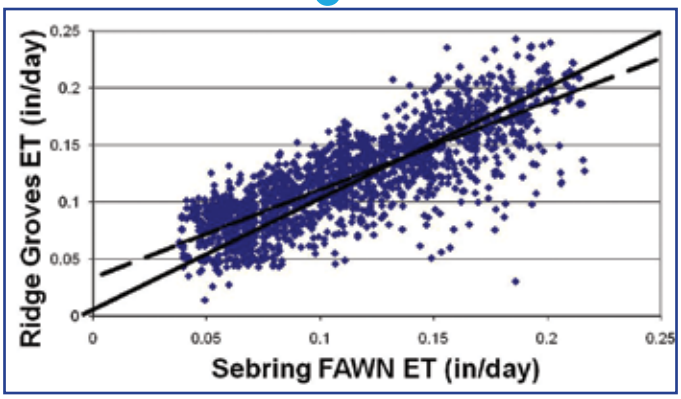
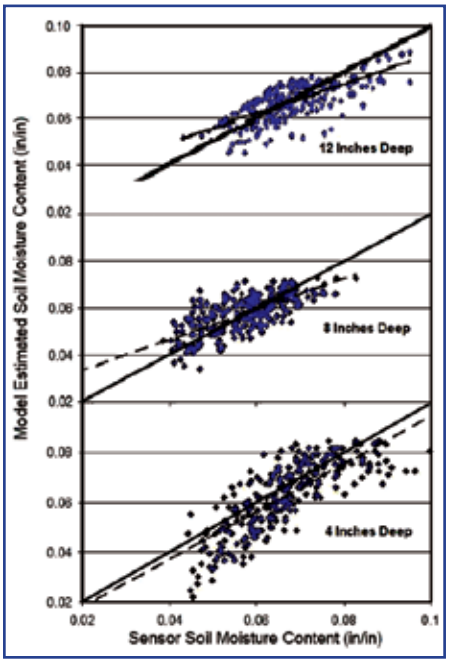


Fig. 1 (left). *Comparison of calculated ET using data from the FAWN weather station site and ET calculated for the Ridge orchard sites. The solid line represents the 1:1 relationship line for the two locations. The dashed line and equation is the linear regression for the data.*

Fig. 2 (right). *Comparison of model estimated and measured soil water content values at the 4-, 8- and 12-inch soil depth. The solid line is the 1:1 relationship line indicating soil moisture sensor data is equal to the model-estimated soil moisture content. The dashed line and equation is the linear regression of soil moisture sensor data and the estimated soil moisture, and are nearly the same as the 1:1 relationship line indicating agreement among the sensors and model estimates.*



For 14 years, FAWN has been meeting its mission of providing a wide variety of users with timely and accurate weather information. FAWN has developed cold protection and irrigation scheduling tools for many crops grown in Florida, and it has been estimated that use of these tools can save billions of gallons of water and reduce irrigation costs by millions of dollars.

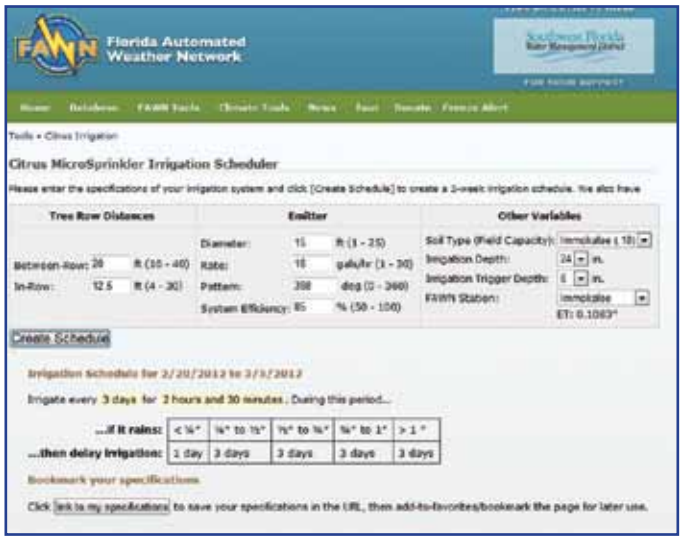


Fig. 3. *Display of irrigation schedule provided by the FAWN Citrus Microsprinkler Irrigation Scheduler using grower-provided information*

Irrigation scheduling is simply applying water to crops at the "right" time in the "right" amount, and is based on crop need and soil moisture content. Soils hold different amounts of water depending on their pore size distribution and structure. Scheduling methods often consist of grower judgment, calendar schedules based on published tables, use of soil moisture sensors, or estimated tree water use based on weather data.

Calendar-based schedules are inaccurate and do not take into account soil or weather conditions.

Soil moisture sensors have improved greatly over the past several years, and are the best way to determine tree water needs, but are still expensive, and require maintenance and site-specific calibration in order to be effective.

Evapotranspiration (ET) — the amount of water transpired by a crop and evaporated from the soil on a daily basis — can be used very effectively for irrigation scheduling, and can be calculated over a relatively large area using available FAWN weather data. The ET by a specific crop changes as the *crop coefficient* (Kc) — a ratio based on observed ET and a reference ET — changes, and is based on temperature, wind speed and relative humidity. The ET required for optimum citrus production has been determined and can be used to schedule irrigation using weather information from FAWN.

Field tests of a citrus ET-based microsprinkler irrigation scheduler were conducted in six groves over a period of three years. Weather stations were placed in the groves, irrigation schedules were provided to the grower cooperators, and soil moisture measurements were taken every hour. ET rates at the grove sites were compared with ET estimates from the closest FAWN site (Fig. 1, page 22), and soil moisture sensor data were compared with values estimated from the model (Fig. 2, page 22). Results of these tests were positive. For example, results showed that FAWN stations provide reliable ET data that can be used for irrigation scheduling, thereby eliminating the need for growers to have and maintain their own weather stations. Also, it was shown that ET-based scheduling provides the accuracy growers need for irrigation decision-making, and can sufficiently determine the amount of water needed by Florida crops, which can potentially reduce water use and fertilizer leaching.

The FAWN Citrus Microsprinkler Irrigation Scheduler was developed as FAWN's first ET-based irrigation scheduler. Since then, the number of irrigation scheduling tools available at FAWN has grown and now includes schedulers for most crops grown in Florida. The FAWN Citrus Microsprinkler Irrigation Scheduler estimates the soil water balance in multiple soil areas and layers under a mature citrus tree using tree spacing and irrigation system information provided by the user (Fig. 3, page 22). Grove in-row and between-row tree distances are used to estimate the canopy volume, which in turn is used to calculate root distribution. Irrigation system characteristics provided by the user are spray diameter, shape of wetting pattern and flow rate. These factors are used to determine irrigation delivery rate and application time. Soil characteristics for a given site can be selected from a list of soil types.

The current ET is automatically provided from a user-selected FAWN site, and appropriate Kc and allowable moisture depletion are determined based on the current date. A two-week schedule of days between irrigation and hours of irrigation duration are provided, and suggested irrigation application delays for rainfalls of up to 1 inch are also provided.

Use of the FAWN Citrus Microsprinkler Irrigation Scheduler can easily provide growers with information for irrigation decisions that will potentially improve yield and reduce fertilizer costs.

Kelly T. Morgan is an associate professor, and Rick Lusher is FAWN director, both with the University of Florida-IFAS.

CRDF approves next round of 67 research projects

By Harold Browning

Each year CRDF updates its research portfolio by requesting new project proposals from the research community. Projects are approved for up to 3 years, and thus most of the first-round projects established in 2009 are nearing completion.

In October 2011, 192 pre-proposals for new research projects were received and reviewed, leading to 114 full proposals being invited. The resulting 99 full proposals passed through two levels of scientific review, where experts evaluated the quality of science as well as the practical relevance of the research. Project reviews and rankings were forwarded to the CRDF Research Management Committee (RMC), composed of citrus growers, who then evaluated each proposal for its value in responding to infectious disease, primarily HLB and canker. As the final step in this process, CRDF's Board of Directors approved the recommendation of the RMC for 67 new projects. These projects represent a broad range of priorities addressing HLB: the psyllid vector; the citrus host plant; and the HLB pathogen. Priority areas of research on citrus canker also were included, and a few projects addressing disease-related interactions of other stresses and diseases of unknown etiology were approved. The list of approved projects, as well as the ongoing projects, can be viewed at www.citrusrdf.org.

Approximately 50 percent of the 2012 projects approved build on prior work that is focused on near-term solutions, as well as continuing directions to better understand the biology and development of the diseases, thus leading to longer-term solutions. These projects dovetail nicely with the projects already in place with citrus industry funding, and seek to move earlier results closer to field use. The total first year cost of the projects approved is approximately $7.1 million and will bring the FY 2012-13 research project cost to approximately $14 million, about $2 million less than the previous year.

At the February board meeting where the projects were approved, RMC chairman Bobby Barben provided his thoughts on the process involved in bringing the best projects forward for support by the industry. Bobby attended the 3-day Scientific Advisory Board (SAB) meeting that provided recommendations on the quality of science and practical use of results to the RMC.

Bobby stated, "The Scientific Advisory Board is a group of very smart people who are very critical of the proposed work. They spent three-and-a-half days in deep discussion of the proposals, as well as spending a lot of time reviewing continuing projects to determine if the ongoing work is on target."

The SAB represents the disciplines involved in HLB and canker research, and includes citrus expertise as well as researchers working in other plant systems. Bobby reported that he was "happy to see that the new proposals being considered relied heavily on results of previous research funded by CRDF," demonstrating that the results are "foundational to the new CATP11 projects."

Bobby expressed his comfort in the process gained by observing the SAB in action and leading the RMC, adding that his confidence in the process was increased. The citrus industry and scientists alike should be confident in the process for selecting projects of greatest value, and also can feel encouraged by the strong leadership and commitment of Bobby Barben and the other growers representing the industry on the RMC.

Harold Browning is Chief Operations Officer of CRDF. The foundation is charged with funding citrus research and getting the results of that research to use in the grove.

CRDF Grower Dollars at work for you

Column sponsored by the Citrus Research and Development Foundation