age, and FAWN weather station data for each block of the CWMS demonstration site were entered into the CWMS from information provided by the irrigation manager. Rainfall and irrigation application for each irrigation zone are provided daily using two files read by CWMS. A program to read these two files was developed to automate data collection from the large number of irrigation zones in this large grove operation. The two files utilize the report generation system of the Motorola irrigation control system. One file contains the rainfall amount for each rain gauge installed at pump stations within the grove. The second file contains daily irrigation by run time for each irrigation zone in the grove. Irrigation schedules developed by CWMS were used for a number of irrigation zones. Most trees within each irrigation zone had been affected by HLB for several years.

Soil moisture at the demonstration grove was collected using arrays of capacitance sensors reading soil moisture at depths of 4, 8, 12 and 18 inches. Observations of soil moisture values were used to manually adjust the irrigation times scheduled for blocks containing sensors. Average soil moisture for the 4-, 8-, 12- and 18-inch depths ranged from 0.08 to 0.13 cm^3/cm^3, with the lowest values during the dry months and the highest values during the rainy season. The measured soil moisture was not significantly different than the CWMS-simulated soil moisture for either of the two years of the study.

Water use based on grove acre was calculated by dividing the water applied in a block by the grove land area. Significant increases in water use were found in 2012–2013 and 2013–2014 for blocks irrigated with schedules based on grove managers' experience compared with blocks irrigated using soil-moisture-sensor data or model simulations. Likewise, comparable reductions in irrigation system run time were found for sensor- and model-irrigation schedules.

Water use with sensors and model simulation reduced average monthly

Researchers Working on the HLB Problem Are Second to None

By Harold Browning

There are a range of emotions swirling around the Florida citrus industry on a daily, sometimes hourly, basis — from optimism to pessimism to resiliency to complacency. Probably the most prominent sentiment is frustration. Why don't we have an HLB silver bullet yet? Is anything we do going to work long-term? Believe me, I feel it.

But from the beginning, we knew this was not going to be an easy puzzle to solve. We are literally dealing with the Gordian knot of citrus diseases.

The good news is that we have an impressive stable of citrus research minds from across the globe working to untie the knot. The brainpower is extraordinary. Of course we all know the talented researchers at the University of Florida and U.S. Department of Agriculture (USDA) who are pouring an immense amount of energy into this problem. We've worked with most of them for years and understand how dedicated they are to the industry.

But outside our tight Florida circle is a roster of scientists that have long and distinguished resumes. I venture to say the research push is an unprecedented marshalling of scientific resources on behalf of a specialty crop.

For example, George Bruening continues to provide a wide-angle look at the disease and is in constant contact with the public and private sector organizations who are part of our fight. Bruening is a National Academy of Sciences Fellow, a plant pathologist/molecular biologist and an emeritus professor at the University of California, Davis. He led the National Research Council Team of the National Academy of Sciences Committee on the Strategic Planning for the Florida Citrus Industry: Addressing Citrus Greening Disease; that team developed a research plan for the Florida industry. He also chaired the Scientific Advisory Board of the Citrus Research and Development Foundation (CRDF) to provide peer review of Citrus Advanced Technology Program research proposals.

And then there is Brian Federici, insect pathologist and molecular biologist, emeritus, of the University of California, Riverside. He serves as a science advisor to the CRDF-led nuPsyllid grant project. This project, funded by USDA, is a 5-year, $9-million effort of approximately 45 scientists from 22 institutions to develop a psyllid insect population that is unable to host and transmit *CLas*, the causal agent of HLB. The result of this interdisciplinary effort will be deployed in citrus as a biological control.

Federici brings unique expertise to this project, having been involved in numerous similar projects to attack mosquitos that transmit human diseases. His current activities include participation in U.S. efforts to combat Zika virus and its mosquito vectors.

These are just two names out of many.

There is no doubt that scientists have made inroads toward solutions to HLB over the past decade. There is a lot of promising research out there. Science is going to get us there, and growers can ease their frustration just a bit by knowing the best minds in the business are engaged.

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

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