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FEATURES - WATER

Growers get high-tech help wiht irrigation frequency and leaching reduction.

JOHN LEA-COX | April 26, 2011

Photos by TMP Studios

Steve Black and Terry Hines are two tree growers focused on getting the most out of their water resources, for good reason. Steve Black, owner of Raemelton Farm near Adamstown, Md., can only pump a maximum of 72 gallons per hour from his two wells. With 50 acres of trees ranging from 1-5 years in age, that amounts to less than 4 gallons of water per tree per day. His one-year-old transplants are irrigated every day. Black does all he can to minimize transplant losses, which usually amounts to less than 1 percent. There is too much capital tied up in establishing new blocks not to irrigate these young trees.

Black typically establishes 10 acres of trees every year, and until 2010, irrigated these blocks for two hours every day—amounting to about 1.75 gallons per tree. He knew this was probably sufficient, but wondered how efficient his irrigation scheduling really was. How much water is actually getting into the rootball? Was he wasting water? Could he be overwatering these trees by applying this water every day?

Soil moisture monitors

Black had some tools at his disposal to help him figure out the answer. He's been using Decagon sensor networks (www.decagon.com) since 2008 to monitor soil moisture in two indicator species, Acer rubrum and Cornus florida. Black chose to monitor these species since these give him comparative information about the fast-growing maples versus the slower-growing dogwoods. By calibrating the soil moisture sensors to his specific soil type (a Duffield-Ryder Silt-Loam) and placing sensors at 6 inches and 12 inches deep in the root zone, he knew that field capacity was about 35 percent soil moisture content. But below 15 percent, soil moisture probably starts limiting plant growth. With that knowledge, he redeployed two sensor nodes (each with five sensors) in newly transplanted rows of Acer rubrum and Cornus florida in late June 2010.

Watching the root zone

PVC tubes were augured into the ground about 1 foot away from the tree for easy placement of the sensors. Four Decagon 10-HS sensors were placed 6-inches deep directly in the center of the rootball of each tree. Apart from being able to monitor soil moisture at any time, Black can also determine from the data

transmitted to his office computer, exactly how much time it took for an irrigation event to move into the root zone, from the two drip emitters located about 12 inches on either side of each tree. The actual volume of water applied with each irrigation was measured by placing an ECRN-50 rain gauge (with a rain cover) under a dripper in the row.

In addition to monitoring soil moisture, Black has a weather node, which logs rainfall, temperature, relative humidity, and light and leaf wetness data every five minutes. A drought occurred during the summer of 2010 in western Maryland, with just 12.4 inches of rain between July and September. Consequently, with a high irrigation demand from his 50 acres of trees, scheduling irrigations with limited well capacity was a challenge for Black. He chose to monitor the transplant blocks and to maintain a target root zone soil moisture content of 25 percent.

Real-time data

Right at installation, Black made the decision to cut his two-hour per day irrigations to just one hour per day, actively monitoring both the maples and dogwood blocks. For the maple transplants from late June through early October, irrigation totaled 65.5 gallons per tree (32.75 gal x 2 drippers) over the summer. Total water applied—less than 0.75 gallons per tree per day.

Hale and Hines Nursery is using monitoring systems to make better irrigation choices.

By using this real-time information and monitoring the target soil moisture, Black had the confidence that he could maintain adequate soil moisture in these transplant blocks with only one hour of irrigation per day. And more importantly, he knew he could re-allocate more than 30,000 gallons of saved water each week to another 10-acre block of 2-year-old trees. Without this water, these trees would not have been irrigated. It's likely that in this drought year, some of the species in this block would have suffered some level of water stress, causing a reduction in growth and longer production times.

Reduce leaching

Terry Hines, owner of Hale and Hines Nursery, has a large container production nursery, the majority of which is in pot-in-pot production in the heart of nursery country—McMinnville, Tenn. Hale and Hines is a major producer of various dogwood cultivars, but also produces a wide range of shrubs and trees in 10-,15-, 30- and 45-gallon containers. Hines uses a soilless pine bark substrate in his containers. Since rooting volumes are more limited and because of the higher porosity of his substrate, irrigation demands are greater and scheduling is much more frequent than in field soils. Leaching of nutrients from containers is a certainty without careful irrigation scheduling.

Real-time reactions

With my assistance, Hines installed his own Decagon sensor network in 2009 to monitor substrate water content primarily in his dogwood blocks. In spring 2010, an additional 6-node (30-sensor) research network was installed on three red maple trees. Eight 10-HS sensors were placed in each rootball at cardinal directions (North, East, South and West) at two depths.

Hines also had a great idea—he wanted to use his networks to actually monitor water applications and leaching by making some simple modifications to the outer socket pot. So two ECRN-50 rain gauges were added to each tree to measure the applied irrigation volume from the irrigation emitter and the leachate from each tree.

Similarly to Black, Hines has a weather node that provides him environmental data on a 5-minute basis. The summer of 2010 was extraordinarily hot in McMinnville, with daily temperatures higher than 90°F from June through August. Rainfall totaled 23.6 inches between April and September, but the majority of that rain occurred in just 10-12 events. Consequently, irrigation demand was high throughout the summer and Hines had to actively monitor and adjust his irrigation schedules, sometimes on a daily basis. By monitoring the eight sensors placed in the upper and lower quadrants of these trees, he could monitor soil moisture by depth and throughout the season in real-time, relating this information to irrigation frequency and duration (volume of application).

Now that he has this information, he can reduce the number of sensors and nodes used on each tree in 2011, since he knows more precisely where to monitor in these large containers.

From May through October, 200 gallons of water (not including rainfall) were applied to these trees—data that is automatically tabulated by the DataTrac software. That equaled about 1.25 gallons of water per tree per day, excluding rainfall. According to the data, a total of 51 gallons of water leached from one of the monitored trees from May through October. The majority of this leaching appeared to be associated with increased irrigation volumes and additional rainfall in early July. Based on the data, Hines adjusted the irrigation times down after July 16, but readjusted them back up in early August due to higher temperatures and no evidence of further leaching from the container.

Remote access

Hines also reconfigured some of his other nodes in the network in May 2010 to provide him similar data for other indicator species, including Betula nigra (river birch) and various Cornus florida cultivars. This additional indicator species information has allowed Hines to extrapolate and make more informed irrigation scheduling decisions for the many other species that he grows. What is really interesting is that in both cases, Black and Hines have learned they can probably use even less water in the future, with good information and by developing smart strategies specific to their growing operations.

With both grower's consent, I set up remote access to the irrigation computers at their nurseries using a program called logmein (www.logmein.com). Having this remote access has proven to be a major time-saver for not only myself, but also Hines and Black, since they can securely access their data from anywhere with an internet connection. It has also allowed me to troubleshoot network and sensor issues with the growers on a day-to-day basis. But more importantly it has allowed everyone to discuss and learn from each other about applying irrigation water more precisely.

For more: Raemelton Farm, www.raemelton.com. Hale and Hines Nursery, www.haleandhines.com.

John Lea-Cox, associate professor at the University of Maryland, and a national team of researchers and grower partners are continuing to implement and refine this research for the green industry. *This research is supported by the USDA-NIFA Specialty Crops Research program, Award No. 2009-51181-05768. For more information about this project, visit* http://smart-farms.net.