Study seeks efficient irrigation

At the turfgrass field lab, Dr. Garry Grabow checks an irrigation controller that is connected to soil moisture sensors.

Photo by Dave Caldwell, CALS Perspective Magazine 2007

For both homeowners and local governments, water increasingly is becoming a resource of concern. Municipal and county water systems are stretched thin providing water supplies adequate to keep up with growth, while homeowners, particularly those who have made significant investments in landscaping, can find themselves forced to choose between rising water bills and keeping an expensive landscape alive.

But help could be on the way. College of Agriculture and Life Sciences researchers are investigating landscape irrigation, hoping to determine how homeowners and others can water their lawns most efficiently.

With the prospect of reducing overall water consumption in the landscape, it's no wonder that officials from three local governments have expressed interest in the study, even through it's barely under way.

The study compares different methods of irrigating tall fescue turfgrass -- the typical residential lawn - and is designed to determine which irrigation strategy is most efficient.

In the fall of 2006, researchers planted 5,000 square feet of tall fescue sod at N.C. State's Lake Wheeler Turfgrass Field Laboratory just south of the Raleigh city limits. Installed beneath the grass are 160 sprinkler heads designed to individually irrigate 40 separate experimental plots.

The site is also equipped with an array of devices that allow scientists to determine when the turf needs water. All the watering will be done in the middle of the night, between 12:30 and 6 a.m. That's the least windy time of day, and it will be less likely that water is blown from one experimental plot to another.

"We're going to compare the (irrigation) technologies against the standard type of operation," says Dr. Garry Grabow, assistant professor of biological and agricultural engineering and North Carolina Cooperative Extension specialist. "We'll compare how much water they use and what we think the turf required. We'll also compare the turf quality. If a technology can use less water and maintain turf health, that would be a good technology."

Grabow is working with another engineer, Dr. Rod Huffman, associate professor of biological and agricultural engineering, and two turfgrass experts, Dr. Dan Bowman, associate professor of crop science, and Dr. Grady Miller, professor of crop science.

The researchers will evaluate what Grabow calls "irrigation frequencies," watering turf daily, once a week or twice a week. Regardless of the irrigation frequency, this is the kind of in-ground irrigation system typically used in residential and commercial settings throughout North Carolina. The system is controlled by a timer, which is set to turn the water on at a certain time, then irrigate for a specified amount of time.

Also to be evaluated are several more complicated irrigation systems. Located beneath the turf are a number of soil moisture sensors, says Grabow. In effect, the sensors mimic turf roots and tell the researchers when the soil gets too dry. The sensors are a central element in two watering schemes.

The sensors are connected to irrigation controllers, which in this study are set to allow irrigation when soil moisture content drops below 24 percent. In one scenario, the water will come on each day at the allotted time if the moisture content is below 24 percent. Irrigation will continue for a preset amount of time.

What Grabow calls a more complicated "two-setpoint" system is also being tested. This system allows irrigation when soil moisture content drops below a certain level, then continues irrigation until soil moisture rises to a preset level, perhaps 30 percent.

"When you get to 30 percent, it cuts off," says Grabow.

Soil moisture sensors have been used in the Southwest for some time, says Bowman, adding that while such systems are more expensive to install, they may pay for themselves fairly quickly by conserving water.

Finally, an irrigation system that uses weather data to determine when to water is being tested. Grabow explains that an irrigation controller is set up to receive satellite weather data for the area. The controller then interprets the data to determine whether or not to irrigate and how long to irrigate. If significant rainfall occurs in the area, the controller would likely determine that irrigation is not needed.

It seems likely that this system will be less accurate than the sensor-based systems in meeting turfgrass irrigation needs, and that is one of the things the scientists hope to learn.

The condition of the turf will also be monitored. Turf quality will be rated on a scale of 1 to 9. Grabow admits this system is "somewhat arbitrary," adding that canopy temperature of the turf will also be recorded as a measure of turf quality. The temperature rises when the turf is stressed.

Grabow adds that all the irrigation systems are equipped with rain switches that turn off the water if it's raining. Grabow thinks all irrigation systems should be equipped with the relatively inexpensive switches.

The scientists began collecting data in late April 2007, with the project scheduled to run for at least three years. The effort is funded with a grant from the Center for Turfgrass Environmental Research and Education at N.C. State. Grabow says it has already attracted the attention of officials from Durham, Raleigh and Cary.

Grabow says the project should provide officials in these and other cities the kind of research-based information they need to deal more effectively with water conservation and use issues.

"We're tying to see what works both in terms of turf quality and efficient water use as evaluated by how much water we use," says Grabow. "We're trying to balance turf quality and conservation."

- Dave Caldwell