The great debate

Irrigation efficiency vs. distribution uniformity? Determining which is more important is a dilemma facing many golf course superintendents.

There's a great debate raging in the world of irrigation. These days the big question is: "What's more important: irrigation distribution uniformity or irrigation efficiency?"

To illustrate the question, let's play a little game.

If you were to place coffee cans spaced out evenly, one for every square foot of your golf course, and run the sprinkler system, would every can have the same amount of water in it? If it did, you would have just achieved 100 percent irrigation distribution uniformity (DU). Congratulations!

Now, let's say you also placed coffee cans, one per square foot, in your waste areas as well. If you had the same amount of water in the coffee cans on the drought-tolerant native grass as you did on the manicured turf, you wouldn't be as pleased. You would have discovered your system has very poor irrigation efficiency.

See the difference?

"Knowing the distinction is important. You can have a golf course irrigation system with good distribution uniformity and very poor efficiency, and vice versa," says Bob Dobson, president of Middletown Sprinkler Co., based in Port Monmouth, N.J. Along with installing irrigation systems, Dobson teaches classes on irrigation as an adjunct instructor at Rutgers University. He is also a past president of the Irrigation Association (IA), the organization that, along with industry advocacy and promotion of smart water use, trains and certifies irrigation auditors.

"Distribution uniformity is a measurement of how evenly water is applied over an area," Dobson says. "Irrigation efficiency is directly related to the quantity of water necessary to irrigate
a course. The lower the efficiency, the more water required."

Michael Dukes, Ph.D., is a professor and irrigation specialist at the University of Florida in Gainesville. In November, Dukes was honored with the Excellence in Education award from the IA.

"DU is basically a measurement of the variability of the irrigation applied," Dukes says. "If your target is 1 inch of water everywhere, for sprinkler irrigation, there's some variability in that. Over here it might be 0.9 inch, and over there it might be 0.8 inch, and in another location, it might be 1.1 inches. So if you measured many, many locations, you would get a sense of that variability. You'd like to have that variability very low, so if your target value is 1 inch, then you apply 1 inch exactly everywhere.

"In the real world it just doesn't work that way. A pretty good DU for sprinkler systems would be 0.75, where zero is the worst and 1 is the best, or maybe even 0.8 would be very good. There are lots of factors that figure into that: spacing of sprinklers, pressure they're run at, environmental conditions during irrigation like wind, to some extent, the topography."

The standard practice for measuring DU is to conduct a water distribution audit, says Paul Roche, Rain Bird Corp.'s national sales manager for the United States and Canada for golf.

"An audit consists of placing catchment devices across the area to be irrigated and running the sprinklers in a fashion that best represents how they would be operated during an irrigation cycle. After the irrigation event or test period, the amount that is received in each catchment device is measured and the uniformity is calculated by taking the average amount of water in the low quarter (25 percent) of the catchment devices divided by the average of all the catchment devices," Roche says. "In a few hours, DU can be calculated for several areas of the golf course. It can be used as a 'report card' for how well the sprinklers are delivering water to the turfgrass. Uniformities over 70 percent are generally thought to be good; however, it is often very possible to achieve water distribution uniformities in the 80s with a well-maintained irrigation system using newer nozzle technologies."

Without distribution uniformity, it's almost impossible to have irrigation efficiency.
A consistent benefit

So what does this mean for you and your golf course? Turns out, quite a lot.

"Golf course superintendents are frequently evaluated on the consistency of playing conditions. Higher irrigation uniformity improves turf consistency and allows for more precise irrigation. This, in turn, reduces irrigation run times and produces harder, faster playing conditions. Systems with higher distribution uniformity also typically use less water," Dobson says.

A few years ago, Dobson and his staff worked with David Pughe, the GCSAA Class A superintendent at Garden City Golf Club on Long Island, to install a new irrigation system. The old irrigation system employed large-radius, full-circle sprinklers that overthrew into the native grass areas. The system had poor distribution uniformity and, because so much water was wasted, low efficiency. To correct the issue, the new system used part-circle, short-radius sprinkler heads along the perimeter of the native areas.

"Garden City Golf Club is a true links-style golf course," says Pughe, a 23-year GCSAA member. "Since the installation of our new irrigation system, the turf consistency on our greens, tees and fairways has improved. I attribute this to better uniformity in the sprinkler coverage. We have fewer dry and wet spots, and have also been able to reduce hand watering. The elimination of overthrow into the native grass areas has improved the appearance. We used to have thick green clumps of native grass where the overthrow hit. These are gone, and the members notice the improvement.

"The improvement in the greens, tees and fairways at Garden City is a result of improved distribution uniformity. The improvement in the native areas is a result of improved irrigation efficiency," Dobson says.

Paying dividends

Another example of the benefits of improved distribution uniformity can be found in an ongoing upgrade of the irrigation system at Lakewood (N.J.) Country Club.

"We have a very limited water allocation," says Fran Owsik, the superintendent at Lakewood and a 31-year member of GCSAA. "We are gradually replacing our 25-year-old sprinkler heads with new Rain Bird heads. I have worked with Middlerown Sprinkler Co. doing irrigation audits to document the change in distribution uniformity between the old and new heads. We lay out collection cups and then run the system and measure the uniformity. We then change the sprinkler heads and do another audit.

The results at Lakewood have been dramatic.

"The improvement averages 13 percent on the greens and 10 percent on the fairways,"
A decade of success

"With where I was in my career at the time, Green Start Academy put a fire underneath me. It gave me an opportunity for education and networking I’d never before experienced in our industry – and improved my understanding of how Bayer develops new solutions. You leave there wanting to be the best of the best. It was a jump start to get involved and I left with a whole new mindset for the future.”

ANDY KLEIN, CGCS
Falcon Ridge Golf Course
Lenexa, KS

Owsik says, “The numbers are impressive and helped me sell the upgrade to our owners. Now I don’t need the numbers. I can see the difference in the turf quality on the holes where we have completed the changeout.”

For the most effective results, uniformity and efficiency must work together.

“You can have a perfectly designed system that’s very uniform and the system is capable of being efficient, but you can still be inefficient based on how it’s managed,” Dukes says. “If it’s not managed properly — meaning irrigation is not at the right time or in the right amount — that well-designed irrigation system can still be very inefficient.

“If you apply X amount and that’s just enough to supply what the plant needs, then you’re 100 percent efficient if the plant uses all the water you apply ... but if, for whatever reason, the irrigation system runs right after a rain, and none of it was needed, then all of that was wasted. So, that would be on the management side of inefficiency.”

Dobson adds, “Practices that impact irrigation efficiency include irrigating during the day when a percentage of water is lost to evaporation; irrigating at a rate above the soil’s infiltration rate, which causes puddling and/or runoff; irrigating in windy conditions where the sprinkler discharge is blown off the intended target; and irrigating with heads that overthrow the intended target.”

System improvement tips

For a new system, Dobson says there can be a difference in distribution uniformity within the same sprinkler series depending on spacing, operating pressure and nozzle selection. “Within a sprinkler model series, there is usually a sweet spot — a spot where one nozzle at a certain pressure and spacing outperforms the others. If you don’t ask, you may never know,” he says.

“The best thing that anyone can do, even anyone with a brand new irrigation system, is maintain the system. Create a routine to go and observe the system operate; make sure nozzles are clear, screens are clean; make sure heads are level. A rotor tilted five degrees can affect distribution uniformity by 12 percent or more,” Roche says. “It can be dramatic.”

Dobson agrees. “If your club doesn’t have the funds to install a new system, this doesn’t mean you can’t improve distribution uniformity. Raising low sprinkler heads and straightening tilted heads will improve distribution uniformity. A couple of tilted sprinkler heads in a pattern can lower uniformity by 10 or more percent. Upgrading the sprinkler heads typically improves distribution uniformity. If the funds aren’t available to replace sprinkler heads, replacing old nozzles with new higher-efficiency nozzles can improve uniformity.”

For more information go to backedbybayer.com/green-start-academy
As part of an irrigation audit, Rain Bird staff check the amount of water captured in a catchment device.

The power of technology

Rain Bird's Roche says irrigation system manufacturers are continually conducting research to improve products' uniformity and efficiency. New developments include high-efficiency nozzles and central control systems that integrate and communicate directly with the irrigation pumping station, weather station, in-ground soil sensors and rain cans. Hand-held devices that measure soil moisture levels can also be a "big help," he says.

Once the irrigation system is adjusted to the course's optimal settings, superintendents can apply other products more efficiently using the water where it falls. Products such as wetting agents and surfactants can help water stay in the root zone longer. Other soil amendments are available that can assist in improving the turf's ability to retain and hold moisture, making it available to the root zone when it's needed most.

So what's the answer to the original question? What's more important, DU or efficiency? Roche says, "Until you can get distribution uniformity, it becomes harder to manage the rest."

And why should this matter to you? "Golf is a highly visible industry and a discretionary user of water," Dukes says. "If superintendents can be proactive and show they're being efficient, they don't have to be on the defense when there's a drought. If they can say, 'Yes, we do use water, but here's how we're doing it efficiently,' that's a pretty powerful position to be in."

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