Irrigation Efficiency:

ATTENTION PAYS

A typical grid layout for a catch-can test. Photo courtesy: David Shaw, University of California Cooperative Extension.

By Kurt Mengel

Catch-can water audit tools include identical collection vessels, a ruler or graduated cylinder, tape measure for spacing between heads and grid layout, calculator, and a pitot tube for testing head pressure.

The goal of good irrigation management is to supply turf with the correct amount of water at the proper time. In areas where water costs are high and supplies are limited, and there is a demand for high-quality turf and landscapes, the irrigation system must be maintained for peak performance.

Among the most important concepts in securing an efficient irrigation system are:

- Irrigation systems should be designed and maintained to distribute water as uniformly as possible.
- Irrigation systems should be operated long enough to apply a depth of water equal to the needs of the landscape.
- Irrigation systems should be managed for minimal runoff.

If these three basic concepts are not met, turf will display dry spots, wet spots or both. The results are loss of plant material or the application of more water than is needed. Either way, it ends up costing more money to maintain the landscape.

There is an easy procedure you can use to audit the performance of an irrigation system called a catch-can test. With information derived from this catch-can test, you can be even more effective in managing the system. The audit will help you identify problem areas so that they can be corrected.

The irrigation audit will measure two important variables: distribution uniformity and precipitation rate. Distribution uniformity (DU) is a measure of how evenly the system is distributing water. Precipitation rate (PR) represents the depth of water delivered to an area in a given length of time. Precipitation rates are measured in inches of water per hour. Gauging these variables provides data used to calculate irrigation schedules.

While there are several methods for testing the precipitation rate of an irrigation system, there is only one practical way to measure distribution uniformity — the catch-can test.

Calculating Distribution Uniformity

The objective of the catch-can test is to obtain a representative sample of the true application rate and distribution uniformity of a sprinkler system. If a sprinkler system was truly 100 percent uniform in its water application, then a single catch can could be placed anywhere within the sprinkler pattern and consistently capture equal amounts of irrigation water.

However, since no irrigation system is 100 percent uniform, additional cans (usually 20 or more) need to be used to achieve accurate results. The layout of the containers can be in a grid, a radial or even a random pattern. A grid layout lends itself to easy catch-can data collection and identification of problem areas.

Your first task in performing a catch-can test is to collect the catch cans. With recycling efforts today, this should not be a problem. Coffee cans work great, but any container with straight sides will do. Straight sides are important for accurate precipitation rate calculations. All of the containers in the grid should be of the same configuration (all tuna cans, all coffee cans, etc.).

The grid pattern is the easiest and most practical layout for your cans. For the most meaningful data, do not spread the cans more than 10 feet apart. If you recognize excessively wet or dry areas, place a catch can there, even if it doesn't fall into the grid. The results may surprise you. Remember, for accurate precipitation rate information, use cans or containers with straight sides. This makes the calculation of inches per hour very easy.

If testing an area controlled by one valve, the testing procedure is straightforward. Large areas irrigated with two or more stations can be tested at the same time, as long as the sprinkler type and spacing are similar. If stations have different characteristics, test their coverage area separately.

Lay out your cans in a grid at a maximum of 10-foot intervals — it's crucial to keep the spacing at 10 feet or less. Run the stations long enough to catch at least a 1/2 inch of water. Run times should be equal for overlapping stations. Try and conduct your audit under real-time conditions, so that operating pressures match "normal" conditions.

Measure the depth of water in each can either with a rule or a graduated cylinder and record them on a sprinkler evaluation data sheet. Recording the data in a grid pattern representing the layout of the catch cans will help easily identify wet and dry spots.

Next, summarize your data. To do this, you must determine the average depth of water in all catch cans and then calculate the average of the lower 25 percent of the readings.

The distribution uniformity is then calculated by dividing the average of the lower 25 percent by the overall average of the catch can readings, or:

$$DU = \frac{\text{Average of the low quarter}}{\text{Average of all}} \times 100 \text{ (for a percentage)}$$

With a good design and modern equipment, systems should attain an 85 percent DU. Decreasing uniformity rates indicate a problem with the system and the resulting increased amounts of applied

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irrigation water to adequately cover dry spots and maintain turf quality. Problems to look for include:

- Improper operating pressures
- Poor spacing of heads
- Sprinkler head tilt
- Mixed equipment types
- Mismatched precipitation rates on a zone
- Broken equipment
- Misalignment of equipment
- Wind drift
- Improper installation
- Altered conditions after installation, like plant material interfering with spray patterns, etc.

Making a Match

One of the more frequent problems contributing to low DU is precipitation rates that are not matched. Generally, PRs more than 1.0 inches per hour are considered high; 0.5 to 1.0 moderate; and less than 0.5 low. Low precipitation rates are useful when designing for slopes and soil conditions conducive to runoff and/or erosion.

Fixed spray heads and bubbler systems typically have high PRs. Impact rotor and gear rotor systems generally have low to medium PRs. Manufacturers' catalogues usually list precipitation rates for their products used in triangular and square spacing designs. Spacing is typically 50 to 60 percent of the diameter of the sprinkler's throw.

An irrigation system that utilizes sprinkler heads with identical PRs is said to have a "matched" precipitation rate. With proper system design, matched PRs minimize excessively wet and dry areas in the landscape.

Because manufacturers market fixed spray heads with matched PRs, their use in rectangular areas is relatively straightforward. Odd-shaped areas and strips require more design creativity and frequently require more valves.

Rotor heads also have incorporated the concept of matched PRs. They achieve this by using different-sized nozzles to match the sprinkler arc. The selection of nozzles for these rotor heads to secure matched PRs is the same in principle as nozzle selection for fixed-spray heads.

For heads with similar radius of throw, as the arc increases so should the flow rate. For example, if the flow rate of a quarter-circle head is 1 gallon per minute (GPM), the half-circle should be 2 GPM and the full-circle should be 4 GPM.

Bear in mind that if you alter or vary the throw radius of rotor or impact sprinkler heads on the same valve, you will be changing the precipitation rate. As the radius decreases, the same amount of water is covering a smaller area. Therefore, the precipitation rate goes up.

With fixed-spray heads, reducing the radius reduces the amount of water dispensed from the head. Therefore, the PR is reduced. Since the spacing was not changed, the uniformity of water distribution clearly would not be as good. Be careful when adjusting the radius of throw of heads. Your carefully-matched PR may no longer be accurate.

Pressure-compensating devices may be useful in improving matched PRs because they are designed to ensure that the same amount of water comes out of the sprinkler heads within a given pressure range. This may be particularly helpful on long laterals and in areas where elevation varies significantly. It may be in your best interest to further investigate the use of pressure-compensating devices.

Calculating Precipitation Rates

The precipitation rate of the system is determined by finding the average depth of water in the catch cans. Assuming that the catch cans have straight sides, the following formula may be used:

$$\text{PR in inches per hour} = \frac{\text{Average depth in inches} \times 60}{\text{Test time in minutes}}$$

The precipitation rate and distribution uniformity of an irrigation system are required to calculate proper irrigation schedules. Together, the PR and DU tell us how long it will take to apply the needed amount of water to the driest areas.

The catch-can audit is an invaluable tool to continually monitor a sprinkler system's efficiency and effectiveness. Identifying and correcting problems with this technique will help sports turf managers save resources and money. ❑

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