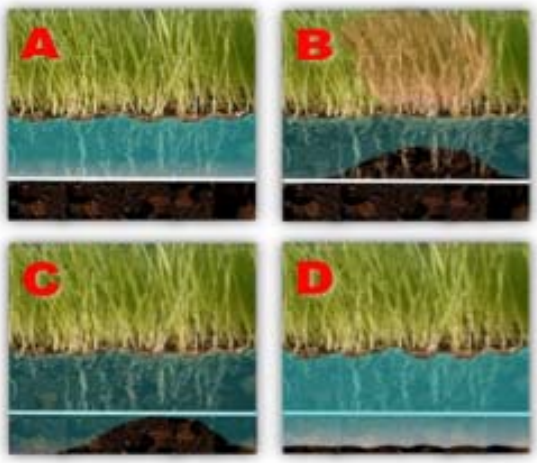
The Science of Irrigation: Efficiency vs. Uniformity
By Melissa Baum-Haley, Ph.D., MWDOC Water Use Efficiency Programs Specialist

When is the last time you observed your sprinkler system running? Observing your sprinkler system in action can help you save water by improving both the irrigation system efficiency and uniformity. This article will explain the difference between efficient irrigation and uniform irrigation – and what you can do to achieve both when you water your lawn and plants.

The terms efficiency and uniformity are often confused when discussing irrigation. It is a common mistake to use them synonymously. Efficiency refers to how much of the water applied to the plants is ultimately used by them, while uniformity refers to how evenly the water is applied. Uniformity is increased with proper landscape coverage. And while an irrigation system can have sufficiently good uniformity, this does not mean that the actual irrigation event is necessarily efficient.

Here's a little game to test your knowledge. The following illustrations depict four irrigation water application scenarios in the soil. Within the root zone of the plants, indicated as the area below the ground surface and above the line, the water is used beneficially. Below the root zone, below the white line, the water is lost to deep percolation (drainage). Can you tell the difference between the efficient and uniform irrigation?



(A) The irrigation water applied is both uniform and efficient (the goal).

(B) While efficient in terms of conservative water use, the irrigation was not uniform. Under-watering areas in the root zone will result in plant quality decline (leading to pest and weed invasion, or "dry spots").

(C) The common cure the "dry spots" is watering longer. This leads to non-uniformity and inefficiency due to over watering some areas.

(D) Uniform but inefficient due to overwatering, resulting in drainage below the root zone (which, with time, can result in plant loss as well as the transport of excess nutrients, fertilizers and pesticides that harm the environment).

So, how does your irrigation system compare? Here's a simple way to evaluate the uniformity of the irrigation distribution in your own yard.

You will need:

- 16-24 empty tuna cans, pet food cans, ramekins, or similar containers for water catchment (note: all catchment containers must be the same size)
- A ruler
- A pad and pen

What to do:

- Evenly distribute the catchment containers around the turfgrass area.
- Draw a map of the catchment container locations.

- Irrigate the turfgrass area as usual.
- Measure and record the depth of water collected in each container.

Results:

- If there is more than a ¼ inch variation of water collected within a certain area of the test site, the distribution of applied irrigation is not uniform.

Want to know more? What you have just measured is the uniformity of how you water your lawn during your regular watering cycle. The lack of even distribution (uniformity) can result from either 1) how the timer is set, or 2) the sprinkler equipment. Let's dig a little deeper.

- Manually turn on the irrigation system, zone by zone.
- Determine which zone(s) are watering the turfgrass area.
- Note whether the zone(s) are using spray heads, rotor heads, or other.
- Observe the sprinklers as they run.

Spray Head

Rotating Nozzle (can replace a spray head for increased uniformity)

Rotor Head

Q: Is the area irrigated by more than one type of sprinkler head?

A: Different types of sprinkler heads will apply different amounts of water (referred to as the application rate).

Q: Is the test area irrigated by one, two, or more zones?

A: If the test area is irrigated by multiple zones, the scheduled run time for each zone must be matched. If the zones both have the same equipment type (sprinkler head), try retesting so each zone is set to run for the same length of time (for example, 15 min). If the zones water the area with different types of sprinklers, use this rule of thumb for rerunning the test, set the spray head zone to run for half of the time as the rotor head zone.

Q: Are there any geysers, leaks, or ponding?

A: Broken equipment can result in variations in water pressure within the system. Changes in water pressure will affect the water distribution pattern and system uniformity.

Issues like these reflect both the uniformity of distribution and overall efficiency of the system. Good uniformity combined with proper irrigation scheduling will result in reduced pest and weed invasion and fewer “dry spots”.

Remember, even the smartest of irrigation controllers cannot correct for inefficient irrigation design, improper installation, or lack of maintenance. The potential of water savings that result from efficient watering practices must take the irrigation system, landscape design, and maintenance each into consideration. The three fundamental roadblocks for fully achieving the watering efficiency potential when considering the use of irrigation technologies are: (1) how to use the equipment, (2) when and how long to water, and (3) system uniformity. This requires a holistic approach, to realize true water use efficiency potential.

So, we've now completed the second lesson in our Science of Irrigation series. In the next installment, we will examine irrigation controllers and explain just what makes a "smart" controller so smart.