What happens when we irrigate?

Using the fundamentals to reduce water waste

by John Ossa

An area of critical concern for our industry is landscape water management: **effective use of water when scheduling irrigation.**

Numerous studies have shown that fall is the season where the most over-irrigation, or waste, occurs.

Typically, summer or peak season irrigation schedules are not adjusted downward as days become shorter and ambient temperatures drop. Spray irrigation hardware, with its inherent inefficiencies, adds to the problem. Fortunately, the green industry is responding with new technology and better training.

Back to basics

Water waste due to irrigation scheduling boils down to a lack of grounding in the fundamentals of "what happens" when we irrigate.

What we are trying to irrigate is a **root zone**. If we thought of the whole block of soil around the roots as a reservoir, then we could think of irrigation as an act of sustaining the reservoir so that water is available to the plant. The trick is to fill the reservoir (root zone) in a way that **encourages and produces more and deeper roots.** To do that takes a basic understanding of four different issues: plant water requirement, weather, irrigation hardware, and last and perhaps foremost – soil, specifically how water is held by and moves through soil.

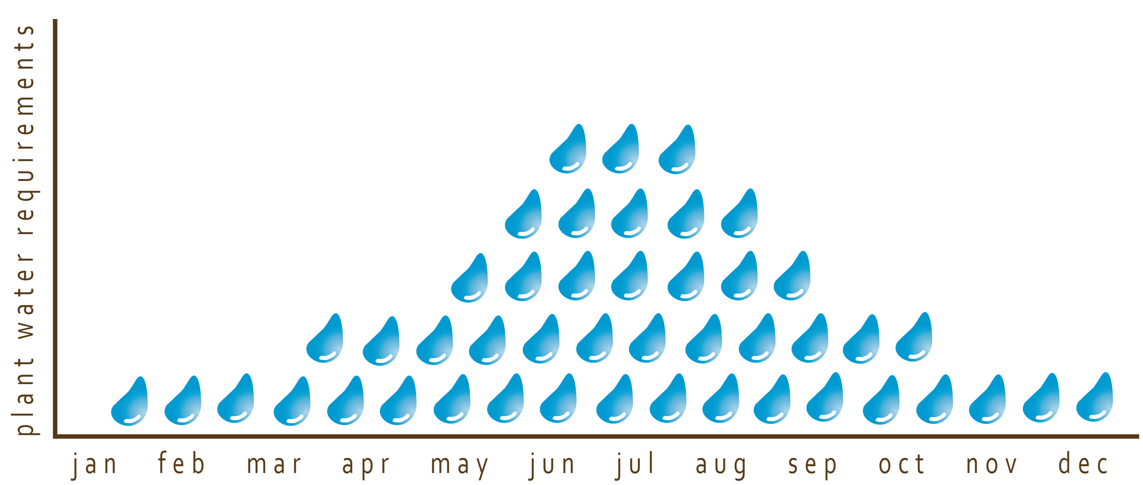
Plant water requirements

To state the obvious, different plants have different water requirements. Any given plant has a water requirement that **changes throughout the year** in direct correlation to the length of the day. So, plant water requirement is a moving target, moving in a bell shaped curve on an axis that has January and its' short days on the left, peak season (typically July) in the middle, and December on the right.

There are several drivers to plant water requirement but keeping it simple, they are **plant genetics, length of day, the strength of sunlight or heat, and wind.**

So, if you are using a schedule that keeps your landscape thriving in July, any other time of the year – and particularly in fall as the days become shorter – you are wasting water.

What is described by the bell shaped curve – the increasing/decreasing plant water requirement – is formalized in scientific nomenclature as **evapotranspiration (ET)**: the combination of



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water transpired from vegetation and evaporated from the soil and plant surfaces. For scheduling purposes in turf and landscape, this value is typically a monthly average when corrected for plant species characteristics, and can be used as a baseline to evaluate the plant's expected water needs in that geographic area.

In our industry I believe this is understood in principle, but often misinterpreted in practice. I am amazed by how often contractors I meet promote the idea of irrigation scheduling as merely adjusting up/down based on a percentage of the peak season value. As a crude approximation of a direction to aim that is ok, but that's all!

Hardware limits

It is helpful to understand the limitations of irrigation distribution hardware. For many years we have used fixed sprays, impact heads, rotors and multi-stream nozzles -- spray irrigation hardware of various configurations. They all **share key characteristics and constraints**; they irrigate in circles or part circles. But landscapes have straight edges and often rectilinear areas, so inevitably there is overspray onto non-landscape or a majority of a given area is over-irrigated, to give the least "overlapped" area an adequate minimum of water.

Soil

When spraying water on the surface, above the roots, we seek to flood the surface to the point that water will infiltrate and move down with the force of gravity through the soil's pore spaces. This downward percolation is **gravitational water**: water in such concentration that it can't be held by the soil so it moves downward with the force of gravity. If thought about this way, it points out the high potential for waste inherent in spray irrigation. Although plants will certainly take up gravitational water while it is moving, the practical reality is **most of the water is wasted to runoff and deep percolation**.

Through scheduling we are attempting to time the "right amount" of water to infiltrate down through the root zone and stop at its lower perimeter.

Putting it all together

Putting all these factors together is to understand key aspects of the soil, water, and plant interaction.

The water content in soil is not the sole determinant of what is available to plants for their plant water requirement; it is **soil particle size and density** that determines if water will be available to plants. The smaller the majority of particles, the more tightly water is held. A sand-sized soil and a clay-sized soil with the same amount of water have completely different amounts of water available to plants. For example:

> Sand with 20% water by volume may only bind 5% (water by volume) tightly so 15% is freely available for plant uptake.
>
> In contrast, clay with 20% water by volume will bind water so tightly (because of its extensive surface area of fine particles) that none of the water will be freely available to plants. Therefore plants in that situation may not be able to uptake any water and may begin to wilt.

This example emphasizes the importance of **understanding soil type and structure** to maintain an adequate and consistent moisture level in the root zone. The water availability defined by soil type is one of the reasons why reflexively adding/subtracting minutes to irrigation events, as a percentage of ET is a crude methodology at best.

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Looking forward

For our industry to grow it may need to embrace irrigation without flooding, or creating excess gravitational water. We need to **focus on supplying the right amount of supplemental water** to what nature may provide through rain or groundwater. Fortunately there is a **new class of technology** available, a significant improvement over existing sub-surface drip irrigation has gained acceptance around the world. This technology incorporates textiles along with pre-embedded emitter tubing to create highly uniform wetting of the soil. The tubing supplies a low volume of water; the textile distributes it in a highly uniform manner. Sub-surface textile irrigation leverages the principle of capillarity to move water upward though the root zone. The soil simply does not "take up" more than it can hold. Therefore there is no flooding or gravitational water loss, creating an ideal soil, air pore and water relationship – one that will promote root development. These unfailing principles at work in nature, combined with reliable distribution hardware, provide the opportunity for **extremely high irrigation efficiencies**.

Regardless of the irrigation hardware used, how much water a given soil can hold and how long to irrigate before water becomes gravitational water is "knowable." Recognizing the need for grounding its members in science-based irrigation scheduling, the California Landscape Contractors Association developed the Water Management Certification Program. This is a performance-based program that teaches science-based concepts in a practical manner. With training like this, and new high efficiency sub-surface textile irrigation hardware, the green industry will continue to evolve and provide the sustainable solutions that communities are seeking.

About the author

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