Introduction to Landscape Irrigation in Louisiana

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Introduction

Despite the perception of an abundant water supply in Louisiana, irrigation is commonly needed for establishing and maintaining healthy landscapes for plants with generally shallow roots and because of extreme hot or dry weather conditions in the summer months. The plant water requirement, or the amount of water needed to sustain a healthy plant, cannot always be satisfied by natural rainfall alone. Even when rainfall occurs, not all of it can be stored in the soil. For example, high-intensity storms can cause rainwater to runoff into ditches rather than infiltrating the soil. The responsible way to irrigate is to follow a motto: "Right time, right place, right amount." This article will provide an overview of irrigating landscapes appropriately based on this motto.

Right Time

It's important to remember that irrigation should only be used to supplement rainfall during periods of significant plant growth. The need for irrigation can be expressed as the irrigation demand or plant water requirement. The plant water requirement can be approximated as the potential difference between water leaving the system through evapotranspiration and water entering the system through rainfall. Estimations of the plant water requirement were calculated using historical weather data for multiple locations around the state (Figure 1).

The reference evapotranspiration (ET_O) curves represent the natural growth periods of typical perennial plant material with peak growth occurring during the summer months. The ET_O was calculated using the standardized reference evapotranspiration equation that assumes a short grass as the reference plant material. As a result, these ET_O curves best approximate a turfgrass lawn. However, these curves can be adjusted for other horticultural plants common to the Louisiana landscape using crop coefficients if they are available.

According to the historical averages, the highest irrigation demand occurred in the northern and central areas of the state where rainfall was less abundant from the spring through the fall. Abundant rainfall can occur during many parts of that timeframe within a humid region such as Louisiana. Not all rainfall events are fully effective (i.e., enter the root zone), even when cumulative totals exceed cumulative demand, making irrigation timing an extremely important concept.

Ideally, irrigation should occur in the early morning hours between 2 a.m. and 8 a.m. Irrigation occurring after 8 a.m. results in increased losses to evaporation prior to infiltration, allowing only a portion of the irrigation to become available to the plant. This reduces the efficiency of the irrigation events, ultimately requiring more water to achieve the same growth potential. Irrigation occurring in the evening or at night — 6 p.m. to midnight — is the next best option. However, evening irrigation can exacerbate the potential for diseases because of moist conditions on the leaf blades for an extended period of time. Irrigating between midnight and 8 a.m. provides enough time for water to infiltrate the soil followed by morning evaporation to dry the leaves.

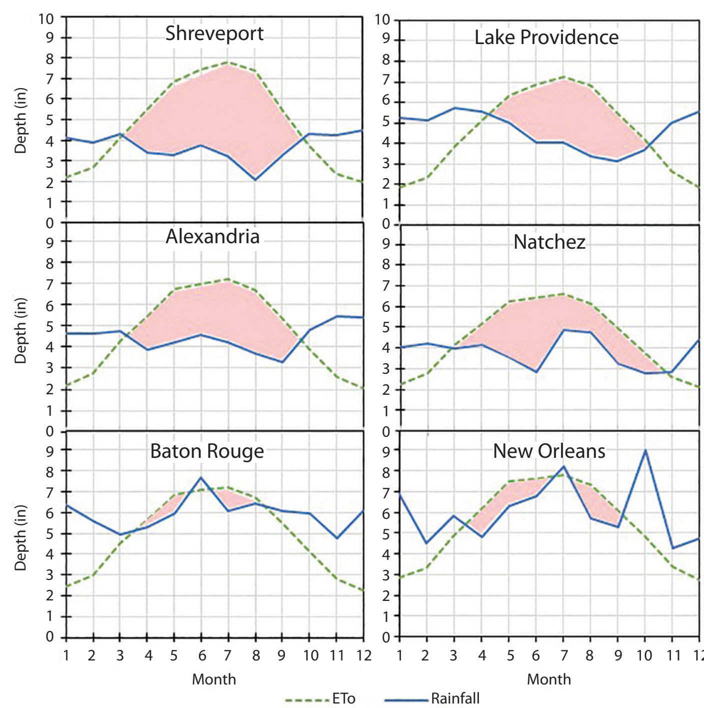

Figure 1. The difference between ET_O and rainfall was calculated using historical weather data as a general way to approximate the plant water requirement. The shaded region indicates the need for irrigation, assuming all rainfall is effective.

Right Place

The first step to efficient irrigation is to have an adequately designed and installed irrigation system that can distribute water uniformly throughout the landscape. A properly designed irrigation system will minimize water placement outside of the active root zone while maintaining good hydraulic operation. An improperly designed system will only waste water, time and money. Some considerations for installing a new system or updating an older system include:

Pressure: The entire system should be designed to account for the pressure available from the water source, the optimal pressure to run the sprinklers and the amount of pressure that the pipe can handle. Too much pressure can put unnecessary stress on the pipe joints, increase the frequency of sprinkler replacement and cause increased losses of water to evaporation from misting. All these issues decrease the efficiency of the system. Too little pressure can significantly reduce the spray radius, resulting in decreased distribution uniformity and potentially dry areas around the landscape.

Sprinkler heads: The sprinkler head placement is critical to achieving good uniformity. Sprinklers are designed to apply more water toward the edge of the spray pattern than at the base of the head. A properly designed system uses head-to-head coverage, or complete overlap, so that the edge of the spray pattern hits the base of the next sprinkler in the same zone. If the design calls for sprinklers spaced farther apart, then the designer may be trying to save on the system cost by installing fewer sprinklers. Although this may also save the owner in upfront costs of the irrigation system, it will ultimately create unnecessary long-term costs related to plant stress that can lead to pest, weed or disease problems; supplemental manual watering; replacement of plant material; or inefficient use of water resources. An irrigation audit conducted by a licensed irrigation professional can help determine if the sprinkler placement was adequate for good landscape health.

Hydrozoning: This concept is defined as the creation of irrigation zones based on location-specific water needs instead of just geographical location. Considerations for determining plant water needs include plant type, soil type, sun and shade amounts, and slope. For example, a turfgrass with 12 hours of full sunlight per day will require more irrigation than established drought-tolerant shrubs that receive four hours of filtered sunlight per day. If these two scenarios were placed together in the same zone, then the shrubs would receive too much water to maintain turfgrass health or the turfgrass would suffer to maintain the health of the shrubs.

Licensure: It's important to be selective in choosing an irrigation professional with good qualifications. The Irrigation Association encourages professionalism through certifications in many areas, including designing, auditing and managing irrigation systems. Also, the Louisiana Department of Agriculture and Forestry requires landscape irrigation contractors to hold a license in good standing before they may design, install or maintain irrigation systems within the state of Louisiana. Although employees of licensed irrigation contractors are not required by law to officially train their employees, some professionals encourage or even require continuing education, certification or licensure for their technicians. As the customer, the recommended practice includes requesting a list of all qualifications when receiving a quote and verifying their authenticity through the appropriate agency.

Right Amount

In landscape systems, a soil-water balance is the best way to schedule irrigation events. This concept is based on the law of conservation of mass that allows the accounting of water movement through the active root zone using the following equation:

$$SWL_i = SWL_{i-1} - ET_{L,i-1} + R_{E,i-1} + I_{E,i-1}$$

SWL = Soil water level (in.)

ET_L = Landscape evapotranspiration (in.)

R_E = Effective rainfall (in.)

I_E = Effective irrigation (in.)

i = Duration

The SWL represents the amount of water in the root zone of the top soil at any given point in time. Every naturally occurring soil system contains the combination of soil particles with pore space for air and water storage (Figure 2). While the total volume and the volume of soil particles do not change during the irrigation season, the volume of water can fluctuate, resulting in changes of air space. The SWL can be expressed as a depth (e.g., 1.5 inches of water) or as a volumetric water content (e.g., 25 percent) when dividing by the estimated root depth. Volumetric water content is the ratio of the water volume to the total volume of the soil.

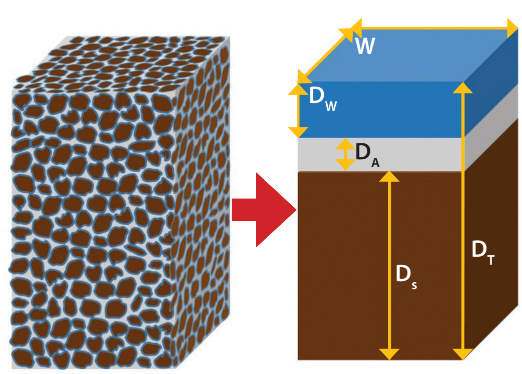

*Figure 2. Every naturally occurring soil column contains soil particles with pore space containing some combination of air and water. The volume of air space (DA*W*L) is affected by changes in water storage (DW*W*L) because the soil volume (DS*W*L) and total volume (DT*W*L) remain constant.*

Plants absorb water from within the soil and release it primarily through the surface of the leaves. This process is called transpiration. Additionally, areas of exposed land surface are subjected to evaporation, or the release of water from the soil surface to the atmosphere. Examples of exposed land surfaces are bare soil and the small areas between and around turfgrass, leaves or mulched areas. The combined processes of evaporation and transpiration of a landscape is termed landscape evapotranspiration (ET_L). Landscape evapotranspiration is explained further in Figure 3.

In general, ET_L is the primary process that causes a decline in soil moisture. Ideally, rainfall supplies the root zone with enough water to balance ET_L. However, rainfall is highly variable and sometimes intense. Thus, the plant water requirement is calculated as the difference between ET_L and effective rainfall (R_e), or the amount of rainfall able to be stored in the soil. Irrigation is a good way to supplement rainfall during drought cycles, which can occur in as little as two weeks or when high intensities lead to little storage of the rain in the soil.

Once the necessary amount of irrigation is calculated, it must be converted into a time (minutes) to program into the irrigation controller. This calculation requires two key pieces of information: the area of the zone (square feet [ft^2]) and the application rate of the sprinklers (gallons per minute [gpm]). The area can be roughly calculated with a walking measuring stick or tape measure. The application rate requires running the zone for a specified time and measuring the volume of water used, typically from the utility water meter. If your actual application rate is unknown, then the estimated information can be found for most sprinkler nozzles on technical specification sheets on manufacturer websites. The calculation to apply one-half inch of water over 500 ft^2 with an application rate of 20 gpm looks like this:

$$0.5 \text{ in} \times \frac{1 \text{ ft}}{12 \text{ in}} \times 500 \text{ ft}^2 \times \frac{7.48 \text{ gal}}{1 \text{ ft}^3} \times \frac{\text{min}}{20 \text{ gal}} = 8 \text{ min}$$

Most irrigation practitioners will not take the time to calculate a soil-water balance for irrigation scheduling on their own. Alternatives to estimating soil moisture include:

Look and feel method: This method includes digging a small hole at least 2 inches below the surface and placing soil from the hole into the palm of your hand. There is sufficient moisture if the soil holds together when squeezed into a ball, but irrigation should be scheduled if it crumbles apart.

Visual plant status: Most plants will show visible signs of water stress by curling or folding leaves, discoloration or loss of rigor. When using this method, it's important to understand that visual signs of drought stress occur when the soil moisture has reached a critically low status, and irrigation should be applied swiftly to prevent permanent damage or death. A good example of this technique would be to schedule irrigation when you firmly step on a turfgrass and it does not spring back to the original orientation.

Smart irrigation technology: The irrigation industry has taken advantage of today's available technology to develop products that can determine when and how much irrigation should be applied. Currently, the two main categories of products on the market include weather-based irrigation controllers and soil moisture sensors.

A weather-based irrigation controller either replaces or interacts with the automatic irrigation timer already controlling the system. The device obtains weather information (e.g., temperature, solar radiation, relative humidity or wind speed) to calculate ET_O. Then it uses the soil-water balance to estimate the irrigation requirement. Failing to specify the correct settings to adjust each zone can cause a significant error in the estimation. It is critical that the controller be installed and programmed by someone who understands the soil-water balance.

Soil moisture sensor (SMS) products consist of a sensor installed in a centralized, sunny, open-air location that wires into a solenoid valve and a controller that replaces or interacts with the automatic irrigation timer. The SMS will bypass irrigation events when it reads above a programmed threshold and will allow irrigation when below the threshold. If using an add-on device, the irrigation timer will still need to be programmed appropriately to prevent over or under-irrigation.

Conclusion

Over-irrigating can be just as detrimental as under-irrigating in many scenarios. However, it's important to strive for better water management rather than no water management. If irrigation scheduling seems unattainable for any reason, keep in mind that a turfgrass in full sun should need no more than 1.5 inches of water per week during the hottest part of the year and can usually handle less. Most soils cannot accept 1.5 inches of irrigation in one application, so those events should be broken down into two to three days spaced throughout the week and skipped if rainfall occurs.

Other recommendations for improving efficiency without scheduling include:

- Leaving the timer in the off position until you're sure that the landscape requires irrigation.
- Only irrigating zones showing signs of water stress.
- Occasionally running the system during the day to check for leaks, clogs or other performance issues.

Landscape irrigation frequently occurs in urban areas where there is already competition for water resources from multiple sectors, such as power generation and public supply. This competition puts an economic strain on our underground aquifers, which are consumed at a much faster rate than they are recharged. Thus, landscape irrigation must become more efficient to be a sustainable practice and avoid additional regulation. While water sustainability affects the entire community, efficient irrigation can also help the economic investment of the owner by contributing to the longevity of the landscape through good plant health.

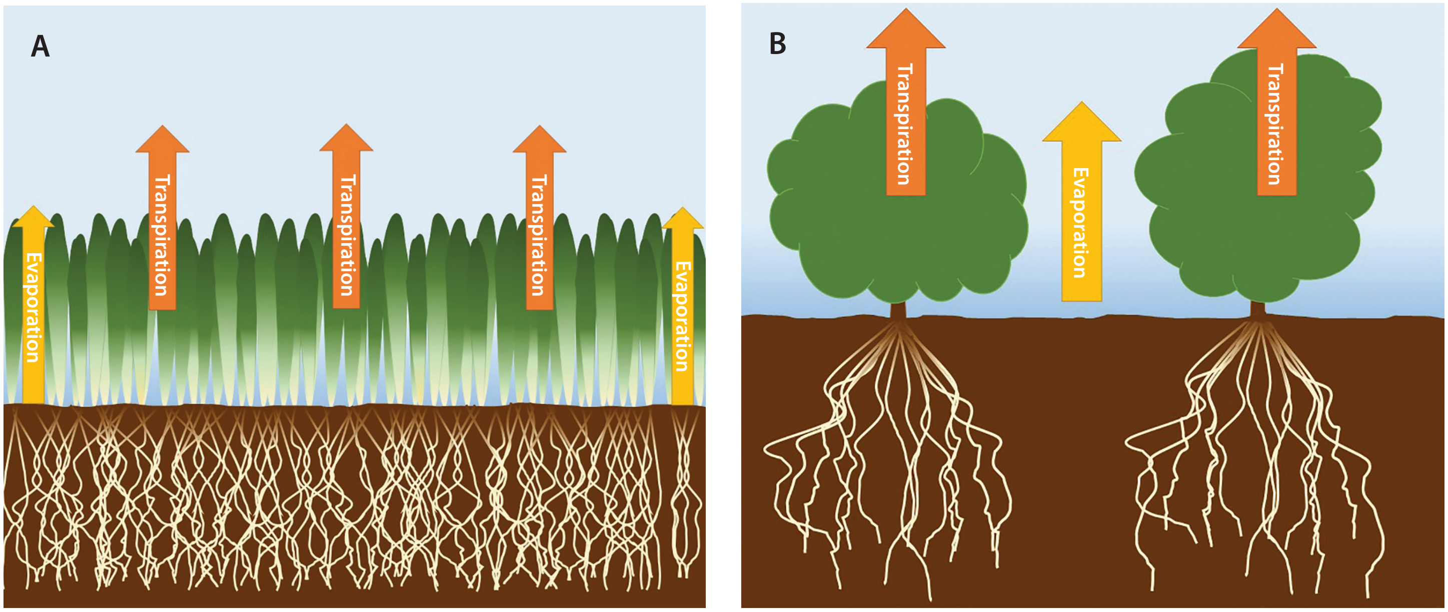

Figure 3. Landscape evapotranspiration represents the combined evaporation from the soil surface and transpiration from the plant material in a landscape system. Transpiration is the dominant term in dense plant materials such as turfgrasses, (A) whereas evaporation is a major component in situations where bare ground occurs in the landscape (B).

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