Importance of Proper Irrigation Management in Christmas Trees

Proper irrigation plays a key role in promoting the growth and survival of Christmas trees, particularly in newly established fields during drought conditions. In Michigan, a recent survey found that 32% of Christmas tree growers are planning to install or expand irrigation systems. Despite this interest, determining the appropriate timing and amount of irrigation remains challenging. Water requirements depend on several factors, including soil water-holding capacity, tree developmental stage, and weather conditions. Over-irrigation can lead to soil erosion, increased risk of root diseases, nutrient leaching, and unnecessary use of water and energy. On the other hand, under-irrigation can limit soil moisture availability, reducing tree growth and survival.



Figure 1 – *Center pivot irrigation system in a Christmas tree field.* Credit: Dr. Bert Cregg

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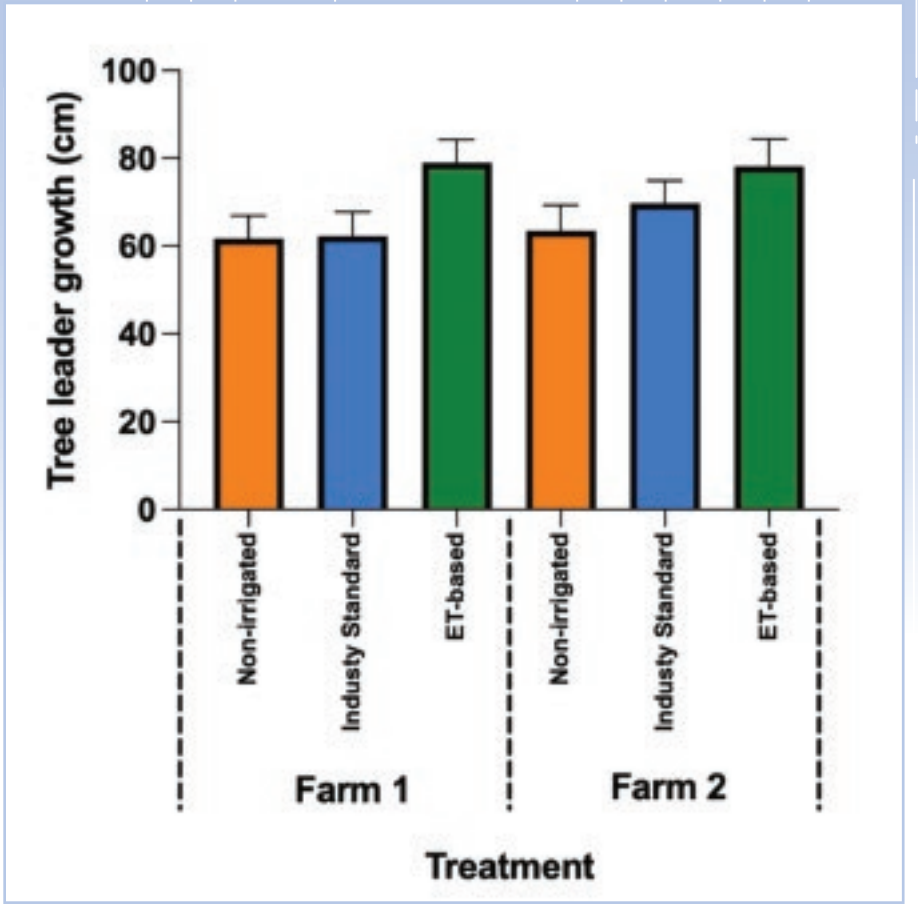

Figure 2. *Cumulative two-year (2024 +2025) leader growth for each irrigation treatment at two demonstration Christmas tree farms. Credit: MSU Christmas Tree Team.*

To help address these challenges, the Michigan State University Christmas tree team established irrigation trials at two commercial farms in Allegan and Wexford counties. The study compared three treatments: no irrigation, grower-standard irrigation (e.g.; rule of thumb, 1" per week) and evapotranspiration (ET)-based irrigation. ET-based irrigation scheduling estimates crop water use by accounting for water lost through evaporation from the soil and transpiration from the trees. Weather data are used to estimate reference potential ET (RPET), which is based on a well-watered 6-inch grass surface. The MSU Enviroweather website (enviroweahter.msu.edu) provides RPET current and projected estimates for stations throughout Michigan. This reference PET is then adjusted using crop coefficients that vary by crop type and growth stage to estimate actual crop ET, enabling growers to apply only the amount of water lost since the last rainfall or irrigation event. Results from 2024–2025 showed that ET-based irrigation increased cumulative leader growth by about 10-30% compared to both the grower-standard and non-irrigated treatments. These findings indicate that scheduling irrigation based on ET can help to maintain optimal soil moisture, improve growth, and enhance water-use efficiency.

Practical tools for implementing irrigation scheduling are available in the *Irrigation Scheduling Tools fact sheet*. In addition, in-field soil moisture monitoring using sensors is recommended, as it tracks soil moisture dynamics within the root zone, enhances understanding of crop water use, and helps prevent both over- and under-irrigation. Soil moisture sensors provide continuous, non-destructive measurements of soil water content or soil water tension, allowing growers to monitor how water moves through the soil profile and is used by the crop over time.

These sensors are typically installed at multiple depths within the root zone to capture real-time changes in soil moisture following rainfall and irrigation events. The data helps growers determine when soil water has declined to a threshold (e.g., maximum allowable depletion) where irrigation is needed, and how much water should be applied to refill the root zone without exceeding field capacity.

A range of sensor types is available, including capacitance (FDR) sensors and time domain reflectometry (TDR) sensors that estimate volumetric water content, as well as tensiometers that measure soil water tension, an indicator of how difficult it is for



Figure 3. *Installed soil moisture sensor monitoring system in a Christmas tree farm.*

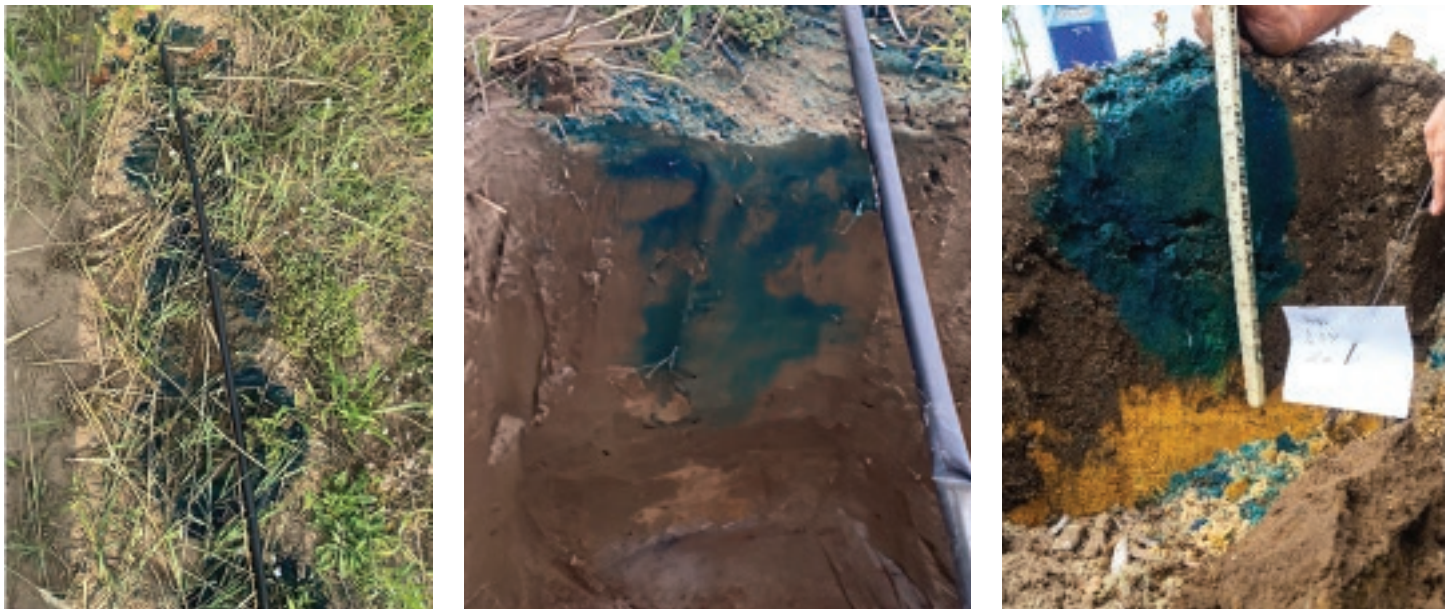

Figure 4. *Blue dye test illustrating the distribution and depth of irrigation water within the soil profile.*

plants to extract water. By providing site-specific, real-time information, soil moisture sensors improve irrigation timing, reduce water and energy use, minimize nutrient leaching, and support better crop growth and yield. Information on using soil moisture sensors for irrigation management can be found in *MSU Extension Bulletin E3445: Improving Irrigation Water Use Efficiency: Using Soil Moisture Sensors.*

In addition to soil moisture sensors, a blue dye test can be used to evaluate whether too little or too much water is being applied. Blue dye provides a visual representation of how irrigation water moves through the soil profile and distributes within the root zone. By revealing the depth and spread of the wetted area, it helps growers assess whether irrigation is reaching the active roots of Christmas trees or moving beyond them.

This blue dye testing method allows growers to diagnose irrigation performance directly in the soil. For example, a shallow or narrow dye pattern indicates insufficient water application, while deep downward movement suggests over irrigation and potential nutrient leaching. Based on these observations, growers can adjust irrigation duration, frequency, or system design to better match tree water needs and improve overall irrigation efficiency.