Pecan Water Requirements and Irrigation Scheduling

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UNIVERSITY OF GEORGIA
EXTENSION

Water has more of an effect on pecan production than does any other environmental factor. Drought stress affects nut size and filling, leaf and shoot growth, and return crop. Adequate soil moisture is necessary to stimulate strong, vigorous growth from budbreak through shell hardening for nut size, and during the nut filling stage for optimizing kernel percentage. If trees do not receive adequate soil moisture levels late in the season, shuck split and energy reserves are affected.

Pecan trees extract most of their water from the upper 32 inches of the soil profile. Though they are deep-rooted, most of the deep water available to the tree is considered survival water and is not useful for fruit production. The deeper the available water, the less water the tree will usually be able to absorb. Excessive water stress will cause the tree to shed leaves, drop nuts, or only moderately fill the pecans.

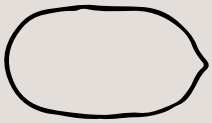
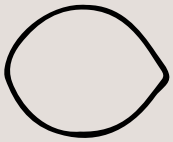
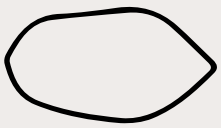
Water stress in pecan correlates with soil moisture from budbreak through the end of nut sizing. Pecan trees bearing a moderate to heavy crop load may undergo water stress during the kernel filling stage regardless of soil moisture level. This suggests that crop load and nut development drive the tree's demand for water.

Nut Sizing Stage

The nut sizing period normally occurs from May 1 through August 15. Although the nut sizing period is not a critical water use stage for pecan, serious drought conditions during this period can affect yield.

The most common visible effects of an extended drought during this period are excessive nut drop and "shell hardening" on small nuts. Additionally, lack of sufficient water during the nut sizing period causes small or misshapen nuts (Table 1) and may lead to water stage fruit split, resulting from a sudden influx of water during the nut filling stage in some varieties. The effects of drought on nut size can be observed in Figure 1.

Table 1. Effect of the timing of water deficit on nut shape and size (Adapted from Sparks, 2006).

Nut Profile	Nut Size and Shape	Water Deficit Timing
	Normal	No Water Deficit
	Reduced size; normal shape	Throughout Season
	Reduced size; round shape	June to July 15
	Slightly reduced size; obovate shape	July 25 to August 15

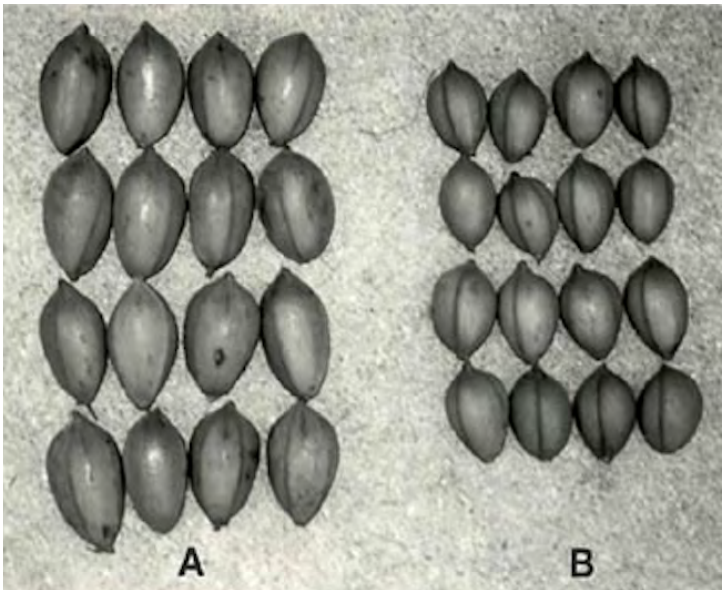


Figure 1. Effect of adequate water during the nut sizing period. Pecans on the left (A) are from irrigated trees, while those on the right (B) are from non-irrigated trees. (Adapted from Sparks 2006).

Nut Filling Stage

The nut filling stage occurs from about August 15 through the first week of October, depending on variety. Even with properly managed irrigation, a heavy crop of large nuts can be difficult to fill out completely.

The most critical period for water use is during the first two weeks of September. Lack of sufficient water during the nut filling stage will lead to poorly filled nuts, which result in poor nut quality. Following nut maturity, adequate soil moisture is necessary to promote uniform shuck dehiscence until shuck split is completed.

Water Requirements

A mature tree can require as much as 350 gallons of water per day during the nut filling stage. Based on this recommendation, if a mature orchard has a plant density of 12 trees per acre with 60-by-60-foot spacing, 4,200 gallons per acre per day may be needed. Bear in mind that in the humid Southeast, irrigation is designed to supplement rainfall.

Clearly, pecans have high water requirements, using as much as 60 inches of total water (including rainfall) during the growing season. Georgia receives an average of 50 inches or more of rainfall annually. While the rainfall received certainly meets a portion of the water requirement for pecan trees, periods of moisture stress occur during the growing season, particularly during the months of August and September when pecans are in the kernel filling stage and water demand is at its peak. Thus, irrigation has been proven to markedly enhance pecan production in the region. With increasing agricultural water use, a growing population, and declining groundwater levels, irrigation efficiency in the region is necessary for sustainability.

Irrigation Systems

Drip and micro irrigation system capacity for a mature pecan orchard should be 3,600-4,000 gallons of water per acre per day. Because of evaporation losses, solid-set sprinkler irrigation can require as much as three times more supplemental water than drip or micro irrigation. Solid set irrigation systems should have a design capacity of 1.5 to 2 inches per week.

There is a trade-off between how much water the irrigation system can apply and the economics (initial cost) of the system. Growers should make certain that they know the limitations of their irrigation system and how the system should operate in order to minimize the system's weak points.

Irrigation Scheduling

Whether an orchard is irrigated with solid-set sprinkler, drip, or micro irrigation, an irrigation schedule that meets the needs of the pecan orchard will be required. There are several ways to schedule irrigation. Tensiometers, which are based on available soil moisture, and evaporation pans, which are based on evaporation rates, are the two most common scheduling methods.

For solid-set systems, either method can be used but pan evaporation is the most common. Where drip or micro irrigation is used, tensiometers are the most common method (Figures 2 and 3). Solid-set sprinkler irrigation will allow moisture levels to fluctuate because a large volume of water can be applied rapidly, whereas drip and micro irrigation should maintain relatively constant soil moisture levels near the emitters. Maintaining volumetric soil moisture at no less than 10 percent or the equivalent of about 70 to 75 percent of field capacity on loamy sand soils provides an effective threshold value for determining drip and micro irrigation application.

Systems should be in operation for a maximum of 12 hours per day in order to prevent water logging and oxygen depletion in the root zone. Roots thrive best when water is present in the soil as a liquid film covering each soil particle, while leaving soil interspaces filled with air. Growers should be aware of their system's delivery rate and adjust their operation times accordingly. At the maximum rate, the system should have the capability to deliver the required gallons per acre per day or inches per week.

Proper scheduling of the irrigation system during the year could save money in operating costs. If a system is designed to operate 12 hours per zone during peak water usage, then it should be used at only a fraction of that time during the early part of the season due to the tree's requirements at that stage. Depending on the irrigation system design, as little as four hours per zone may be sufficient during the first part of the growing season. The operating time should be increased monthly until reaching the maximum 10 to 12 hours during peak water demand in late summer. A general, calendar-based operating schedule is provided in Table 2 for both solid set systems and drip or micro irrigation systems.

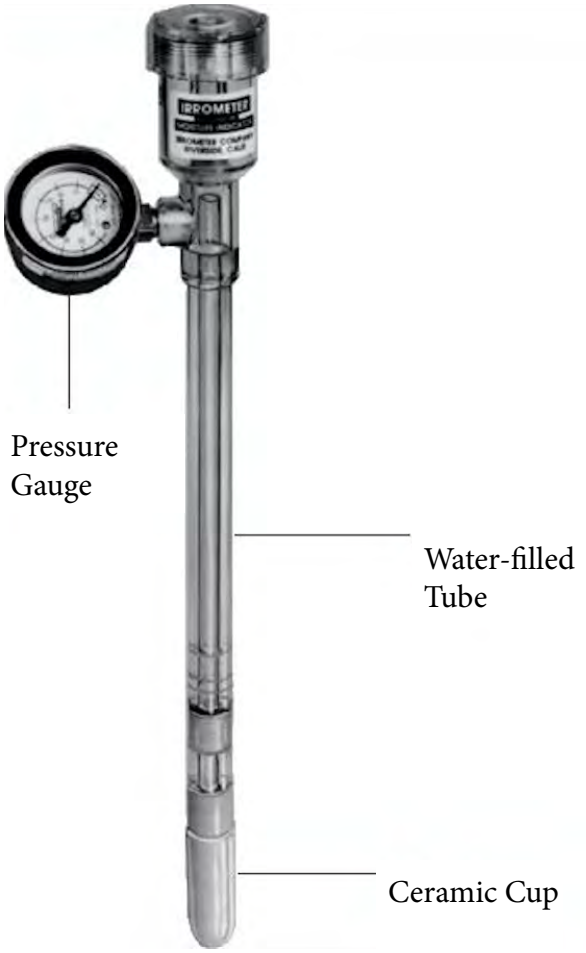


Figure 2. Tensiometer used for determination of irrigation scheduling.

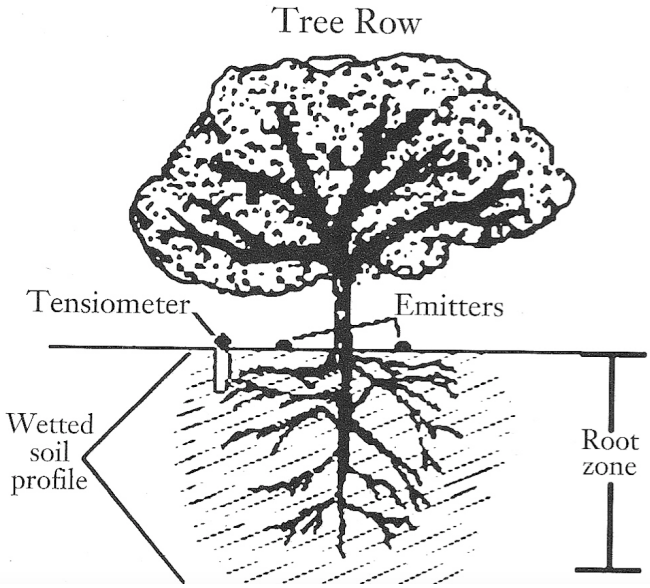


Figure 3. Proper placement of tensiometers in the root zone of pecan trees.

Table 2a. Recommended operating schedule for drip and micro-sprinkler irrigation of pecan.

Month	Percent cycle*	Gallons/acre/day
April	18	648 - 720
May	27	936 - 1080
June	36	1296 - 1440
July	45	1620 - 1800
August	100	3600 - 4000
September	100	3600 - 4000
October	40	1440 - 1600

Table 2b. Recommended operating schedule for solid-set sprinkler irrigation for pecan.

Month	Percent cycle*	Sprinkler inches/acre
April	60	0.5
May	70	0.75
June	80	1
July	90	1.25
August	100	1.5
September	100	2.0
October	90	1
November	60	0.5

*If you receive 1 inch or more rain per day from budbreak to the onset of kernel filling, turn the system off-for three days. Throughout the kernel-filling period, apply irrigation daily regardless of rain events up to 2 inches. With a 2-inch rain during kernel filling, turn the irrigation off for three days.

References

Sparks, D. (2006.) *Drought reduces Georgia's 2006 Pecan Production*. Retrieved October 1, 2016, from http://www.geocities.com/CollegePark/Campus/3370/DroughtReducesGa06PecanProduction.htm

Wells, M. L. (2015.) Irrigation water management for pecans in humid climates. *Hortscience*, *50*(7), 1070–1074. https://doi.org/10.21273/HORTSCI.50.7.1070

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