Funding Proposal
TAES Water Conservation 2005

Irrigation scheduling in Pecan Orchards using a Soil Water Balance Model

Leonardo Lombardini, Assistant Professor
Department of Horticultural Sciences, Texas A&M University – TAMU 2133, College Station, TX 77843-2133. Ph. (979) 458-8079, Fax: (979) 845-0627. Email: l-lombardini@tamu.edu

Bruno Basso, Associate Professor
Department of Crops, Forest and Environmental Sciences, University of Basilicata – Via Ateneo Lucano, 10, 85100 Potenza , Italy. Ph: +39 - 0971205387, Fax: +39 0971 205378. E-mail: basso@unibas.it

Objectives

Pecan (*Carya illinoinensis* (Wangenh.) K. Koch) is distributed over a wide area of geographic and climatic variation, extending from northern Illinois and southeastern Iowa to the coast of the Gulf of Mexico. Pecan trees evolved in deep, well-drained, bottomland soils, usually adjacent to rivers. They require large amounts of water for their growth. The average amount of water that a single mature pecan tree utilizes on a hot summer day is approximately 200 gallons/day, which adds to as much as 3 to 4 ft/year in a commercial orchard (Miyamoto, 1983). These amounts can be even greater if we consider that pecan cultivation has been extended to region such as west, southwest and south Texas where higher evaporation rates are typical. Sadly, most small- to mid-size pecan growers still base their irrigation schedule on intuition, or by counting the calendar days since the last rainfall or irrigation. Previous studies have shown that most well-managed pecan orchards receive much more water than what is really needed to optimize tree performance and productivity (Sammy and Herrera, 1999; Sorensen and Jones, 1999). As much as 10 ft/year have been applied in pecan orchards near Las Cruces, NM (Sorensen and Jones, 1999). Overirrigation not only leads to loss of water to deep drainage, but it also increases nitrate leaching into groundwater (Basso and Ritchie, 2005; Jones et al., 1999). Consequently, new strategies for irrigation of pecan orchards are now a necessity to reduce the volume of water used.

The objective of the proposal is to introduce an alternative method for scheduling irrigation in pecan orchard through the use of a soil water balance model. The validation of the model in pecan orchards will allow for its use in other locations with different soil and climatic conditions.

Methods

The initial study will be conducted at the Texas A&M University Pecan Experimental Orchard (lat. 30°31'N, long. 96°24'W, elevation 220 feet), located near College Station, Texas. The size of the orchard is approximately 8.6 acres, and the soil type is a Westwood silt loam soil, 0% to 1% slope (fine-silty, mixed, thermic Fluventic Ustochrepts). Trees are spaced at 35 × 35 feet and were planted in 1984 and irrigated with microsprinklers. Soil water content will be measured using a soil moisture probe (Diviner 2000®, Sentek, Australia). Eighteen access tubes will be placed at fixed distance from the trunk of representative trees. To measure soil water in bare soil conditions, two additional tubes will be placed within the row. Daily weather will be recorded with an automatic weather station (Campbell Scientific, Logan, Utah) and used by the soil water balance model.

The soil water balance model used in this study was initially developed by Ritchie et al. (1984), and further described in Ritchie (1998) and Basso (2000). The soil water balance model requires inputs for establishing how much water the soil will hold by capillarity, how much will drain out by gravity and how much is available for root uptake. The calculation procedures require knowledge of soil water contents (volumetric fraction) for the lower limit of plant water availability, for the limit where capillary forces are greater than gravity forces, and for field saturations. These variables can be estimated by soil texture using pedotransfer functions (Ritchie et al., 1999). The model has been tested for a wide range of soil and weather condition mostly on annual crops.

Anticipated Results

Pecan cultivation is a type of horticultural operation that can be maintained *only* with enormous volumes of water, which is extremely precious in regions where natural rainfall and supplemental irrigation are limiting.

The proposal herein presented wishes to accomplish through the model validation procedure of soil water content measurements a correct estimate of the soil water available for pecan thus minimizing water losses and environmental impact. Research results will consist in soil water content measurements at different depth in the soil profile; simulated soil water content data will be shown and compared with measured data. Soil water content data will then be correlated with tree size, leaf area index, leaf transpiration rate and leaf water use efficiency to further validate the model prediction for irrigation scheduling.

Final results will be presented at industry/extension meeting (e.g., Texas Pecan Growers Association, Western Pecan Growers Association, field days, and other extension programs), published in industry publications (e.g., *Pecan South*) and in scientific journals (e.g., *HortTechnology, Agriculture, Ecosystems and Environment, etc.*).