Water Management in Pecan Orchards

Cooperative Extension Service
College of Agriculture and Home Economics

Guide H-652

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This publication is scheduled to be updated and reissued 10/06.

Adequate soil moisture content is critical to pecan producers in the arid Southwest. Water is essential for normal plant growth and makes up a large percentage of the plant's overall weight. Irrigation is used to maintain proper soil moisture to achieve optimal yields and nut quality. Thus, it is essential that growers apply the right amount of water at the right time. Understanding the basic principles of soil moisture storage, measurements, and management is necessary to use water efficiently in irrigated pecan orchards and to reduce deep percolation and potential pollution from runoff.

Watering pecan trees should entail more than just applying water to orchards every 14 to 21 days. Often growers ask what is the appropriate number of days between irrigations. But they should be more concerned with the best way to water the orchard.

First, growers should know the soil type and soil profile in each orchard block. Soil type and profile are very important in determining the soil's water-holding capacity. Clay soils hold more water and can be watered less often than sandy soils.

Second, apply a large amount at the first watering of the year. After that, the goal should be to replenish the water that has been used by the trees and lost to evaporation.

Third, tree age plays an important role in water needs. Trees in established or mature orchards demand more water than do young, growing trees.

Fourth, water demand at the beginning of the season is much less than in June and July, when temperatures are high, foliage is fully developed and pecan nuts are growing. Nuts are full of liquid for about six to seven weeks, beginning in about mid-July in Las Cruces, New Mexico.

Although plants can withdraw water up to the permanent wilting point, their growth usually decreases before signs of permanent wilting occur. In order to obtain good yields and growth, soil moisture must be maintained above the wilting point. For many plants, including pecans, irrigation water should be applied before 50-60% of the available water is depleted.

Soil acts as a "bank" to store water for crop use. Rain and irrigation are deposits; water used by the crop and soil evaporation are withdrawals. A daily balance of these deposits and withdrawals will give the amount of water remaining in the soil profile.

The crop root zone often is viewed as a reservoir for these "deposits" and "withdrawals." Irrigation is used to fill the soil reservoir or to bring the soil moisture content up to field capacity in order to store water for crop use. Thus, the root zone's depth must be known in order to determine how much irrigation water is needed. Rooting depth is not constant, but increases as a plant grows. In addition, many factors, such as high water tables, soil type changes in the profile, soil compaction, soil salinity, and soil fertility, may restrict root development.

The depth for soil moisture management in irrigation (3 feet for pecan orchards) often is referred to as the "effective root zone" or the "effective rooting depth." Generally, depth that contains about 80% of the total root mass is used for estimating effective root depth (about 2 feet for pecan orchards). Of that depth, about 40% of the total water requirement comes from the top one-fourth of the effective root zone.

Water requirements for pecans are not constant, but increase as the trees grow (figs.1 and 2). When planning for irrigation, both seasonal and peak water requirements for the crop must be

determined. In addition to the peak water use period, pecans have growth stages when significant yield or quality reductions will occur if adequate soil moisture levels are not maintained. Good soil moisture during August will not only help pecan nuts reach optimum size but also dramatically diminish August nut drop. Also irrigations must be timed to minimize water stress periods and must not exceed the available root zone storage, except as needed for excess salt leaching.

Pecan growers should measure soil moisture depth after irrigation as part of those steps needed in order to have a better water management efficiency in a particular orchard. Ideally, water should penetrate 3 feet. Whenever soil moisture penetrates more or less than 3 feet, water management practices must be corrected accordingly. Water penetration can be checked after each irrigation with a simple device built with a $^1/_2$ inch construction rod. The rod should measure about 3.5 feet in length and have one end sharpened. A 1-foot long rod welded across the other end makes a T-shaped handle. The rod penetrates wet soil easily, but does not penetrate dry soil. This rod can be used to measure the depth of the irrigation water penetration. Samples also can be taken at different depths with a shovel to measure the soil moisture depth by "feeling" the soil moisture.

Moisture depth should be uniform over the whole field between borders. The best time to measure soil moisture depth in a loamy soil is about 24 hours after an irrigation, when soil saturation has drained to full capacity. It may take 36 hours in a heavy soil and about 16 hours in a sandy soil. A practical rule of thumb to measure soil moisture depth after irrigation could be whenever a grower can walk without slipping on the orchard floor.

Soil moisture monitoring is an effective method for determining the amount of water to apply per irrigation. Several monitoring methods and devices are available to measure soil moisture and determine when pecans need water. Soil type will influence the interval between irrigations (figs. 1, 2, 3 and 4). Pecan growers can use tensiometers, gypsum blocks or any other instrument that measures soil moisture to monitor moisture in the top 3 feet of the soil profile. Then they can determine when and how much water to irrigate.

Usually a 3-foot root zone is considered for programming a computer model to determine water quantity for a given irrigation and the interval between irrigations. This assumption is true especially in clay soils, when irrigation water saturates the area below 3 feet and no roots grow there. However, it may not work for sandy loam soils that are characterized by higher permeability and roots that may grow 4-feet deep. This could mean that an orchard growing in sandy loam soils could require longer intervals between irrigations than normal if the roots have grown below the third foot. In any case, clay soils would have a large interval between irrigations because of their higher water-holding capacity.

Orchards should have good drainage to eliminate excess irrigation water, which helps prevent salt buildup. Growers should improve the orchard's drainage if necessary perhaps by digging trenches between the tree rows. For more information on this matter, read NMSU Extension Guide H-649, *Managing Soils in Pecan Orchards.*

When planning an orchard, growers may encounter different opinions regarding what irrigation system—flood irrigation, sprinklers, microsprays, drip irrigation or subsurface irrigation (drip tape)—is best. If an orchard is established, growers may face difficulties trying to change systems, although growers have been known to switch from flood to drip and vice versa, and from flood to subsurface.

However, growers owning established orchards still can improve their watering practices by following some cultural practices. First laser level the orchard floor. Second, before each irrigation use a shovel to "feel" the soil moisture and to learn how to judge the correct number of days between irrigations. It is important not to let the soil get too dry between irrigations or to irrigate wet soils. Next, check the soil moisture after each irrigation to be sure water penetrates at least 3 feet. If the water is salty, it needs to penetrate more than 3 feet to leach salts away

from the root system. Finally, use soil moisture measuring devices, such as tensiometers, gypsum blocks, or dielectric soil moisture sensors, to monitor soil moisture constantly.

Also, there are specialists who can provide technical assistance in water management by studying orchard soil types and measuring soil moisture, evaporation, light interception and water needs for a particular physiological stage of pecan growth. They then make recommendations about the timing and quantity of irrigation accordingly.

Pecan producers also can use computer programs to help make wise decisions about irrigation timing and quantity. Pertinent information about the orchard, such as soil type and seasonal water requirements, needs to be entered, and data from soil moisture instruments can be downloaded into the programs.

Pecan growers need to take into account several factors to make the right decision about when to water and how much water is needed. It is imperative for growers to know soil type, soil profile (layered soil or not), soil drainage capabilities, season timing, tree physiological stage (bud breaking or nut sizing) and respective water needs, water penetration depth after irrigation, and how dry or wet the soil is before watering. When this information is used to decide when to water and how much to water for a particular irrigation, growers truly will be managing the orchard's water, not just watering the orchard.

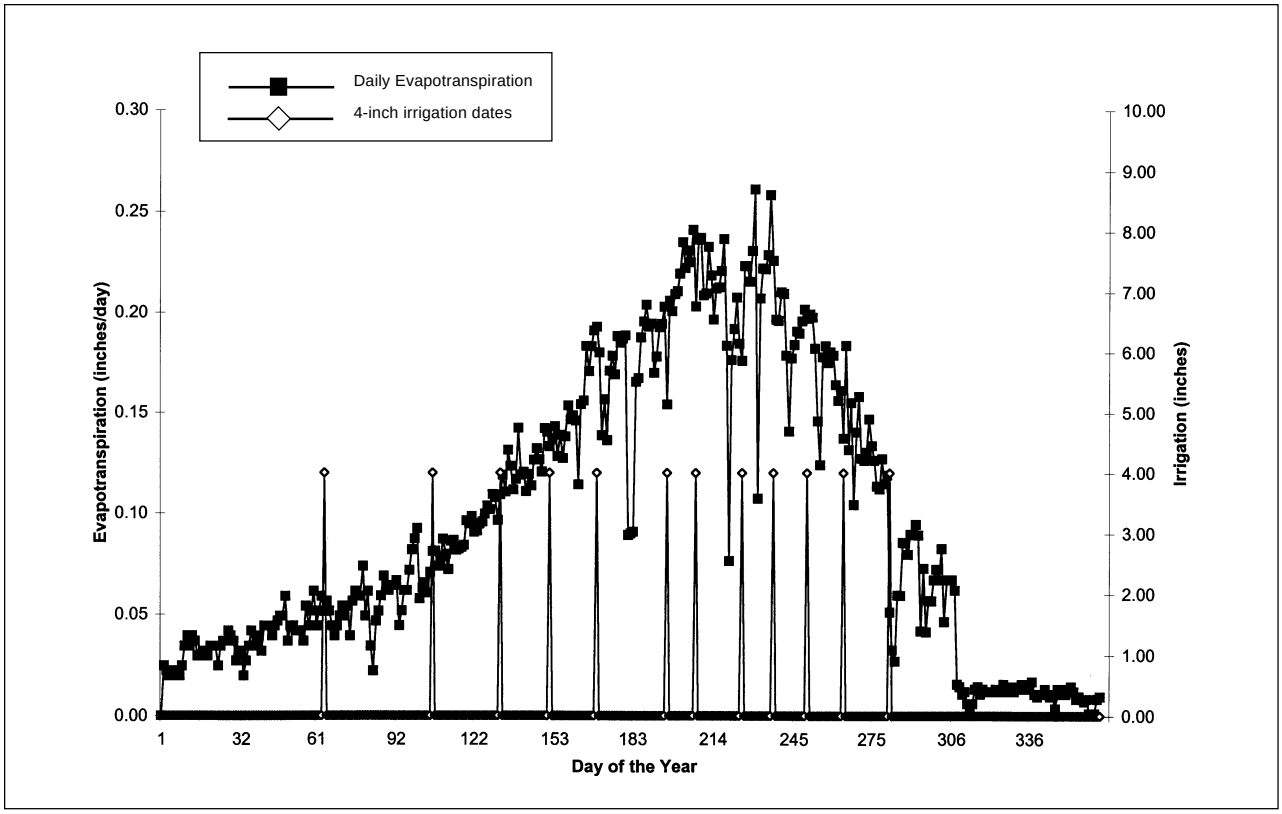

Figure 1. Modeled pecan daily water use in 2000 for New Mexico's Mesilla Valley and irrigation dates for an orchard with 7-inch tree trunks growing on a sandy loam soil with 1.5 inches/foot of available soil moisture and assuming a 3-foot root zone. Yearly tree evapotranspiration rate is 35 inches.

Irrigation Amount Inches	Date of Irrigation
4.00	1/1*
4.00	3/3
4.00	4/14
4.00	5/10
4.00	5/29
4.00	6/16
4.00	7/13
4.00	7/24
4.00	8/11
4.00	8/23
4.00	9/5
4.00	9/19
4.00	10/7

* A January irrigation is needed to fill the root zone to field capacity, if winter rainfall has not filled the root zone.

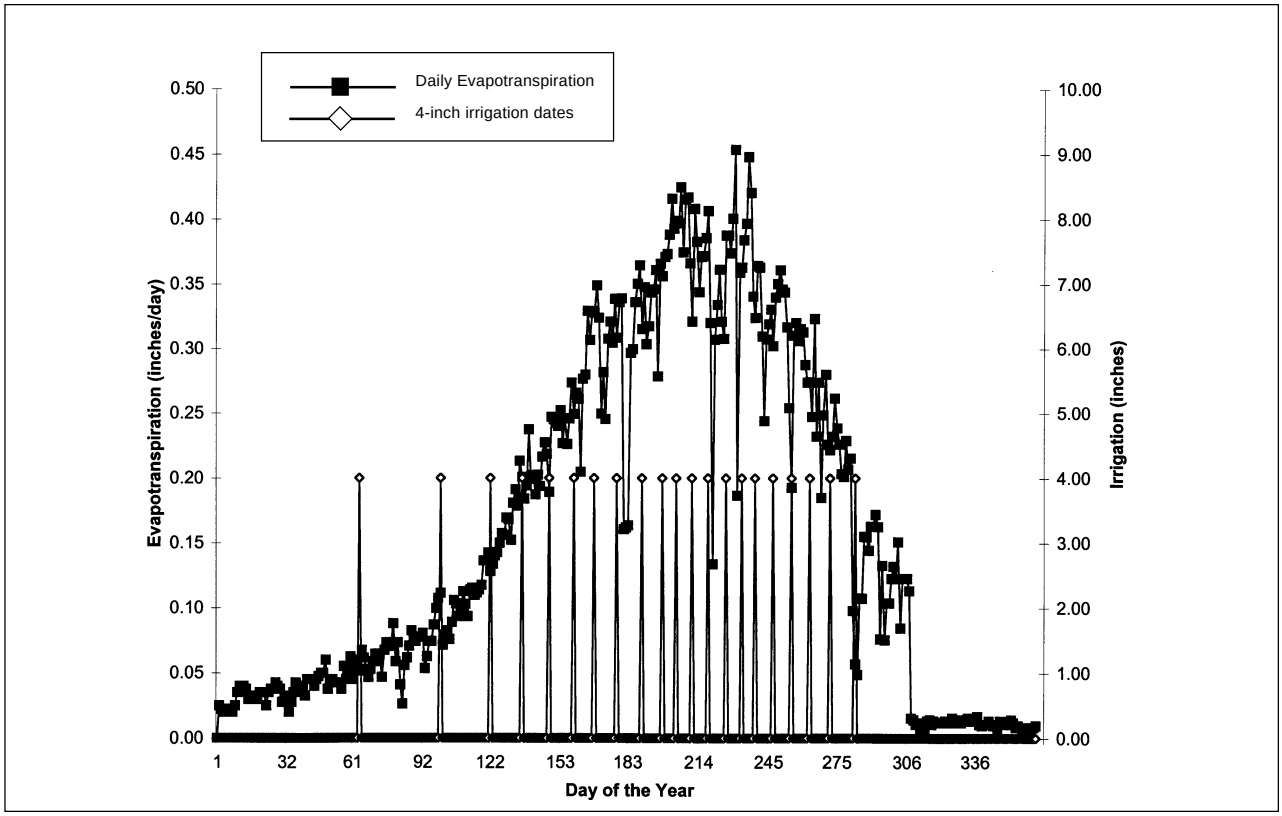

Figure 2. Modeled pecan daily water use in 2000 for New Mexico's Mesilla Valley and irrigation dates for a mature orchard growing on a sandy loam soil with 1.5 inches/foot of available soil moisture and assuming a 3-foot root zone. Yearly tree evapotranspiration rate is 57 inches.

Irrigation Amount Inches	Date of Irrigation	Irrigation Amount Inches	Date of Irrigation
4.00	1/1*	4.00	7/21
4.00	3/3	4.00	7/28
4.00	4/8	4.00	8/4
4.00	4/30	4.00	8/12
4.00	5/14	4.00	8/19
4.00	5/26	4.00	8/25
4.00	6/6	4.00	9/2
4.00	6/15	4.00	9/10
4.00	6/25	4.00	9/18
4.00	7/6	4.00	9/27
4.00	7/15	4.00	10/8

* A January irrigation is needed to fill the root zone to field capacity, if winter rainfall has not filled the root zone.

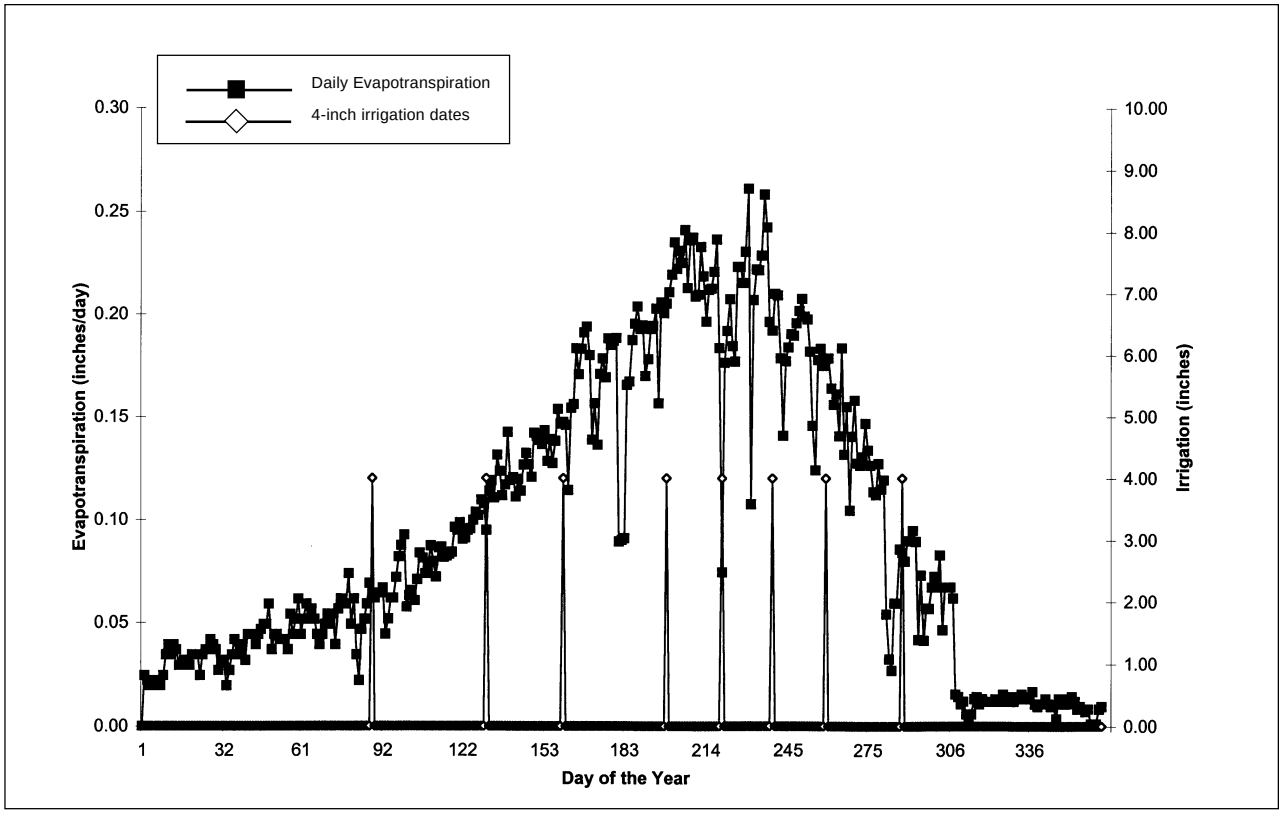

Figure 3. Modeled pecan daily water use in 2000 for New Mexico's Mesilla Valley and irrigation dates for an orchard with 7-inch tree trunks growing on a clay soil with 2.25 inches/foot of available soil moisture and assuming a 3-foot root zone. Yearly tree evapotranspiration rate is 35 inches.

Irrigation Amount Inches	Date of Irrigation
4.00	1/1*
4.00	3/27
4.00	5/9
4.00	6/7
4.00	7/16
4.00	8/6
4.00	8/25
4.00	9/14
4.00	10/13

* A January irrigation is needed to fill the root zone to field capacity, if winter rainfall has not filled the root zone.

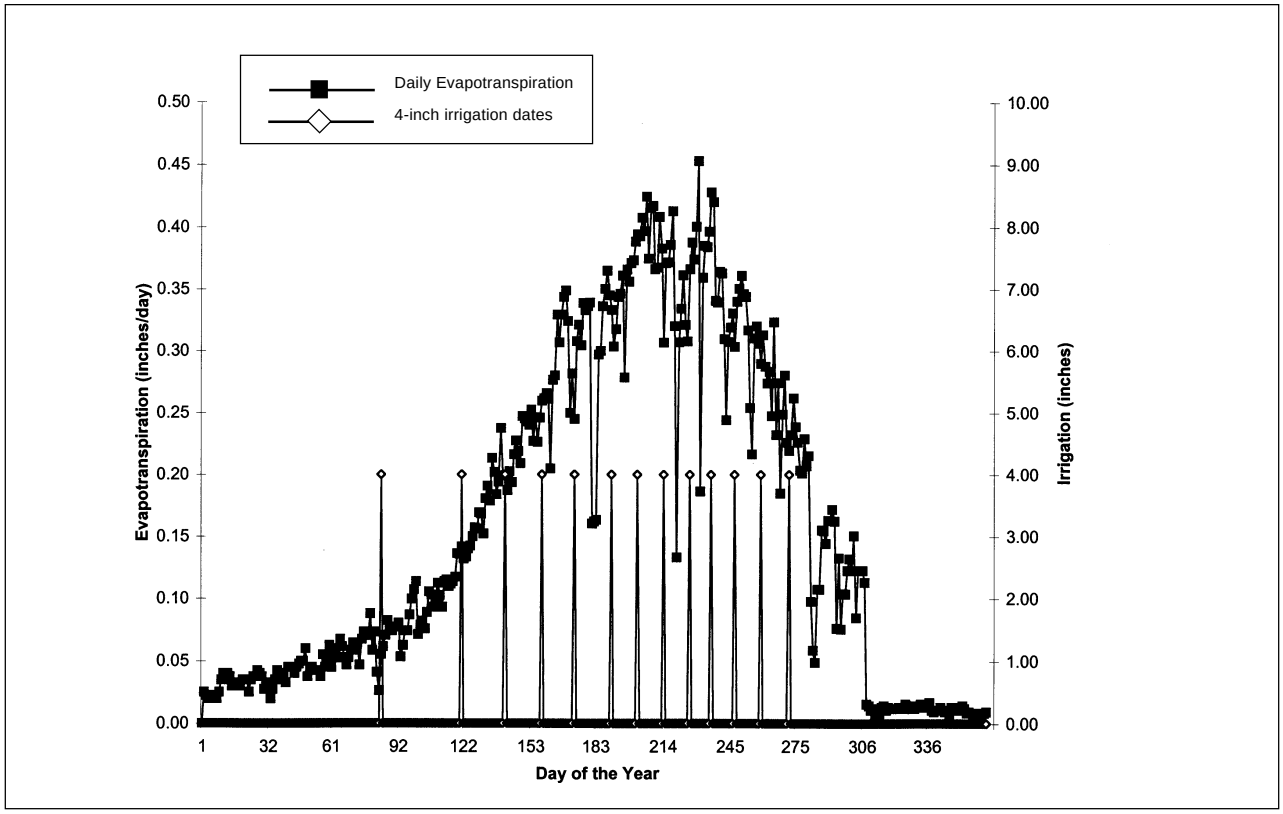

Figure 4. Modeled pecan daily water use in 2000 for New Mexico's Mesilla Valley and irrigation dates for a mature orchard growing on a clay soil with 2.25 inches/foot of available soil moisture and assuming a 3-foot root zone. Yearly tree evapotranspiration rate is 57 inches.

Irrigation Amount Inches	Date of Irrigation
4.00	1/1*
4.00	3/23
4.00	4/29
4.00	5/19
4.00	6/5
4.00	6/20
4.00	7/7
4.00	7/19
4.00	7/31
4.00	8/12
4.00	8/22
4.00	9/2
4.00	9/14
4.00	9/27**

* A January irrigation is needed to fill the root zone to field capacity, if winter rainfall has not filled the root zone.

** The model indicated that the soil water profile would have been close to the 50% depletion level by the third week in October, but it was decided not to irrigate because it would have been too late to benefit trees during the current season.

October 2001 **Las Cruces, NM**
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