Pecan Irrigation

Lenny Wells
UGA Horticulture
What do all plants (including pecan trees) need most?

Photosynthesis

In the process of photosynthesis, plants convert radiant energy from the sun into chemical energy in the form of glucose (or sugar).

\[
\text{water} + \text{carbon dioxide} + \text{sunlight} \rightarrow \text{glucose} + \text{oxygen}
\]

\[
6 \text{H}_2\text{O} + 6 \text{CO}_2 + \text{radiant energy} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{O}_2
\]

Sunlight+Water = carbs = Tree growth and Nut Production
Effect of Sunlight and Air Movement on Yield---2012

**OPEN**

- Sunlight: 1843 lum/ft²
- Yield: 137.4 lbs/Tree

**CROWDED**

- Sunlight: 1005 lum/ft²
- Yield: 93.6 lbs/Tree

32% increase
Effect of Sunlight and Air Movement on Yield---2013

**OPEN**

Sunlight=1176 lum/ft²
Yield=110.6/tree

**CROWDED**

Sunlight=996 lum/ft²
Yield=68 lbs/tree

39% increase
WHEN GROWING PECANS:
IF YOU HAVE TO CHOOSE BETWEEN WATER AND FERTILIZER..........

CHOOSE WATER!

And Remember: Its not **how much** you water, but **when**
What happens to pecans when drought occurs:
Fruit-drop Pattern

1 = weak flowers, low energy reserves
2 = lack of egg fertilization or tree regulated
3 = problems with endosperm development
4 = problems with embryo development

Other Factors:
- Water stage fruit split
- Mechanical injury
- Animals, Insects
- Diseases
- DROUGHT
Nut Sizing

July Drought Results in Greater Fruit Abortion

September drought---leaf abscission/poor kernel filling

Sparks, 1989
Effect of Drought During Nut Sizing

A=Irrigated
B=Non-irrigated
Effect of Drought During Kernel Fill

Sparks, 1992
Stein, et al., 1989
Pecan Water Stress is a function of water + soil depth
How Do Pecan Trees Use Water?

Water diffuses into guard cells which causes them to open. On hot/dry days, the guard cells have less water, they relax and the stoma close.
Pecan Water Use

• Pecans extract most of their water from the upper 32 inches of the soil profile
• Need 60” of water per year
  – In the SE, rainfall can account for 50-67% of needs
• Pecan trees can use as much as 350 gal/day
• Greatest demand is during August/September
• Pecan Irrigation systems are designed to be supplemental to rainfall
• At 12 trees per acre, Drip/Microjet system capacity should be **3600-4200** gallons/acre/day
Costs of Drip Irrigation

• System Parts and Installation: $800 per acre
• Well & Pump: 4” + 5 hp = $7800
  6”+30 hp = $34,000
• Operation Cost: $40-$60 per acre
## Value of Fertilizer

<table>
<thead>
<tr>
<th>Fertilizer Rate (lbs/acre)</th>
<th>Yield/Acre (lbs)</th>
<th>% Increase</th>
<th>Value of Increase (@$1.34/lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1696</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>400 lbs biennially</td>
<td>1837</td>
<td>8.3</td>
<td>188.94</td>
</tr>
<tr>
<td>400 lbs annually</td>
<td>2211</td>
<td>30</td>
<td>690.10</td>
</tr>
<tr>
<td>800 lbs annually</td>
<td>1577</td>
<td>-7.0</td>
<td>-159.46</td>
</tr>
</tbody>
</table>

‘Stuart’ Worley, 1974

Worley, 1974
## Value of Irrigation

<table>
<thead>
<tr>
<th>Water Application (Gal/Day/Acre)</th>
<th>Yield/Acre (lbs)</th>
<th>% Increase</th>
<th>Value of Increase (@ $1.34/lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1034</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1200</td>
<td>1374</td>
<td>32</td>
<td>455.60</td>
</tr>
<tr>
<td>3600</td>
<td>1761</td>
<td>70</td>
<td>974.18</td>
</tr>
</tbody>
</table>

‘Stuart’  
Daniel, J.W. 1982
Return on New Irrigation System

Example: 25 acre orchard

Assumes $1.34/lb.

- Cost of new irrigation system: $27,800
- Value of increase in production: $974.18/acre X 25 = $24,354.50
- 27800-24354.50=$3445.50 left to recover in year 2

- At $2.00/lb, the value of the increase is $1454/acre
- $1454X25=$36350
- 36350-27800=+8550
Return on New Irrigation System
Example: 100 acre orchard

• Cost of new irrigation system: $114,000
• Value of increase in production:
  $974.18/acre X 100=$97,418.00
• 114,000-97418= -$16,582

At $2.00/lb:
$145,400-114,000=+$31,400

Assumes $1.34/lb.
Pecan Irrigation Systems

- Solid Set
  - Expensive
  - Poor water use efficiency
  - Water large area quickly

- Sprinklers often in every other middle
- Pump capacity should be at least 75 gpm/A
Drip Irrigation

- Lateral lines normally 6-8 ft from tree
- Most emitters used are 2 gph
- 8-16 emitters per tree
Pecan Irrigation Systems

• Microjet
  – Same benefits as drip
  – Larger wetted area
  – Best system for establishment of young trees

16 gph

16 gph
Results

- Water Stress on pecan occurred at about -0.78 MPa using the pressure chamber to measure stem water potential
- Regression analysis suggests that irrigation scheduling for mature pecan trees may be needed when volumetric water content reaches 10-11% on Tifton loamy sand.
- Pecan trees may undergo water stress due to crop demand during the kernel filling stage regardless of soil moisture.

Relationship between stem water potential ($\psi$) of non-irrigated pecan trees and volumetric soil moisture on Tifton loamy sand (y=0.0259x-1.0421, $R^2=0.28$).

Relationship between stem water potential ($\psi$) of non-irrigated pecan trees and volumetric soil moisture on Tifton loamy sand from April-July 2012 (y=0.0277x-1.079, $R^2=0.35$).

Relationship between stem water potential ($\psi$) of non-irrigated pecan trees and volumetric soil moisture on Tifton loamy sand from August-September 2012 (y=0.0017x+0.7263, $R^2=0.0014$).
# Pecan Irrigation Schedule

## Recommendations for Bearing Orchards

<table>
<thead>
<tr>
<th>Month</th>
<th>% Full Capacity</th>
<th>Gallons/acre/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>April</td>
<td>17%</td>
<td>612-680</td>
</tr>
<tr>
<td>May</td>
<td>26%</td>
<td>936-1040</td>
</tr>
<tr>
<td>June</td>
<td>33%</td>
<td>1188-1320</td>
</tr>
<tr>
<td>July</td>
<td>40%</td>
<td>1440-1600</td>
</tr>
<tr>
<td>August</td>
<td>100%</td>
<td>3600-4000</td>
</tr>
<tr>
<td>September</td>
<td>100%</td>
<td>3600-4000</td>
</tr>
</tbody>
</table>

*If you receive 1” or more of rain from bud-break to the onset of kernel-filling, turn the system off for 3 days.

*Throughout the kernel filling period, apply irrigation daily regardless of rain events up to 2”. With a 2” rain during kernel filling, turn the irrigation off for 3 days.

Sandy Soils=Use higher end of rate  
Clay Soils=Use lower end of rate
Summary

• IRRIGATION IS A NECESSITY FOR CONSISTENT PECAN PRODUCTION

• Water is key to many important processes involved in the development of a pecan crop

• Well capacity for pecans should be approx. 4000 gal/acre/day

• Irrigation provides the most immediate results and the fastest return on investment of virtually any management practice you can use