Irrigation Management Practices in Citrus Groves for Advancing Sustainable Water Supplies for South Texas

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ON FARM IRRIGATION STUDIES
Plan for Evaluating Irrigation Use

- The Texas Water Development Board (TWDB) funded a 10 yr study of on-farm water use in (LRGV) Lower Rio Grande Valley of South Texas

- Purpose: to evaluate and promote more water conserving irrigation methods at the on-farm level

- Harlingen Irrigation District
- Texas A&M University-Kingsville Citrus Center
- Texas AgriLife Extension, Weslaco and Corpus Christi
Directives of Texas AWE Program

• Established On-Farm demonstration sites with collaborators (growers) to evaluate irrigation use efficiency in South Texas citrus crop production

• Evaluate the effectiveness of irrigation methods:
  – Flood
  – Narrow Border Flood
  – Drip
  – Microjet Spray
On-Farm Demo Sites Across LRGV

Irrigation Districts of the Lower Rio Grande Basin
Traditional Irrigation techniques in South Texas. Approximately 85% of all citrus is flood irrigated.
Traditional Flood Irrigation

- Most irrigation in the Valley is by gravity flow flood irrigation
- Large Pan Flood Irrigation is the most common method of irrigating Citrus in the Lower Rio Grande Valley
- Polypipe is sometimes used for water distribution from orchard valve connections
On-Farm Alternative Flood Designs

Narrow Border Flood Irrigation
Border Flood Irrigation

- Use of raised borders between rows can facilitate faster water movement down the field in mature groves

- Both polypipe and gated-pipe can be used to deliver water to bordered rows

- Water meters can be placed inline with the pipe to measure the amount of water applied to an orchard
Microjet Spray Irrigation

- Some citrus producers use microjet sprinkler systems to irrigate their crops.
- The fine spray pattern can also mitigate short-term freeze impact on citrus.
Microjet Spray Sprinklers Placement Between Trees
Microjet Sprinklers Target Watering Underneath the Tree Canopy
Microjet Spray Sprinklers Can Easily Irrigate Entire Root Zone
Single Line Drip Irrigation
Typically placed along side of tree trunk
Single line drip
Irrigation Pattern
Single line drip Soil Moisture Monitoring

Tree Canopy Dripline

Sensors Placed at Various depths from canopy dripline to trunk
Soil Moisture Monitoring

WaterMark™ soil moisture sensors
Single line drip Soil Moisture Pattern Evaluation
Tree Canopy Dripline

Tree Canopy Dripline

Dry Root Zones When Under Irrigated or During Drought
Dual Line Drip System

Spaced Mid-Way Between Trunk and Canopy Dripline
Dual Line Drip Can More Easily Irrigate Entire Root Zone
Targeting the Effective Rootzone of Citrus

Soil Sensors Can Assist in Proper Water Monitoring

The majority of feeder roots occur in the upper 18 inches of soil profile

Irrigation until entire rooting depth is wet can lead to excessive water loss

Leaching
Traditional Flood vs Narrow Border Flood Irrigation
Traditional Flood Irrigation (TFld)
TFld
20min
TFld
40min
TFld
60min
TFld
70min
TFld
80min
TFld
120min
TFld
140min
Traditional Large Pan Flood (TFld) with 3 rows of trees irrigated between raised berms
Cultivation and cultural practices between tree rows lead to lower soil elevation than under the canopy of citrus trees standing which alters water flow in TFld irrigation.
Water will typically have to fill up the lower elevations between the tree rows and down the entire length of the tree row before the water will fill in underneath the tree canopy in TFld irrigation.
In the short-term, non-uniform watering occurs underneath the trees as water rises to meet the highest soil surface level underneath the tree canopy.
When citrus irrigators wait until all the soil surface is covered with water using TFld, an excessive amount of water will percolate beyond the rooting depth of trees.
Narrow Border Flood (NBF)
Narrow Boarder Flood (NBF)
Initial flow
NBF
10min
NBF 20min
NBF
30min
NBF
40min
NBF
50min
NBF
60min
Narrow Border Flood (NBF) Irrigation Uses Raised Berms Between Each Tree Row
NBF Increase water application by irrigating between the raised berms
NBF Irrigation can more adequately target the rootzone of citrus trees. While applying this water at a faster rate to minimizing deep percolation. Thus resulting in water saving and retaining fertilizer within the rootzone.
Annual Water Saving Over Flood Irrigation

Annual Irrigation Water Saved
5 Yr Average (2005-2009)

Irrigation Type
- Trad Fld
- Brd Fld
- MJ Spray
- Drip

Irrigation Water Savings (acre-inch / acre)
- Trad Fld: 0
- Brd Fld: 5
- MJ Spray: 10
- Drip: 15
Estimated Annual Water Saving Over Flood

– If entire South Texas citrus industry converted to this irrigation type: **17 to 21 thousand acre-ft.**

### Potential Water Savings
If Entire Citrus Industry in LRGV Converted to this Irrigation Type

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<tr>
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<td>0</td>
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<tr>
<td>Brd Fld</td>
<td>5000</td>
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<td>MJ Spray</td>
<td>10000</td>
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<tr>
<td>Drip</td>
<td>15000</td>
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<td></td>
<td>20000</td>
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5 Year Average Annual ‘Rio Red’ Grapefruit Yield

Rio Red Grapefruit Yield
5 Year Average (2005-2009)

Grapefruit Yield (Tons / Acre)

Irrigation Type

- Trd Fld
- Brd Fld
- MJ Spray
- Drip
# Cash Flow Based on 5 Years Citrus Yield Pack Out

Cumulative 10 Years Cash Flow/Acre based on 5-years (2005-2009) of yield data and pack-out from ‘Rio Red’ grapefruit production in Lower Rio Grande Valley, Texas

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<th>Irrigation System Type</th>
<th>Fancy Fruit %</th>
<th>Choice Fruit %</th>
<th>Juice Fruit %</th>
<th>Cuml. 10-Yr Cash Flow $1000/Ac</th>
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<tr>
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<td>21.0</td>
<td>35.4</td>
<td>9.0 (±3.0)</td>
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<tr>
<td>Border Fld</td>
<td>47.3</td>
<td>23.0</td>
<td>29.7</td>
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The Bottom Line

- Citrus producers with established mature groves that want to conserve water will have better fruit quality and greater net farm income by changing to an alternative flood irrigation method like Narrow Border Flood.
**Water Quantity Implications**

- Narrow Border Flood irrigation can save up to 35% water, equivalent to that of drip or microjet spray irrigation, without the expensive costs associated with installing these low-flow irrigation systems.
Water Quality Implications

- The implementation of Narrow Border Flood irrigation as an cultural practice has great potential to improve ground water quality in high water table soils, as it can reduce excessive downward leaching of salts, fertilizers, herbicide and pesticide residues beyond the effective rooting zone of citrus trees.
TexasAWE.org

Mr. Mac Young and Dr. Juan Enciso
Texas AgriLife Research & Extension Centers
Corpus Christi and Weslaco, Texas
Thank You

questions
Narrow-Border Flood

• More information regarding TexasAWE project can be found at the Harlingen Irrigation District website:

  www.hidcc1.org

Video:  http://youtu.be/wHZ0tBCGlms

https://www.youtube.com/watch?v=wHZ0tBCGlms&feature=youtu.be
Surge Irrigation

- More information regarding ADI project can be found at the Harlingen Irrigation District website:
  www.hidcc1.org

Video:  http://youtu.be/pQeFdGlB3qw
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AWE Project Videos

• More information regarding ADI project can be found at the Harlingen Irrigation District website:

  Videos: http://www.texasawe.org/videos

Why Texas AWE?

http://www.texasawe.org/about/why-texas-awe-rt-1110