Irrigation scheduling for improved tree performance of HLB-affected trees

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Key points and takeaways

- Reduced water amounts can result in smaller trees and increased time to initial harvest.

- The lack of water in any stage of the citrus trees' growth decreases yield and fruit quality.

- Higher irrigation amounts could result in loss of nutrients and herbicides from citrus root zone through deep percolation and surface runoff.
Key points and take aways (2)

• Greater water use by greening infected trees from daily irrigation than healthy trees.

• Daily irrigation resulted in improved irrigation management compared with current IFAS or Intermediate irrigation schedule.

• Water uptake or use reduction was proportional to leaf area reduction for HLB affected trees.
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• Irrigation decisions should be based on use of soil moisture sensors recommended for Florida sandy soils to minimize nutrient leaching.

• It is good to also use soil moisture sensors to help determine if enough water is maintained in the root zone.
Evapotranspiration (ET)

Definition: The loss of water from a vegetated surface through the combined processes of soil and plant evaporation and plant transpiration

\[ \text{Evapotranspiration} = \text{Soil and Plant Evaporation} + \text{Plant Transpiration} \]
Evapotranspiration (ET)

Definition: The loss of water from a vegetated surface through the combined processes of soil and plant evaporation and plant transpiration.
Reference ET vs. Crop ET

Reference ET (ETo): The evapotranspiration from a hypothetical grass reference crop.

Actual ET (ETc): The crop evapotranspiration under standard conditions

Crop Evapotranspiration ($ET_c$)

$$ET_c = ETo \times K_c \times K_s$$

Where,

- $ET_o$ = Reference ET.
- $K_c$ = Crop Coefficient,
- $K_s$ = Soil water extraction factor.
Crop Evapotranspiration

- ET provides reference measure of water use based on plant water demand
- Scalable for specific crop, growth stage, climate, and season of year
- $ET_c = ET_o \times K_c$
Effect of Time of Year

\[ \text{ETc} = \text{ETo} * Kc * Ks \]
Computer Programs

- Web based
  - Schedule based on nearest FAWN station
  - Enter: Field capacity, spacing, irrigation specifications
- PC Irrigation program
  - Same information required
  - Stores irrigation data
  - Print reports
- Smart Phone Apps
  - Use real-time data
  - Irrigation schedule in units of time
  - Send notifications and forecasted probability of rainfall
Irrigation Scheduler - Input

- Irrigation Schedulers
  - Citrus
  - Vegetable
  - Strawberry
  - Row crops
  - Turf grass
Irrigation Scheduler - Output

- Provides record of inputs
- Two week schedule based on ET
- Delay for rainfall
Smartphone Apps

- iPhone or Android
- FAWN ET, expand to grower weather stations
- Real-time data
- Citrus, Strawberry, Turf, expand to row crops, vegetable
Irrigation: Helpful tools to meet tree water requirements

- FAWN weather stations can be used along with irrigation apps to schedule irrigation and reduce nutrient leaching.
- FAWN-based irrigation scheduling prevented soil NO₃ leaching below 15 cm (6 inches)

https://fawn.ifas.ufl.edu
Factors impacting irrigation decisions

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• It is good to also use soil moisture sensors to help determine if enough water is maintained in the root zone.
# Soil Water Sensors (pros/cons)

<table>
<thead>
<tr>
<th>Soil water sensor type</th>
<th>Measured soil volume</th>
<th>Sensitivity to air gaps/loose soil</th>
<th>Sensitivity to salinity</th>
<th>Suitability for sandy soils</th>
<th>Accuracy</th>
<th>Calibration for different soils</th>
<th>Maintenance</th>
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<tr>
<td>Tensiometer</td>
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</tr>
</tbody>
</table>
Water management strategies for HLB-affected citrus trees

Water monitoring at grove scale and soil moisture measurement at 6-, 12- and 24-inch soil depth
Water management strategies for HLB-affected citrus trees

- Daily irrigation > Intermediate (irrigating every 1.5 days) > IFAS irrigation (irrigating every two days) scheduling

- Daily irrigation could help in managing HLB affected trees and reduce tree water stress


Water use of HLB affected trees in south west and central Florida
Water management strategies for HLB-affected citrus trees

Moisture contents (left) and significant relationships with sapflow (right)

Keeping water in the top 0-30 cm improved water use for HLB affected trees. Greater moisture content beyond the root zone (at 45 cm) in Immokalee could be due to capillary rise since the soils have a high water table and in Avon Park could be due to deep percolation because those soils are well drained.

Water management strategies for HLB-affected citrus trees

Water monitoring at grove scale and soil moisture distribution at 15, 30 and 60 cm soil depth

~217,238 gal/acre since Feb 2018
Irrigation scheduling experiment

- The aim of the study was to determine the amount of water required to grow young trees at higher tree densities.
- Initiated in November 2017 with eight-month-old sweet orange ‘Valencia’ (Citrus sinensis) trees grafted on the ‘US-897’
- Two and three rows of five-540-foot-long beds with drainage swales on each side.
- Two irrigation treatments (62% and 100%) of daily crop evapotranspiration (ETc) were adjusted during 2019 to (81%, 53%, 40.5%, and 26.5% of ETc).
Water applied per tree

- Water applications were proportional to percentage ETo during the experiment at both two rates and four rates.

- 100% line is the amount of water that would have been applied if ETo was applied each day.

The volume of water applied per young citrus trees under different irrigation rates on daily bases.
As expected, soil at higher irrigation rate resulted in soil moisture at or above field capacity (0.10).

Stem water potential is used as an indication of stress with lower (more negative) values.

Less stress was indicated at higher irrigation rates.
Citrus tree growth (2019-2020)

- Tree height and canopy volume increased with irrigation rate.
Impact of irrigation rate on citrus tree root growth (2018)

Impact of irrigation rate (A) and planting densities (B) of young citrus trees on root length growth during 2018-2019 at the southwest Florida research and education center demonstration grove.
Impact of irrigation rate (A) and planting densities (B) of young citrus trees on root length growth (in) during 2018-2019 at the southwest Florida research and education center demonstration grove.
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Acknowledgements

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Thank you!