Innovation in Agriculture Irrigation: Today and Tomorrow

Kati Migliaccio, Diane Rowland, Kelly Morgan, Lincoln Zotarelli, Michael Dukes, Tatiana Borisova, Clyde Fraisse, Paul Fisher, Reza Ehsani
Irrigation benefits

Irrigation is one part of the production system, ideally this input results in greater output or yield.
Economics

There is also economics to consider, does additional irrigation result in additional net revenue?

Figure 2. Simulated Net Returns Above Variable Irrigation Costs as Related to Irrigation Threshold and Water Application Rate per Hectare, Soybeans.
Purpose

• Show innovative tools for agriculture water management
• Showcase some specific examples from UF IFAS faculty
• Provide some ideas/tools that increase viability of agriculture in Florida
Seepage irrigation/water tables: L Zotarelli

• Research to maximize potato yield through better seepage irrigation water management
• Investigated potato production with different water table levels (14, 21, & 30 inches below surface) and fertilizer levels, assessed yield
Seepage irrigation/water tables: L Zotarelli

Atlantic

FL1867

Kg/ha

Kg/ha
Improving agricultural viability by reducing inputs & increasing yield

• Irrigation volume was reduced by 60-70% without a reduction in yield
• Reduce losses due to flooding (reduce risk)
Irrigation scheduling: D Rowland

- Study to improve irrigation scheduling using Growing Degree Day based method for sesame
Sesame Production: A New Crop for Florida

Growers Randall Dasher and Jerry Geff at a sesame field in McAlpin, FL. Photo credit: Diana Rowland

by Diane | October 16, 2014
Improving agricultural viability by reducing inputs & increasing yield

• On average lower amounts of irrigation and fertilizer performed better (in a wet year) than relatively high irrigation and nitrogen application

• Results suggest a relatively wet growing season combined with irrigation may show negative yield impacts

• Sesame is a low water crop, alternative crop for Florida

• Climate variability – ENSO phase
El Niño is already causing conditions in the tropical Atlantic to be less conducive to tropical storm development and the systems that have formed have encountered high wind shear and struggled to survive. During the winter El Niño causes the Pacific jet stream current to dip into the Southeast. This provides cold fronts with more moisture and energy. El Niño typically leads to 40 to 50% more rainfall than normal for the Florida peninsula, and about 30% more than normal for South Georgia. El Niño's impacts on the weather in the Southeast US are usually most prominent in the winter, but given the strength of this year's event, we could begin to see its effects this fall. Many climate models are predicting a wet fall with above-normal temperatures for the Southeast.
Improving agricultural viability by providing risk management information

- Dynamic, free tool to help predict climate variability
- Provide information to modify production practices based on predicting climate patterns
Primed acclimation: D Rowland

- Induction of physiological responses that prepares plants to tolerate or resist stresses by activating defense responses faster, stronger, or both; mechanism of stress memory (based on Bruce et al. 2007)

- Water-saving irrigation strategy that takes advantage of priming and stress memories in crops to improve drought response
  - Deficit Irrigation during vegetative growth
  - Mild to moderate deficit (Rowland et al., 2012)

- Leads to changes in root architecture, biomass partitioning, increased WUE, yields
Stress in PA Only

Solid line represents normal plant
Dotted line represents plant receiving PA
Peanut yield

Irrigation treatments:

1) Rainfed control (RF)
2) PeanutFARM with applications at a 1.9 cm amount for the entire season (PF)
3) Application of 1.1 cm until mid-bloom and 1.9 cm following mid-bloom scheduled using tensiometers placed treatment #2 (PA)
4) Application of 1.1 cm application amount for the entire season scheduled using tensiometers
5) Irrigation scheduled with tensiometers at an optimum application amount of 1.9 cm (Full) for the entire season
Improving agricultural viability by reducing drought impacts

- Using **primed acclimation** to reduce water needs and improve yield during drought
- **Tensiometer** based irrigation with greatest yield (based on soil water content)
Soil moisture sensor irrigation: M Dukes
Discrete Sensors

5/19 irrigation treatments initiated

May 8, 2015

May 15, 2015

May 22, 2015

Sum of Sensors
T1 = Typical practices in the field
T2 = Soil water balance with FAWN
T3 = Soil moisture sensors
T4 = 60% of T1
T5 = No irrigation
Improving agricultural viability by optimizing water inputs

• More than one way to optimize irrigation: FAWN / water balance approach and using field equipment such as soil moisture sensors
• Applicable to most crops and locations
Smartirrigation apps

- Smartphone apps that develop real-time irrigation schedules

Avocado (*Persea Americana*)
Citrus (*Citrus spp. L.*)
Cotton (*Gossypium hirsutum L.*)
Peanut (*Arachis hypogaea L.*)
Strawberry (*Fragaria ananassa*)
Urban turf [e.g., St. Augustine grass (*Stenotaphrum secundatum*)]
Vegetable [cabbage (*Brassica oleracea var. capitata*), squash (*Cucurbita pepo*), tomato (*Solanum lycopersicum L.*) and watermelon (*Citrullus lanatus*)]
<table>
<thead>
<tr>
<th>Method</th>
<th>2013/2014</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Sap Flow (g hr⁻¹ m⁻²)</td>
<td>Applied (1000 L ha⁻¹)</td>
</tr>
<tr>
<td>Site 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citrus App</td>
<td>38.88 a</td>
<td>2218.4 b</td>
<td>299.2 a</td>
</tr>
<tr>
<td>Std Practice</td>
<td>18.72 c</td>
<td>3189.0 a</td>
<td>263.7 b</td>
</tr>
<tr>
<td>Current IFAS</td>
<td>29.02 b</td>
<td>2913.2 a</td>
<td>283.3 a</td>
</tr>
<tr>
<td>Site 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citrus App</td>
<td>21.78 a</td>
<td>2251.9 b</td>
<td>315.1 a</td>
</tr>
<tr>
<td>Std Practice</td>
<td>9.77 b</td>
<td>3223.7 a</td>
<td>284.7 b</td>
</tr>
<tr>
<td>Current IFAS</td>
<td>18.75 a</td>
<td>2825.6 a</td>
<td>289.6 b</td>
</tr>
<tr>
<td>Site 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citrus App</td>
<td>69.39 a</td>
<td>2223.8 b</td>
<td>374.1 a</td>
</tr>
<tr>
<td>Std Practice</td>
<td>34.54 b</td>
<td>3207.6 a</td>
<td>315.1 b</td>
</tr>
<tr>
<td>Current IFAS</td>
<td>60.58 a</td>
<td>2117.5 b</td>
<td>325.1 b</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Method</td>
<td>2014/2015</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sap Flow (g hr⁻¹ m⁻²)</td>
<td>Applied (1000 L ha⁻¹)</td>
</tr>
<tr>
<td>Site 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citrus App</td>
<td>39.72 a</td>
<td>2968 b</td>
<td>258.5 a</td>
</tr>
<tr>
<td>Std Practice</td>
<td>23.84 b</td>
<td>3684 a</td>
<td>216.1 b</td>
</tr>
<tr>
<td>Current IFAS</td>
<td>26.21 b</td>
<td>2681 b</td>
<td>223.4 b</td>
</tr>
<tr>
<td>Site 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citrus App</td>
<td>34.82 a</td>
<td>2801 b</td>
<td>298.4 a</td>
</tr>
<tr>
<td>Std Practice</td>
<td>23.68 b</td>
<td>3195 a</td>
<td>226.8 b</td>
</tr>
<tr>
<td>Current IFAS</td>
<td>25.95 b</td>
<td>2984 a</td>
<td>216.5 b</td>
</tr>
<tr>
<td>Site 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citrus App</td>
<td>28.98 a</td>
<td>2811 b</td>
<td>286.5 a</td>
</tr>
<tr>
<td>Std Practice</td>
<td>19.90 b</td>
<td>3846 a</td>
<td>198.4 b</td>
</tr>
<tr>
<td>Current IFAS</td>
<td>29.54 a</td>
<td>2843 b</td>
<td>265.1 a</td>
</tr>
</tbody>
</table>
Harvested fruit weight and fruit number per treatment for each harvest date (n=21 trees per treatment)
Improving agricultural viability by optimizing water inputs

- Smartphone apps for real-time scheduling with FAWN data / evapotranspiration based
Floriculture Research Alliance

The Floriculture Research Alliance includes researchers that collaborate across universities and organizations on applied research.

Our mission is to partner with industry stakeholders to develop science-based solutions to sustainability issues for floriculture.

This website publicizes our research on sustainable production including efficient use of water, energy, agrichemical and nutrient resources.

http://floriculturealliance.org/
Our research and outreach funding comes from a 'Clean WaterR3 - Reduce, Remediate and Recycle' Specialty Crop Research Initiative grant.

The Water Education Alliance for Horticulture helps growers conserve irrigation water and manage water quality issues. We include multiple universities, with additional support from industry partners.

Sign up here for our newsletter.

Visit this page to sign up for our webinars and workshops.

If you have questions or comments please contact us.

1. Check out one of our most recent FAQs
   What resources are available to help me in planning and funding irrigation improvements to reduce water use at my nursery?

2. Ask us a question about water use and irrigation in your nursery.

3. Watch a short video on an aspect of improving your use of irrigation water.
   Irrigation capture factor
   Dr. Tom Yeager of University of Florida IFAS Extension explains the Florida Nursery Best Management Practice for measuring the "Irrigation capture factor" - how effectively container plants capture overhead irrigation water.
   • Irrigation capture factor

http://watereducationalliance.org/
Improving floriculture viability through education

- Floriculture Research Alliance and Clean WateR3 - Reduce, Remediate and Recycle
- Programs that assist growers
- Extension programs / educational programs
FUTURE INNOVATION
Future innovation: smartphone monitoring and control

- Smartphone based communication with field monitoring equipment (using real time data)
- Adopt industry-wide data communications standards, data format standards, and metadata requirements
  - Improving communication amongst devices, equipment, information, and people
Future innovation: Use of Unmanned Aerial Vehicle (UAV)

- Monitor for disease, problems, etc.
- Collect data
- Provide ‘eyes’ for hard to get to places
- Reduce man power and increase on-ground knowledge
Future innovation: forecast data integrated into scheduling

• Incorporation of forecast data (such as forecasted ET and rainfall considering day-to-day variability and seasonal variability) into agricultural production planning

• Combining real-time data with forecast data for better irrigation need assessment
Future innovation: smartphone monitoring and control

- Optimized systems: considering in-field spatial variability for water, nutrients, pests
- Variable Rate Irrigation / Fertigation Systems
Take home points to increase agriculture viability

• More water doesn’t always equal more yield
• Consider economics, does a practice result in greater profit?
• Low water alternative crops
• Primed acclimation to ‘prep’ plants for drought
• Manage irrigation considering potential flood risk
• Use tools for optimizing schedules: soil moisture sensors, smartphone apps, ET or GDD information
• Stay connected with UF IFAS extension agents and specialists for the latest information
Take home tools

• AgroClimate.org
  • Help predict wet/dry year, make decisions on water management and crop

• Florida Automated Weather Network (FAWN)
  • Real-time weather and tools (more to come)

• IFAS apps: http://ifas.ufl.edu/mobile-apps/
  • List of many tools to help optimize different aspects of production using IFAS science
  • http://agronomy.ifas.ufl.edu/peanutfarm

• Evapotranspiration and Soil Moisture Sensors
  • Many resources on this in EDIS http://edis.ufl.edu for irrigation scheduling (or email Kati)

• Floriculture websites
  • Learning opportunities to optimize production
Acknowledgements

UF IFAS Departments and Centers
Graduate students, post docs, technicians
Funding agencies
SFWMD and hosts

Kati’s contact info:
kwhite@ufl.edu
@hydroKati