UNIVERSITY OF GEORGIA
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# Developing Easier-to-use Applications for Peanut Irrigation Scheduling

Sensors

No Sensors


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## BACKGROUND

**Irrigator Pro** is a public domain decision support system (DSS) for irrigation scheduling in peanuts that was developed by USDA ARS. (https://irrigatorpro.org)

- Widely used by peanut farmers and consultants in the Southeast.
- Original version requires weekly manual inputs of soil temperature and precipitation.
- Recently-released version uses soil matric potential from wireless soil moisture sensor networks.
- High soil variability in Coastal Plain fields requires an adaptive DSS that provides actionable decisions.
- Volumetric water content (VWC) or capacitance sensors with wireless telemetry are widely available.

## OBJECTIVES & GOAL

This project aimed to make Irrigator Pro an easier-to-use irrigation DSS by incorporating multiple data sources. Specific objectives were:

- Modify the DSS to accept VWC data from capacitance sensors (Figure 1).
- Develop water release curves to convert irrigation thresholds to VWC.
- Test and compare the new versions of the DSS to existing versions and other irrigation scheduling tools at the plot scale.

## METHOD & MATERIAL

- Rewrite the Irrigator Pro code to accept VWC data from capacitance probes.
  - Code currently converts matric potential to VWC using empirical equations to estimate daily water use (DWU).
- Year 1 entailed using VWC and matric potential sensors (Table 1) to benchmark published Kc curves for peanuts at the plot scale. The research was conducted at two research farms (SIRP and HHERC) in southwestern Georgia, USA.
- Irrigation was scheduled using sensors and the soil temperature and soil matric potential version of Irrigator Pro. Scheduling methods were:
  - SWT (UGA SSA) = irrigation triggered with a matric potential threshold
  - ET-based = DWU is estimated according to the Kc-curve
  - Irrigator Pro (VWC) = irrigation triggered with VWC threshold using Sentek sensors
  - Irrigator Pro (Temp) = model uses manually input of soil temperature and precipitation readings
  - Irrigator Pro (SWT) = Irrigator Pro using matric potential data
  - Rainfed = no irrigation except to promote germination and activate herbicides

## RESULTS & DISCUSSION

- Scheduling with VWC sensors was the most efficient although the rainfed treatment outperformed all irrigation scheduling treatments in 2021 (Table 1).
- Root activity can be monitored using VWC.
- During 2022, VWC scheduling plots at the SIRP field produced the highest average yield among the Irrigator Pro options without any significant difference though.
- Highest IWUE for HHERC location during Year 2.
- VWC version is available for public use.

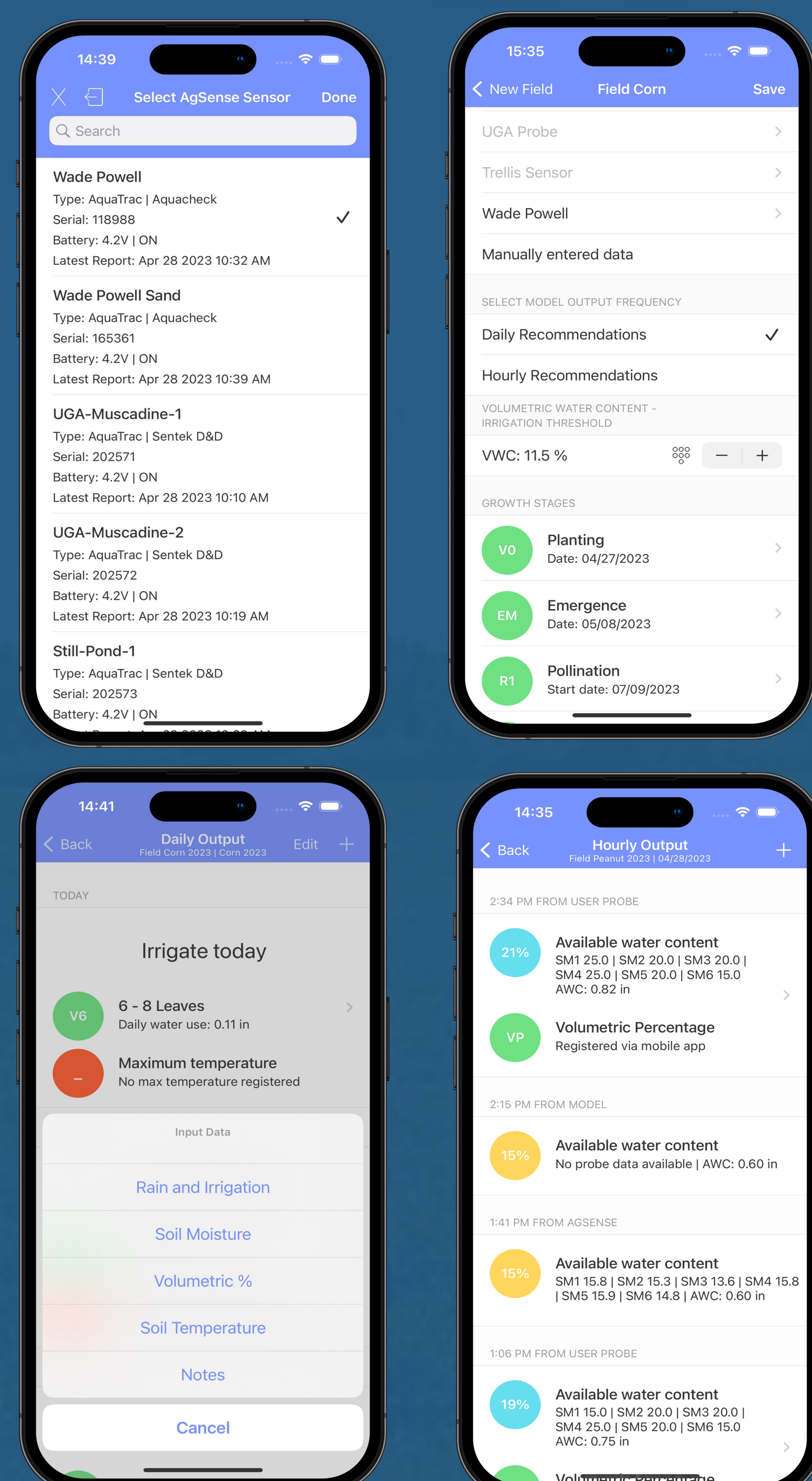


Figure 1. VWC version of Irrigator Pro on a mobile device.

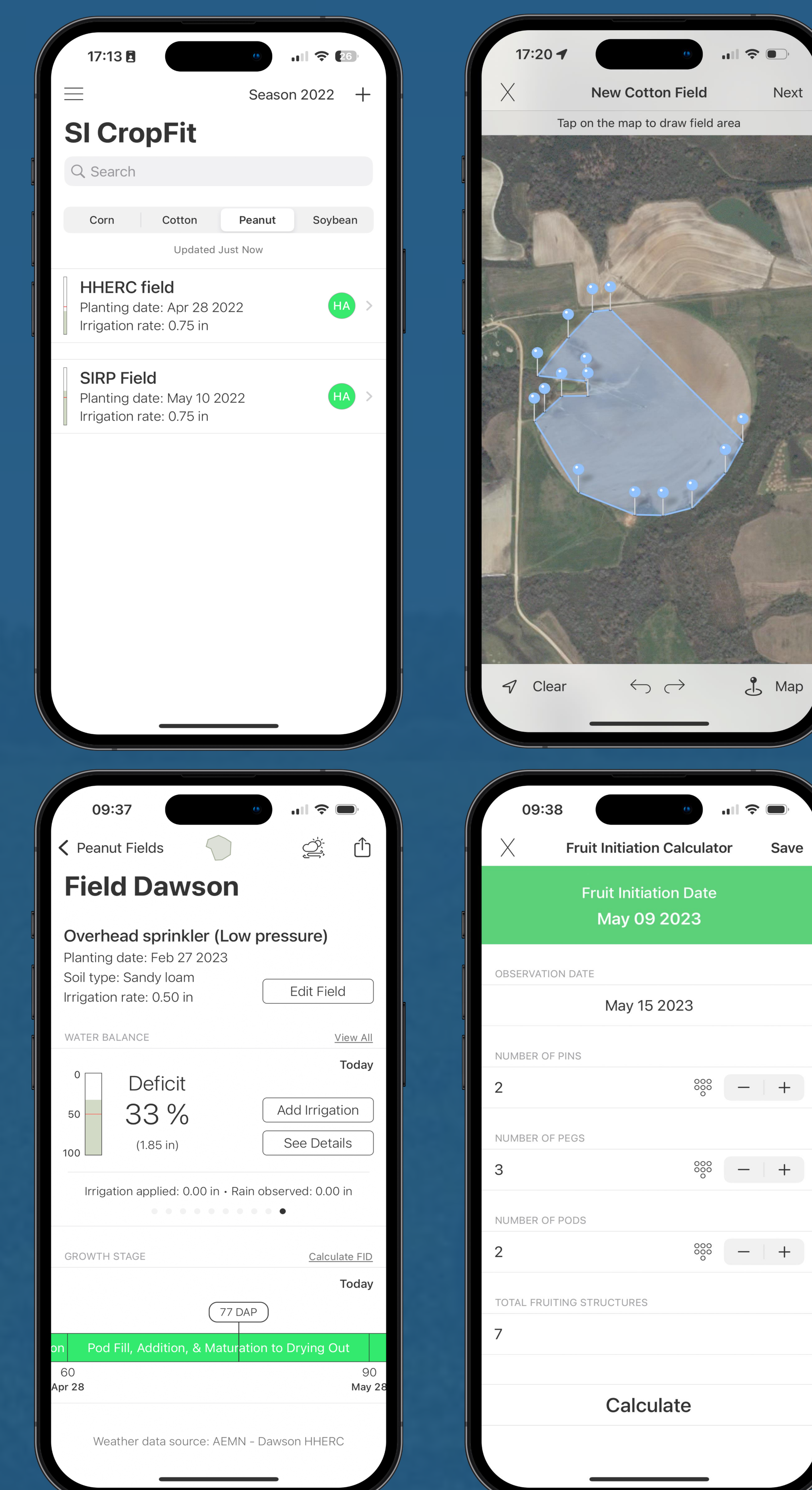


Figure 2. Peanut CropFIT interface on a mobile device.

**Table 1.** Yield and IWUE* results after the 2021-2022 seasons at the SIRP field, and the 2022 season at the HHERC field.

| Treatment | SIRP Field (Year & Precipitation) | | | | | | HHERC Field (Year & Precipitation) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 2021 (681 mm) | | | 2022 (525 mm) | | | 2022 (405mm) | | |
| | Yield (kg ha$^{-1}$) | Irrigation (mm) | IWUE (kg ha$^{-1}$ mm$^{-1}$) | Yield (kg ha$^{-1}$) | Irrigation (mm) | IWUE (kg ha$^{-1}$ mm$^{-1}$) | Yield (kg ha$^{-1}$) | Irrigation (mm) | IWUE (kg ha$^{-1}$ mm$^{-1}$) |
| **ET-based** | - | - | - | 5410 $^a$ | 119 | 51 $^a$ | 4144 $^a$ | 142 | 33 $^a$ |
| **Irrigator Pro (Temp)** | 6445 $^a$ | 131 | 68 $^d$ | 5154 $^a$ | 137 | 41 $^b$ | - | - | - |
| **SWT (UGA SSA)** | 6605 $^a$ | 74 | 173 $^b$ | 4967 $^a$ | 137 | 40 $^b$ | - | - | - |
| **Irrigator Pro (SWT)** | 6510 $^a$ | 112 | 85 $^c$ | 5453 $^a$ | 137 | 44 $^b$ | 3808 $^a$ | 160 | 26 $^b$ |
| **Irrigator Pro (VWC)** | 6480 $^a$ | 55 | 340 $^a$ | 5467 $^a$ | 155 | 38 $^b$ | 3997 $^a$ | 124 | 36 $^a$ |
| **Rainfed** | 6780 $^a$ | 36 | - | 5267 $^a$ | 13 | - | 1937 $^b$ | 18 | - |

*IWUE = Irrigation Water Use Efficiency

## BACKGROUND

In 2012, a group of UGA and University of Florida (UF) researchers began developing a suite of irrigation scheduling apps for various crops. The suite was called **SmartIrrigation Apps** for Scheduling Irrigation (**SI Apps**) and includes horticultural and agronomic crops. (https://smartirrigationapps.org)

- Evapotranspiration (ET) -based irrigation scheduling could serve as an alternative to soil moisture sensors.
- Cotton, Corn, Blueberry, Turf, and other crops and vegetables are already in use throughout the southeast.
- Multiple weather station APIs have been implemented.

## OBJECTIVES & GOAL

The goal was to develop a new version of the CropFIT App that will schedule irrigation for peanuts without using soil moisture sensors.

- Use VWC data to benchmark the suggested FAO-56 curve to southeastern conditions using Growing Degree Days.
- Develop the new version Kc-GDD curve.
- Compare the new version with other irrigation scheduling treatments at the plot scale.

## METHOD & MATERIAL

- Use the FAO-56 (Penman-Monteith) approach to develop an ET-based model for estimating DWU using the VWC data from Year 1.
- Develop a growing degree day (GDD)-based crop coefficient curve (Kc) that estimates DWU using ETo (Figure 3).
- Use of water balance model to estimate the plants' available water and recommend irrigation when needed.

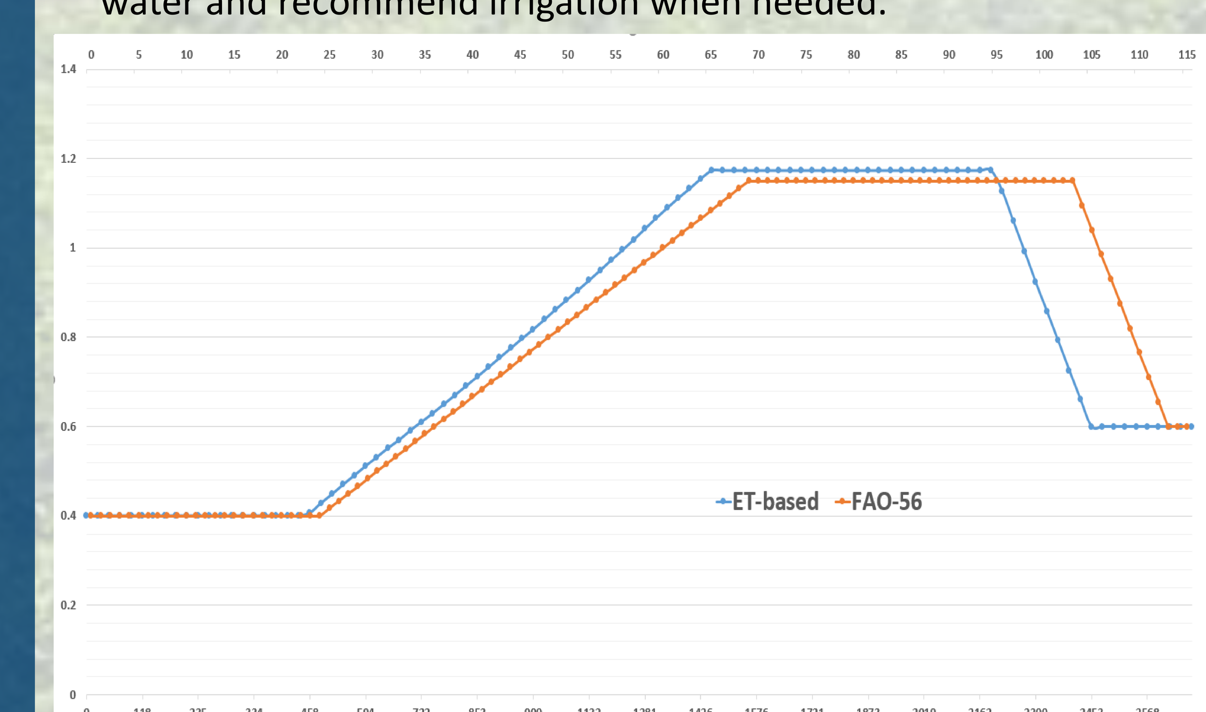


Figure 3. Developed Kc-GDD curve compared to standard ET-based scheduling from FAO-56 guidance. X-axes feature both DAP (top) and GDD (bottom).

## RESULTS & DISCUSSION

- Filtered ETc data from 2021 led to DWU estimation during the season.
- DWU values from soil moisture data were used to benchmark the generic FAO-56 peanut Kc curve (Figure 3), and watch the root activity through the season.
- FAO-56 seems to underpredict from 30-70 DAP and overpredict near maturity.
- Et-based treatment performed at least as well as the other irrigation treatments, and in some cases it significantly outperformed them.
- New Fruit Initiation Date (FID) feature will benchmark real on-field GDDs with estimated accumulated GDDs on the App.
- Public release in 2023.