A Smartphone App for Scheduling Irrigation in Cotton

Jose Andreis, Ed Barnes, Vasileios Liakos, Calvin Perry, Wesley Porter, George Vellidis
Vories et al. (2006) found that improper timing of irrigation in cotton can result in yield losses of between $150/ac to $750/ac.

Our Goals

• An interactive ET-based irrigation scheduling tool
• Operates on a smartphone platform
• Can be used to implement both conventional and precision irrigation across the Cotton Belt
• Cost growers only a few dollars per year provided they have a smartphone
  • Minimum user input
  • Ready-to-use output
  • Engaging – not static
Soil Profile Water Balance

Crop Evapotranspiration (ETc)

0% Deficit
100% of Available Soil Moisture (Full Profile)

50% Deficit
50% of Available Soil Moisture (Irrigation Threshold)

75% Deficit
25% of Available Soil Moisture (Dry Profile)

Rain + Irrigation
How do you Calculate ETc?

\[ ETc = ETo \times Kc \]

where

ETc = estimated crop ET
Kc = crop coefficient
ETo = Penman-Monteith reference ET (FAO 56)
FAO Irrigation and Drainage Paper 56

by
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Leuven, Belgium
Martin Smith
Water Resources, Development and Management Service
FAO
FAO - Food and Agriculture Organization of the United Nations
Rome, 1998
How do we Calculate ETo?

\[ ET_c = ETo \times Kc \]

ETo = Penman-Monteith reference ET (FAO-56)

\[
ET_o = \frac{\Delta(R_n - G) + \rho_a c_p (\delta e) g_a}{(\Delta + \gamma (1 + g_a/g_s)) L_v}
\]

• Calculated from meteorological data
  • Temperature
  • Solar radiation
  • Wind speed, etc.
Forecast Reference ET (FRET) Tool
Crop Coefficient, $K_c$

Days After Planting (DAP) 2013

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160

0.0 0.2 0.4 0.6 0.8 1.0 1.2

Accumulated Heat Units (GDDs)

1st Square
1st Flower
1st Open Boll
Crop Coefficient, $K_c$
What About Rain?

https://darksky.net
Available for iPhone and Android phones

Search for “Smartirrigation Cotton” in Apple and Google Play stores
Available for iPhone and Android phones
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• **Irrigation System Type**
  - Irrigation Effectiveness – % of applied water which becomes available in the soil
  - 85% for pivots; 90% for SSDI

• **Rooting Depth**
  - Minimum = 6 in; Maximum = 30 in
  - Increase = 0.3 in/day
A rain event of 0.35 in was observed in Midville GAEMN area yesterday. Adjust as appropriate.

The water deficit in Homestead2018 Grid is 42%. Irrigation is recommended.

A rain event of 0.53 in was observed in Midville2018 Grid area yesterday. Adjust as appropriate.

Yesterday

Theofanis Gemtos Gemtos: Γιώργο, μια μέρα καθυστέρηση, Χρόνια Πολλά και Καλά. Να χαίρετε την οικογένεια.

A rain event of 0.61 in was observed in Tifton1 GAEMN area yesterday. Adjust as appropriate.

A rain event of 0.07 in was observed in Homestead2018 Grid area yesterday. Adjust as appropriate.

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Smartirrigation Cotton

Updated Just Now

Homestead Fawn
Planting date: 03/21/2018
Irrigation rate: 0.75

Tifton1 GAEMN
Planting date: 03/08/2018
Irrigation rate: 0.75

SIRP1 GAEMN
Planting date: 03/21/2018
Irrigation rate: 0.75

Midville GAEMN
Planting date: 03/21/2018
Irrigation rate: 0.75

Tifton2018 Grid
Planting date: 03/08/2018
Irrigation rate: 0.80
A rain event of 0.35 in was observed in Midville GAEMN area yesterday. Adjust as appropriate.

The water deficit in Homestead2018 Grid is 42%. Irrigation is recommended.

A rain event of 0.53 in was observed in Midville2018 Grid area yesterday. Adjust as appropriate.

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A rain event of 0.61 in was observed in Tifton1 GAEMN area yesterday. Adjust as appropriate.

A rain event of 0.07 in was observed in Homestead2018 Grid area yesterday. Adjust as appropriate.

Drip irrigation
Planting date: 03/21/2018
Soil type: Sand
Irrigation rate: 0.50 in

WATER BALANCE
Deficit: 42%
(0.47 in)

Irrigation applied: 0.00 in Rain observed: 0.00 in

GROWTH STAGE
Emergence to First Square

Today

452 CDD
A rain event of 0.35 in was observed in Midville GAEMN area yesterday. Adjust as appropriate.

The water deficit in Homestead2018 Grid is 42%. Irrigation is recommended.

A rain event of 0.61 in was observed in Tifton1 GAEMN area yesterday. Adjust as appropriate.

A rain event of 0.07 in was observed in Homestead2018 Grid area yesterday. Adjust as appropriate.
Precipitation above 1 in/day and below 0.15 in/day is not considered in soil water balance.
Overhead sprinkler (Low pressure)

- **Planting date:** 03/21/2018
- **Soil type:** Loamy sand
- **Irrigation rate:** 0.75 in

**WATER BALANCE**

- **Deficit:** 0%
- **(0.00 in)**
- 04/22/2018

**Irrigation applied:** 0.00 in  
**Rain observed:** 2.50 in

**GROWTH STAGE**

- **110 GDG**
- **Emergence to First Square**

**ROOTING DEPTH**

- **16.5 in**
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Irrigation Scheduling on Cotton
Results from Stripling Irrigation Research Park
2013-2017

- For Cotton App to perform well
  - Good rain data
  - Good estimate of soil type

Negative IWUE values indicate that irrigation resulted in lower yields than measured in Rainfed plots.
ET Models vs Sensors

**ET Models**
- Low Cost
- Require accurate weather data
- Characterize soils

**Sensors**
- Measure directly
- Higher cost
- Install/remove
- Point measurement
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