

SmartIrrigation Avocado App: A Step-by-Step Guide¹

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Background

Irrigation is a necessary part of growing most plants in Florida, due to the low water-holding soils and insufficient rainfall during the November-to-May dry season when many high value crops are grown. Irrigation methods and systems vary statewide, as does the technology used for developing an irrigation schedule. A good irrigation schedule provides the right amount of water at the right time so the plants receive adequate water for optimum growth and water is not lost to runoff or drainage. By scheduling irrigation efficiently, plants are healthier and fewer nutrients are lost from the system. Additionally, maintaining the proper soil water content (i.e., not too much or too little) reduces the occurrence of pests and diseases. Thus, efficient irrigation scheduling can also protect downstream water supplies from agrochemicals transported with runoff or drainage.

Several methods have been implemented for irrigation scheduling for agricultural crops in south Florida. These include use of evapotranspiration controllers (<http://edis.ifas.ufl.edu/ae446>), soil water sensors (SWS; <http://edis.ifas.ufl.edu/ae437>), and traditional observation-based methods. Traditional methods rely on the grower's knowledge of crop water requirements, local soil characteristics, crop response to drought and irrigation, and historical weather conditions. However, even with the grower's knowledge of these factors, traditional methods may result in water losses

and low water- and energy-use efficiencies since they do not account for real-time weather data.

A suite of smart irrigation apps that operate on smart-phones and tablets were developed (SmartIrrigation Apps 2015) to offer convenience, ease of irrigation scheduling, and increased water and energy use efficiencies. These apps are available as free downloads in the Google Play and iOS App Stores. In this document, step-by-step guidelines are provided on how to set up and use the SmartIrrigation Avocado app to determine irrigation timer settings.

Avocado Smartphone App

SmartIrrigation Avocado was developed by the University of Florida and operates on iOS and Android platforms. The app determines an evapotranspiration (ET)-based irrigation schedule using crop evapotranspiration (ET_c), irrigation systems characteristics, soil characteristics, and root depth. As shown in Equation 1, ET_c is calculated from crop coefficients (K_c; Table 1) and reference evapotranspiration (ET_o) data, with the ET_o data being determined by using the FAO 56 Penman-Monteith method (Allen et al. 1998):

$$ET_c = K_c ET_o \quad (\text{Equation 1})$$

Weather data from the Florida Automated Weather Network (FAWN) are automatically downloaded from a station

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in the network close to the field locations or from a station assigned by the user.

The SmartIrrigation Avocado app generates a 15-day irrigation schedule based on the previous five days of ETC calculations. This schedule is updated any time there is a 50% or greater change in the average ETo for the previous five days.

Table 1. Kc values to compute the ETC values

Growth Stage	Description	Kc
Dormancy	Occurs during fall (Nov./Dec.) when temperatures and water demand are generally low.	0.6
Flower bud development	Generally Dec. through Feb. depending upon cultivar; low demand for water.	0.8
Flowering and fruit set	Occurs during mid- to late winter. Trees typically drop their leaves during this period, although flowering panicles and set fruit require some water.	0.7
Fruit growth	Occurs over a 5- to 15-month period depending upon cultivar; high demand for water.	1.0
After harvest	Demand for water is reduced during this time.	0.7

Source: Crane (personal communication)

Step 1: Registration

After downloading and installing the app on the user's device, create an account to use the app or sign in with an existing account. Information used during account creation is kept confidential and is for administrative purposes only.

Step 2: Entering Site Specific Information

- Initiate the app by tapping the SmartIrrigation Avocado app icon on the smart device screen (Figure 1). This launches the app and shows any information previously entered.



Figure 1. SmartIrrigation Avocado app icon

- From the SI Avocado home screen, enter a new field by tapping the Add button (+) (Figure 2).

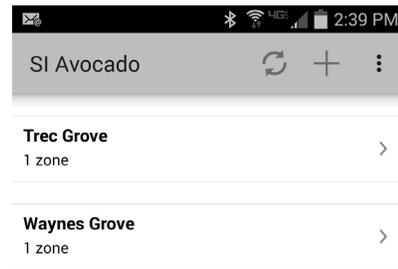


Figure 2. Opening screenshot with Add (+) button to add new fields. Established fields are also shown with their number of zones. (Note that all screenshots are from the Android version and iOS will be slightly different.)

- To select the location for the new field, tap Select Location and then tap on the map where you want to set the field location (Figure 3). The latitude and longitude coordinates of the field location are saved based on the site selected.

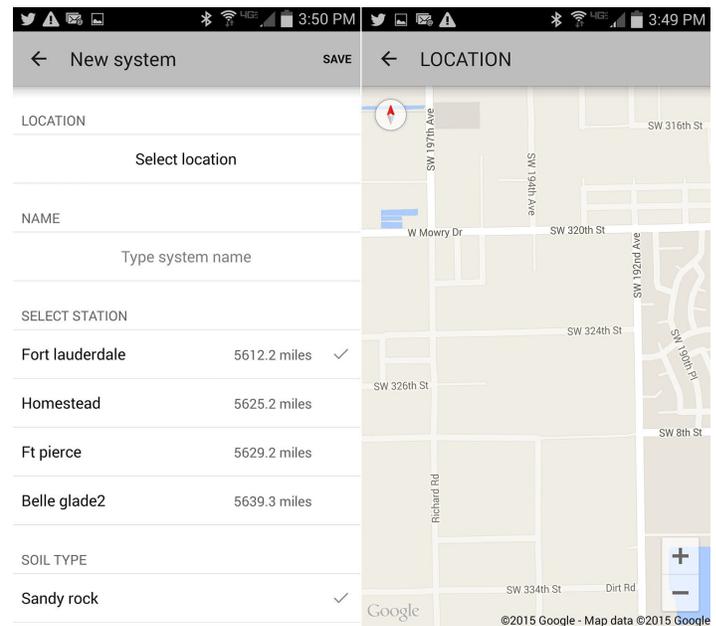


Figure 3. Input screenshot for new field location and information (left); screenshot of map used to locate field (right)

- After identifying the location, tap Name to enter a field name. The closest FAWN weather station is assigned to the field for developing the irrigation schedule. Alternatively, users can select a different station from the list of the four nearest stations in the FAWN system.

Step 3: Soil Characteristics

- Soil type information is selected from the Soil Type field's three default soil type options—(1) sandy rock, (2) Krome/Chekika or Rockland, and (3) Marl/Glad-eland (Figure 4).

- b. In the Cold Protection field, tap the + or – buttons to select the cold protection alert temperature for the field (a 40°F cold protection temperature is provided as a default value for the app).
- c. After inputting all this information, tap Save to save the field characteristics.

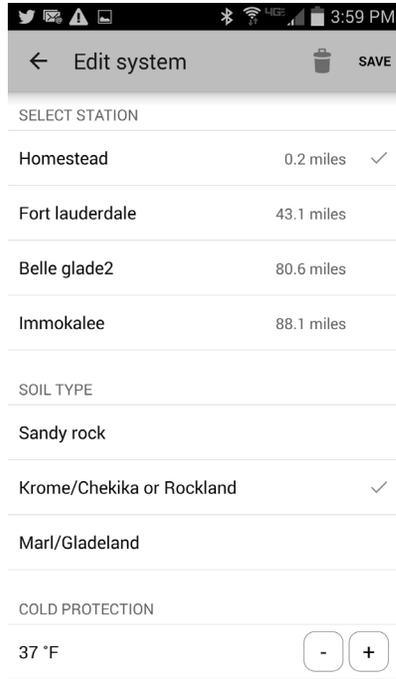


Figure 4. App screenshot of soil types and cold protection input features

Step 4: Zone Information

Zone parameters and descriptions are entered in this step.

- a. On the Add Zone screen, the irrigation Type field includes the default options of Micro Sprinkler or Solid Set Sprinkler (Figure 5). These default options were included because they represent the dominant irrigation systems in south Florida commercial avocado production.
- b. Additional input fields on the Add Zone screen include the following:
 - Number of Trees
 - Irrigation Rate
 - Efficiency
 - Root Depth
 - Spray Diameter
 - Pattern

- c. In the Minutes to Pressurize System field, users can input the minutes it takes to pressurize the irrigation system. The app adds these extra minutes onto the irrigation schedule. Users also select the days to irrigate by tapping on the calendar week boxes.

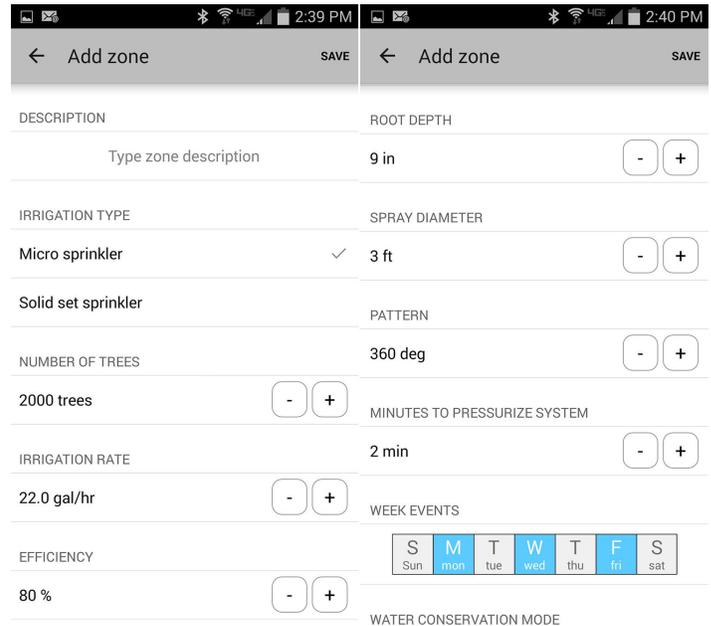


Figure 5. The zone inputs for the Add Zone screen of the SI Avocado app. The blue boxes under Week Events represent irrigation days, while the white boxes are non-irrigation days.

- d. Another feature on the Add Zone screen is the Water Conservation Mode field. This option allows modification of the irrigation schedule for deficit irrigation (irrigation that does not completely refill the soil profile). The default setting is Normal, which replaces 100% of evapotranspiration losses. If the Seasonal Water Savings setting is selected, irrigation volumes will be scheduled to replace 75% of evapotranspiration losses whenever rainfall amounts exceed ETc. If the Year Round Water Savings setting is selected, the app creates irrigation schedules that replace 75% of estimated evapotranspiration losses at all times.
- e. To receive an e-mail of the app’s output every Monday morning, select Yes from the Weekly Report Email field.

Step 5: Growth Stages

- a. After entering the irrigation zone information, the Growth Stages screen opens. According to avocado field conditions growth stages of avocado—flower bud development, dormancy, flowering and fruit set, fruit growth, and after harvest—are adjusted by the user on the Growth Stages page (Figure 6).

It is important to have growth stages adjusted according to field observations, because the crop growth stages determine the crop coefficient to be used in predicting an irrigation schedule. The user can adjust the growth stages' duration and the current day in the crop growth stage. These features are necessary as there are many different avocado varieties, each of which may mature at different rates.

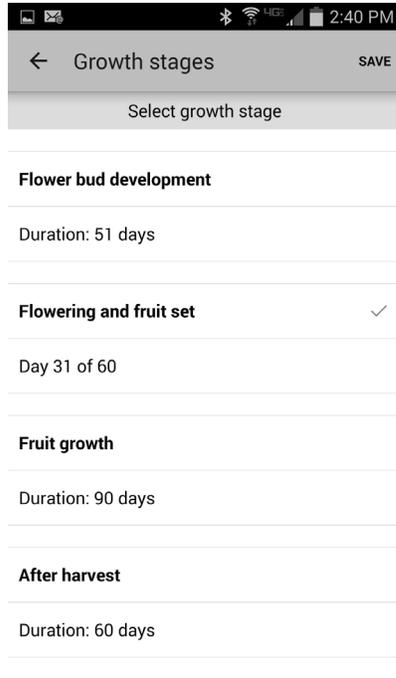


Figure 6. Screenshot of avocado crop growth stages. The check mark indicates the current stage.

- b. After this process, the zone input is complete. Now, on the main SI Avocado screen, the user can tap on any of the zones that were set up and view a summary of the irrigation system rate, sprinkler type, efficiency, irrigation time, days of the week to irrigate, irrigation amount per event, accumulated rain in the previous seven days, and the avocado growth stage.

Step 6: Adding New Zones to System

To add new zones to the system from the main SI Avocado screen, tap on the field of interest and then tap on the Add icon (+) to go through steps 4 and 5.

Step 7: Irrigation Schedule

The irrigation schedule developed by the app is displayed after field and zone data are saved (Figure 7). This irrigation schedule should be used to adjust irrigation timer settings and run times in the field.

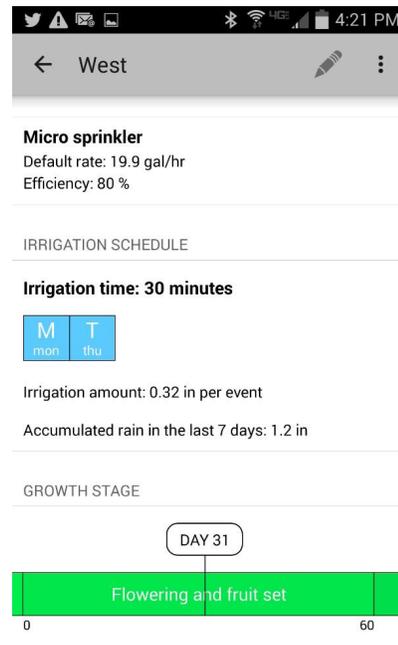


Figure 7. Screenshot of app output for scheduling irrigation

The app also provides the equivalent irrigation depth and rainfall for the past seven days. If you selected Yes from the Weekly Report Email field, e-mails that include app output are sent to users every Monday morning to assist with irrigation planning (Table 2).

Editing Zone Information

To edit the properties of each zone, tap on the field of interest on the main SI Avocado screen. This allows the field to pop up and also displays the Edit icon, which allows the user to change parameters of interest.

Table 2. Sample irrigation schedule weekly report sent by the app to the user

System	Zone	Irrigation type	Irrigation days	Irrigation time (hrs)	Irrigation time (mins)	Irrigation amount (in)	Last 7 days rainfall (in)
Homestead	Avocado app	Micro sprinkler	Monday, Wednesday, Friday	0	10	0.3	0

Main Menu Features

A drop-down menu offers additional features (Figure 8). From this drop-down menu, you can access the Savings, Forecast, and Notifications screens.

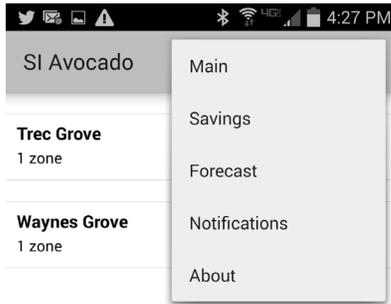


Figure 8. Dropdown menu for SI Avocado app

Savings (Water Saved by the App)

By selecting Savings from the drop-down menu, the app shows the amount of water savings (in gallons and as a percentage) obtained by using the SI Avocado app. Water savings are calculated by comparing a 1.5-inch irrigation rate per week to the schedule provided by the app. This comparison rate was selected based on observed irrigation practices in commercial avocado groves in Miami-Dade County. The savings will have a positive sign and appear in green if water is saved, or appear with a negative sign and in red if excess water is applied (Figure 9).

Month	Gallons	Percentage
Mar/15	3215 gal	+ 60 %
Feb/15	8684 gal	+ 60 %
Jan/15	37507 gal	+ 66 %
Dec/14	35163 gal	+ 60 %
Nov/14	30140 gal	+ 60 %
Oct/14	32735 gal	+ 56 %
Sep/14	26205 gal	+ 48 %
Aug/14	10047 gal	+ 40 %

Figure 9. Water savings obtained by using the app to schedule irrigation

Forecast (Weather Forecast)

By selecting Forecast from the drop-down menu, the app shows a forecast of weather conditions. The forecast displays the temperature, relative humidity, wind speed, and probability of rainfall events for the next eight hours and for the next five days (Figure 10).

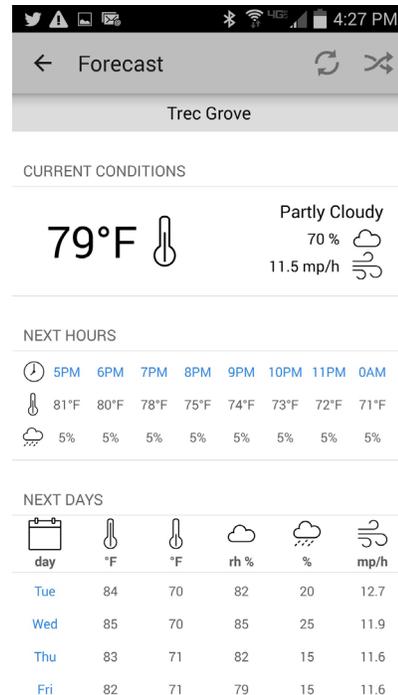


Figure 10. Forecast data from the National Weather Service provided in the SI Avocado app

Notifications

By selecting Notifications from the drop-down menu, the app shows notifications sent to the user's smart device (Figure 11). Notifications are sent to alert of an irrigation schedule change, a rainfall event within 24 hours of a scheduled irrigation event, and an alert if the probability of rainfall is greater than 60%.

Summary

The SI Avocado app provides a simple ET-based method to schedule irrigation and is expected to provide 20%–50% water savings based on findings with other schedule tools. The app provides flexibility and e-mail output for convenience. The notifications are targeted to alert the user when irrigation changes are needed based on changing evapotranspiration and rainfall. Additional information about the SmartIrrigation Apps can be found at <http://smartirrigationapps.org/>.

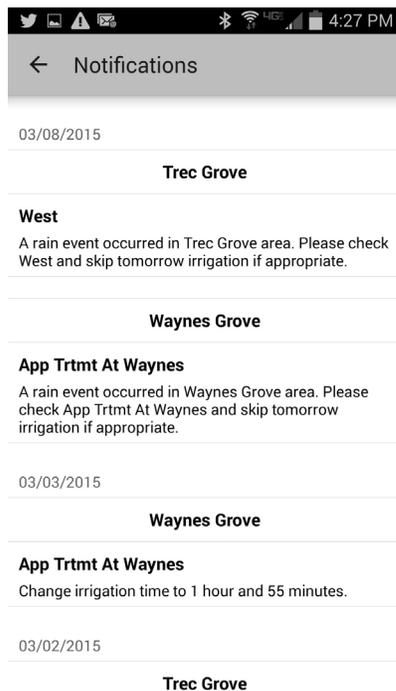


Figure 11. Example notifications stored on the avocado app

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