Irrigation is used throughout the world to supplement plant water needs for either agricultural production or for urban/residential aesthetics. Agricultural irrigation has increased yields substantially; as worldwide, irrigated agriculture includes 20% of agriculture land and results in 40% of the world’s food and fiber (Hoffman and Evans, 2007). Irrigation has also transformed communities into beautiful gardens and lawns which are desirable for recreating, meditating, and socializing. Thus, irrigation contributes to our lives in numerous forms.

While we enjoy the benefits of irrigation, there has also been some unintended consequences. Enterprising people have developed ways to deliver water and schedule irrigation with minimal human interaction or feedback from the plant system. An excellent example of this is the automated irrigation timer. These timers have become common place in irrigation due to their convenience as they allow users to irrigate on specific days and times without the user being present. This has resulted in widespread implementation of automated irrigation systems. The use of these set-and-forget type of tools were found to irrigate as programmed but were often over irrigating due to the failure of users to modify the irrigation schedule based on the ever changing plant water demand (Mayer et al., 1999).

As irrigation researchers, we have developed various methods to calculate irrigation schedules for different plants. These methods often include some type of water balance where the user must consider soil water holding capacity, effective rainfall, and evapotranspiration. Methods range from web applications with current weather conditions to hardware that is installed at the irrigation site (e.g., soil water sensors and evapotranspiration controllers). While both are acceptable mechanisms for scheduling irrigation, they are not always practical nor are they widely implemented. Some users find accessing the web site and performing calculations to develop an irrigation schedule too cumbersome and prone to calculation error. Others find that installing soil water sensors and evapotranspiration controllers not feasible given their current irrigation system or expense.

The limitation of current irrigation scheduling methods and the obvious need for them, led us to the idea of developing smart phone apps or SmartIrrigation (http://smartirrigation.org). The concept was to develop commodity or application specific irrigation apps that would provide users with an irrigation schedule based on real-time, location specific weather data. We also wanted to integrate forecast data and use of notifications. To date, we have released three apps: SmartIrrigation Citrus, SmartIrrigation Strawberry, and SmartIrrigation Turf. We expect to release a cotton app this year as well as an app for avocado, cabbage, peanut, and tomato by 2015. The apps are currently available for Android and iOS platforms and can be downloaded for free at Google Play and App Store. Apps are limited to Florida and Georgia, USA but we plan to expand the apps region as funding becomes available.
Each app was developed with the user in mind. Thus, each app is different in its approach. For example, the citrus app considers a micro sprinkler irrigation system while the strawberry app considers a drip irrigation system. All the apps are in continuous development as new funding and interest emerge. One new feature we are adding to the apps is estimated water savings that result from using the app as compared to a standard irrigation rate. This will provide the users with a measurement of their benefit from using the app.

To give some perspective on the apps and their function, we will step through some features of the turf app. The turf app is the only urban/residential app we currently are developing. This app plant is warm season turf grass but we anticipate adding cool season grasses, shrubs, trees, and annual plants in the future. The app allows you to input up to 10 sites with up to 10 irrigation zones per site.

The first step in using the turf app is to select an irrigation location starting with the location of the device. The user may modify this location by moving the pin. The location is translated into latitude and longitude and displayed. The screenshots in Fig. 1 show this step. This allows the app to associate the closest weather information to the irrigation site for developing the irrigation schedule. The irrigation schedule for the turf app is based on a 5-day average crop evapotranspiration value. Rainfall is considered through notifications to the user of events that have occurred or are predicted to occur due to the spatial variability of rainfall in the Georgia-Florida region.

The next few steps of the app require the user to provide some information about the irrigation location that is used to develop the irrigation schedule. Depending on the user and app characteristics, input terminology and parameters differ to fit each stakeholder group’s specific needs. For turf, the inputs include soil type, irrigation rate, and days of the week to irrigate (Figs. 1 and 2). The ability to designate the days of the week for irrigation is essential as many municipalities have watering restrictions that limit users to specific days and times.

Figure 1. Screenshots of turf app with map and latitude and longitude.
We have been testing the turf app schedule against other scheduling techniques in a plot study in Homestead, Florida, USA and have found that the turf app irrigates similar depths to an on-site evapotranspiration controller. This indicates the scheduling technique is sufficient and has resulted in an approximate water savings of 30% for the study period. While these savings are expected, we believe greater water savings are achievable.

The first stage of turf app develop used an irrigation schedule that would replenish water losses to fill soil field capacity. This concept is generally used in irrigation as it results in minimal risk of plant stress. However, with increasing pressure on water supplies this luxurious style of irrigation may not be prudent or realistic. Researchers have shown that plants can flourish and perhaps perform better when exposed to different levels of deficit irrigation (Rowland et al., 2012; Smith, 2012; Huangjun, 2013). Water conservation options were included in the turf app which modify the irrigation schedules based on a percentage of the field capacity irrigation estimate. There are two levels of water savings, seasonal and year-round (Fig. 3). These water savings levels are based on research for warm season turfgrass and weather patterns in Florida and Georgia, USA. Depending on the plant and location, the approach to deficit irrigation will differ.
The apps provide a method for delivering real-time and forecast information to users to improve irrigation scheduling such that water is used more efficiently in agriculture and water savings occur in urban/residential environments. The widespread use of smartphones makes irrigation apps a realistic tool. The potential sophistication and data incorporation options are endless which provide motivation for scientist as well as users.

References


