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Evapotranspiration-Based Irrigation for Agriculture: Sources of Evapotranspiration Data for Irrigation Scheduling in Florida[1]

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This article is part of a series on ET-based irrigation scheduling for agriculture. The rest of the series can be found at http://edis.ifas.ufl.edu/TOPIC_SERIES_ET-based_irrigation_scheduling_for_agriculture.

Introduction

To optimize irrigation water application through evapotranspiration (ET)-based irrigation scheduling, the first step is to obtain an accurate estimate of reference ET (ET_o). This article lists some of the public sources of ET_o data for irrigation scheduling in Florida.

Evapotranspiration: Basic concepts

ET is the process through which water is lost to the atmosphere collectively from the soil by evaporation from plants by transpiration. ET of a specific crop (also referred to as "crop ET" or "actual ET") is affected by several factors including weather, the crop under consideration, its management, and environmental variables (Table 1). The more information available about factors affecting ET, the more accurate the ET prediction will be. Generally, ET is not directly measured but estimated using mathematical equations that have been developed over time and selected site specific factors listed in Table 1. Equations for ET estimation vary in complexity and therefore vary in accuracy and applicability. More information on basic ET concepts can be found in *Evapotranspiration: Potential or Reference* http://edis.ifas.ufl.edu/AE256.

Crop ET (ET_c) is calculated as reference ET (ET_o) multiplied by the crop coefficient (K_c) (Equation 1). ET_o refers to the rate of ET from a well-watered hypothetical grass surface of known characteristics (height and surface resistance). It expresses the evaporative demand of the atmosphere at a given location independent of crop type, stage of

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development, and management practices. The different mathematical equations used for ET_o estimation are based on different concepts, and the variables (inputs) to include depend on the equation selected. ET_o may be determined using a complex equation (i.e., Penman Monteith) or simpler equations (i.e., Hargreaves). It is important to know which radiation or temperature-based method to use in the calculation of ET_o because some equations are more accurate than others depending on location (Table 2). Basic information on how to estimate ET_o can be found in *Smart Irrigation Controllers: Operation of Evapotranspiration-Based Controllers* http://edis.ifas.ufl.edu/AE446.

The K_c component of Equation 1 integrates the characteristics of the crop (e.g., crop height, fraction of net radiation absorbed at the land surface, canopy resistance, and evaporation from bare soil surface) into the ET_c estimation equation, to account for the difference in transpiration between the actual crop and the reference grass. Typical K_c values for some crops grown in Florida can be found in *Crop coefficients of some commercial crops in Florida* http://edis.ifas.ufl.edu/AE456. General information on estimating crop water requirements for irrigation from ET_c can be found in *Evapotranspiration-Based Irrigation Scheduling for Agriculture* http://edis.ifas.ufl.edu/AE457.

Sources of ET_o data for implementing ET-based irrigation scheduling in Florida

There are two types of ET_o data that can be used in ET-based irrigation scheduling: 1) historical ET_o and 2) real-time ET_o. Historical ET_o should represent long-term daily, monthly, or seasonal ET_o averages, for a long record of data that includes yearly and 10-year variations is most representative. Real-time ET_o used to schedule irrigation is updated daily, which provides an advantage over the historical ET_o -based approach because it accounts for daily variations in weather conditions. Florida growers can easily obtain real time ET_o and monthly average ET_o data from the Florida Automated Weather Network (FAWN) Web site at http://fawn.ifas.ufl.edu/ where ET_o is estimated using the University of Florida Institute of Food and Agricultural Sciences (UF IFAS) (1984) modified Penman equation. Daily, average daily and historic monthly ET_o can be obtained from the FAWN database for numerous locations throughout Florida by the following steps:

- Go to http://fawn.ifas.ufl.edu/
- Click **FAWN Tools Database** on the top menu
- Click **Evapotranspiration** (ET) on the drop-down menu click **Report**
- A table with daily ET_o for the past 7 calendar days and 7-day average ET for each of the FAWN weather station sites will appear. A graph with the past 14 days ET_o for selected FAWN sites is also available.
- Above the daily ET table, a table of monthly historic daily ET_o by ENSO phase (El Niño, Al Niña and Neutral) for selected sites can be viewed. These averages are updates daily.

Using these procedures, 'historical' ET during the past 10 years can be obtained. Current daily ET_o values may be obtained directly from the FAWN Web site for all FAWN locations by clicking on the 'Tools' menu on the main page and selecting 'Evapotranspiration (ET)' from the drop-down menu.

Other sources of ET_o data in Florida are the United States Geological Survey (USGS) hydrological data Web portal at http://dataport.er.usgs.gov/ (where ET_o is estimated using the Penman Monteith equation) and the National Climatic Data Center (NCDC) at http://www.ncdc.noaa.gov/oa/climate/stationlocator.html (where the available daily ET_o estimations are based on pan evaporation). ET_o for various locations can be obtained from the NCDC database by following these steps:

- Go to http://www.ncdc.noaa.gov/oa/climate/stationlocator.html
- Under locate station check **Zip Code;** enter your zip code number and click **search**
- On the next page click on the **name of station closest to you**

- On the next page click **DATA;** under Forms, Publications, and Web Pages; click **Daily/Monthly/Annual Florida Climatological Data**
- On the next page select month and year and click submit
- A file containing several weather parameters including average daily pan evaporation will be displayed.

Of the three public sources of ET_o data, the data from USGS has the greatest quality control in estimating ET_o but the data available is limited to a 10 year period (1995 to 2005). ET_o data from FAWN follows in terms of quality control while the ET_o data from NCDC has the least quality control.

Conclusion

Obtaining ET_o values from the above public weather data sources will improve estimation of ET_c and crop water requirements, which are key to implementing ET-based irrigation schedules. For ET_o estimation using radiation or temperature based methods, always select the method most suitable for your area.

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Table 1. Factors that influence ET

Factors that influence ET	Examples			
Weather parameters	solar radiation	air temperature	relative humidity	wind speed
Crop factors	crop type	variety	stage of development	
Management	soil water management	pest control	poor soil management	plant density
Environmental	soil salinity	impenetrable soil layers		

Table 2. Examples of simpler radiation-based equations that can be used to estimate ET_o for different locations in Florida

Geographical location	Radiation-based methods
[1]Southeast Florida	Turc (1961) Priestley-Taylor [3]SFWMD-SM
[2]Northeast and North Central Florida	Turc (1961) [4]Hargreaves [5]SFWMD

Note: These simpler radiation-based ET_o estimation equations should only be used when complete weather data sets are not available to evaluate the American Society of Civil Engineers-Environmental and Water Resources Institute (ASCE-EWRI) standardized ET_o estimation equation.

[1]Methods selected are based on comparison of ET_o estimation equations in southeast Florida (Miami Dade and Broward counties) by Kisekka et al. (2009) (unpublished).

[2]Methods selected are based on comparison of ET_o estimation equations in northeast and north central Florida (Jacksonville, Gainesville, and Daytona Beach) by Jacobs and Satti (2001).

[3]South Florida Water Management District (SFWMD)-Simple Method

[4]Jacobs and Satti (2001) classified Hargreaves et al. (1985) as a radiation-based method.

[5]Modified Blaney-Criddle with SFWMD crop coefficients.