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Use of Real-time Florida Automated Weather Network Data in Support of Strawberry Cold Protection and Irrigation Scheduling

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Weather-related information is essential to Florida's agricultural producers for making important decisions. Strawberry (*Fragaria ×ananassa*) growers, in particular, routinely monitor current weather conditions to make informed decisions regarding the use water for irrigation and cold protection as well as the application of chemicals. Real-time monitoring of air and wet bulb temperatures is critical in cold protection and determining daily evapotranspiration rates can significantly impact irrigation scheduling. The Florida Automated Weather Network (FAWN), a program of the University of Florida Institute of Food and Agricultural Sciences (UF/IFAS), provides strawberry growers with a variety of weather-related tools that can aid them in making these decisions. The FAWN Freeze Alert Tool can send an email or SMS text message when certain conditions have occurred at a FAWN site—receiving information in this way allows the grower more time in the field on nights when temperatures can be critically low. The FAWN Strawberry Irrigation Scheduler can assist growers in determining the appropriate number of days between irrigation, irrigation run-time based on evapotranspiration rates and specific grove spacing data, irrigation system design, and soil type. These tools can be found at http://fawn.ifas.ufl.edu/tools.

The Florida Automated Weather Network (FAWN) was established in 1998 in response to the discontinuation of the National Weather Service (NWS) agricultural weather forecast products. What began as a network of 11 Cooperative Extension Service sites in Lake and Orange counties is now a statewide system of 36 sites located from Homestead to Jay, near Pensacola. Data are collected from each site every 15 min, and along with several calculated products and weather-related tools, are delivered to the public by way of the Internet. Data can also be retrieved via telephone voice message system. FAWN's mission is to "provide timely and accurate weather data to a wide variety of users," develop effective management tools to assist resource managers and those involved with protecting life and property; and subsequently generate a substantial positive financial impact on numerous economic segments of Florida.

In response to the water shortages that occurred in the strawberry growing regions of Florida during Winter 2009–2010, FAWN worked with the Southwest Florida Water Management District (SWFWMD) to develop and deploy water conserving management tools to benefit strawberry growers. In particular, the FAWN Freeze Alert Tool, primarily designed as a cold protection tool, notifies growers when certain conditions occur at a user-selected FAWN site, and the FAWN Strawberry Irrigation Scheduler assists growers in determining the appropriate number of days between irrigation, and irrigation run-time based on evapotranspiration rates and specific grove spacing data, irrigation system design, and soil type.

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FAWN Freeze Alert Tool

The FAWN Cold Protection Toolkit provides step-by-step guidance for using water for cold protection by first helping users find their critical temperature, determine generally which upcoming nights might require cold protection, then guidance during individual cold events for when start and stop irrigation. It has been estimated that use of the FAWN Cold Protection Toolkit can save 2 h of irrigation per cold event (Jackson and Fraisse, 2004). Therefore, depending on the number of nights that require protection, billions of gallons of water and millions of dollars can potentially be saved.

Use of the FAWN Cold Protection Toolkit typically requires that a user view specific web pages on a computer, and then take the results of those pages into the field to aid in making important decisions regarding water use. On nights when temperatures are critically low, growers need to be away from the computer screen and in the field. Recognizing this need and the growing popularity of cellular and smart phone use, FAWN developed the FAWN Freeze Alert Tool, which can notify a user via SMS (Short Message Service) text message when certain conditions have occurred at a user-selected FAWN site.

To reach the tool, users can point their web browsers to http://fawntest.ifas.ufl.edu/tools/freeze_alert/login.php. There they can either log into, or register for, the service. If registering, they can submit their first and last name, email address, cellular phone number, cellular phone carrier, FAWN station, and the critical temperature of their crop of interest. They can then select the method by which they would like to receive the alerts (email or cellular phone text message). Upon registering, the system will send a text or email message confirming registration. If logging in, they can adjust their preferences by either changing their criti-

cal temperature or activating /deactivating notifications. Figure 1 shows an example of a user-received text message

During each "cold event"—a night when the temperature decreases to the user critical temperature, or lower—the user receives a set of four messages:

Alert 1: When temperature at the FAWN site is 2 °C above the user critical temperature.

Alert 2: When temperature at the FAWN site is equal to the user critical temperature.

Alert 3: When the temperature at the FAWN site is 2 °C below the wet bulb cutoff temperature.

Alert 4: When the temperature at the FAWN site is equal to the wet bulb cutoff temperature.

FAWN Strawberry Irrigation Scheduler

To better address the irrigation needs of the central Florida strawberry growers, FAWN developed an irrigation-scheduling tool using IFAS developed crop coefficients, available science, and field level research results. The scheduler utilizes user-submitted information to determine both duration and interval between each irrigation event for a 2-week period. Specifically, users submit row spacing, planting and anticipated harvest date, irrigation system flow rate and efficiency, and then select a FAWN site.

Planting and harvest dates are used to determine the percentage to date of the current crop season. Crop coefficients are then calculated for drip-irrigated strawberries on plastic mulch beds (Clark et al., 1992; Fig. 2). The scheduler then uses this information along with the evapotranspiration (ET) rate at the FAWN site to estimate daily water use. Water use estimates are for the area under the mulched row and thus would need to be replaced daily.

Once the daily crop water use is determined in inches of water per day then the amount of water need for a daily irrigation is estimated based on the number of 100-ft rows in an acre as a function of the distance between rows and the amount of water applied per 100 ft of row per hour by the irrigation system. Figure 3 shows an example of the user input and resulting schedule. Users can save their input data by selecting "link to my specifications" at the bottom of the page, then adding the page as a Bookmark.

The scheduling equations are given below:

$$K_c = 0.164\left\{\left(\frac{D_c - D_p}{D_h - D_p}\right)\cdot 100\right\}^{0.344} \quad [1]$$

Where: K_c = Crop coefficient
D_c = Current date
D_p = Planting date
D_h = Anticipated harvest date

$$ET_{CROP}\left(\frac{gal}{acre}\right) = ET_{FAWN}\cdot K_c \cdot 27154\left(\frac{gal}{acre\cdot in}\right) \quad [2]$$

Where: ET_{CROP} = Evapotranspiration of crop
ET_{FAWN} = Evapotranspiration at user-selected FAWN site (inches)
K_c = Crop coefficient

$$W_a(gal) = \frac{ET_{CROP}}{E_S} \quad [3]$$

Where: W_a = Water need per acre
ET_{CROP} = Evapotranspiration of crop
E_s = User-submitted irrigation system efficiency

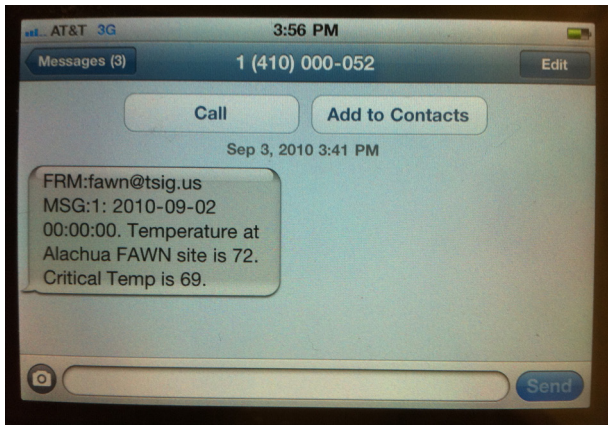

Fig. 1. Sample text message from FAWN Freeze Alert Tool.

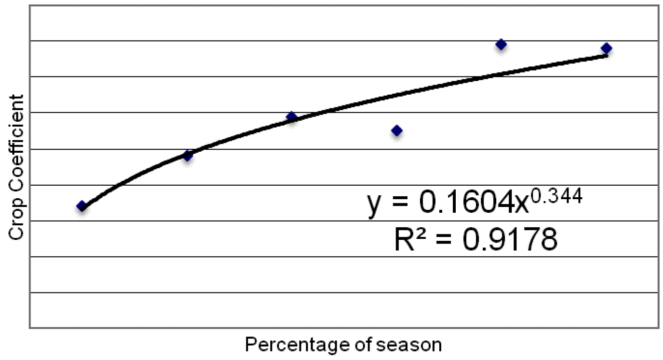

Fig. 2. Regression of measured crop coefficient (Kc) from Clark et al. (1992) as a function of percentage of season.

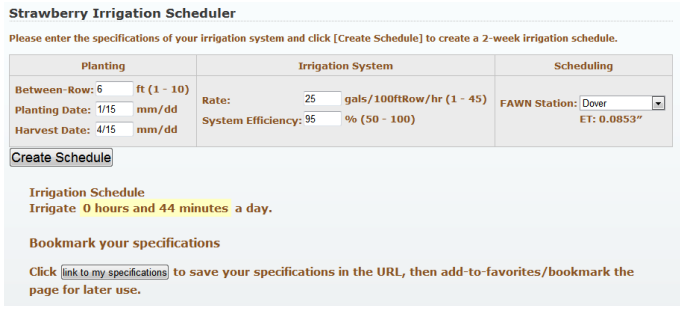

Fig. 3. User input screen of the FAWN Strawberry Irrigation Scheduler and resulting irrigation schedule.

$$N = \frac{R_a}{100} \quad [4]$$

Where: R_a = Row length per acre
d = distance between rows

$$R_a = \frac{43560}{d} \quad [5]$$

Where: N = Number of 100-ft row segments per acre
R_a = Row length per acre

$$W_r(gal) = \frac{W_a}{N} \quad [6]$$

Where: W_r = Water need per 100-ft row segment
W_a = Water need per acre
N = Number of 100-ft row segments per acre

$$T_d(min) = \left(\frac{W_r}{A_g}\right) \cdot 60 \quad [7]$$

Where: T_d = Daily Irrigation Run Time
W_r = Water need per 100-ft row segment
A_g = User-submitted emitter application rate (gal/hour)

Users should re-submit updated information every 2 weeks for a current schedule. The Strawberry Irrigation Scheduling Tool can be found at http://fawn.ifas.ufl.edu/tools/irrigation/strawberry/.

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