Strawberry Advisory System (SAS): Improved Disease Risk Estimation for Florida Growers

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Summary

The Strawberry Advisory System has been successful to help strawberry growers improve the management and control of botrytis and anthracnose fruit rot. Improved estimation of leaf wetness duration based on a combination mathematical models and sensors has been implemented to increase the quality of the information provided by the system.

Strawberry Advisory System (SAS)

The Strawberry Advisory System (SAS) has been successful in helping strawberry growers improve the management and control of both botrytis fruit rot (BFR) and anthracnose fruit rot (AFR) in Florida fields. Automated weather stations provide the observations of the weather variables required to estimate disease risk (Table 1). Figure 1 shows the infection index observed at the Plant City station during the 2021-22 season. November was pratically the only month during the season where conditions were favorable for diseases, i.e. rainy weather with extensive leaf wetness and warm temperatures. However, since there were few flowers and fruit, not a lot of disease developed (*N. Peres, personal communication*).

The objectives of this project were: (1) To maintain SAS operating during the 2021-22 season ensuring that the disease risk level information was available to growers 24 hours per day during seven days of the week, and (2) To implement data quality checking algorithms in the system to ensure that simulated risk levels don't result into under or over application of fungicides that may compromise disease control or increased costs. Disease risk simulation is based in two main observations, air temperature and leaf wetness duration.

In that respect, our focus was to introduce a methodology that would improve our confidence in leaf wetness duration (LWD) estimations, given that air temperature is normally a reliable observation in stations maintained by FAWN.

Leaf wetness can be either measured by sensors or estimated by models. However, there are potential problems related to estimating LWD with sensors, such as the agreement of wet events occurring on the sensor surface with those on leaf surfaces, lack of standardization of sensors, maintenance, or sensor calibration.

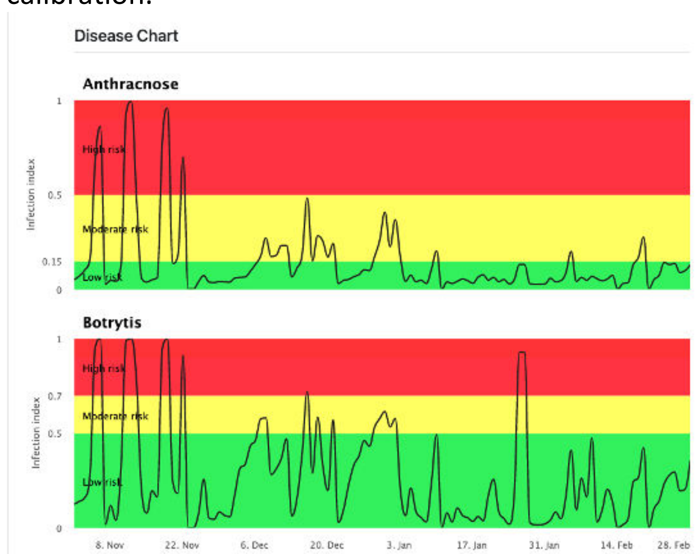

Figure 1. AFR (top) and BFR (bottom) infection index levels observed at the Plant City station during the 2021-22 season (Nov-1 through Feb 28).

Methods

Four leaf wetness models were implemented in the system to enhance the confidence of the information provided by SAS: (1) *Number of hours with relative* *humidity equal to or greater than 90% (NHRH90)*. The NHRH90 is the simplest of models used for LWD estimation; (2) *Dew point depression (DPD).* The DPD model considers the difference between air and dew point temperatures; (3) *Classification and regression tree (CART)*. The CART model considers relative humidity (RH), dew point depression (D) based on air and dewpoint temperature, and wind speed to estimate wet periods, (4) *Penman-Monteith (PM)*. The PM is a physically based model and requires several observations (air temperature, solar radiation, wind speed, and relative humidity to estimate latent heat flux as an indicator of leaf wetness.

Results

The improved SAS was designed to work with any combination of models and leaf wetness sensors. It uses the majority approach to decide if the time interval is considered “wet” or “dry”. In other words, the system is flexible to simulate leaf wetness occurrence for weather stations equipped or not with leaf wetness sensors and with different configurations of meteorological sensors. The minimum configuration to be considered is a weather station equipped with relative humidity and air temperature sensors.

In this case the *NHRH90* and *DPD* models are used to simulate leaf wetness. When a model simulates “wet” conditions and another simulates “dry” conditions, the time interval is considered as “wet”, since it is safer to indicate conditions that favors disease occurrence. If all required meteorological sensors are available for the models and leaf wetness sensors are also present, all four models and sensors are considered in the decision-making process (Figure 2).

The system has been operating quite successfully with the implementation of this methodology and the confidence in the disease risk alerts provided by the system increased during the last season. The combination of the different models for leaf wetness estimation has also allowed us to expand the system to other locations with a small acreage of strawberry production and open the possibility for easier expansion to other areas in the future as needed.

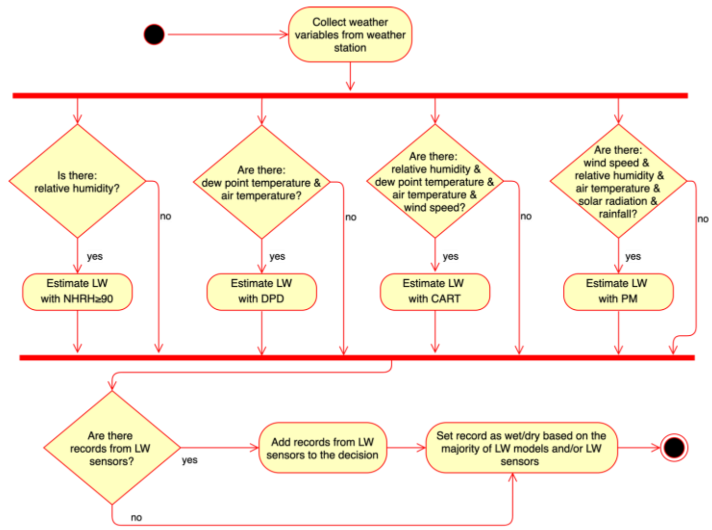

Figure 2. Decision tree to estimate leaf wetness based on the sensor’s configuration of a weather station.

Table 1. Florida weather stations available in the Strawberry Advisory System.

ID	Station Name	Location	County
1	Arcadia	Arcadia	DeSoto
2	Apopka	Apopka	Orange
3	Avalon	Winter	Orange
4	Balm	Wimauma	Hillsborough
5	Bronson	Bronson	Levy
6	Citra	Citra	Marion
7	Dover	Dover	Hillsborough
8	Floral City	Floral City	Citrus
9	Fort Pierce	Fort Pierce	St. Lucie
10	Lake Alfred	Lake Alfred	Polk
11	Plant City	Plant City	Hillsborough
12	Umatilla	Umatilla	Lake

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