Monitoring for Real-time Risk Management in Strawberry

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Background

Our primary objective is to provide real-time information to growers, for better daily management decisions.

Issues: Ensure the quality of the data

Tools: Ensure users can access and understand the information

Value: *Understand what information gives the most benefit to growers, and which applications provide a rapid return on investment*

Value Components (ROI):

Systems should be:

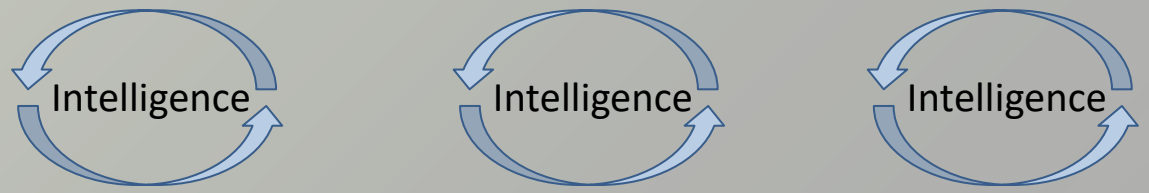
- → Scaleable and Adaptable (add nodes, sensors)
- → Reliable and relatively easy to use
- → Good Precision
- → Low Maintenance
- → Reasonable Cost
- → Good Software, Easy Access, Easy-to-use
- → *Provide Multiple Uses / Benefits*

The Process

Data → Information → Knowledge → Action

The System

Sensors → Software → ‘Analyst’ → Decision-Maker



Traditional Weather Station

DS-2 Sonic Anemometer
Wind speed and direction

VP-4
Temp, RH, VPD,
Barometric Pressure

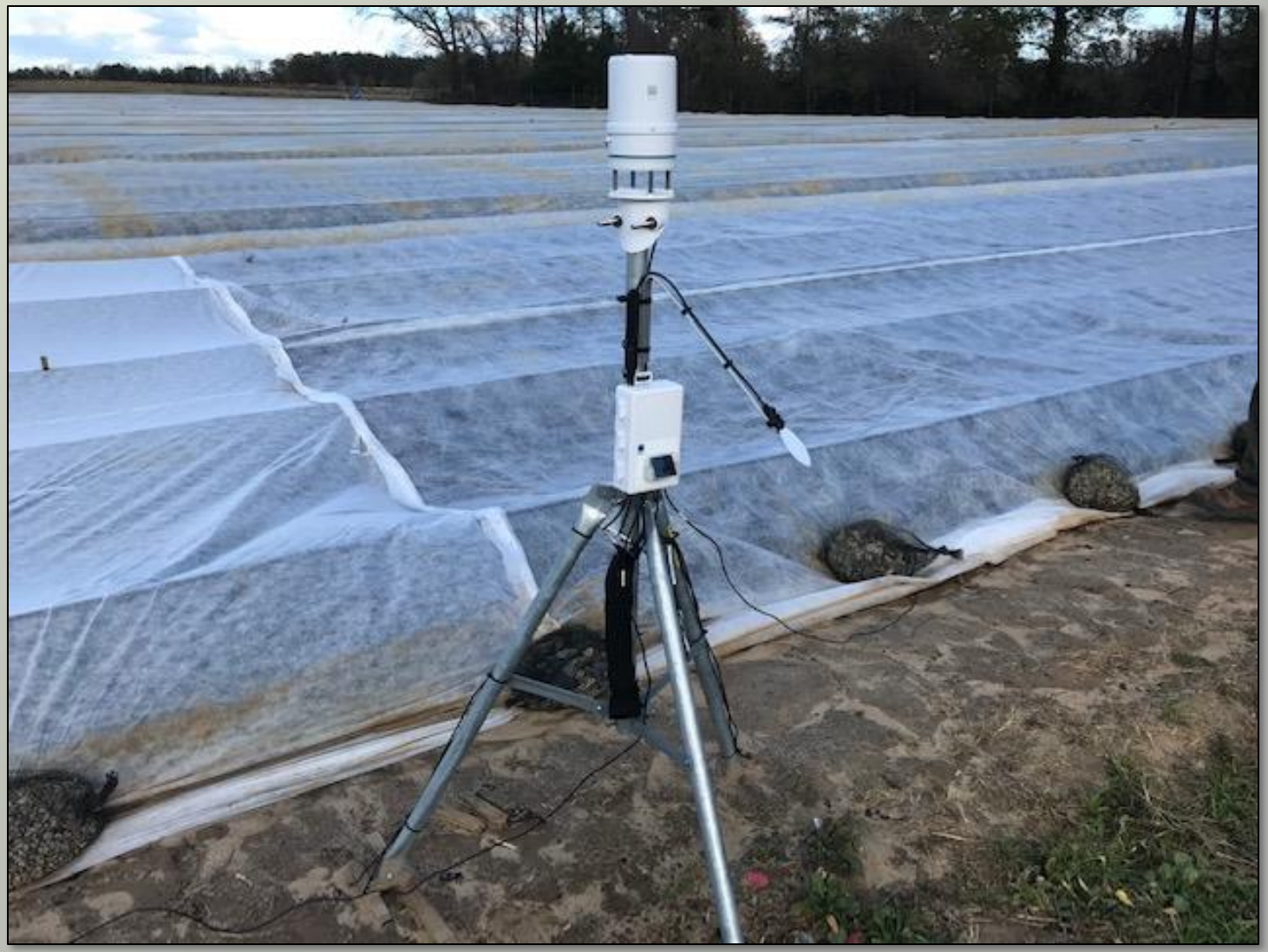
Pyranometer
Solar Radiation

QSO-S PAR
PAR (visible light)

ECRN-100 Rain gauge
Precipitation

Em50G “cloud –based” data logger

Latest All-in-One Weather Station

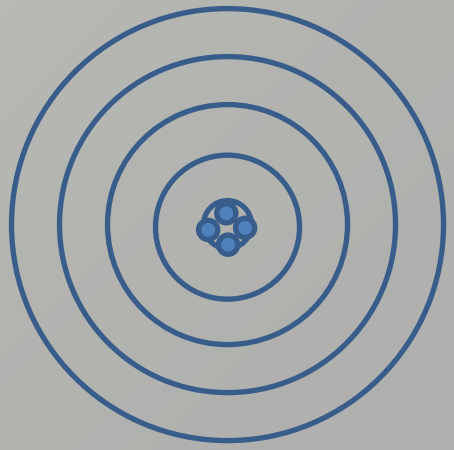


Data Precision vs. Accuracy:

Both Sensor Quality and Placement are Important

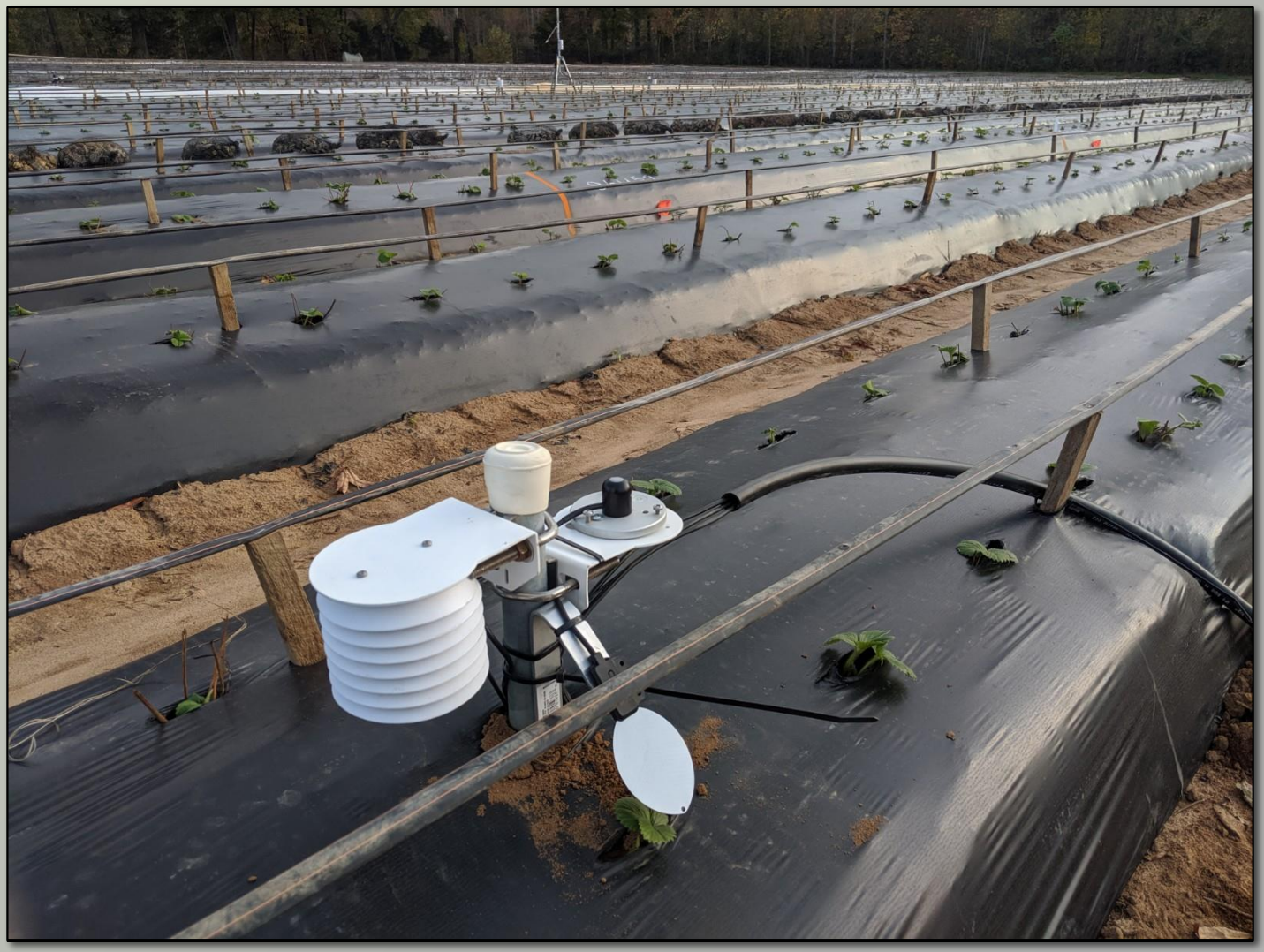
Low Precision,
Low Accuracy

High Precision,
Low Accuracy



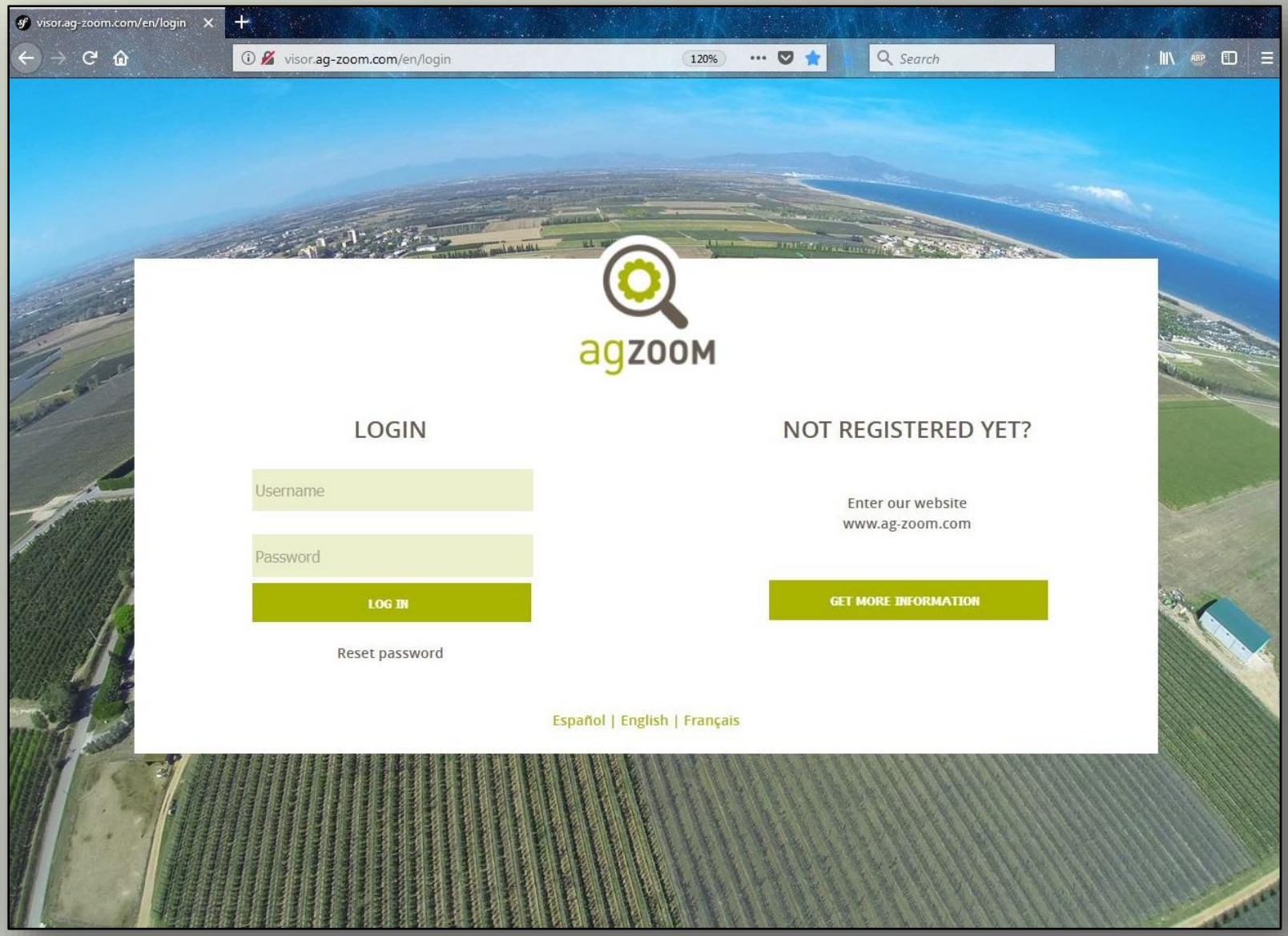
High Precision,
High Accuracy

Canopy-level Microclimate Sensors

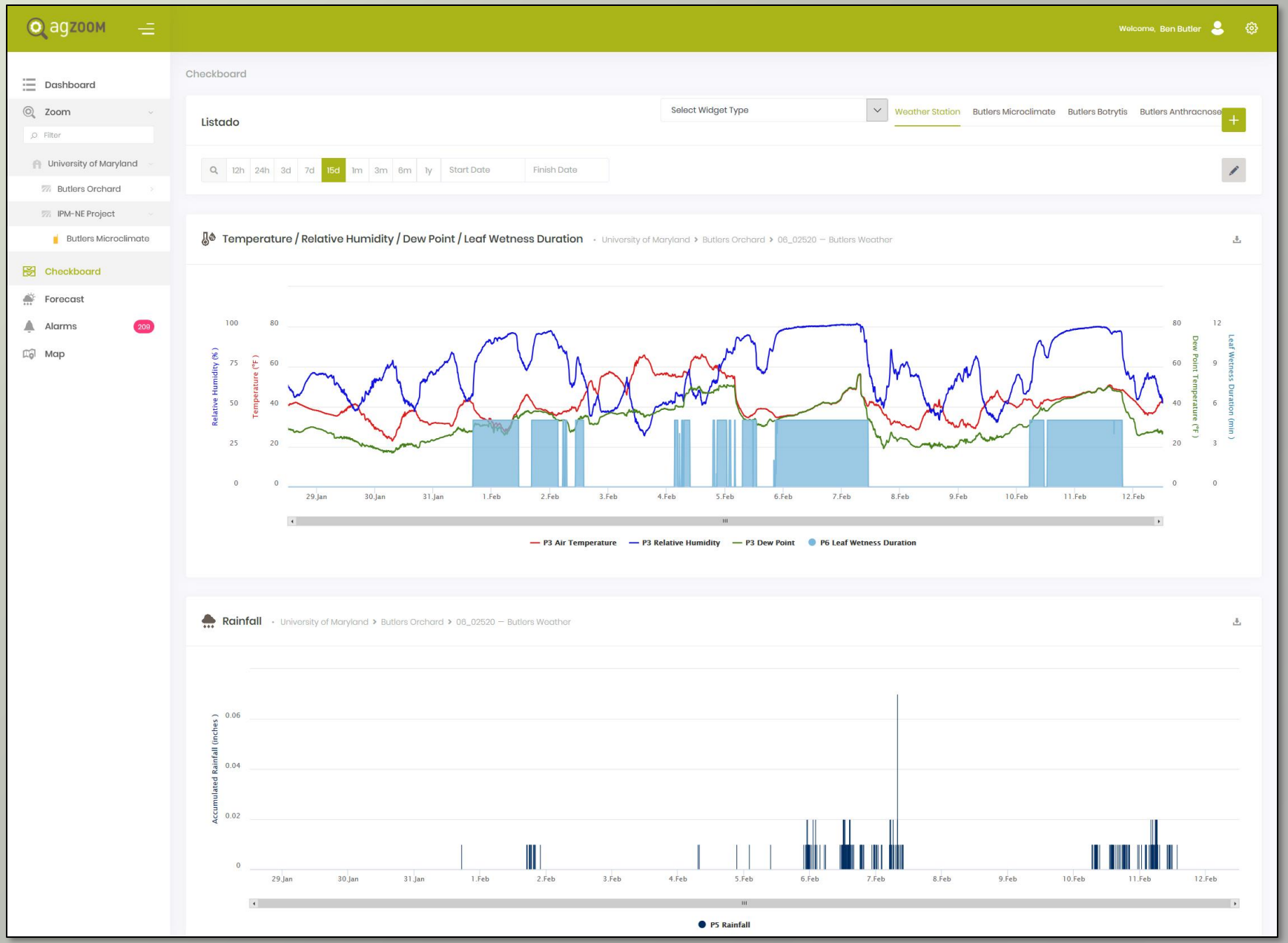


Cloud-based Telemetry

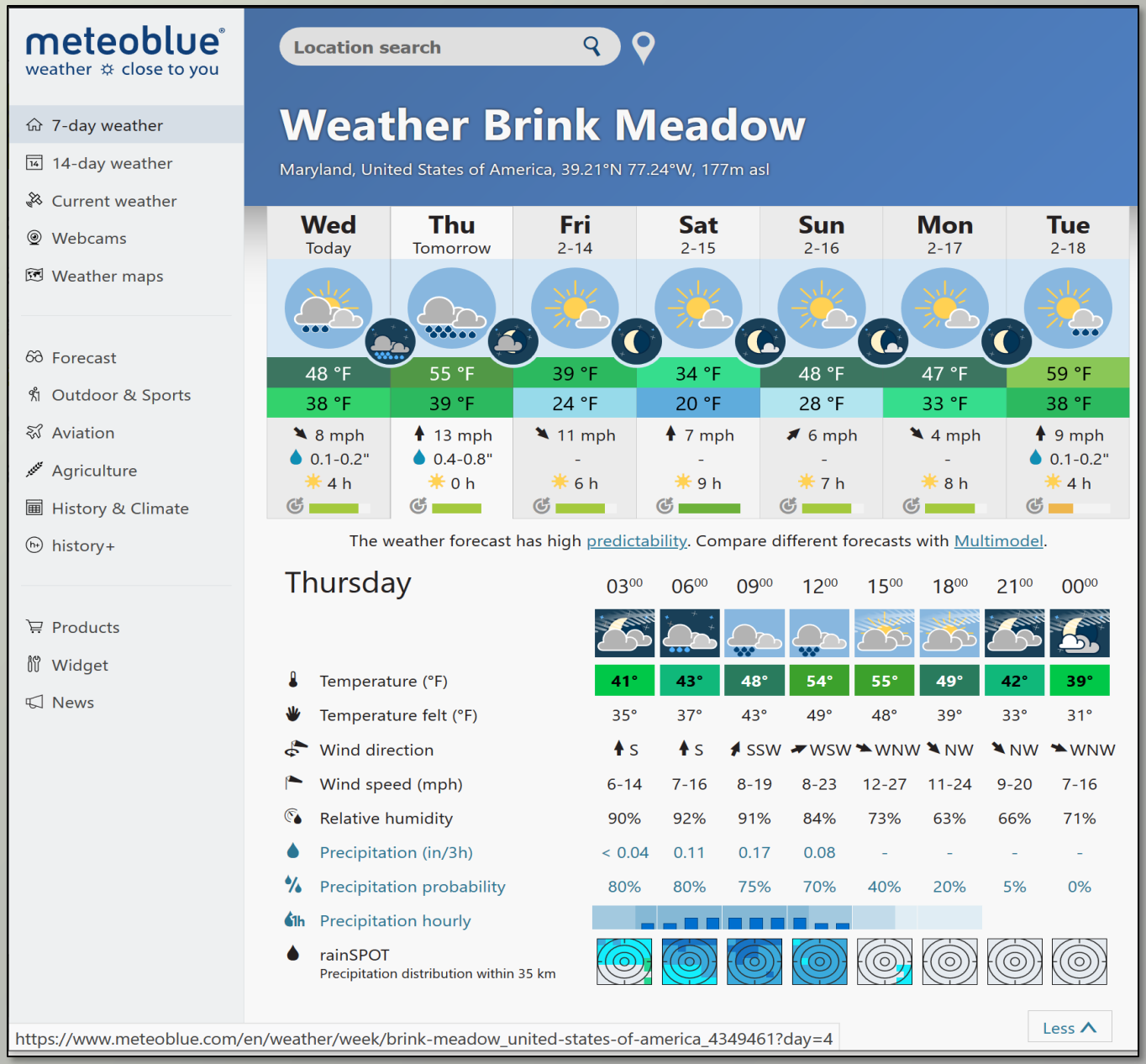
AgZoom Cloud Software



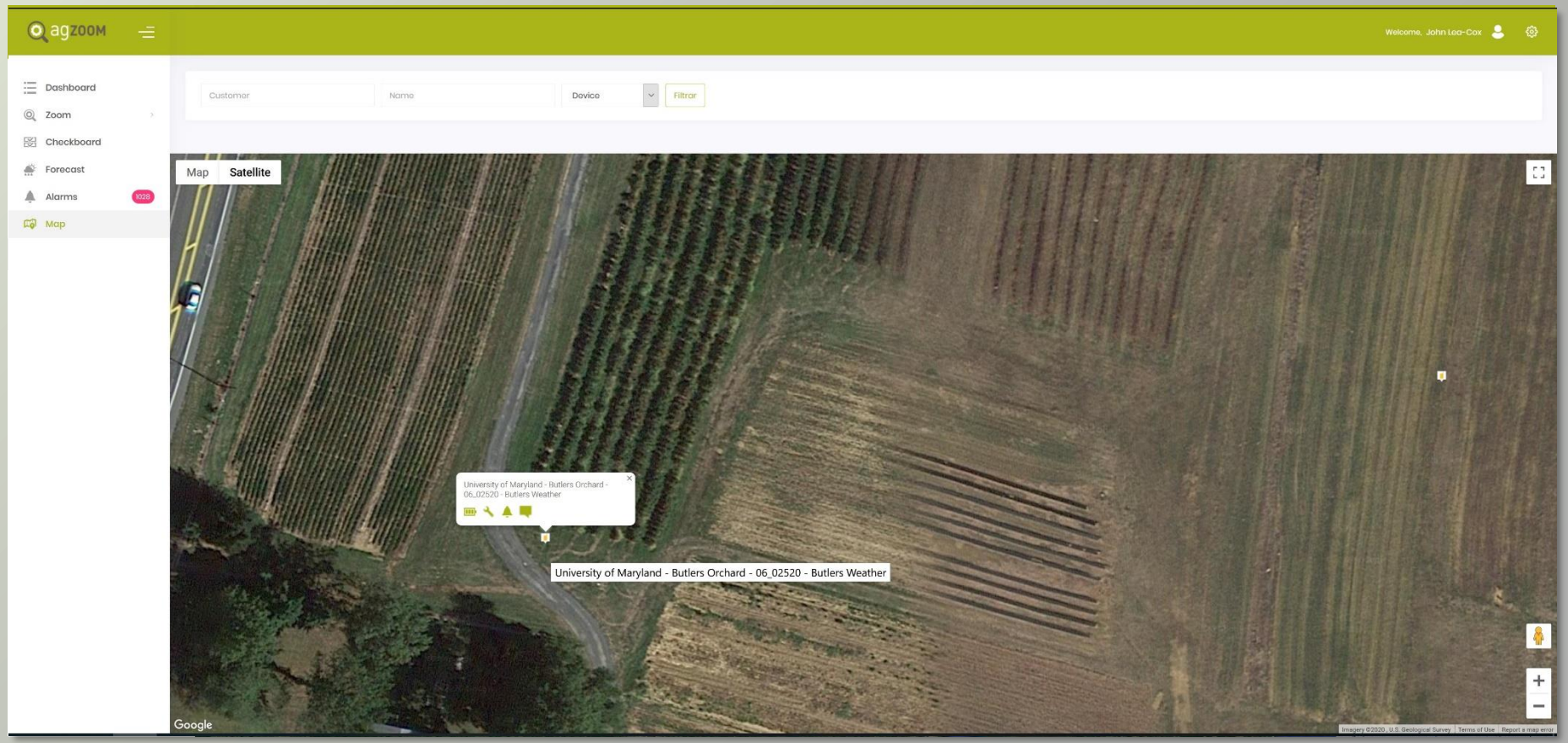
AgZoom Displays Aggregated Data in ‘Widgets’



Geolocated 7-Day Weather Forecast



Geolocation of Cloud Dataloggers



Risk Management Uses, Benefits

- ✓ Phenological and Growth Tracking – Degree Days
- ✓ Frost Monitoring
- ✓ Disease Monitoring
- ✓ Irrigation Management

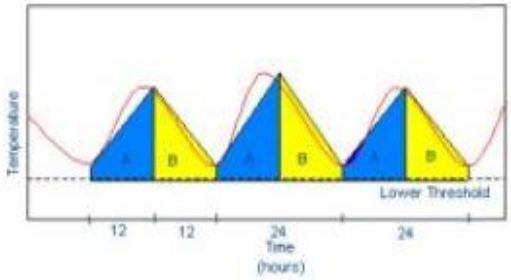
➡ All achieved with the same set of sensors

Agricultural Risk Management

Precision Farming is more than just GPS controlled harvesters. It also helps keeping track of pathogen development, optimize treatments to hit a disease dead on, warn of frost, and to produce as environmentally friendly as possible.

Growing Degree Days, Heat Units

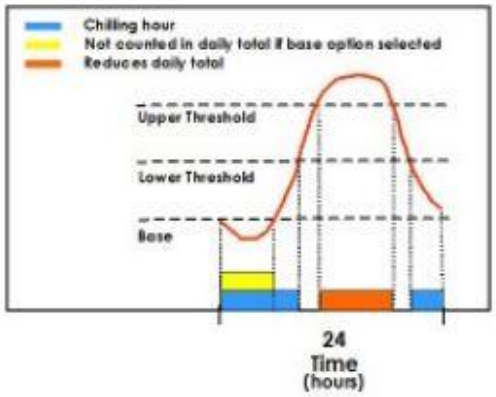
The growth and development of plants, insects, and many other invertebrate organisms is largely dependent on temperature.



In other words, a constant amount of thermal energy is required for the growth and development of many organisms, but the time period over which that thermal energy is accumulated can vary. Many organisms slow or stop their growth and development when temperatures are above or below threshold levels. The accumulation of thermal energy over time is known as degree-days or heat units. Degree-days and other heat unit measurements have been used for determination of planting dates, prediction of harvest dates, and selection of appropriate crop varieties.

Adcon's Heat Unit extension, which is part of our data visualization and distribution software addVANTAGE Pro, includes the most commonly used methods for calculating heat units. The user is able to create templates based on information found in published models. The templates can include the method of heat unit calculation and thresholds levels for alarms - crucial for precise management decisions.

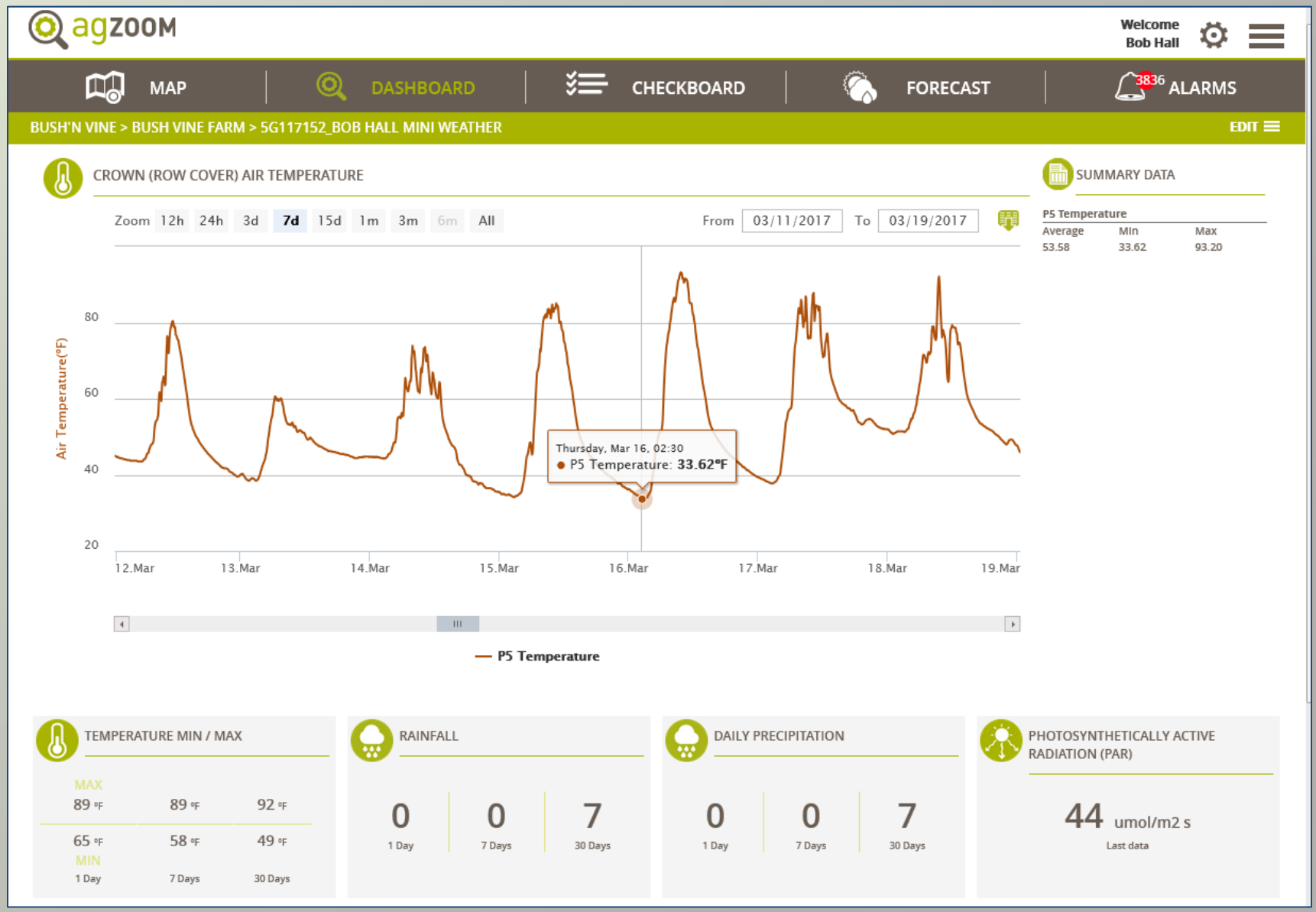
Calculation methods	Cutoff method	Chilling Hours	User friendly model template	Download information



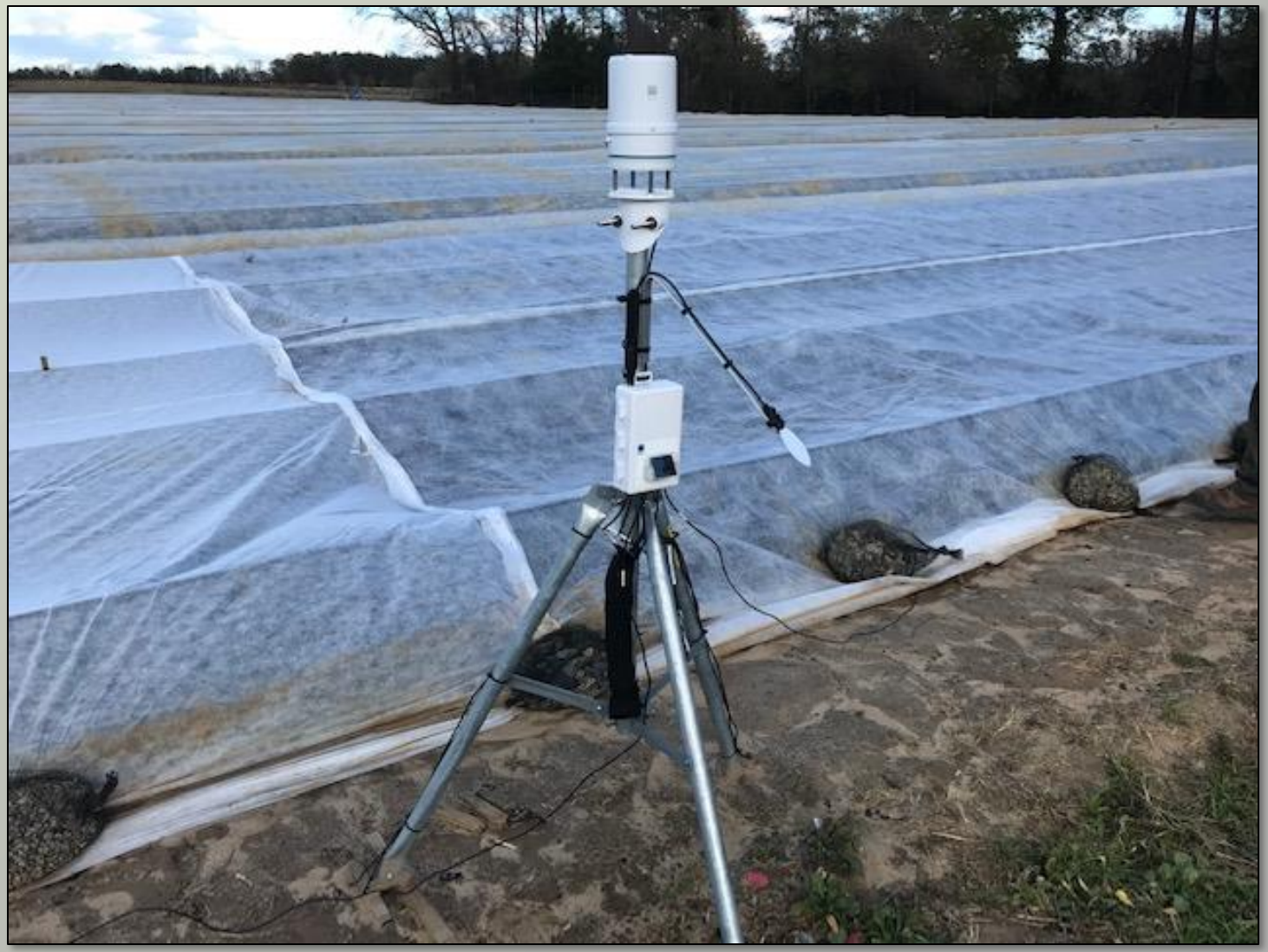
Chilling units values are used to predict several management factors. Fruit growers are the primary users of chilling hours. Decisions such as varietal selection, pruning, and other management factors related to potential yields can be aided by chilling hour calculations.

Soil Temps, Degree-Day Accumulation

Frost Events South Carolina – March 14-16, 2017

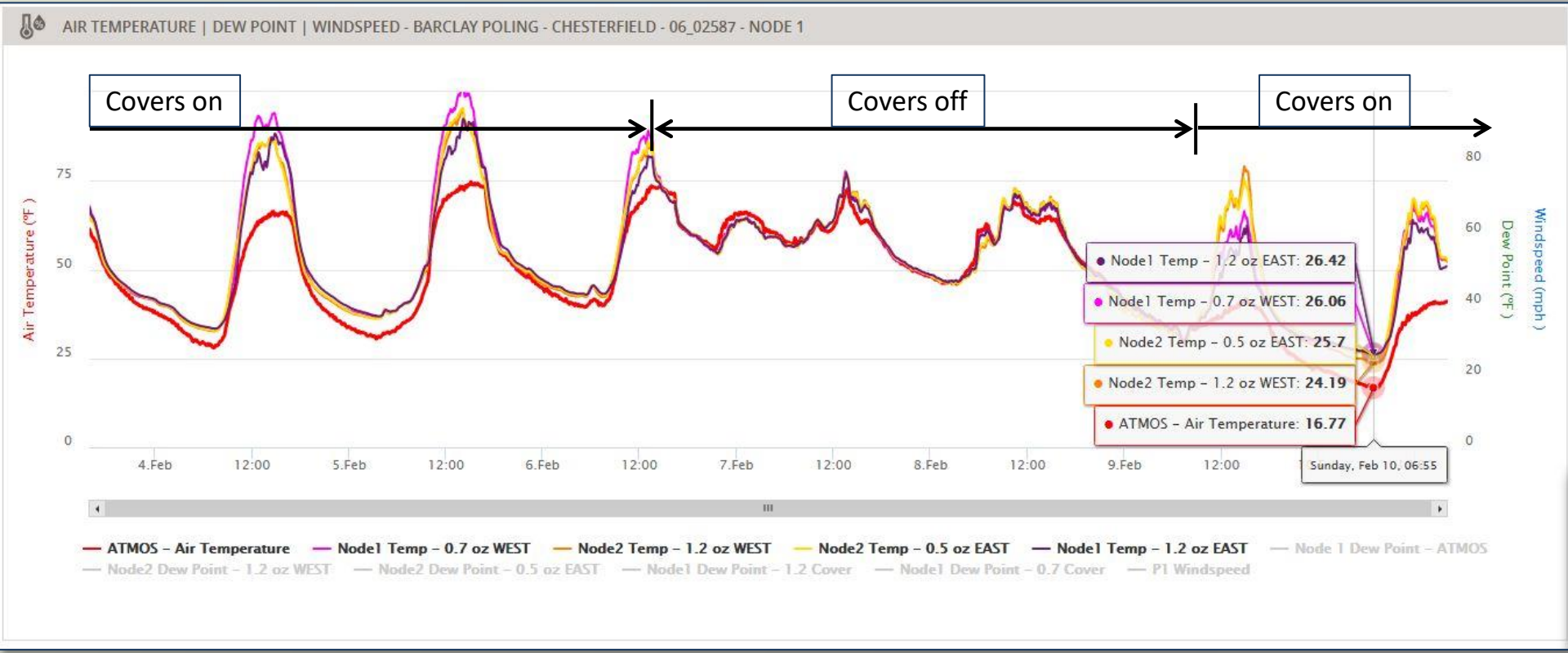


Row Cover Management



Row Cover Temperatures

Row Cover Minimum Temperatures



Disease Prediction Models

- Infection risk for Botrytis and Anthracnose fruit rot (BFR and AFR) can be predicted using disease models based on **leaf wetness duration and temperature**
- Strawberry Advisory System (StAS) originally developed in Florida
- On average 40% reduced fungicide use compared to (weekly) calendar sprays, no significant differences in marketable yield
- 30% fewer sprays in Mid-Atlantic trials 2017-2019, marketable yield and disease incidence were largely comparable

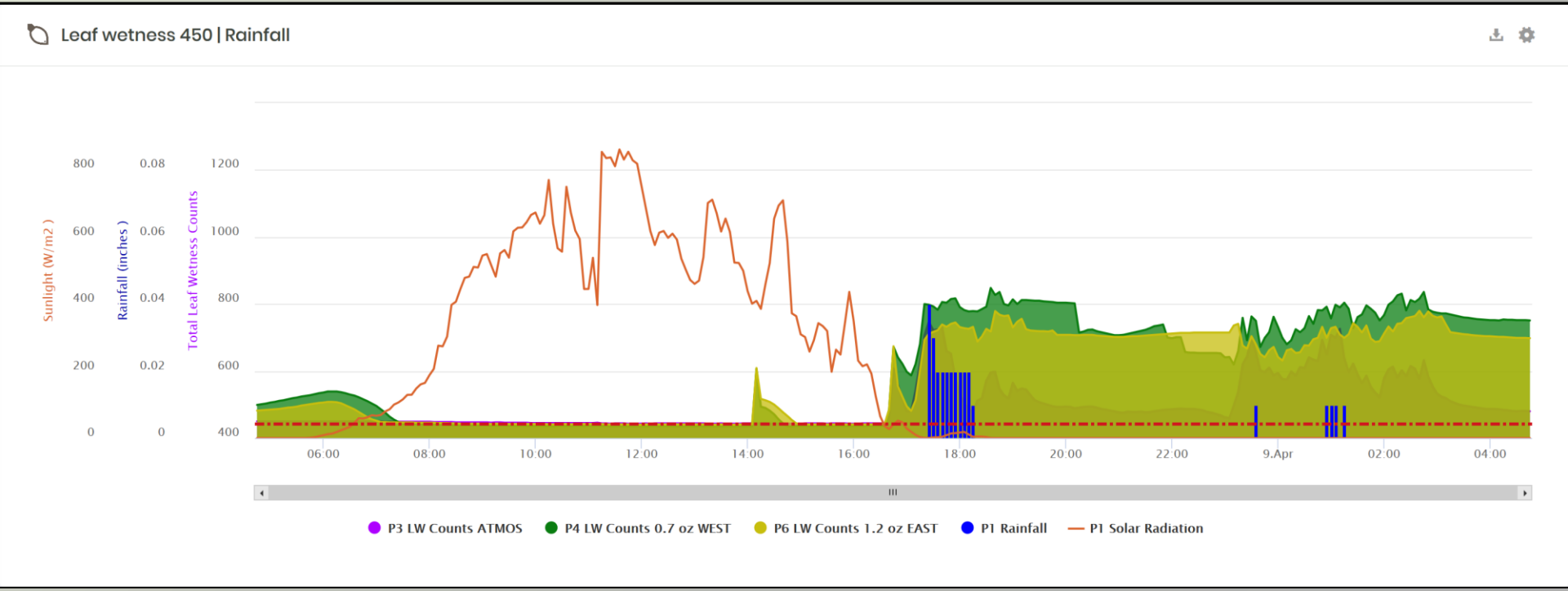
Disease Management and Row Covers

Problem: *On-farm weather stations do not account for microclimatic conditions in the canopy and under row covers.*

Hypothesis: *Monitoring canopy-level environmental variables will significantly improve disease prediction precision.*

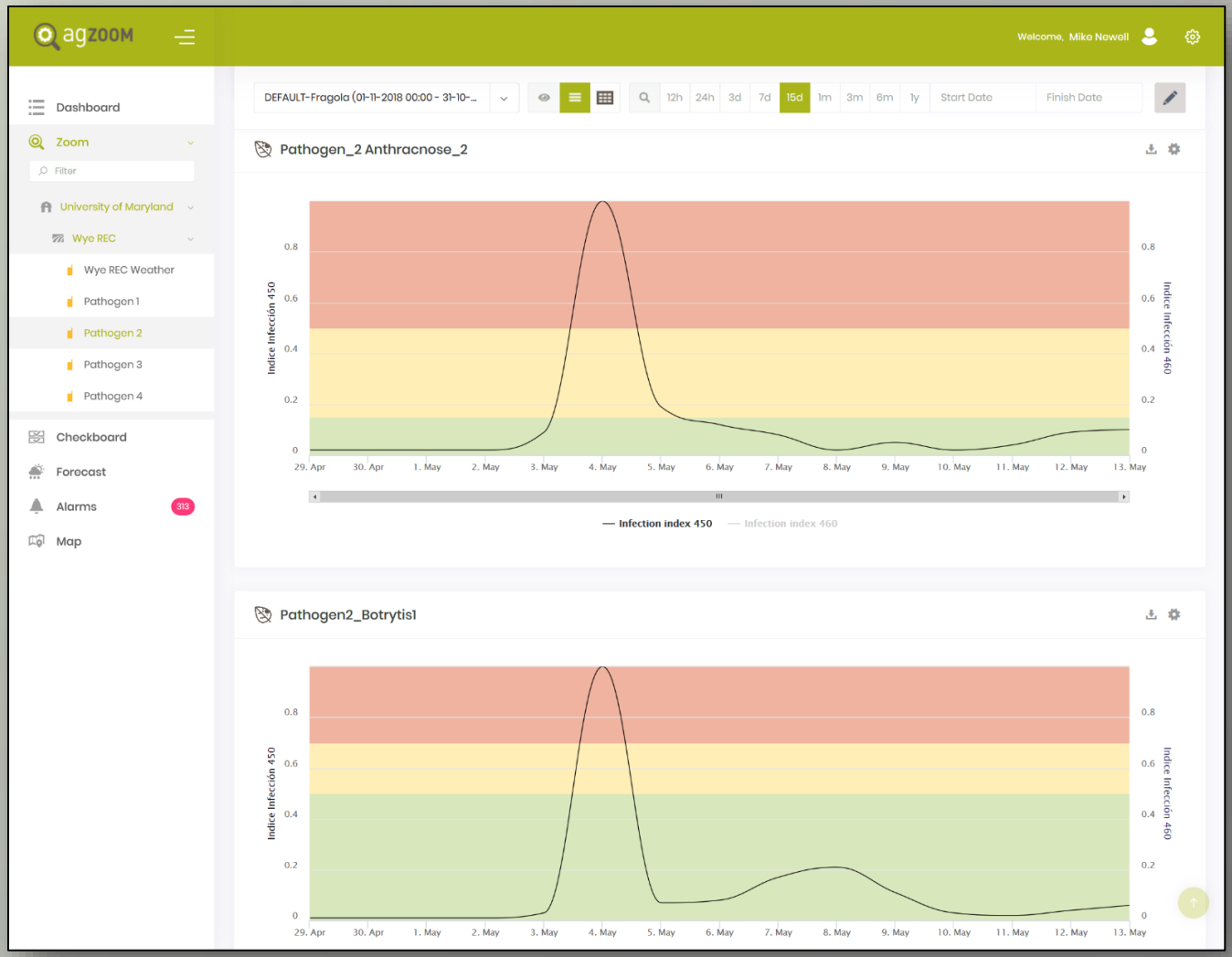
Leaf wetness sensor

Effect of Row Covers on Leaf Wetness, Disease Dev.



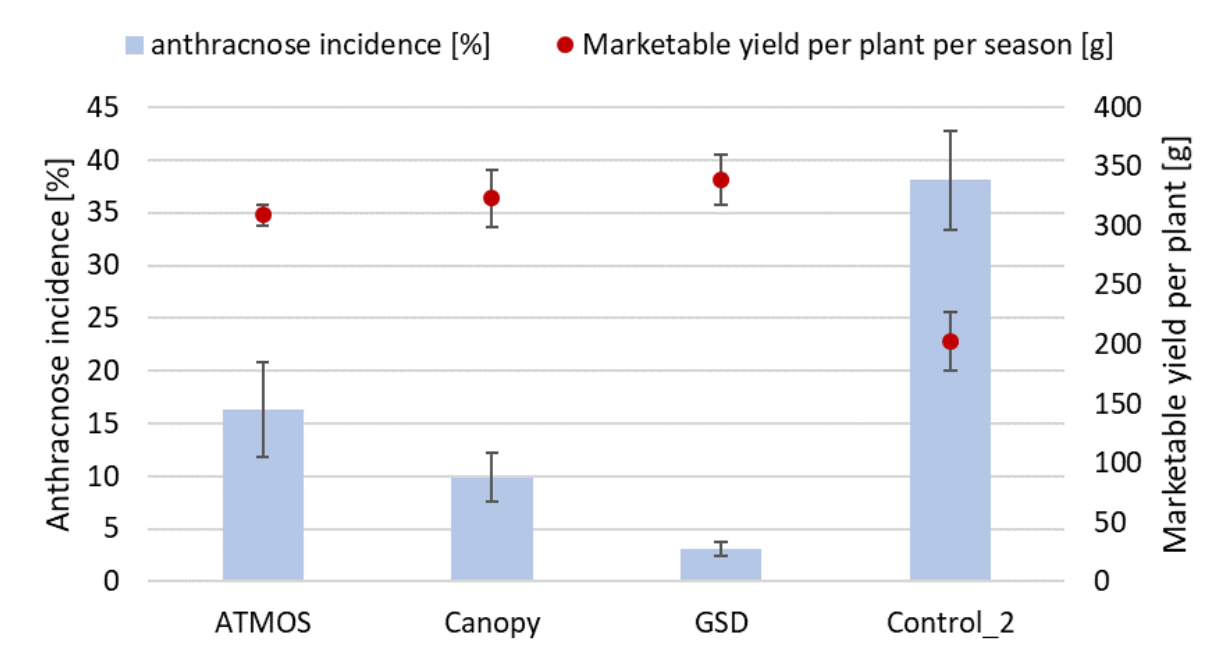
Microclimatic Disease Model Predictions

Disease risk is monitored at the canopy-level, with or without row covers. Model data is updated daily



Microclimatic Disease Spray Results

Wye REC Chandler 2020 (averaged over 7 picks)



3 sprays, same timing

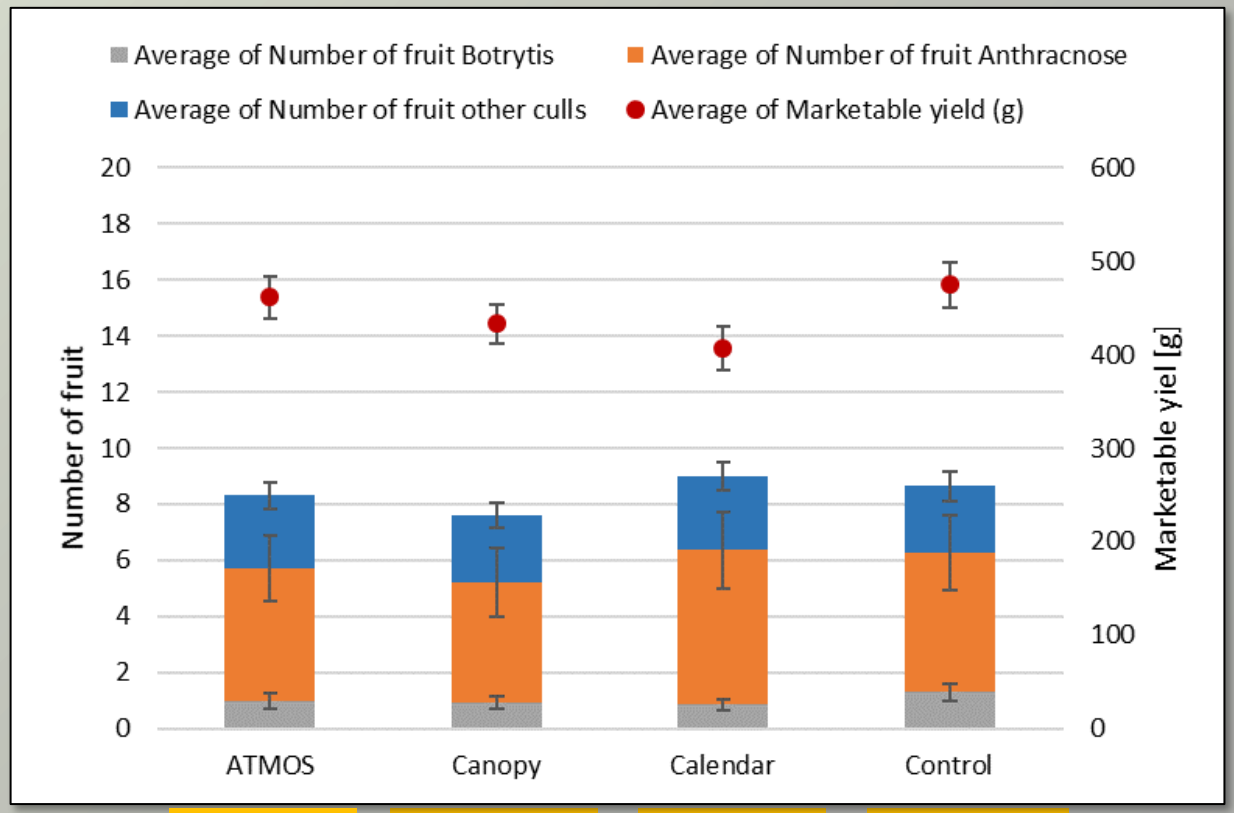
9 sprays

no spray

- Only very little Botrytis
- High anthracnose pressure
- Slightly lower yields in model-based treatments, but with 1/3 of sprays

Microclimatic Disease Spray Results

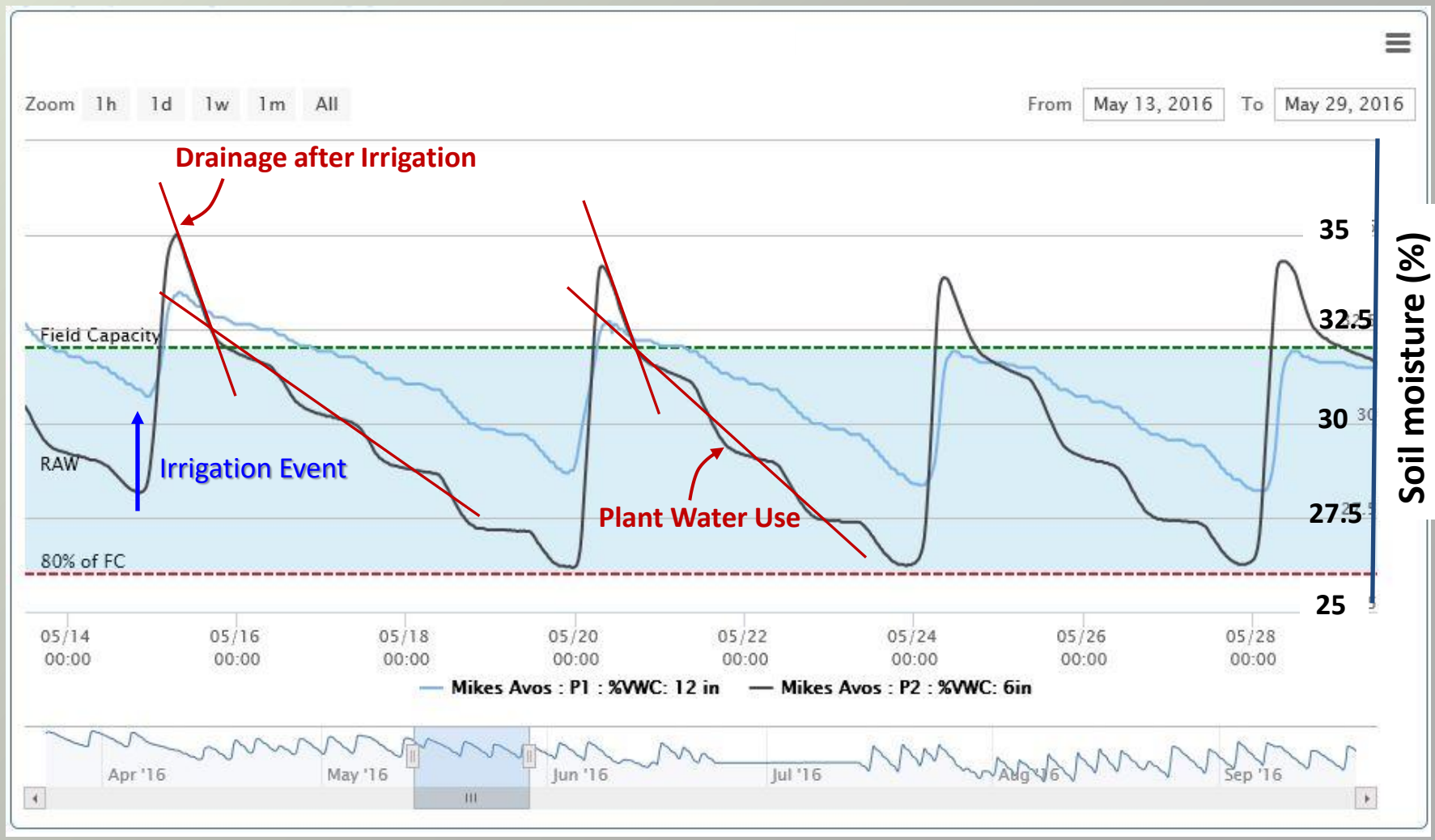
Virginia Beach Commercial Farm 2020 (organic site)



- Decreasing yield with increasing number of sprays
- Limitation of the organic fungicide (Regalia, extract of giant knotweed) at the specific site and year?

Hu et al., 2021 (in prep)

Using Soil Moisture Data for Irrigation Management



Outcomes

Synergistic Capabilities:

1. Precision Crop, Frost and Disease Risk Management
2. Timeliness of Decisions; Opportunity Costs
3. Intelligent Alerts
4. Better Predictive Capabilities

Can translate into Multiple Benefits:

1. Reduced Risk and Crop Losses
2. Reduction in Production Times
3. Increased Crop Yield and Quality

Acknowledgements

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