METER
ENVIRONMENT

# SMART ORCHARD AIMS TO INSTALL THOUSANDS OF SENSORS FOR ACTIONABLE INSIGHTS

## WHEN BIG DATA IS A PROBLEM

Orchard growers today live in an exciting time where environmental data are becoming inexpensive and abundant. But going from a data-poor to a data-rich environment has its challenges. Big data can be so overwhelming that growers struggle with how to turn that data into actionable insight.

Disease or pest modeling predictions can be inaccurate if you don't locate your weather station in your field

One grower on the Washington Tree Fruit Research Commission recently commented that he uses no less than 19 data apps for making decisions. Steve Mantle, founder of innov8.ag, says, "It's just overwhelming to a grower to consolidate all of this data together. We need to figure out how to help them with actual insights that impact either their yield quality / quantity—and just as importantly—their costs: particularly on labor, chemical/nutrients, and irrigation." That's why in 2020, Mantle and his team approached the Tree Fruit Research Commission's technology

committee to see if they could bring their capabilities, ingesting data from many different data silos and sensor providers into one place, with the goal of providing actionable insights for growers in the apple orchard space. Thus, the idea of a "smart orchard" was born.

## TURNING BIG DATA INTO A SOLUTION

In March, Innov8.ag began piloting a smart orchard project in collaboration with researchers from Washington State University & Oregon State University at Chiawana Orchards in Washington state. Their goal was to "sensorize" an orchard from multiple hardware providers, bringing together growers, data, and researchers to create a sustainable, "smart" orchard with insights that impacted a grower's bottom line. To do this they combined data from on-farm and off-farm, online and offline sources including satellites, drones, weather providers, telemetry from IoT devices such as soil moisture probes and leaf wetness sensors, and more." Mantle adds, "We're trying to see how the sensors at different price points and from different vendors compare against each other in terms of accuracy. But the biggest goal is to get more granularity around and prove the value in canopy, soil, and weather measurements. Then we tie that in with yield, quality, and profit."

Innov8.ag uses TEROS 12 soil moisture sensors along with other types of sensors to make precise, informed decisions and better manage their water usage, labor, equipment, and chemical usage

## INSTALLING SENSORS SO THAT COMPARISONS ARE VALID

The smart orchard consists of 100 rows of Gala apple trees spaced out over two 20-acre blocks. A number of different sensor/instrumentation providers, including METER Group, have their sensors deployed at this smart orchard measuring

parameters such as weather, irrigation, soil water and nutrients, chemicals, disease, pests, crop health, labor, and drone/satellite imagery. All these data are aggregated and organized on a regular basis to try and enable growers to better understand weather and climate change to make precise, informed decisions and better manage their water usage, labor, equipment, and chemical usage.

Smart Orchard team member and researcher, Harmony Liu, says one challenge they face is making sure the comparisons are valid. “We are careful to install the same sensor types at the same heights so we are making “apple-to-apple” comparisons.”

Liu says in addition to sensing, they collect soil samples every week throughout the season and send them out to two different labs for nutrient testing so they can look at how that data compares with the soil nutrient sensors. They sample at five different locations at three different depths to match the sensors. She adds, “We have the dendrometer, soil nutrient data, soil moisture data, and canopy data all being collected within the same zone. It’s part of our intent to show this data all connecting with each other.” The team also measures irrigation line pressure with a sensor as opposed to using an irrigation switch. Liu says, “We want to know what the pressure signature is as everything turns on and activates so we can understand what that signature looks like and start to identify when there are abnormalities in how the irrigation system fills.” Additionally, they’re using METER NDVI and PRI sensors as well as a pyranometer for ground truthing the drone imagery that they’re doing at a 7 centimeters per pixel resolution.

## DATA CLEANUP IS TIME-CONSUMING

Liu says getting the smart orchard up and running was not without its challenges. “The first challenge was gaining access to some of the data from grower owned instruments because those instruments are not all grouped together.” Liu says that challenge made data cleanup time consuming, but they worked their way through it. She adds, “Overall, having this density of data is difficult because it’s a lot to wade through. But at the same time, it’s been really helpful. Data has been reliable coming in across the board.”

## IN-FARM VS. OUTSIDE-FARM MEASUREMENTS

Liu says one thing they are interested in is accurately measuring temperature and humidity within the orchard because these parameters are critical for apple disease modeling. She says, “When people are modeling disease, they take the inputs from weather forecasts into the disease model for risk calculations. But there are some differences in environmental conditions inside vs. outside the orchard where evapotranspiration will cause temperatures in the canopy to be cooler compared

to outside-farm temperatures while the vapor pressure is higher. So that's one thing we use METER group instruments for. We have outside-orchard, above-orchard, and in-canopy ATMOS 41 weather stations and ATMOS 14 temperature and relative humidity sensors. We use these to compare the temperature and relative humidity difference. By using an instrument from the same provider, we eliminate the systematic bias vs. if we were to compare temp and RH from different providers. We also set up a vertical profile by installing sensors on the same pole at different heights and could see how the temperature and humidity changed across height for that location."

ATMOS 41 all-in-one weather station is a more accurate, affordable way to measure environmental variables in your exact field location

## FUTURE SMART ORCHARD GOALS

Mantle says their most important goal is understanding in-canopy weather and how they can work with WSU and other institutions on adapting models for disease, pests, and ultimately informing spray management. Liu adds, "We also want to understand data comparison and unification. We want to bring together soil moisture measurements like volumetric water content and data from the METER TEROS 21 matric potential sensor. What we found is that, although they're looking at soil moisture from different perspectives, unifying the two measurements will be critical for people working on irrigation scheduling." The team also plans on working with WSU professors to create an evapotranspiration map that blends together some of the sensor telemetry and the view from a drone.

TEROS 21 field water potential sensor measures water availability which is critical for irrigation scheduling

## SEE THE LIVE WEBINAR

Want to learn more? METER soil physicist, Dr. Colin Campbell and Washington State University soil scientist Dr. Dave Brown discuss the smart orchard project at a METER Group live webinar .

## QUESTIONS?

Want to learn more about monitoring weather variables and soil moisture in your application? Talk with an expert—Our scientists have decades of experience helping researchers and growers measure the soil-plant-atmosphere continuum.

Get higher yields fueled by real-time data. Discover the ATMOS 41 weather station, the TEROS 12 soil moisture sensor, the ZL6 data logger, and ZENTRA Cloud.

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