Precision Irrigation Systems for Tree Fruit Orchards 2020 Season Updates

Long He

2021 Mid-Atlantic Fruit and Vegetable Convention

February 11th, 2021







£

 \mathcal{O}

Fundamental Principles



Soil Water Parameters (From: Texas A&M AgriLife Extension, E-618)

Soil Moisture Sensors







Soil water potential sensor: TEROS 21 @ QTY 2





A Cellular Network based IoT Irrigation System



- Soil water content and Potential sensors
- Datalogger to record sensor data
- Cellular network for data communication (cloud server)



Test in Commercial Orchards



Twin Springs Fruit Farm (Crimson Crisp)



El Vista Orchards (Gala)



Hollabaugh Bro. Inc (Honey Crisp)

Mt. Ridge Farms (Fuji)



Soil Moisture Data Monitoring & Recording

AT&T LTE	3:54 PM	20% 🚺		
<u>`@</u>	z6-02464		APP-Access	
z6-02464		at AT&T LTE	3:54 PM	20% 💶
Battery	Storage Space	2	z6-02464	
Serial Number	30% Measurement	TEROS 12		Port 1
z6-02464 Firmware Version	10 minutes Last Updated	Water Content	Soil Temperature	
2.04.2	3:53 PM	0.359 m³/m³	4.9 °C	>
Actions		Saturation Extract EC	<u>}</u>	
C		TEROS 12		Port 2
Refresh	Configure	Water Content	Soil Temperature	
		0.354 m³/m³	4.8 °C	>
TEROS 12		Saturation Extract EC		
Water Content	Soil Temperati	0.500 m3/cm		
Saturation Extract EC	4.9 0	TEROS 12		Port 3
0.668 mS/cm		Water Content	Soil Temperature	
		0.350 m³/m³	5.0 °C	\
		Saturation Extract EC		/
		0.395 mS/cm		



WEB-Access



2020 Season Results – Site One

Twin Springs Fruit Farm (Crimson Crisp)







2020 Season Results – Site One

Twin Springs Fruit Farm (Crimson Crisp)





2020 Season Results – Site Two

El Vista Orchards (Gala)



Day of Year 2020





El Vista Orchards

(Gala)

2020 Season Results – Site Two



Day of Year 2020



2020 Season Results – Site Three

Hollabaugh Bro. Inc (Honey Crisp)





2020 Season Results – Site Three





Day of Year 2020



Summary

- Soil moisture is a direct and convenient indicator for irrigation
- Remote data accessing through App or Website
- Precision irrigation was proved to be water saving

Some Other Issues:

- Multiple irrigation zones with one water supply
- Location of sensors
- Cost of the sensor system and the operation
- Automated irrigation



Water Movement in the Soil



http://www.trickle-l.com/new/gallery/soilpat.html



https://cmg.extension.colostate.edu/Gardennotes/263.pdf



Experimental Design



Representative Sensor Locations





Soil Moisture Sensors



Sensors and Data Loggers

Sensor Readings from the 1st Column

LoRa (Long Range) IoT Irrigation System

Automated Irrigation System

A Preliminary Study in A Peach Orchard

A Preliminary Study in A Peach Orchard

- Water supply with an electric pump controller
- Tested the irrigation with soil moisture level
- Remotely controlled the valve
- A water pressure sensor shows the status of the valve (on/off)
- Possible to run automatically

Funding Sources:

State Horticultural Association of Pennsylvania (SHAP) Northeast SARE, Project No. 19-378-33243

Thanks to: Dr. Daniel Weber, Dr. Lihua Zeng, Haozhe Zhang, Xiaohu Jiang.