Transforming your orchard irrigation with sensors and monitoring

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APAL Grower R&D Update

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Background

- Water scarcity
- Crop water requirements
- Modern irrigation systems
- Sensors and monitoring
Orchard irrigation

- When & how much to irrigate?
Crop water requirement

Water required by plants for:
1. Survival
2. Growth
3. Development
4. Economic (fruit) parts
Orchard irrigation

• When & how much to irrigate?

\[
\text{Demand} > \text{Supply} = \text{Irrigate}
\]

• Demand → Crop Water Use

• Supply → Available Soil Water
Orchard irrigation

• When & how much to irrigate?

Crop evapotranspiration - Guidelines for computing crop water requirements - FAO Irrigation and drainage paper 56

11 Chapters
8 Appendices

www.fao.org
Crop water requirement

Varies between orchards due to factors:
1. Crop
2. Soil
3. Climatic
4. Agronomic management
Crop water requirement

Varies between orchards due to factors:

1. **Crop**
   1. Cultivar, rootstock
   2. Growth stage
   3. Canopy size, canopy architecture, tree density
   4. Growing season, maturity

2. **Soil**
   1. Structure
   2. Texture
   3. Depth
   4. Topography
   5. Chemistry

3. **Climatic**
   1. Temperature
   2. Radiation (sunshine)
   3. Relative Humidity
   4. Rainfall
   5. Wind

4. **Agronomic management**
   1. Irrigation system design (drip, microjet)
   2. Irrigation frequency, irrigation efficiency
   3. Tillage, mulching, weedicide, netting
Orchard irrigation

- Evaporative demand
- Canopy size
- Feedback on under irrigation (water stress)
- Feedback on over irrigation
Technologies + Sensors for irrigation management

**Evaporative demand**
1. Weather station (BoM)

**Canopy size**
1. NDVI
2. Canopy cover
3. Light interception

**Under irrigation**
1. Trunk diameter
2. Canopy temperature
3. Water potential

**Over irrigation**
1. Soil moisture
Taking control of water over the phone

With the capacity to take microscopic measurements of the trunk diameter of a fruit tree or the changing dimensions of a piece of fruit during the course of the day gives rise to a new level of technology availability in horticulture.

"The management of water, as an expensive commodity in horticulture production, is now becoming a phase of evolution in technology," Andrew Bannister, a technology consultant, said. "With new hardware and software, we can now monitor and manage the precise flow of water to a plant needs and when it needs it along with when it is ready to be harvested."}

Dr. Mark O'Connell, a research leader at the Agriculture Victoria research station in Victoria, said that the use of technology in horticulture has revolutionized the industry. "We can now monitor the health of our plants in real-time, and make adjustments to our irrigation systems on-the-fly," he said. "This technology is allowing us to be more efficient and effective in our water management, which is crucial for the sustainability of our industry."

"The technology we are using now is not only beneficial for the environment, but also for the bottom line," O'Connell added. "With the ability to monitor our plants in real-time, we can make more informed decisions about our water usage, which can lead to significant cost savings."
Tatura SmartFarm

Artificial Intelligence Irrigation
✓ Evaporative demand
✓ Canopy size
✓ Feedback on under irrigation (water stress)
✓ Feedback on over irrigation
Artificial Intelligence Irrigation

Closed-loop irrigation system

https://supplant.me/
Stonefruit Experimental Orchard Tatura
Stonefruit Experimental Orchard Tatura
‘Rose Bright’ Nectarine
Artificial Intelligence Irrigation

PhD research fellowships

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www.hin.com.au
Other technologies + systems

- Phytech – soil and plant sensing
- Irrisat – weather based irrigation scheduling (NDVI, Kc)
- Ceres Imagery - canopy temperature – tree water stress
- ZIM-probe – leaf turgor pressure
- FloraPulse – tree water potential
- LiDAR – canopy size
- Canopy temperature
SIMPLE PLANT STATUS INDICATOR AND RECOMMENDATIONS

The outcome of the data fusion and analysis is a simple and easy to understand plant status indicator. Keeping plant status in the recommended range (green) assures optimal yield. Machine learning algorithms provide irrigation scheduling recommendations to maintain the plant status in the optimal zone with minimal resources.
https://irrisat-cloud.appspot.com/
https://www.ceresimaging.net/

How it works

We fly farmers’ fields.
Mounted on fixed-wing aircraft, our cameras capture multispectral imagery in greater detail than satellites, more efficiently than drones.

We generate scientific-grade imagery and analyses.
Instead of unprocessed aerial photographs, we use crop-specific, research-validated data models to evaluate plant health.

We provide actionable insights.
Within 48 hours, we deliver specific recommendations to help farmers make decisions with confidence.
Leaf turgor pressure

https://www.yara.com

ZIM-probe
Tree water potential

http://www.florapulse.com
Canopy temperature

ArduCrop
Canopy temperature

Native vegetation

Late season varieties, irrigated previous night

Early season varieties, irrigated previous week

Heavy soil

Light sandy soil

Irrigation channel

Dam

Track

Temperature range: 21.8°C to 42.5°C
Transforming your orchard irrigation with sensors and monitoring

- Crop water requirement

- Smart Irrigation systems:
  - ✓ Evaporative demand
  - ✓ Canopy size
  - ✓ Feedback on under irrigation (water stress)
  - ✓ Feedback on over irrigation

- Emerging technologies:
  - SupPlant
  - Phytech
  - Ceresimaging
  - Irrisat
  - LiDAR
  - ZIM-probe
  - FloraPulse
  - Canopy temperature