



“Adoption of Soil Monitoring Technology remains low”

The technology used to monitor soil moisture and other variables within an orchard has changed dramatically over the past decade or more, however the fundamental reasons for measuring has not.

Knowing how much water to apply and when is a fundamental management decision within an irrigated agricultural or horticultural enterprise, however the adoption of this technology remains relatively low.

A statement made by the Water Minister in 1890, Alfred Deakin, is still relevant, and even more so today, with the ever-increasing pressures on water resources and the ever-increasing prices:

*“It’s **not the quantity of water** applied to a crop that is important: It is **the quantity of intelligence** applied which **determines** the results - Alfred Deakin Minister for Water Supply 1890.”*

The use of soil moisture monitoring equipment is not just about knowing how wet or dry the soil is. Monitoring soil moisture and just as importantly, understanding how to interpret and use the data can provide objective information on which to:

- Determine the rate at which plants are using water.
- Identify the depth of water use by the plants and learn how water extraction is influenced by the amount of water within the profile and the root zone of the plants.
- Monitor the depth and effectiveness of irrigation and rain events.
- Identify when the plants have extracted all the readily available water within the root zone.
- Provides the information to assist with management decisions with the application of the correct amount of water at the correct time to achieve optimum yield and quality potential and better water use efficiency.

Significant water savings can be made by applying water at the correct time and for the correct duration, based on the water use of the plants, the depth of the root zone and the water holding capacity of the soil.

In some cases, significant water savings can be made, however in others, the same or even more water can be used, however the aim is achieving the maximum yield and quality potential for each megalitre of water applied by objectively monitoring the soil moisture levels at strategic locations within an orchard.

Irrigation is not the only management input to successfully growing plants, trees and fruit, however water management does have a major impact on many other management practices.

Better utilisation of fertiliser and fertigation, improved plant health, reduction in pruning and better return on investment in irrigation infrastructure are just some of the added benefits of monitoring soil moisture.

Technology has progressed a long way from the tensiometers, gypsum blocks and dig sticks (screw drivers), even though these tools still have a place in assisting with irrigation management decisions. Sensor technology has improved where multi depth profile probes can be installed, providing soil moisture and soil temperature data to depths of 80 – 160cm, at 10cm increments, and are maintenance free, provided the probes or the cable is not damaged. Incremental measurements down the profile, within and below the active root zone of the plants provides information of water movement and root activity that cannot be achieved by simply looking at the plants or digging some holes.

Research based sensors are now becoming more available and affordable, that adds to the big picture, providing more valuable information on how plants are performing, and fruit is growing. Soil moisture monitoring, combined with sap flow and fruit growth sensors are providing users information not only of soil moisture, but exactly how many mm an hour and litres per day a plant is using, and continuous measurement of fruit size and growth. As further research is conducted, more plant based sensors will become available, providing more in depth information on plant health, vigour, productivity, yield potential, nutrient status and more, that will be available on a continuous basis from your mobile phone, tablet or computer.

Data logging technology has also evolved over the years. In the past, various data loggers and sensors were available, however these were all very application specific. A certain soil moisture sensor could only be connected to a specific data logger. A weather station could only connect to a certain data logger. A flow meter would only work with a specific logger and so on. Some data logging technology can now be used to monitor a wide range of sensors, allowing users to add a range of sensors to the one logger, if or when required, and the ability and flexibility to add new devices as they are developed or needed. As an example, a logger that is monitoring a soil moisture probe only, can also monitor sap flow sensors, an air temperature sensor, fruit size sensor, water pressure, flow, weather sensors and more.

The next discussion point is how the data being collected from the data loggers and sensors in the field is getting to your mobile phone, tablet or computer. As with the sensors and data loggers, technology continues to evolve. In the early days of data logging, for remote data collection, cable was used to link the data loggers to the computer, a lap top was connected to the data logger in the field to upload the data or a removeable data storage module was disconnected from the logger and connected to the computer. This was a big step from the manual monitoring equipment that had been used, however farmers wanted to view data remotely. The

advent of the internet, web site development and evolving wireless communication technology has allowed data to be transferred from the field, via a range of communication solutions, directly to a remote server for displaying on any web enabled device now.

There is a wide range of wireless communication options available now, which can be quite confusing. The most suitable solution is really based around several factors that include:

- The number of sites required.
- Location of the sites – how far they are apart
- Existing services – mobile, Wi-Fi, Lora

For applications where only a few sites are required, and there will be no future need for expansion, then cellular connection is the easiest. The best option would be connection utilising the 4G network, with a unit that can connect to the CATM1 and NBiOT networks, which will offer far more coverage for data and lower connection fees.

For applications where there is a requirement for multiple sites, with the ability to cost effectively expand the number of sites over time, then a radio network would be the best option. This type of system uses a gateway, that either connects to the internet via the mobile network or the local internet access point, and to the field sites by radio.

Once again, there are several radio communication options available, and the suitability of each will depend on several factors such as:

- Distances between sites.
- Whether control is also required or being considered.

For applications where cameras are of interest, either to be used for field or asset monitoring, or security, then WiFi connection is the best option as it provides the bandwidth required for high resolution streaming of footage. Monitoring systems are available that utilise WiFi connectivity, and in most cases, existing internet and WiFi infrastructure can be used by adding range extenders to cover the areas to be monitored with WiFi enabled field units.

One other consideration when looking at the installation of monitoring equipment, which is commonly overlooked, is whether there is a need for irrigation control infrastructure in the short or medium term. A number of monitoring systems can also be used for controlling valves and pumps. Therefore, if valve control upgrades are required, then it is advisable to install monitoring sites close to valves, so that the same telemetry units installed to monitor a soil moisture probe, for example, can also be used to wirelessly control the valves. This is an important consideration especially if there are issues with damaged cable or hydraulic lines, that need to be replaced. Installation of a monitoring site that can be used for wireless valve control can often be a more economical and easier option than repairing or replacing damaged cable or tubing.

A final important consideration in the selection of a monitoring system is the web site / platform that is used to present the data that is collected from the field sites. It is important that the data is displayed in a format that allows for easy interpretation and management decisions to be made. Solution providers should not only supply, install and support the equipment, but also offer training and follow up assistance to ensure the successful use of the data.

If irrigation control solutions are also required, in addition to monitoring, then the system should also include a platform that provides the irrigation control and scheduling features required.

For further information or to discuss products available, please contact

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