Vegetable R&D
Your national vegetable levy at work

vegenotes

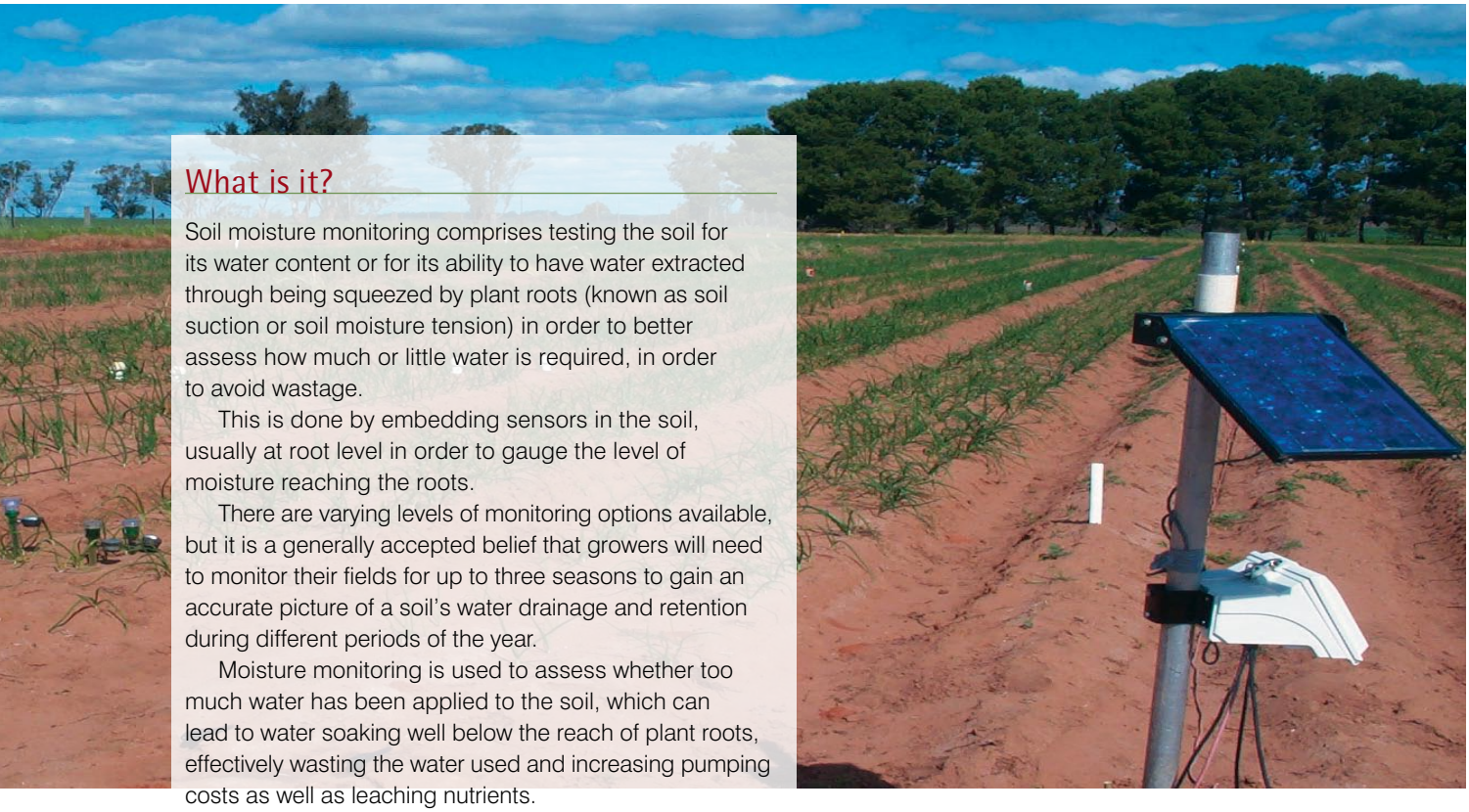
ISSUE 1 2007

Soil Moisture Monitoring

As water availability continues to be an issue across Australia, effective irrigation practices are at the top of growers' agendas as they seek to minimise use of water while maximising crop return. Soil moisture monitoring devices are giving growers a chance to further refine their water usage practices and eliminate the guesswork in irrigating vegetable crops of all sizes.

The bottom line

- Soil moisture monitoring can reduce water wastage while improving quality of crops
- Various options are available which offer growers different levels of information and require different levels of maintenance
- Growers should seek advice on setting up their monitoring system and tailoring it for their crop



What is it?

Soil moisture monitoring comprises testing the soil for its water content or for its ability to have water extracted through being squeezed by plant roots (known as soil suction or soil moisture tension) in order to better assess how much or little water is required, in order to avoid wastage.

This is done by embedding sensors in the soil, usually at root level in order to gauge the level of moisture reaching the roots.

There are varying levels of monitoring options available, but it is a generally accepted belief that growers will need to monitor their fields for up to three seasons to gain an accurate picture of a soil's water drainage and retention during different periods of the year.

Moisture monitoring is used to assess whether too much water has been applied to the soil, which can lead to water soaking well below the reach of plant roots, effectively wasting the water used and increasing pumping costs as well as leaching nutrients.

Similarly, moisture monitoring can also establish if too little water is being used to irrigate a crop. This can lead to reduced crop yields due to plant stress, salt accumulation in the soil's 'rootzone' (the level at which plants actually compress the soil to extract moisture) and a deterioration in the nutrient quality of the soil.

Where should the devices be used?

It is important to ensure the monitoring tool is established in an area of the field that represents the average moisture level of the field to avoid any misinterpretation of the data. Establishing a monitor in a wetter than average section of the field can provide information to the grower that the whole field is well irrigated, when in fact, other sections of the field are not receiving enough water and will therefore be under irrigated. Similarly, if a monitor is established in too dry an area of the field, it can lead to the crop being over-irrigated.

Variations in the soil moisture level of a field can occur due to unevenness of irrigation and the varying ability of a crop to extract water from the soil, which if undetected prior to commencing soil moisture monitoring, will result in inaccurate information being supplied.

One way to reduce the variation in moisture levels is to ensure the irrigation system is consistent throughout the field, by using the same type of components throughout the system (such as drip emitters and sprinklers), minimising pressure variations throughout the system and conducting a regular maintenance program.

Soil moisture monitoring; onion field tension and escan

When should it be used?

Soil Moisture Monitoring can be used to establish the irrigation requirements for a new field prior to a crop being established and as a method of accurately establishing specific water usage characteristics of both the soil and crop on existing fields.

Growers generally already practise some basic form of irrigation monitoring, such as observing the plants and making estimates from the feel and appearance of the topsoil. With extensive experience, this can be the most economical way to judge a crop's irrigation requirements. Making use of soil moisture monitoring tools however, can provide a handy complement to this method and generate reliable data that takes the guesswork out of irrigating a crop.

There are several soil moisture monitoring tools available for use and should be chosen based on the type of soil to be monitored, depth of plant roots and level of information required for irrigation.

Water travels through different types of soils in different ways. In sandy soils, water moves easily in and out of the soil as sand is not able to absorb much water, enabling plant roots to easily extract the moisture. As a result, sandy soils tend to have a low soil moisture tension reading and can appear to be dryer than other types of soil.

Clay soils have a much higher water retention rate than sandy soils and while the moisture level may read as high, plants generally have to work much harder to extract the water.

Vegetable growers in particular need to ensure that the devices used are able to chart a high level of activity in short growing seasons and provide information that can determine moisture stress levels as many vegetable crops are susceptible to moisture stress during growth.

What are the different types of soil moisture monitoring devices?

FullStop

Developed by the CSIRO, the FullStop is the most basic of soil monitoring devices, comprising a buried funnel which collects water and causes a float to rise through a tube which then provides a visual cue to end the irrigation to the crop.

The device does not provide any information on the water distribution down to the funnel. The water housed in the tube can be collected and manually tested for additional information such as salt or nitrate levels.

This device can be used as a basic disconnect device in automated systems, but is heavily reliant on being placed in the soil correctly.

The FullStop is essentially an introductory device to soil moisture monitoring and should be used in conjunction with more sophisticated reporting tools.

Tensiometers

Tensiometers comprise a water-filled hollow tube with a porous cup buried in the soil at the root level of the crop and a pressure gauge mounted above the soil level to measure the soil suction level of water available to a plant. As the soil dries out, it becomes more difficult for the plant to extract moisture and accordingly, the pressure reading increases on the tensiometer, providing a simple indicator to the grower on when to water.

Attachments can also be added to the tensiometer to enable readings to be gathered by an automated logging system or even operate as an automatic irrigation system, using specific tensiometer levels as a trigger mechanism. The basic tensiometer will require regular manual checking to gather the information.

Although tensiometers provide highly accurate information, the soil characteristics of a particular paddock need to be taken into account. Tensiometers have limited use with sandy soils and the time it takes for water to move through heavier clay soils may delay the tensiometer indicating the water in the soil level is suitable, creating the potential to overwater.

As with all soil monitoring sensors, it is recommended the characteristics of the soil in the monitored field should be determined prior to commencing monitoring and a period of observation should be undertaken to determine any special characteristics.

Granular matrix sensor (GMS)

Granular Matrix Sensors (GMS)

Granular Matrix Sensors monitor soil suction, through burying a sensor in the soil with data transferred back to an above soil unit via a cable. The soil unit above ground can be calibrated to monitor several sensors and record data which can be electronically transferred or collected. There is little maintenance required for the GMS and it can operate automatically.

Hand-held readers and PC links are available with this type of sensor.

Capacitance sensors

Capacitance sensors use an electrical field to measure water content in the soil. They can be buried in the soil or an attached to a tube at various levels to provide comprehensive soil readings at different depths.

The data can be retrieved electronically, either with a handheld reader or through a permanent logging system whose information can be stored on a computer, allowing for either a manual retrieval of information or automatic retrieval.

In addition to determining the moisture content within the soil, capacitance sensors are also able to determine additional information such as salinity and temperature levels.

These sensors, like Granular Matrix Sensors can be used as a stand alone option for a field or as part of an integrated monitoring system more likely to be used on larger plantations.

How do growers choose?

The various systems offer benefits and drawbacks for growers. Using standalone devices such as tensiometers or FullStop will give growers some basic, immediate information, but the manual data gathering (i.e. waiting for the water to soak to the right level) can be time consuming and there may need to be regular maintenance of the sensors.

Establishing an automated or more extensive monitoring system using a network of sensors can save time, but will be more expensive and may involve setting up a computer tracking system to interpret the data.

The simplest way for growers to choose is to conduct an assessment of their fields, which may involve seeking the advice of an irrigation officer, other growers or undertaking an irrigation management course.

A good checklist to follow is listed in the Healthy Soils Ute Guide:

- What information will I get from the device and how usable is it?
- How labour intensive is it?
- What level of accuracy do I need?
- Does the device suit my soil type/s and crop/s?
- How durable is it?
- How much maintenance will it need?

Grower's view

One grower who has benefited from soil moisture monitoring is Tony Catanzariti. Using a capacitance sensor with a screen display, Tony was able to establish he was overwatering his mini-pepper crop.

His Nerrigan property, located near Griffith in NSW, is situated on a fairly sandy type of soil, which can give the impression of low soil moisture content, leading Tony to believe his crop wasn't getting enough water.

"Early on in the piece, you could have sworn the crop wasn't getting water," he said.

"We were at the point of trying to saturate to the depth of 30 centimetres," he said. Tony has had a capacitance sensor in place for approximately a year, but was having little success identifying the problem.

Soil moisture monitoring, onion field tension (below); Hansen logger in a mini capsicum crop at Griffith, cover image

Through assistance from a consultant from the NSW DPI, Tony recalibrated his sensor and discovered the soil was overwatered. After a period of allowing the soil to dry out, Tony has recommenced irrigating his crop based on the information from the sensor and using a fraction of the water he used previously.

"We'd check it (the sensor) every day," he said.

"We would basically check the sensor to see what stage of absorption the moisture was at." Once the sensor indicated it had been properly absorbed into the soil, he would then water again, with impressive results.

"We've got the best crop I've ever seen," he said, "it's magnificent."

Tony says the current crop of mini-peppers has the highest yield he has seen and attributes it to the improved irrigation.

"Mini-peppers are a temperamental crop which needs to be carefully monitored and irrigated," he said.

Tony is keen to expand his monitoring, indicating his one hectare crop of mini-peppers could use two more sensors to accurately monitor the moisture levels and will likely look at establishing an automated irrigation system based on the moisture monitoring data.

Further reading

Soil Moisture Monitoring Options for Vegetable Crops in Australia – Philip Charlesworth & Robert Hoogers
NSW Department of Primary Industries
Contact: Mark Hickey, NSW Department of Primary Industries; Ph: (02) 6951 2523

Water for Profit
http://www.growcom.com.au/land&water/wfpfactsheets.html

ISSN: 1449 – 1397

vegenotes is produced by: AUSVEG Ltd
PO Box 563, Mulgrave VIC 3170
T: (03) 9544 8098 | F: (03) 9558 6199

vegenotes was facilitated by HAL in partnership with AUSVEG and was funded by the National Vegetable Levy. The Australian Government provides matched funding for all of HAL's R&D activities.

AUSVEG

HAL
Know-how for Horticulture™