MOISTURE MONITORING

A demonstration by PotatoLink

Beyond providing soil moisture data at a given time and soil depth, can soil moisture probes help in making future irrigation decisions? The potential of moisture probes to serve a dual role was the subject of a PotatoLink demonstration trial.

Moisture probes act as a kind of yardstick, helping farmers align their field observations with real moisture data. They can also help optimise irrigation practices.

Using moisture data, farmers can time irrigation to match the actual water needs of their crops. This precise approach has the potential to boost crop yields significantly – essentially aligning human judgment with data-driven precision to get the best results from the field.

ARE MOISTURE PROBES IMPORTANT?

The use of moisture probes plays a crucial role in smart agriculture for several important reasons. While not used in every paddock due to their cost, even a couple of probes in key locations can serve as valuable tools for improving irrigation practices.

One primary function of these probes is to help farmers align their visual observations in the field with what's happening beneath the ground. This calibration ensures more accurate decision-making regarding irrigation – nobody wants to under or over water.

Overwatering can lead to issues such as nitrogen leaching, while underwatering during critical crop phases, like tuber bulking, can deplete subsoil water reserves, making proper irrigation management essential.

Probes are also useful after rainfall events, providing growers with information on the impact of rainfall on soil moisture, potential nutrition movement and when to resume irrigation.

THE DEMONSTRATION

At the demonstration site, two Wildeye moisture units were installed, each unit with two probes at different depths: at 20cm, where most of the plant roots are located, and another at 40cm to monitor water movement through the soil profile.

The locations represented two different soil types, with lighter sandier soils in northeast (NE) and heavier soils in the southwest (SW).

The data output from these probes shows fluctuations in soil moisture levels, as shown in Figure 1.

The green line, representing the 40cm depth, provides insights into subsoil conditions, while the blue line at 20cm oscillates based on irrigation, rainfall event and crop water usage (clearly showing more usage during the day and low usage at night).

The examples in this trial show the distinct differences in moisture retention in different soil types and therefore varying success of irrigation. As shown in Figure 1, the lighter soils in the NE of the paddock suffered from underwatering compared to the heavier soils in the SW, particularly during the tuber bulking stage.

KEY TERMS

Understanding parameters like the 'full point' (maximum soil water capacity) and 're-fill point' (the level at which irrigation is triggered) is critical and can be adjusted during different crop growth stages.

Full point: Generally, if you've had heavy rainfall, the full point is once the field has been able to drain for a day. It is the most water the soil can hold.

Re-fill point: There is a bit of an art and science to set this at the right level. This is the soil moisture level that you are prepared to let the crop dry down to before irrigating. It is a dynamic number will change as the roots grow into new soil. For example, it is common to change the refill point during sensitive parts of the crop growth curve, especially tuber bulking

In the NE, the moisture levels at 40cm depth fluctuate a lot as the water moves through the profile. When the soil is waterlogged (i.e. persistently in the blue shaded zone), it is difficult for the roots to grow. Additionally, overwatering leads to nitrogen leaching. Following the blue line (20cm depth), the NE section was overwatered during the early vegetative and maturation stages and underwatered during the tuber bulking stage.

PAIRING AND INTERPRETING THE DATA

Pairing data from moisture probes with information from tools like IrriSAT is a smart strategy. It involves combining soil moisture data with real-time insights into what the crop is doing. IrriSAT, for instance, generates a growth curve for the crop, indicating its various stages of development. This curve is valuable because it helps growers understand when the crop's water demand is likely to increase.

For example, when a crop transitions from having limited leaf area to achieving full row closure, its water requirements rise significantly. IrriSAT can track this leaf area growth and provide a growth curve to guide irrigation decisions.

Data collected from the probes can be used to examine how moisture levels change over time, then correlate these changes with rainfall and irrigation.

If the crop is overwatered, topsoil moisturewill increase rapidly immediately following an irrigation event. The key question is whether this excess moisture swiftly reaches the probe below. Sometimes, water can move rapidly through the topsoil and drain below 40cm, effectively stripping away the excess moisture from the upper layers.

It is therefore important to focus on how the subsoil behaves over time to make informed irrigation decisions.

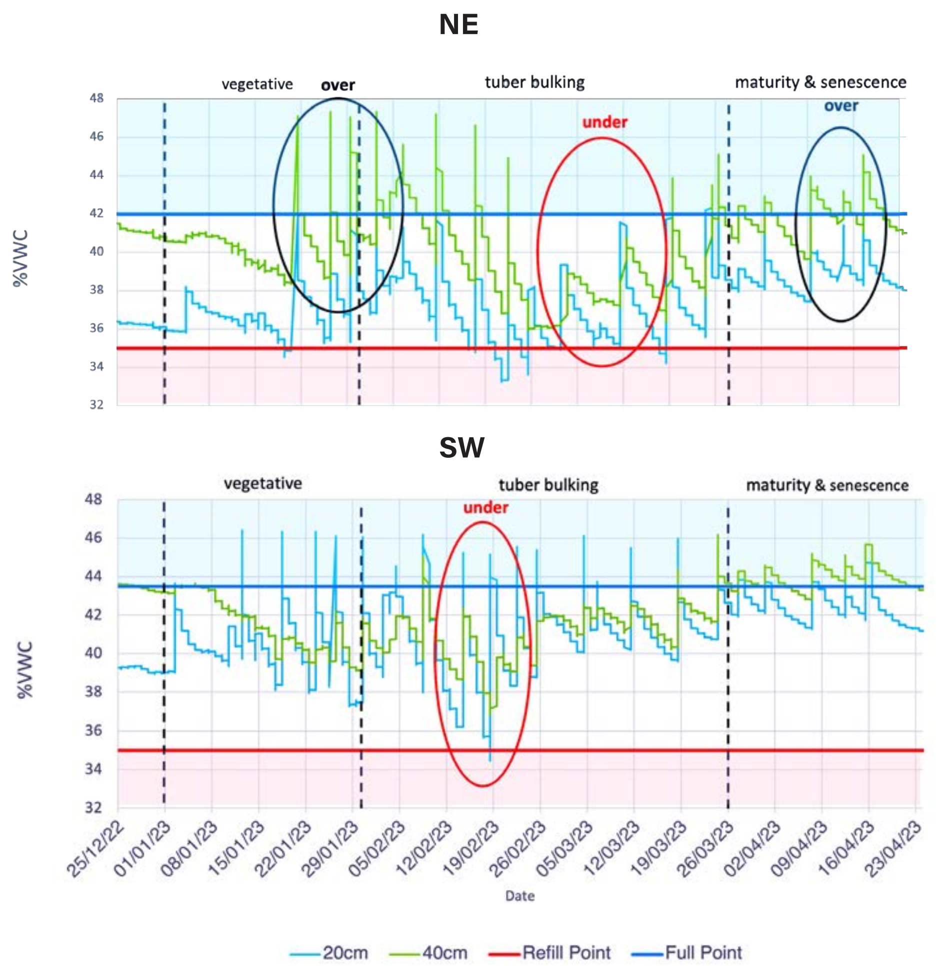

Figure 1. Results showing the fluctuations in moisture levels across the four main stages of development. Shaded red = refill point; shaded blue = full point; green line = moisture levels at 40cm; blue line = moisture levels at 20cm

At the demonstration site, the two distinct areas, SW and NE, show how using the same irrigation management technique for the whole paddock doesn't align with requirements of the crop grown under different soil textures.

The NE section with the lighter soil texture and lower water-holding capacity, was initially over-irrigated. Then later, during tuber bulking, it experienced a period of under-irrigation.

In contrast, the SW area was irrigated well. This difference highlights the challenge of managing irrigation across various soil textures and the importance of using moisture probes to save time and optimise decisions.

When comparing the SW and NE areas, it becomes clear that irrigation was better aligned with the SW area soil type. In contrast, the NE was challenged by both over and under-irrigation.

This underscores the difficulty of managing irrigation when dealing with diverse soil conditions.

EVAPOTRANSPIRATION

Evapotranspiration, or the loss of water through plant transpiration and soil evaporation, is a key factor to consider.

During the early stages of crop growth, when there is limited leaf area, most water loss is due to soil surface evaporation. As the crop develops and leaf area increases, the plant begins to draw more water from the soil, leading to higher water demands.

Evapotranspiration rates can jump significantly, from 2mm per day in the early growth stages to 8-10mm per day when the crop reaches peak leaf area and row closure. Matching this demand with irrigation can be challenging, and if the irrigation system cannot keep up, reliance on soil moisture reserves becomes essential, potentially leading to under-irrigation.

For growers, moisture probes can be valuable learning tools. While traditional methods like spade and visual inspection are useful, moisture probes can help validate what growers observe visually and calibrate their decision-making processes. They also offer growers with a prompt to check irrigation when they are time poor and struggling to get to the field to check soil moisture.

Effective calibration and integration of moisture probe data can lead to more precise and efficient irrigation practices, ultimately enhancing crop yields and water use.

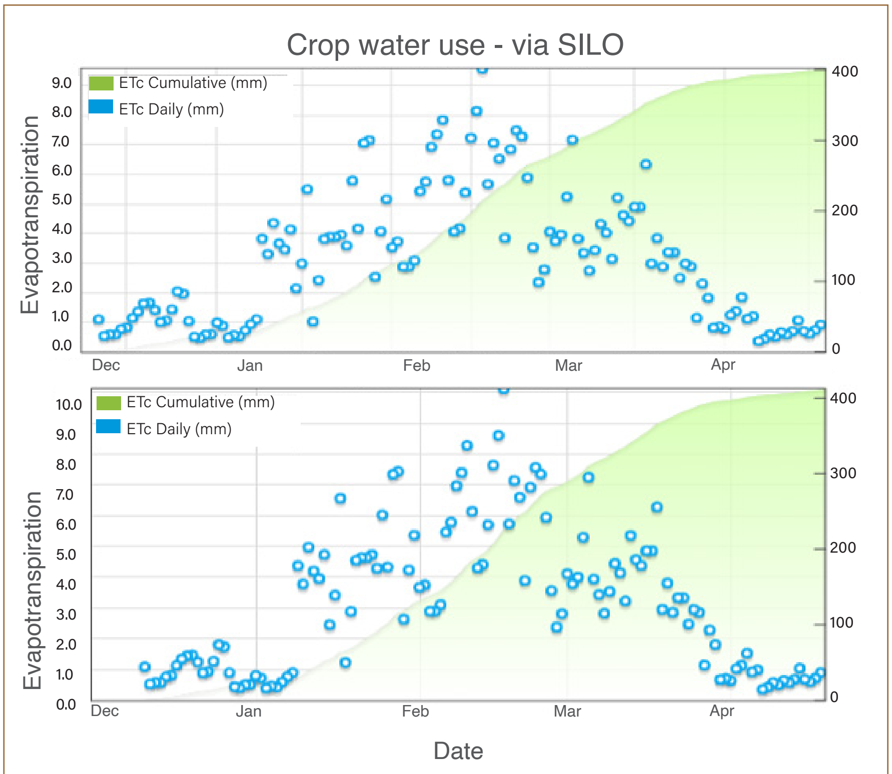

Figure 2. Evapotranspiration rates for the NE (top) and SW (bottom) sites

WILDEYE PROBES

The Wildeye probes used in this demonstration are equipped with a communications box, which is a key feature. Standard moisture sensors are found in various equipment, but the addition of the communications box allows data to be transmitted to phones or computers.

Wildeye probes measure soil moisture at 30-minute intervals, uploading the data to the web daily to reduce battery consumption. The ability to initiate an upload in the paddock is also quite useful, as are the daily notifications provided by the system.

More information about different probe types can be found in the factsheet here (https://bitly.ws/38nBb)

FURTHER RESOURCES:

PotatoLink webinar *Getting your irrigation ready for the summer*

PotatoLink factsheet *Matching irrigation to crop growth*

Soil Wealth ICP webinar *Tools to manage irrigation in potatoes*

Soil Wealth ICP case studies in potatoes
Part 1: Practical use of Irrisat and soil moisture sensors

Soil Wealth ICP case studies in potatoes
Part 2: Practical use of satellite information

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Hort Innovation POTATO – FRESH FUND

This project has been funded by Hort Innovation using the potato – fresh research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au