Optimising cropping management in Dairy Systems using improved data collection

Update: Soil Moisture Monitoring in the Riverina – end of season
April 2016

Seasonal update

For the farm managers involved in this project, knowing the soil moisture levels to a depth of 80cm, and at 10cm increments, assisted to

- Understand the effectiveness of irrigation events
- Identify issues and make decisions about addressing them early enough to avoid significant yield penalties or damage to crops.
    - Site 1 experienced sealing of the soil after the third irrigation. The manager used the moisture probe information to decide whether to irrigate more frequently to compensate for less effective irrigation.
    - On Site 2 the probe data highlighted issues with infiltration under the pivot, allowing the manager to adjust irrigation applications and frequencies at critical growth stages.

- The Manager of Site 1 used the probe to make decisions on when to water under flood irrigation, considering the price of water and the economic return for each megalitre of water applied. Using the probe data to identify the optimum time to water, and not allowing the crop to run into water stress, has a major benefit for yield potential and dry matter production.
- The Manager of Site 2 used information from the probe to fine tune irrigation applications and timing under pivots. Using the probe, the manager altered the quantity and frequency of applications based on prevailing and forecasted weather, as well as the growth stage of the crop. This was critical at stages when water stress can have a major impact on the yield potential of the crop.

With the investment in the machinery, power and water to optimise a crop, irrigation decisions are becoming more critical, and the return on investment for a probe site is significant. If the decision has been made to grow and irrigate a crop, then maximising the return per megalitre of water applied is critical.

Soil moisture monitoring is not the only tool to improve irrigation management, however monitoring the amount of water in the soil profile that is available to the crop, maintaining optimum moisture levels to maximise yield potential, and making informed decisions on when and how much to apply, can only be achieved through monitoring the soil moisture.

Local engagement

On 6 March 2019, fifteen farmers and service providers attended a Successful Soil Management workshop in the Riverina, comparing maize under different irrigation strategies - one flood-irrigated plot and the other currently irrigated using a pivot. The day was designed to provide participants with an opportunity to discuss options for soil management and learn how to get the best from pastures or crops by remediating potential issues. Guest speakers included:

- Soil Scientist, Christian Bannan, who used soil pits in conjunction with soil tests to see what goes on beneath the soil surface
- Adrian Orloff, from Mac Systems, who spoke on the recently installed soil moisture probes

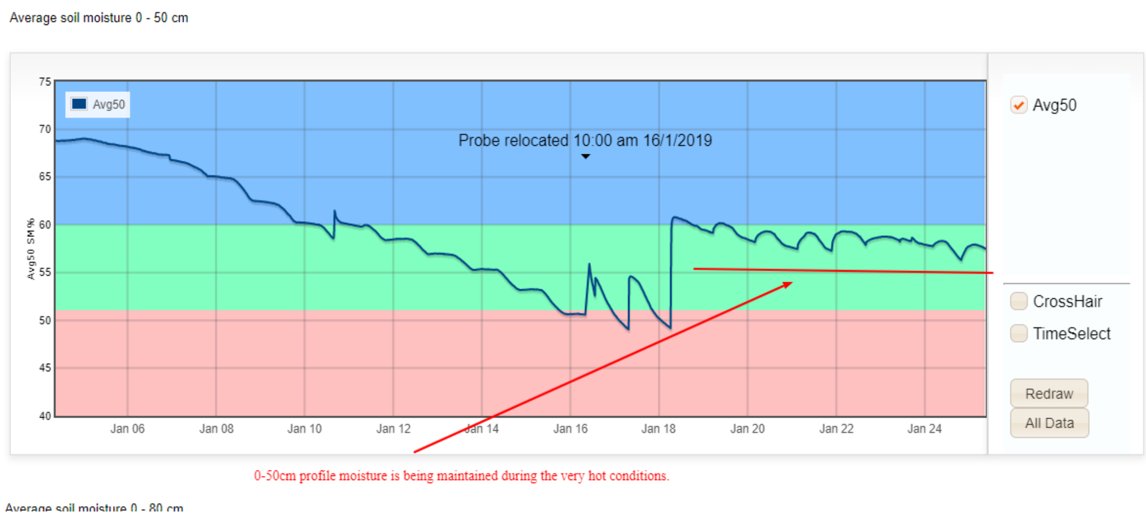
Two soil pits helped to visualise the soil structure and constraints, paddock management and impacts on crop growth and irrigation. Aligned with soil moisture technology, participants were able to see how soil moisture technology can work and be interpreted to help inform agronomic management.

Christian Bannan in soil pit

Cellular telemetry site with soil moisture probe connected.

Information delivered demonstrated a strong correlation between soil pit information and soil moisture probe technology. Site 2 (maize under pivot) experienced staged crop growth and uniformity issues from Christmas 2018.

Data from the probe site clearly showed that in late December, when temperatures began to rise, there was an issue with water infiltration into the root zone of the crop, which quickly resulted in poor growth and uniformity. The farmer used this data to increase application rates and frequencies to lift the moisture level with the maize crop, and then maintain good moisture levels during the prolonged hot and dry conditions (see graph below).



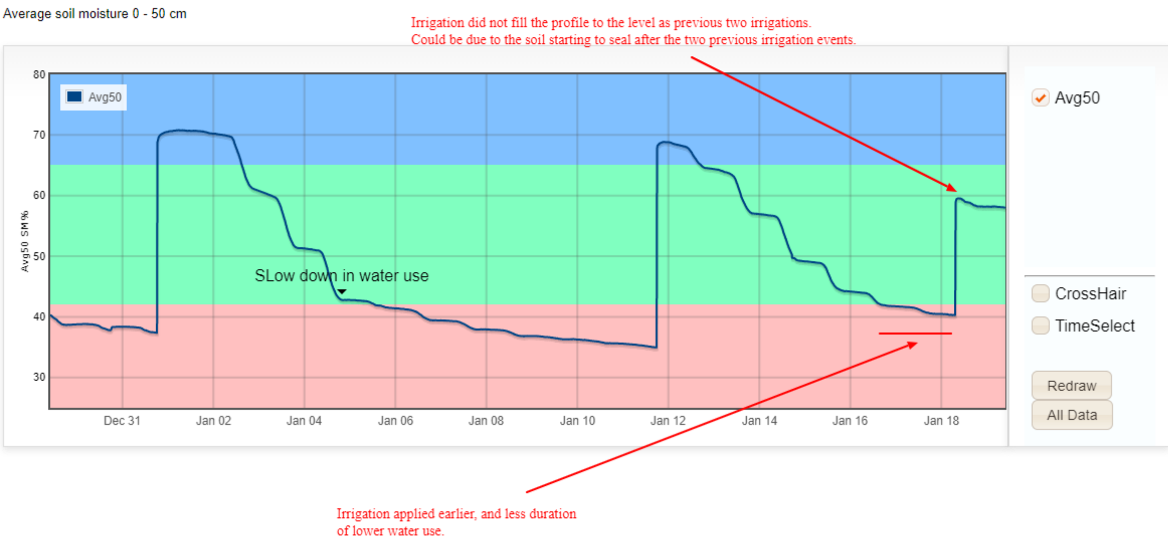
Average moisture chart of the 50cm profile at pivot site under corn

The farmer used the data to allow the profile to dry at strategic periods and encourage better crop utilisation of soil moisture at depth. This encouraged deeper plant roots and the application of correct irrigation to refill the profile. As a result, the farmer could see the real practical benefits of using strategically placed soil moisture probes to monitor soil moisture conditions in conjunction with satellite imagery and visual assessment to view the performance of the crop over the entire pivot.

Similarly, Site 2 (flood irrigated maize) created good discussion around the correlation between soil constraints and soil moisture data. Soil structure and constraints were identified whilst assessing the soil profile using a soil pit. Participants recognised that crop water use slowed significantly once the moisture fell below refill point. For example, discussion suggested that yield potential of the crop may have been reduced due to the periods of low crop water use when the moisture level dropped below the refill point. The refill point is generally the moisture level at which an irrigation is applied. The aim is to maintain an optimum moisture range at which the plants can achieve maximum yield and quality potential. The true agronomic refill point is set above the point where the rate of water use by the crop slows, due to using the readily available moisture, however in some cases, the refill point can be set at a level where the irrigation system can apply the required volume of water to refill the root zone of the crop. If the root zone is left to dry too much, during the hotter months, the crop water use demands can exceed the rate at which the irrigation system can apply the water.

Discussion also highlighted that soil structural constraints below 20cm (including compaction, lack of organic matter and hard pan), provided a good explanation as to why there was a significant reduction in water use when the moisture fell below refill point. With the concentration of production roots within the 0-20cm profile, once this moisture was depleted, the rate of water use declined as there were less roots below 20cm to utilise the moisture. Suggested future management strategies were suggested, including to: increase organic matter; sow a rotation crop with deep roots; breaking open the soil and providing root canals through which water and surface organic matter can migrate.

Interestingly, data suggested that after the third irrigation, the effectiveness of the subsequent irrigation events declined (not refilling the root zone to full point), which was most likely due to the surface soil sealing after the third irrigation (see below).



Average moisture chart of the 50cm profile at flood irrigation site under corn

The demonstration highlighted a great potential for in-crop monitoring by combining strategically placed soil moisture probes in conjunction with satellite imagery and visual assessments, to allow for the entire crop performance to be assessed with the micro measurements of the probe data. Generating good discussion using a combination of visual assessment and soil moisture technology highlighted the importance of using a number of monitoring tools to gain a better understanding of soil health and agronomic management. The day also highlighted that soil variations need to be taken into account within each irrigation management zone to balance the requirements and allow for soil variations across paddocks.