

A knowledge inventory for monitoring soil moisture

Do you know how much water is available in your soil at the start of the irrigation season?

The purpose of irrigation is to ensure plants have the right amount of water available to maximise growth. This is the essence of irrigation management. SIP1 research showed that commencing irrigation too late reduced the dry matter production of many dairy irrigators and, therefore, farm profit.

The Readily Available Water (RAW) for the plant rooting depth and site soil type is a vital piece of information for deciding when you should start-up your irrigation, and how much water is needed via irrigation and rainfall throughout the season.

If there is not enough water in the soil, the pasture or crop will not develop as it should and you may be setting yourself up for long-term soil moisture deficits throughout the irrigation season.

Conversely, over irrigating can lead to waterlogging of soils and wastes expensive water and power inputs.

There are two simple ways to determine soil water status:

- Soil moisture monitoring using a probe
- Water balance using weather data

What do I need to check?

To ensure you can adequately monitor your soil moisture and plan your irrigation scheduling accordingly in the coming season, check that you have the following in place:

- ✓ Are you monitoring your soil moisture?
- ✓ Do you know your site's RAW for the pastures or crops you intend to grow on a particular soil type? This is fundamental information required for soil moisture monitoring
- ✓ How many methods of monitoring do you use? Ideally more than one should be used
- ✓ Do you know the capacity and how much water your irrigation system is applying? Do you know how to set your irrigation system to reliably deliver the amount of water your soil moisture monitoring indicates you need?
- ✓ Do you know how evenly or uniformly your system is applying water? If your irrigation system is irrigating unevenly, over-watering and under-watering is likely across the paddock resulting in poor plant development and therefore lost production.

Soil-based monitoring

Soil moisture monitoring probes use a number of indirect methods that measure the properties of the soil which vary with water content. It is therefore important that equipment decisions and paddock location are determined by commonalities/differences in soil characteristics and pasture/crop varieties being irrigated.

Pre-installation checks

- ✓ Are you working with a trusted irrigation agronomist who can assist with interpretation of SMM data, pasture/crop water demands, system capacity and irrigation scheduling decisions?
- ✓ Do you know the soil types and characteristics of the soils under your irrigation system?
- ✓ Have you considered the variation in plant rooting depth and soil texture characteristics of the areas under your irrigation system to determine the right RAW?
- ✓ Have you made an informed decision about the type of probe, depth of sensors and data-logger which is best for your situation?
Check the Irrigation New Zealand Soil Moisture Monitoring Guide to build your knowledge.
- ✓ Are your probes in a location which represents the majority soil type/characteristics of your irrigated area?
- ✓ Do you have good enough knowledge of the variation in other soil types/characteristics in the paddock so you can calibrate SMM data accordingly and adjust your irrigation? You may have an option to segment or variably apply your water.

Pre-season checks

- ✓ Does the location of your probe/s and depth of sensors still make sense when considering changes to your pasture/crop varieties this season?
- ✓ Did the previous season's readings make sense? Anomalies might indicate a problem.
- ✓ Are the probes soundly installed in the soil, with no disturbance or vertical soil cracks? Inadequate installation will give false readings.
- ✓ Are the cables and conduit intact, protected, and adequately sealed? Problems here will give false or null readings.
- ✓ Is the logger undamaged, clean, securely mounted and protected with sound fencing so the cows cannot access?
- ✓ Is the inside of the logger clean, dry, and insect/rodent free?

- ✓ Is the telemetry functioning properly?
If not, there may be problems with the equipment, the software, or the line of communication (eg. trees may have grown up into the line of sight).
- ✓ Are the readings downloading properly to your computer or device?
Have you set your refill and field capacity and are these displaying on the graphs?
Are there any unexplained data gaps?
If so, there may be a software or equipment problems that should be fixed before the season starts.

Weather-based monitoring

Pre-season checks

- ✓ Are you set-up and accessing reliable ETo readings from your nearest BOM site or a freely available water balance tool such as IrriSat or IrriPasture?
- ✓ Are you accurately measuring rainfall on the farm?
- ✓ Do previous season and cooler month figures from these sources make sense?
Any anomalies might indicate a problem with the source data or calculations.
- ✓ Have you determined the range of Kc values for the pasture or crop you are growing this season?
If you are using a water balance tool, these are most likely predetermined by back-end calculations. Contact the developer if you need a specific crop/pasture Kc added to the tool as this is usually simple to do.
- ✓ To independently source Kc values consult with your trusted irrigation agronomist or refer to Chapter 6 of this resource: [click here](#).
- ✓ Are water balance reports/graphs downloading properly to your computer or device?
Are there any unexplained data gaps?
Check if the problem is at the source end or with your device prior to the start of the season.
- ✓ Do you have the right knowledge to confidently interpret the irrigation scheduling advice provided by the water balance tool and make site based judgments during the upcoming season?

Season checks

- ✓ Are you entering all your irrigation applications into the water balance tool of choice?
- ✓ Are the rainfall and ETo values used by the tool correct for your property—you can override these values if you have site based information.
- ✓ Are you regularly consulting the tool and your soil moisture monitoring information to re-adjust your irrigation scheduling to optimise water, power and labour use?

¹ Crop evapotranspiration- Guidelines for computing crop water requirements – FAO Irrigation and drainage paper 56 (fao.org/3/X0490E/X0490E00.htm)

The project wishes to acknowledge that this checklist has been prepared using information from Irrigation New Zealand's Pre-Season Checklist found at irrigationnz.co.nz and duly acknowledges the Hunter Smarter Farming: Irrigating for Profit Project for its contribution to this material.

USEFUL GLOSSARY

BOM – Australian Bureau of Meteorology

SWAN SYSTEMS – A free daily weather notification that provides a seven day forecast for ETo and rainfall. Can be used to determine basic irrigation requirements (ETo (mm) – rainfall (mm) = irrigation (mm)).

ETo – Reference Evapotranspiration refers to the rate of evapotranspiration from a very actively growing, well-watered grass stand which is 120mm in height. In terms of its water use, this standard reference pasture stand provides a workable representation of good productive pastures across a well irrigated farm.

ETc (crop evapotranspiration)= ETo x Kc (see below).

Kc – The Crop Co-efficient modifies the plant water use if the pasture is in early development, has been grazed or is a crop other than pasture. A conversion factor of 1.0 is applied with ETo for healthy productive pasture. However, other crops will have different water requirement, for example, a tall actively growing maize or sorghum crop is likely to use more water and the appropriate Kc will be approximately 1.2. This means they require 20% more water than good pasture under the same conditions to optimise growth rate.

RAW – Readily Available Water is used to describe the ideal soil moisture content for optimal plant growth, expressed in mm/m. It indicates the depth of water held in every metre of soil that can be easily removed by the plant. RAW should be used to determine the Field Capacity and Refill points on the soil moisture probe graphs. RAW (mm/m) x rooting depth of plant (m)= mm of RAW in the effective root zone.

Field Capacity – the point at which the soil profile is ideally full but not leaky.

Refill Point – the point at which the soil profile needs replenishing as plant growth will slow or become stressed beyond this point.

Fig. 1²– Irrigation requirements should be determined to ensure soil moisture remains within the RAW zone.



² Image sourced from www.agric.wa.gov.au/PC_95247.html?s=1001 (May2013)

IrriPasture a free weather based water balance irrigation scheduling tool being trialled by the SIP2 project: irripasture.cae.usq.edu.au



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