Dairy Australia

SIP2 Snapshot Series

Irrigating to avoid the "Green Drought"

Start irrigation on-time at the beginning of the season and after rainfall to avoid a "Green Drought"

KEY POINTS

A "Green Drought" scenario results from delaying irrigation at start-up. Soil moisture falls below the refill point of the Readily Available Water (RAW) zone. The grass remains green but the soil moisture is too low for optimum growth. Irrigations are ineffective at raising the soil moisture above the refill point.

Increasing soil moisture to within the RAW after a significant decline relies on the capacity of the irrigation system to apply enough water or to increase the frequency of irrigations, both of which may impact the energy, water and economic efficiency of irrigation.

Whilst plants may appear green above the ground, the physiological impacts of a 'Green Drought' scenario have been shown to reduce growth rates by up to 50%.

This opportunity loss results in additional costs to purchase feed to fill the gap. Smarter Irrigation for Profit (SIP) research calculated these costs to range from $30,000 to $120,000 across various Dairy Optimisation Sites.

WHAT IS RAW?

Readily Available Water (RAW) is the term used for the water available within the effective root zone of a crop or pasture plant - measured in mm. RAW is determined by the soil texture and the depth of the root system. It is the soil moisture held between field capacity and the refill point that a plant can easily extract from the soil, without affecting its growth.

Determining readily available water from soils texture information is available on the Dairy Australia website.

Why the Green Drought occurs

A *Green Drought* scenario can occur when irrigation is started too late at the beginning of the irrigation season, or after a rainfall event. The *Smarter Irrigation for Profit* (SIP) project, both phase one (2015-2018) and phase two (2019-2022), found that there is widescale occurrence of a *Green Drought* scenario in irrigated dairy pastures.

When soil moisture is allowed to decline to below the refill point the energy required for plants to extract water from the soil increases, leading to reduced growth rates and yield. Declines in dry matter (DM) growth rates due to a green drought are often not visually obvious. The pasture remains 'green' however the growth rate is reduced. This worsens as irrigation is delayed further or the amount of irrigation applied is below rates required to lift soil moisture back into the RAW zone (nearer field capacity – see Figure 1).

DELIVERING for DAIRY

Australian Government
Department of Agriculture, Fisheries and Forestry

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Figure 1 Whilst irrigation start-up was ideal in this scenario, a delay between the 1st and 2nd irrigations resulted in a Green Drought scenario. Subsequent irrigation applications failed to increase soil moisture into the RAW zone. Failing to keep up irrigation resulted in an extreme soil moisture deficit causing plant stress and reduced growth.

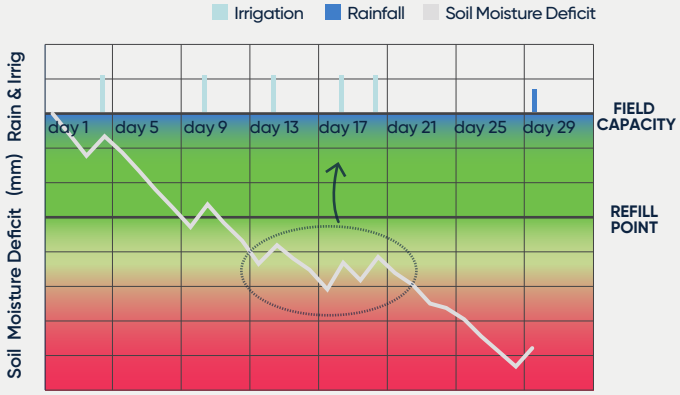
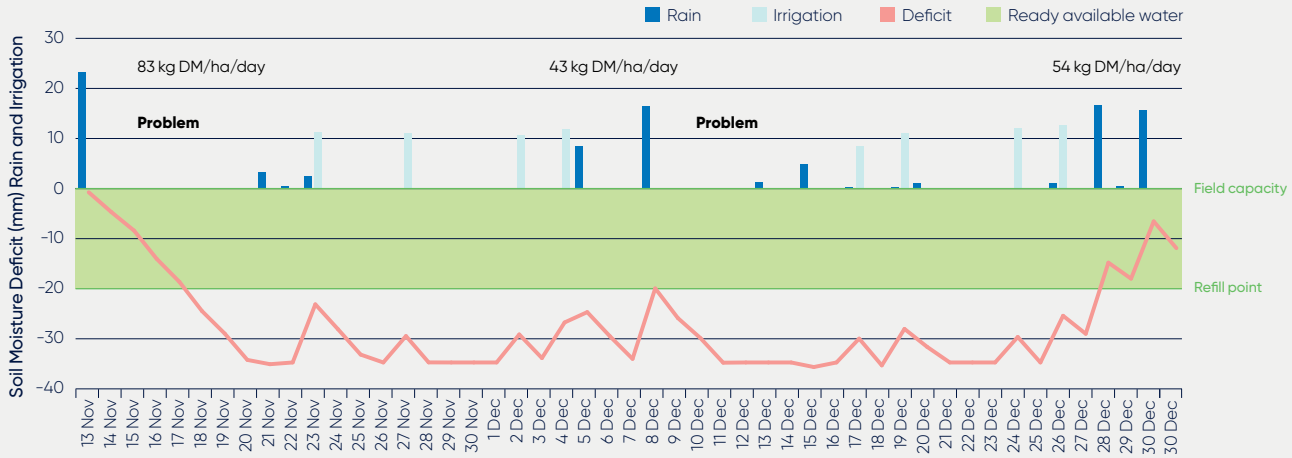


Figure 2 Delayed irrigation at the beginning of the season and after rainfall severely reduced growth rate on this Tasmanian irrigated ryegrass site. Whilst irrigations were applied, and the irrigation rate and frequency matched evapotranspiration (ETo) for the season, it failed to lift soil moisture into the RAW.



ETc: 4.3mm

Rain and irrigation: 198mm required, 191mm received

What recent research has found

SIP research found that poor irrigation scheduling quickly leads to soil moisture deficits and, while the application of irrigation water keeps the grass green, it does not result in optimum pasture growth rates.

In the 2016/2017 season of Smarter Irrigation for Profit phase one (SIP1), a Tasmanian perennial ryegrass site that delayed irrigation start-up by seven days resulting in soil moisture dropping well-below the refill point reduced production by 50 percent from over 80kg DM/ha/d to approximately 40kg DM/ha/d within a few weeks. This was despite irrigation water being applied (see Figure 2). The issue was further exacerbated later in the season when a rainfall event that almost lifted soil moisture to within RAW, was not adequately followed with irrigation, resulting in a rapid soil moisture decline once again. Whilst irrigation plus rainfall closely matched evapotranspiration (ETo) throughout the season, irrigation was required earlier and more frequently following rain, to lift soil moisture into the ideal RAW zone. In this case study, the irrigator was limited by the capacity of their centre-pivot system to increase the rate of each application. Whilst increasing application frequency may have required irrigating during peak power windows (e.g., weekdays), economic evaluation determined that the benefit of increased pasture production outweighed the potential increased energy cost.

Elliott small-plot irrigation research (2020/21)

A rainfall and irrigation controlled replicated trial with 16 small plots by Tasmanian Institute of Agriculture (TIA) researchers applied four different spray-irrigation treatments to a perennial ryegrass site with a soil RAW capacity of 25mm. Four deficit irrigation treatments were used: 12mm (keeping soil moisture in the top half of RAW), 25mm (allowing depletion of RAW to the refill point before irrigating), 30mm (depleting soil moisture below the refill point before irrigation of 12mm to maintain moisture around the refill point or a Green Drought scenario) and a dryland treatment (receiving only rainfall similar to a dry year).

IrriPasture (see Helpful Tools) was used to determine the appropriate irrigation scheduling intervals for the treatments based on a calculation of deficit from local ET_0. Baseline measurements were taken on the 11th of February, with four harvests recorded between the 9th of March and the 22nd of June. Supporting previous research outcomes, the difference in irrigation deficit, and therefore frequency and rate of application, significantly impacted yield.

Harvest 2 Results (1st April):

12.5mm deficit - 83 kg DM/ha

25mm deficit - 76 kg DM/ha

30mm deficit - 66 kg DM/ha

Rainfed - 51 kg DM/ha

Although both the 12.5mm and 25mm were irrigated to field capacity, more frequent irrigation had an advantage over less regular, larger irrigation events. The yield penalty when comparing optimal irrigation with a Green Drought scenario was 20% at this late stage of the season. This equates to a loss of approximately 2 tDM/ha over 120 days.

Figure 3 A: 12.5mm deficit treatment and **B:** 30mm deficit treatment at Harvest 2 (1st April). Although yield differed substantially (83 kg DM/ha and 66 kg DM/ha respectively), the 30mm deficit treatment (B) visually appeared active and green.

Avoiding the Green Drought

Monitoring soil moisture and/ or using a weather-based water balance tool like IrriPasture leading into, and throughout, the irrigation season provides critical information on the status of soil water availability. Irrigators using these technologies can start up irrigation on-time and apply adequate rates of irrigation, at the right frequency, to maintain RAW. This means that they can apply irrigation when the soil moisture deficit (below field capacity) can easily be replenished by the capacity of their irrigation system.

Using weather forecast information (eg. Swan System Weatherwise Forecast Updates) is also an important tool for dairy irrigators when determining irrigation schedules. By considering predicted weather events, irrigation schedules can be adapted to reduce frequency and/ or rate to supplement rainfall, or conversely increase frequency and/or rate when daily ET_0 is forecast to markedly outstrip rainfall. These strategies rely on an optimal soil moisture status baseline in tools such as IrriPasture at the start of the irrigation season.

HELPFUL TOOLS IN AVOIDING THE GREEN DROUGHT

IrriPasture is an online, smartphone accessible, water budget and irrigation scheduling tool, especially developed for the irrigated dairy systems of Australia. Access this free tool at **irripasture.com**

Swan System's Weatherwise Forecast Updates
Register for this free service at **swansystems.com.au**

About Smarter Irrigation for Profit

Dairy Australia's Smarter Irrigation for Profit research, development and extension project was designed to help farmers across Australia make better irrigation decisions which improve water use efficiency and lead to greater profit. Smarter Irrigation for Profit was a partnership between the dairy, cotton, sugar, rice and grain sectors, supported by funding from the Australian Government Department of Agriculture, Fisheries and Forestry as part of its Rural R&D for Profit program and each of the industries involved.

For further information go to
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