SMARTER IRRIGATION FOR PROFIT 2

Cobains Dairy Optimisation Site

TECHNICAL REPORT

SITE BACKGROUND

Dairy Optimisation Site Coordinators: Billy Marshall and Robyn McLean

Owner: Ben Thexton

Manager: Garry Cook

Location: Oakdale Park within the Macalister Irrigation District (MID), GippsDairy Region, Victoria, Australia

Herd size: 445 Holstein-Jersey cows at peak

Irrigation site and set-up: Paddock 39, comprising three bays of perennial ryegrass/clover, each 0.82ha with padman stop outlets; gravity fed by an open channel from Lake Glenmaggie to flood irrigate the 112ha milking area

Irrigation season: mid-August to mid-May

Seasons One and Two were affected by COVID-19 restrictions, during which Victorian Government department personnel were not permitted to visit farms under any circumstances for most of 2020 and for key periods during 2021, which prevented data collection on site.

In Season Three, three treatments were trialled to address site questions related to dry-off strategy:

Bay One: Irrigated all season

Bay Two: Irrigated and dried-off in mid-January

Bay Three: Irrigated and dried-off mid-December

The bays are set-up to receive 16ML/day, but delivery was restricted, and the measured flowrate was 10ML/day, with the total area being irrigated in two hours. There is a reuse dam located next to the site to pump run-off water into the bays but was not used in Season Three.

The measurement period was 154 days in Season Three.

Site questions

- How is dry matter (DM) yield affected by a dry-off strategy?
- Will over-sowing in autumn assist pasture yield to bounce back after dry-off?
- What is the best interval for dry-off: two or three months?
- What are the yield differences between a March dry-off (simulating a water shortage) and a planned, controlled dry-off in January and February?
- Will soil moisture monitoring to inform decisions improve irrigation scheduling and will that improvement translate into increased DM production?

Key messages

- Soil moisture monitoring and forecast data to inform irrigation decisions, especially the first irrigation of the season and after rainfall events, assisted in maintaining soil moisture in the readily available water (RAW) zone and reduced negative effects on yield caused by saturated conditions.
- Efficient operation of irrigation assets and precision scheduling requires other constraints on maximising water productivity to be addressed. The low yield in Bay Three, despite having the same inputs as Bay Two, was affected by other constraints, potentially poor drainage and a high composition of weeds.

Australian Government
Department of Agriculture, Fisheries and Forestry

Dairy Australia

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- "Early" dry-off is likely best between mid-December and the start of February in the MID to increase water use efficiency by not irrigating summer weeds and avoiding periods of high evapotranspiration (ETo).
- Improved knowledge and understanding gained through the SIP2 Project are transferable across other irrigated areas of the farm and across other irrigated dairy pastures and crops of the MID region.

Technologies and strategies used

- Three 40cm EnviroPro® capacitance probes with Wildeye® loggers/telemetry installed in each of the three bays.
- A rain-gauge installed.
- The tools most used and valued by Garry Cook were:
  - Soil moisture monitoring using the EnviroPro®/ Wildeye® equipment.
  - AgVic *Weekly Irrigation Requirement Reports:* seven-day historic and forecasted ETo and rainfall data, with irrigation scheduling advice based on a basic water balance. Reports included Cobains and Yarram Wildeye® graphs.

In Season Two, soil moisture was regularly monitored to start-up irrigation earlier than past practice after rainfall and in Season Three to manage irrigations after significant rainfall to avoid waterlogging, aiming for adequate soil moisture within the RAW zone.

- IrriPasture was used across Seasons Two and Three, primarily by the site coordinators:
  - **Pros:** Simple to use under most conditions and beneficial for identifying when irrigation applications were below estimated pasture water use, using the ETc graph.
  - **Cons:** Unable to account for periods of saturation post-irrigation (generally two days) and after significant rainfall. The tool commences draw-down after 24 hours but often plant uptake can take a number of days to commence.

Findings

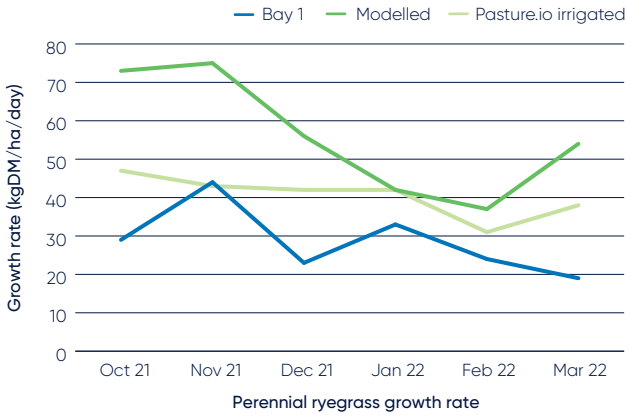
Table 1 shows the DM production, water and power metrics for Season Three for the three treatments. Figures 1, 2 and 3 (top) show the measured and modelled growth rates and the growth rate as measured by Pasture.io. for the three bay treatments. Figures 1, 2 and 3 (bottom) show the soil moisture profile in relation to the field capacity and the refill points for the same time period as the pasture measurements.

Table 1 Season Three metrics results*

Production*	**Season Three Bay One** (Full irrigation)	**Season Three Bay Two** (Dry-off mid-Jan)	**Season Three Bay Three** (Dry-off mid-Dec)
Growth rate (kgDM/ha/day)	29.53	27.52	17.36
GPWUI (tDM/ML) rainfall and irrigation	1.09	1.10	0.69
Dry matter grown per hectare (tDM/ha)	4.548	4.238	2.673
Costs			
Water costs per tonne DM ($/tDM)	$8.11	$4.43	$7.03
Total cost per hectare ($/ha)	$36.89	$18.78	$18.78

* Data confined to Season Three only because of unreliable data results in Seasons One and Two with Covid-19 restrictions and rising plate meter malfunction in Season Two.

Figure 1 Season Three: Bay One



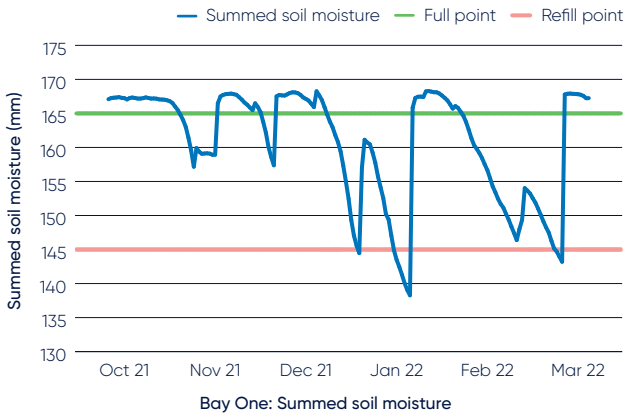
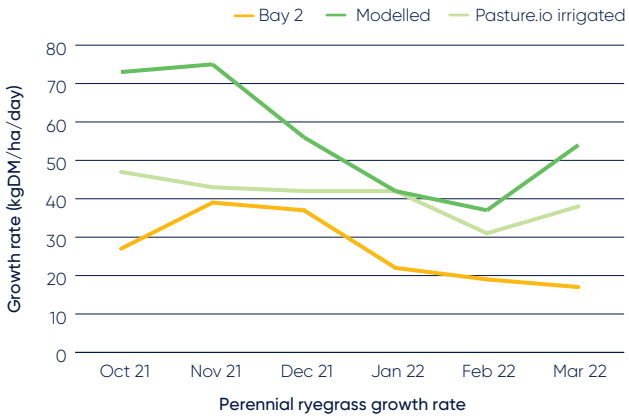


Figure 2 Season Three: Bay Two



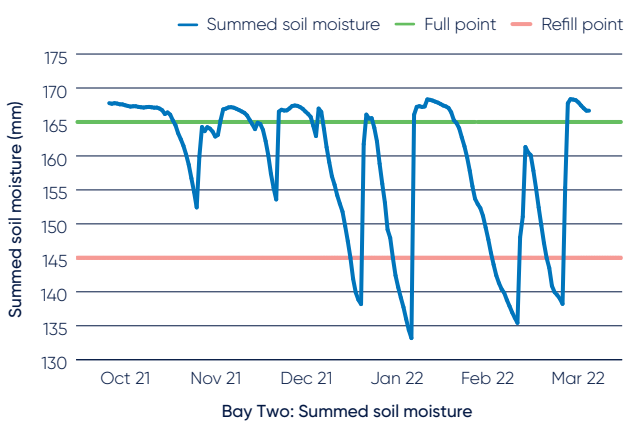
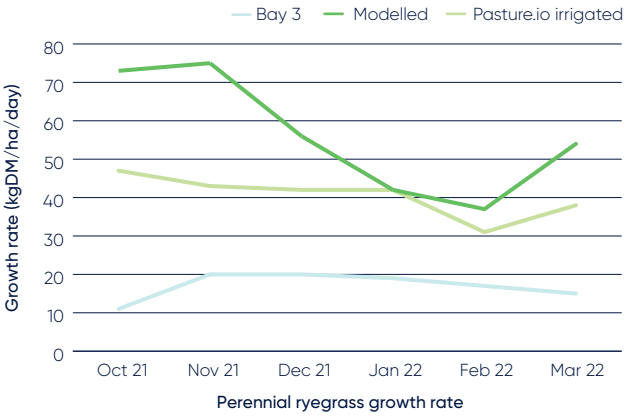
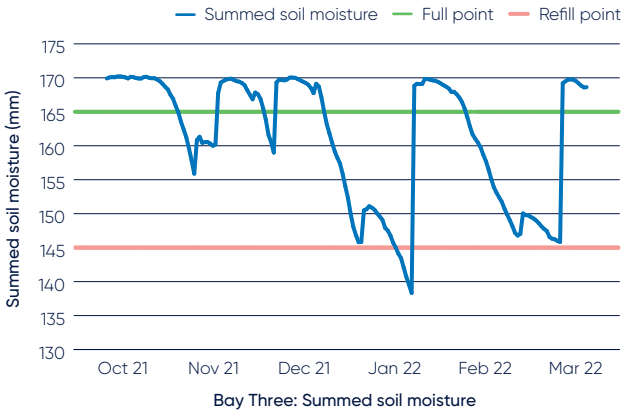


Figure 3 Season Three: Bay Three





- Typically, the irrigation season in the MID commences in mid to late September, but there was an unseasonably late start, with irrigation commencing on-time for Bays One and Three, but a little late for Bay Two, with soil moisture declining below the refill point (summed soil moisture graphs, Figs 1-3) on 3 December.
- Bay One received two irrigations (0.55ML, 3 December and 24 January), but Bays Two and Three received one irrigation (0.28ML, 3 December), which prevented any comparison of treatments. There was significant rainfall during December, and again in early January, so no irrigation was applied to Bay Two after the Bay Three dry-off. This prevented any demonstration of dry-off intervals. In early January, soil moisture did drop below the refill point in Bay Two (summed soil moisture graph, Fig. 2) but, using rainfall forecasting, irrigation was delayed and the subsequent rainfall increased soil moisture to near the full-point.
- Bay One received an additional irrigation and yielded higher than the other two bays (29.53 kgDM/ha/day), but Bay Two, which received half as much irrigation, yielded only 2 kgDM/ha/day less and was more water efficient, saving on water input costs. After the second application on Bay One, the property received 54mm of rainfall about five to six days afterwards, which caused waterlogging in Bay One (summed soil moisture graph, Fig. 1) and affected growth rates.

- The DM results for Bay Three highlight the constraints to production other than irrigation. It had exactly the same water inputs as Bay Two but yielded only 17.36 kgDM/ha/day, costing $7.03tDM/ha as opposed to $4.43 for bay two water costs. The first measurement of the season in October was only 11 kgDM/ha/day for Bay Three, compared to 29 kgDM/ha/day for Bay One and 27 kgDM/ha/day for Bay Two. The coordinators observed that Bay Three remained saturated for longer after rainfall and was particularly weed infested in the lower section.
- In the MID, standard irrigation scheduling intervals are 12–16 days in spring–autumn and 8–12 days over summer (excluding rainfall). The summed soil moisture graph for Bay One (Fig. 1) shows periods of prolonged saturation following heavy rainfall. However, the soil moisture levels did fall below refill point on three occasions. On the first occasion in early January, irrigation was cancelled due to forecast rain to avoid the paddock becoming extremely waterlogged. On the second occasion in late January, there was a delay in supplying water through the district channel system. On the third occasion in mid-March, a four to five-day delay in irrigating was too long.
- The best time to dry-off is dependent on water allocation and spring–summer rainfall. Other factors are summer weed activity and ETo rates. Historical data suggests a suitable dry-off period between mid-December and the start of February to prevent irrigation of summer weeds, avoid high ETo rates and increase water use efficiency.
- The three bays were irrigated-up on 21 March to start the autumn response and assessed by measuring Dry Matter (DM) production and feed quality throughout autumn. A key lesson from drying-off paddocks during the 2016–19 drought was their good response once irrigated-up in autumn and the improved production through autumn–winter compared to paddocks that were irrigated throughout the season. The likely explanation is the dried-off paddocks did not have summer weed competition and the nutrient build-up over summer stimulated growth when water was applied.
- Despite Season Three having lower growth rates in comparison to the modelled average of 56 kgDM/ha/day, DM production can be improved in more typical seasons through better irrigation scheduling using soil moisture data.

Reference group support

- The site was supported by a small group of local farmers and service providers in the initial project establishment where the site questions were determined.
- In Seasons Two and Three the SIP2 Reference Group was integrated into the MID Dairy Discussion Group, coordinated by GippsDairy.
- There were challenges in engaging local farmers in the SIP2 Project, with Covid restrictions most of the operating months, favourable irrigation seasons which lessened the priority of irrigation management and changes in both technical and extension role responsibilities. The final field event was the most successful activity where irrigation was embedded into the 'hot' seasonal topic of nitrogen use efficiency.
- There were two dedicated field days and one SIP2 Project promotion at the annual regional MID Irrigation Field Day, totalling 165 attendees, one workshop on IrriPasture with 12 attendees and three reference group meetings conducted online to a total of 21 attendees.
- Dairy irrigators across Gippsland were kept regularly informed about site activities and data outputs through the integration of the two Gippsland SIP2 sites into AgVic's *Weekly Irrigation Requirement Reports*. A total of 28 reports were emailed directly to 182 recipients each week.

MORE INFORMATION

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