

Getting irrigation right in a furrow system



Introduction

Irrigation plays a crucial role in sugarcane production in the Burdekin region. As the area experiences low rainfall, crops rely heavily on irrigation to achieve their maximum potential. Thanks to abundant sunshine combined with a sufficient water supply, the region can produce some of the highest sugar yields in the world. However, irrigation is also a major cost factor for growers. Applying more water than the crop needs for optimal sugar production can have a detrimental

impact on a grower's financial bottom line. Additionally, excess water may carry fertilisers and chemicals off-farm, causing potential environmental damage. Therefore, it is in the grower's best interest to apply only the amount of water required for optimal crop growth. Furrow irrigation is the primary irrigation system used in the Burdekin region, and there are a few key considerations for setting up or improving a system of this type.

Know your system

To enhance irrigation efficiency, it is important to begin with detailed measurements of the current system. Growers can take some measurements themselves. For example, water inflow rates can be measured using a bucket and stopwatch. Growers can also document the duration of irrigation events, their frequency, and energy usage. These measurements would indicate how closely irrigation applications match crop water use. It is recommended however to work with an irrigation specialist who has access to appropriate measuring devices like ultrasonic pump flow meters, to provide a more accurate analysis and interpretation of the measurements taken.

Maximise your soil moisture storage

Soil serves as a storage medium for both rainfall and irrigation, and its storage capacity should be kept as large as possible. To achieve this, it is essential to maintain good soil structure using ameliorants, maximise soil organic carbon content, and minimising soil compaction.

Determine when to irrigate

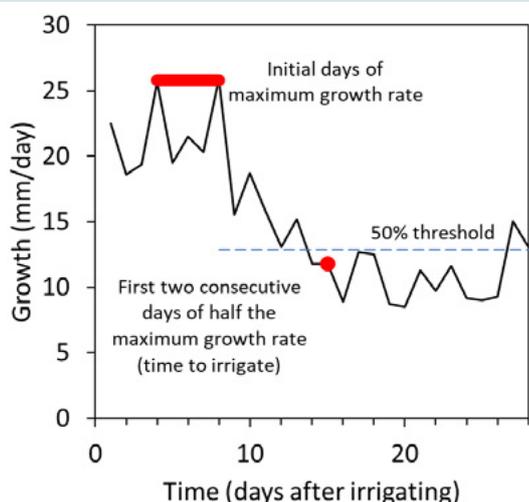
For optimal growth, plants should not be overwatered or struggle to extract water from the soil. It is recommended to allow the crop to extract the readily available water (RAW) from the soil after a rainfall or irrigation event before applying the next irrigation.

One way to determine the point when the RAW has been used up is to monitor daily crop growth. When a soil moisture probe like a [GDot](#) is used at the same time, it can be calibrated to schedule future irrigations without measuring growth. Alternatively, a crop model like [IrrigWeb](#) can be calibrated using growth measurements to calculate the next irrigation start date.



The bucket and stopwatch method of calculating cup flow rates (see Appendix 1 in the [SRA Irrigation of Sugarcane Manual](#) for further details).

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The time to irrigate can be identified when shoot growth is half the daily maximum shoot growth observed after an irrigation event. Daily growth can vary in response to factors other than soil moisture (e.g., light, wind, temperature), so it may take a couple of observations to identify maximum growth (e.g., the two peaks seen here), and it is sensible to identify at least two consecutive days of growth at half this maximum as a cue to irrigate. If soil moisture is known at the time of this cue (e.g., dots on a GDot), this soil moisture can be used to identify when to irrigate in the future.

How to measure stalk growth (modified from the SRA *Irrigation of Sugarcane Manual*, p. 35).

- Mark out 25 stalks from adjacent drills about 10 m into the block of cane.
- Cane to be measured should have about 1 m of stalk growth, and the canopy should be closed.
- Using paper masking tape, label each stalk 1 – 25.
- Irrigate.
- Begin making the following measurements once the ground is firm enough to take your weight.
- Record the height of each stalk to the top of the visible dewlap or collar.
- Repeat this at roughly the same time each day.
- The aim is to identify when the growth slows to half the maximum growth rate – this is when to irrigate.



Measuring to the top dewlap – here the dewlap is 1510 mm above ground level.

Determine how much water to apply

After the crop has used up the RAW, it's time to irrigate. It's important to ensure that the field has irrigation applied as evenly as possible along its full length. Over-irrigation can lead to deep drainage or runoff losses. These losses will increase the cost of irrigation, fail to result in additional growth, and may even inhibit growth due to waterlogging and the loss of nutrients.

To determine the amount of RAW that was extracted by the crop, you can use scheduling software like IrrigWeb. Using local weather station data, this software can help estimate daily evapotranspiration (which is the combination of evaporation from the soil's surface and transpiration from the crop's leaves). For instance, if IrrigWeb estimates that the water use is 7 mm (= 7 L per m²), and it takes 7 days from the last irrigation for growth to slow down to half its initial peak, we should only replace 49 mm (= 49 L per m²) of water with next irrigation event.

An alternative approach is to estimate crop water using [crop factors](#) multiplied by reference evapotranspiration obtained from the Bureau of [Meteorology](#).

Getting irrigation right in a furrow system

Get your soakage right

When irrigating, it is crucial to ensure that the amount of water applied does not exceed the amount required to bring the soil back to its full point, called the field capacity. If the field capacity is exceeded, water will be either lost to runoff, deep drainage or both. It can be challenging to evenly apply water because the soakage time decreases down the furrow. After setting up the irrigation system, growers can only adjust the cup flow and set duration to ensure an even application of the right amount of water along the length of the furrow. This is often referred to as the distribution uniformity. As cup flow increases, the water travels faster down the furrow, leading to a greater distribution uniformity. The rate of infiltration is generally high and declines as the soil becomes wet, which helps make applications even along the furrow.

The ideal scenario is when the furrow inflows are high, and the water reaches the bottom of a block in a short time, ensuring even application and greater distribution uniformity. However, it is essential to provide enough time for the water to soak into the beds, primarily towards the bottom of a set, which can be tricky in some non-soaking hard-setting soils. Ideally, the set time is chosen to ensure the right amount of water is applied to the overall set, and the cup flow is high enough for surface water to reach the tail drain as quickly as possible.

An optimised system can reduce unproductive water loss to below 10%. Over-irrigation, on the other hand, can supply a water volume several times the crop demand, which is not desirable.

Get ready to make compromises

In practice, achieving perfect irrigation settings is not always possible, and there will always be some unevenness in application and some deep drainage and runoff losses. It is important that the irrigation infrastructure is capable of supplying water at the required flow, and that the grower is available to make the necessary adjustments at the appropriate time.

To achieve the best possible results, it may be wise to consider the bigger picture and focus on adjusting where it is most cost-effective. This could include assessing the adequacy of the existing pumping infrastructure to accommodate the required flow rates, application amounts, and set sizes, as well as exploring technological solutions such as pump timers and computerised irrigation systems to ensure timely change-over of sets or pump switch-offs.

Other strategies, such as modifying paddock slopes, minimising cultivation, keeping furrows weed-free, and applying gypsum to increase soakage can also help to improve the evenness of applications.

Trial your new ideas

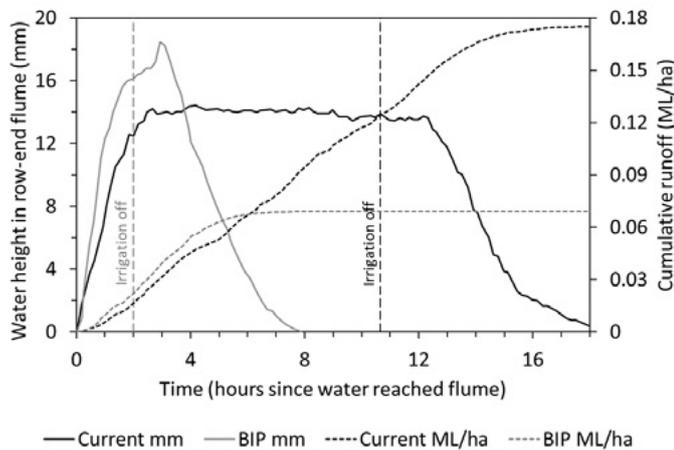
It is important to know there are various ways to solve a problem. Changing one setting can affect other areas, so it is necessary to take all factors into account.

Here is a set of considerations for a hypothetical, but not uncommon, scenario:

- The baseline scenario (current practice) consists of a 24-hour irrigation set which results in excessive runoff. Measurement shows irrigation water consistently reaches the end of the furrow after 16 hours.
- Option A – a 16-hour irrigation that allows water to reach the tail drain is managed manually. Compared to the baseline, this option reduces water application by 33% but requires set changes to be made at varying day and night times.
- Option B – a 16-hour irrigation initiated by either a pump timer or computerised system. This option also reduces water application by 33 % but is more manageable in terms of labour.
- Option C – a 12-hour irrigation made possible by increased cup flows. This option reduces water application by 33 % and also reduces deep drainage and waterlogging at the top of the block. This approach can be managed by labour, or by a pump timer or computerised system.

Before investing in any infrastructure changes, it is advisable to try the new irrigation settings to confirm that the proposed savings are achieved without compromising the crop's water supply.

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Examples of hydrographs obtained on end-of-row flumes installed on contrasting treatments. The 'current' treatment is 24-hour sets and 1 L/s per cup on a set schedule. The 'BIP' treatment is 12-hour sets and 1.5 L/s cups on an IrrigWeb-determined schedule. The data was obtained by BBIFMAC, and they explained that the contrast in cumulative runoff between the treatments is primarily due to set duration.

Where can I find out more about the BIP?

The BIP is a collaborative initiative of Sugar Research Australia (SRA), AgriTech Solutions, Burdekin Productivity Services (BPS), the Burdekin Bowen Integrated Floodplain Advisory Committee (BBIFMAC), Farmacist, James Cook University (JCU) and the Department of Agriculture and Fisheries (DAF). The BIP is overseen by NQ Dry Tropics. The project is funded by the partnership between the Australian Government's Reef Trust and the Great Barrier Reef Foundation.

To learn more about the BIP and its allied projects, contact **Terry Granshaw**, SRA District Manager - Burdekin
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