Using canopy temperature stress technology to reduce yield and gross margin risk

Analysis for cotton production

KEY MESSAGES

- Through water limited trials, where cotton received only one irrigation, CSIRO showed that canopy temperature stress (CTS) technology provides a mechanism by which growers can have increased confidence in deciding when to apply an irrigation in water limited cotton thereby reducing both yield risk and associated economic risk.
- Using CTS technology, the yield-optimising irrigation timing could be narrowed down to within a 1-day window. This compares to a 3-day window when considering *days after first flower* and *soil moisture deficit*, and an 8-day window when considering *cumulative degree days*.
- The reduced irrigation uncertainty helps to keep the yield and gross margin (GM) within 1% of the maximum. In contrast, the wider 3-day window risks reducing yield by <1% and GM by <1% ($6/ha) on average, but with GM losses of 3.9% ($42/ha) in some years depending on relative lint and water prices; while a 8-day window risks reducing yield by 11% and GM by 16% (326/ha) on average, with GM losses up to 11.5% ($124/ha) in some years.

ABOUT THE RESEARCH

A key challenge in limited water cotton production is deciding when to irrigate to maximise yield. As part of Smarter Irrigation for Profit Phase 2 (SIP2) the CSIRO compared canopy temperature stress (CTS) monitoring to other measures of crop stress and irrigation timing: cumulative degree days, soil moisture deficit, and days after first flower.

A MORE CONSISTENT GUIDE TO OPTIMISE YIELD WITH LIMITED WATER

The research found that CTS was a more consistent indicator of maximum yield across different seasons compared to the other metrics. This in turn allows a more reliable and precise guideline for optimising yield with limited water. For CTS, optimum yield was found to occur within a 1-day window. In comparison, maximum yield occurred within a 3-day window when considering *days after first flower* and *soil moisture deficit*, and within an 8 day window when considering *cumulative degree days*. As a result, there is higher uncertainty when using these methods to apply limited irrigation water to achieve optimum yield.

This uncertainty is shown in Figure 1, where the yield potential decreases with every day the irrigation application moves away from the optimum timing.

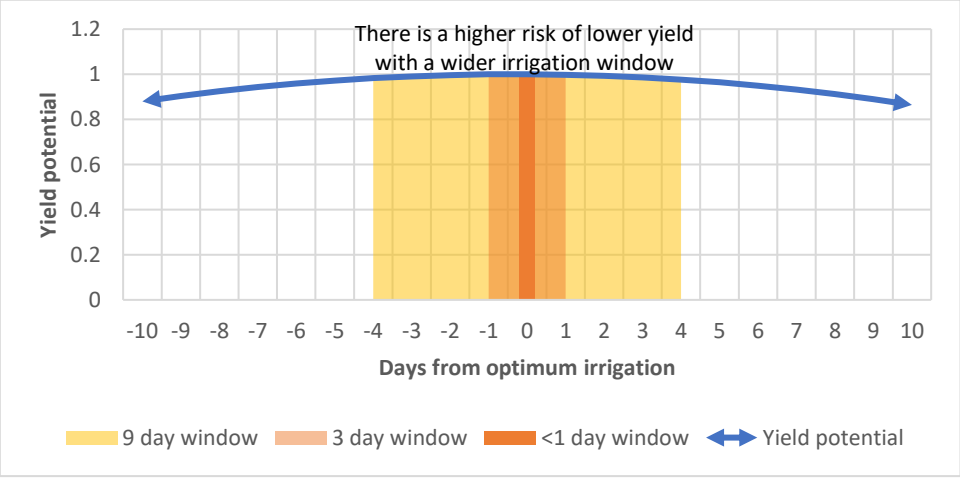

Figure 1. Yield impact from uncertainty in irrigation timing

From Figure 1, we can see that within a 1-day irrigation window using CTS, the yield losses are close to 0% from the maximum. Within a 3-day window using days after first flower or soil moisture deficit the yield losses are still less than 1% of the yield potential, and with a 8-day irrigation window using cumulative degree days the yield losses are up to 2% of the maximum yield potential.

ECONOMIC COST OF UNCERTAINTY AROUND IRRIGATION TIMING

Applying gross margin data (GM) to the yield curve, the economic cost of these differing levels of uncertainty can be seen (*Figure 2*), with a greater risk of GM losses associated with a wider irrigation window. Figure 2 applies the trial average of 6.7 bales/ha with corresponding water application of 1ML/ha, and uses the 10-year average inflation adjusted prices of $604/bale, and $194/ML. All other GM costs were drawn from the 2021-22 CottonInfo semi-irrigated cotton GM[1].

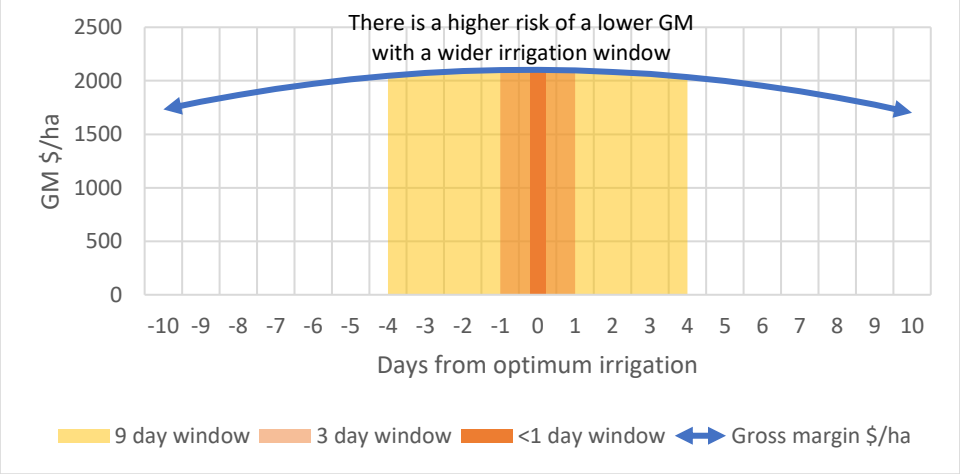

Figure 2. Gross margin impact from uncertainty in irrigation timing

Within a 1-day irrigation window using CTS, the GM is maximised at $2154/ha. Within a 3-day window using *days after first flower* or *soil moisture deficit* the GM losses are up to $6/ha (<1% of the maximum potential GM), and with an 8-day irrigation window using *cumulative degree days* the GM losses are up to $70/ha (3.8% of the maximum potential GM). While these figures reflect average cotton lint and water prices, varying prices for water or cotton could result in greater GM risk. Applying the 10-year historic price ranges for water and lint shows higher potential GM loss of $41/ha with a 3-day irrigation window, and $124/ha for an 8-day window.

In comparison the CTS technology, commercially available through Goanna Ag GoannaAg as part of its *GoFieldPlus* package (including CTS and soil moisture probes), has an annual cost of $1225/year[2], or $25/ha/year when applied over 50ha (which will depend on field variation and layout).

This SIP2 research and economic analysis show that CTS technology has the potential to provide a cost effective mechanism by which growers can have increased confidence in deciding when to apply an irrigation in water limited cotton thereby reducing both yield risk and associated economic risk.

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[1] CottonInfo, 2021, Australian cotton industry gross margin budgets

[2] Pers comm with Tom Dowling, GoannaAg, Jan 2021.

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