



New technologies: Plant-based sensing for cotton irrigation

1. What is the project about?

Plant-based sensing techniques including canopy temperature (CTS) and UAV thermal imaging (Fig. 1) can increase cotton yields while reducing labour and water costs¹. These benefits are realized by matching the irrigations with crop water demand through continuous monitoring of plants. This project is testing and refining these technologies on commercial cotton farms to better understand how they can be most effectively used to improve water use efficiency and productivity for fully irrigated and partially irrigated cotton.

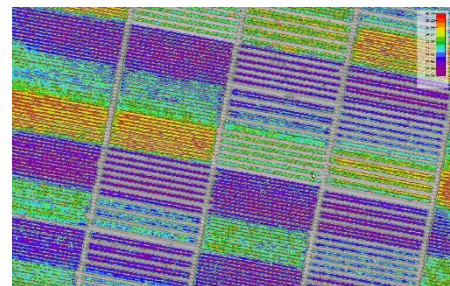


Figure 1: UAV thermal image showing spatial variability in crop water stress

2. How do canopy temperature sensors improve irrigation management?

In previous research we monitored the canopy temperature on farms in different valleys where growers used their own experience and/or fixed soil moisture deficits to make irrigation scheduling decisions. The continuous measurements of canopy temperature showed that there were opportunities to optimize the timing of irrigations using the canopy temperature technology.

As canopy temperature is a direct response of plant's access to (or lack of) soil water (Fig. 2), continuous monitoring of canopy temperature provides real time information on a crop's need for water that can be used to inform irrigation scheduling. Avoiding water stress and over watering improves farm profitability by increasing yield and water use efficiency. The canopy temperature infrared sensors (Fig. 3) being assessed in this project are affordable, easy to use and maintain, and can be a significant addition to the suite of tools available to growers for making important irrigation decisions.

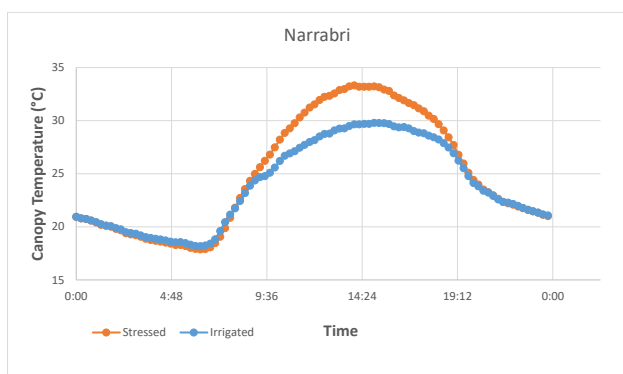


Figure 2: Diurnal pattern of differences in canopy temperature caused by crop water status



Figure 3: Infrared canopy temperature sensor monitoring crop stress in an irrigated cotton field

¹Revell, G (2021) *Responsive irrigation management with Canopy Temperature Stress (CTS) technology*. SIP1 Case Study.



3. How does this research benefit irrigators?

An assessment of the economic benefits of incorporating CTS technology into irrigation management found it has the potential to improve farm profitability. Researchers are working closely with commercial growers and technology providers to further refine the methodology. Practical considerations being investigated include:

1. Utility of multipixel canopy temperature sensors for early season irrigation decision making when standard canopy temperature sensors with single field of view cannot be used because of smaller canopies.
2. Extending the utility of canopy temperature sensors for irrigation scheduling in limited water situations by developing new thresholds based on detailed research and on-farm trials.
3. Testing CSIRO's canopy temperature predictive algorithms platform for scheduling irrigations in advance.
4. Assessing spatial variability of canopy temperature on larger commercial farms to determine the minimum number of canopy sensors required for effective and efficient irrigation scheduling.
5. Integrating canopy temperature technology with existing tools including soil moisture probes.

4. Key results to date

- To enable canopy temperature monitoring during early season, the research team assessed the utility of a low cost multipixel sensor to inform irrigation decisions. Field trials were conducted over the last two cotton seasons using this sensor and a thermal segmentation algorithm has been successfully developed that will enable extraction of canopy temperature from the mix of pixels with leaves and soil.
- In limited water situations growers often have water for a single in-season irrigation. Detailed field trials were conducted over two cotton seasons to optimize the timing of a single irrigation. This research identified the optimum time to apply a single irrigation for best yield and demonstrated yield losses of up to 56 per cent or 2.7 bales/ha going too early or too late, meaning optimised irrigation scheduling is central to achieving high water productivity in these systems.
- In the current canopy temperature algorithms, the effect of rainfall events on cumulative stress hours is not well defined and needed refinement. Using combined soil water and canopy temperature datasets the research team have established a relationship between stress time and crop water use which will help define the effect of rainfall on stress accumulation.
- A field experiment was successfully completed at a commercial farm in Carathool (southern NSW) to monitor spatial variability in crop water stress by using helicopter-mounted thermal camera and in-field canopy temperature.
- Grower-demonstration trials were conducted at 7 sites in Upper Namoi, Lower Namoi and Gwydir valleys in collaboration with CottonInfo. Canopy temperature was monitored continuously during the cotton season and weekly virtual meetings held with growers to explain results.
- CTS technology is available through Goanna Ag as part of its GoFieldPlus irrigation management system. The researchers involved in this project are working closely with Goanna Ag to streamline the process of providing growers the actionable data in real time and resolve any technical issues that are expected in the first year of commercial roll out of this product.

For more information visit the [Smarter Irrigation for Profit](https://smarterirrigation.com.au) website.

- Plant based sensing to optimise irrigation timing (podcast). Available at: <https://smarterirrigation.com.au/plant-based-sensing-optimising-irrigation-timing-in-limited-water/>
- Canopy temperature sensors (webinar). Available at: <https://smarterirrigation.com.au/cottoninfo-webinar-canopy-temperature-sensors/>
- Plant Based sensing through the use of Canopy Temperature Sensors (video). Available at: <https://smarterirrigation.com.au/hiz-jamali-and-chriss-nunn-talk-canopy-temperature-sensors-at-the-gvia-field-day-2021/>
- Economic Case Study - Responsive irrigation management with Canopy Temperature Stress technology. Available at: <https://smarterirrigation.com.au/responsive-irrigation-management-with-canopy-temperature-stress-technology/>

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Smarter Irrigation for Profit PHASE II

FACT SHEET | COTTON



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