An “eye in the sky” helps irrigation scheduling

By Julie O’Halloran*

In limited water seasons, opportunities for improving water use efficiency are keenly sought. At ‘Caroale’ in the Gwydir Valley, Chris Humphries has found thermal imaging data valuable in irrigation scheduling. Chris first became interested in thermal imaging technology in 1997 and believes that one of its most important benefits is optimising irrigation in a limited water season.

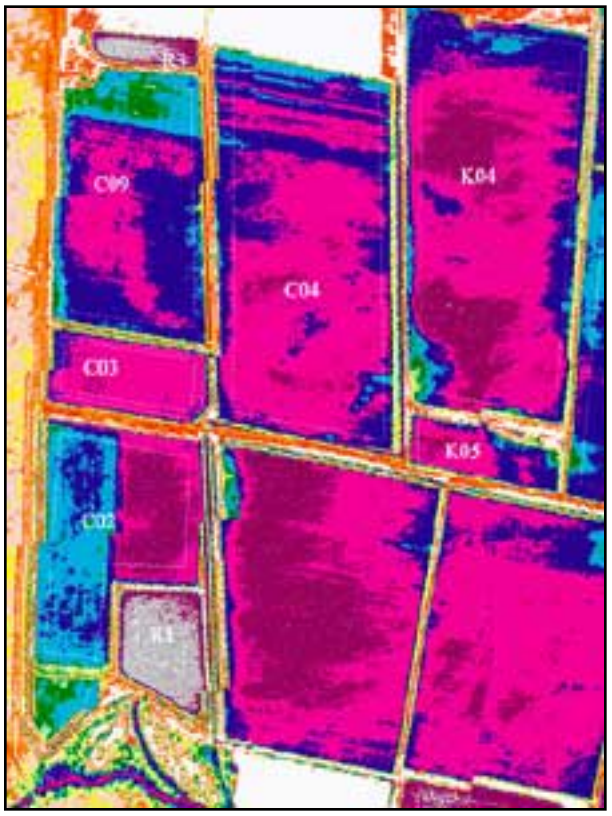
Thermo-imagery data from aerial photographs of a crop taken with a digital thermal camera measures crop canopy temperatures to an accuracy of 0.1°C. This temperature reading is compared with that of a well-watered crop and the atmospheric water content to estimate the reduction in crop transpiration — termed the Crop Water Stress Index (CWSI).

Ranking fields

A CWSI is calculated for each field or management unit at the time the images were taken. These are used to rank fields from driest to wettest to set up an appropriate watering schedule.

A colour image of the property is generated, indicating the spatial variation of temperatures over the farm. To use thermal imaging as a scheduling tool, multiple passes are required to measure changes in stress and project them forward to time the next irrigation.

Chris has been able to use this technology to delay some irrigations — increasing water use efficiency and minimising waterlogging. Similarly, yields have been increased by timing irrigation events after rainfall. For example, some heavy rainfall events were thought to be the equivalent of a full irrigation until the



ABOVE: A thermal infrared image of ‘Caroale’, Moree. It provided important information for irrigation scheduling

Generally:

- The grey colour is water in a storage (cool);
- Purple is well watered (also cool);
- Light blue is cotton ready for irrigation;
- Orange is dry pasture/soil; and,
- White is very hot soil.

The image was taken 2700 metres above the ground and has a spatial resolution of 3.7 metres.

Points to note include a variety trial in field 4 and Ingard cotton in half of field 2.

thermal imaging data indicated watering was warranted.

An advantage of thermal imaging for irrigation scheduling is the spatial information provided (for every two to four metres) compared with probe data that give measurements at two or more points in a field.

This allows any problems in watering — such as missed syphons or incomplete irrigation runs — to be identified which may otherwise not have been detected.

There are significant advantages in having scheduling and variability information on large multifield properties and after variable rainfall events. While the results do not show moisture throughout the soil profile, the data does reflect the plant's response to moisture in the profile.

There are some limitations, including:

• Best results require cloud free conditions so that an even 'solar load' is placed on the crop;

• Timing of flights can be delayed;

• An even or full canopy is required; and,

• Cost — this has been the main obstacle to widespread implementation to date. Chris feels the technology can be economical with multiple passes over large farms or areas.

In addition to scheduling irrigation, thermal imaging has other potential applications including:

• Early detection of Fusarium;

• Accurate yield variation maps in the growing crop to identify crop and soil factors that affect yield;

• Defoliation information with rank and late maturing crop areas identified for variable rate and product selection;

• Hail damage assessment;

• Agronomist overview and precision mapping overlay with EMS;

• Contours and farm maps;

• In trickle irrigation systems to monitor distribution and design; and,

• Helping to explain the reasons for loss or gain in picker yield maps and relate them back to a dollar value.

Chris feels that the best way to use thermo-imagery for irrigation scheduling would be to initially use it in conjunction with existing decision making systems and, if possible, site probes as well.

More information on precision agriculture technologies in cotton systems will soon be available in a booklet being compiled by the Cotton CRC, University of Sydney and CRDC.

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