

PRD/RDI cotton trial demands careful engineering

By Gary Alcorn

During the first season of his three-year Cotton Research and Development Corporation funded partial rootzone drying (PRD) and regulated deficit irrigation (RDI) trials, PhD student Simon White is finding agricultural engineers are very handy people.

"Designing and fitting a complex watering system capable of various irrigation applications and alternating which side of the plant row was irrigated with LEPA socks under a commercial lateral move irrigator required plenty of brainstorming sessions with my supervisors and other colleagues," he said.

Simon is a recent UQ Gatton honours graduate in Rural Technology and university medal winner but he now realises the complex irrigation trials capable of delivering precise amounts of irrigation water to a site situated in a commercial cotton crop require many skills.

"I was lucky enough to tee up

What PRD is

Already being implemented as a technique in the grape industry, PRD is also being trailed in a range of woody perennial horticultural crops in Australia. Claims of potential savings of 50 per cent of normal irrigation allocation have been made. Initially aimed as a technique for controlling vigour it has been found to have an even greater benefit in improved water use efficiency.

PRD is implemented by irrigating down only one side of the plant at a time and these dry and wet soil zones around the plant are alternated during the season.

What is RDI?

RDI is the process whereby irrigation is applied which maintains soil moisture at a regulated deficit which does not return the soil profile to field capacity after an irrigation event. The aim in cotton is to maintain soil moisture at a deficit, which reduces vegetative growth and/or transpiration, but does not compromise yield nor reduce yield while compensating through increased water use efficiency.

'Macquarie Downs' management near Leyburn as a collaborating grower. The staff were kind enough to provide me with a 4.2 hectare trial site without yield compensation in late September.

"I had just a month to get my modified irrigator designed, built and installed before the crop was due to be planted.

"The staff at National Centre for Engineering in Agriculture (NCEA) came up with some innovative solutions to my host of problems," Simon said.

It was not as simple as turning on and off certain irrigation lines or leaving some running longer to apply more water because the trial was under just one span of a 20 span wide lateral move irrigator.

Simon needed some way of alternating the irrigation amount and the side of the plant row the water was applied as the machine travelled through the paddock irrigating the remaining commercial crop.

Because the irrigator could take 48 hours to cross the paddock (travel speed determined the amount of irrigation nor-



Simon White is using glasshouse trials at USQ to check the effects of alternating irrigation applications in cotton against field trial data.



An overhead view of the electric ram and pulley arrangement used to move the sub-mains across or back one metre and reposition the socks beneath them on the opposite side of the plant row.

mally applied) it needed to be a fully automated system.

Early suggestions included pulsing valves to regulate water applied and GPS tracking so the irrigator knew where it was in the paddock and could then switch from one irrigation treatment to the next.

Based on simplicity and cost, Simon and his USQ supervisors (Steven Raine, Rod Smith and Joseph Foley) decided to use a

PLC (Programmable Logic Controller), sub-mains with alternative irrigation flow rates and electric rams. A transformer was fitted to covert the 480 volt power of the machine down to 12 and 24 volts to run the PLC, valves and rams.

LINE OF MARKERS

A micro switch was repositioned on the irrigation cart which was triggered by a line

of markers placed down the roadway where the cart runs.

“We calculated the quickest time the cart would take to travel between drums and a time delay was programmed into the PLC to avoid signals from other sources such as wildlife (wild pigs or birds) tripping the switch and disrupting the irrigation sequence.”

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The cart can run in forward and reverse to irrigate so the PLC was also fitted with a signal from the cart to recognise which way it is going and whether to count up through the irrigation sequence at each drum or back down again when in reverse.

The sub-mains fitted under the span required three supply pipes to be fitted to the LEPA sock instead of the existing one. Each sub-main was fitted with a solenoid valve operated by the PLC. One sub-main was set-up with appropriate nozzles to apply 25 per cent of the flow rate which was being applied through the existing LEPA socks. The other two sub-mains could each supply 50 per cent of the existing flow rate.

“By having the three sub-mains we still end up with one LEPA sock in the same place as normal but are able to apply either 25, 50, 75, 100 or 125 per cent of the irrigation amount applied to the rest of the paddock by turning on different combinations of the solenoids.


“Alternation of the side of the plant row where the LEPA sock was placed was achieved by using electric rams which were

cabled onto the sub-mains and when triggered would pull the sub-main and underlying LEPA socks across. As the rams had only a travel distance of 150 mm, a pulley arrangement was used to allow a one-metre travel distance for the cable and subsequent sub-main,” Simon said.

“The aim of the research is to investigate the potential for using RDI and PRD in cotton and whether it can be used as a tool to increase water use efficiency by reducing leaf transpiration through reduced vegetative growth and/or reduced stomatal aperture by inducing and maintaining mild moisture stress on alternative sides of the plant. Another challenge in this trial was soil moisture monitoring across the trial area.

“This required the installation of 80 neutron probe tubes and many hours in the midday sun taking readings,” Simon said.

At the end of his first season Simon and his support team have learnt a lot about conducting large-scale trials on-farm.

“We are very confident that after all the adjustments and improvements and a few more seasons of field data we will have a lot to show growers and researchers at the end of this three year trial,” Simon White said. 

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