



FINAL REPORT 2015

Choose an item.

Part 1 - Summary Details

Please use your TAB key to complete Parts 1 & 2.

CRDC Project Number: GVIA1302

**Project Title: Grower led research in irrigation system
comparison in the Gwydir**

Project Commencement Date: June 2012 **Project Completion Date:** June 2015

CRDC Research Program: 1 Farmers

Part 2 – Contact Details

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Signature of Research Provider Representative: _____

Date Submitted: 30th June 2015

Part 3 – Final Report

(The points below are to be used as a guideline when completing your final report.)

Background

With continuing pressure on water availability, cotton growers are looking at the commercial implementation of alternative irrigation systems. Irrigators are considering infrastructure change to help adapt to reduced water availability, but there is little information on the commercial applicability and practicality of these systems specific to the Northern Murray Darling Basin cotton growing regions.

During the 2009-2010 cotton season, the Gwydir Valley Irrigators Association (GVIA) in partnership with Sundown Pastoral Co and the National Water Commission set up a multi-system comparison trial at the property “Keytah” Moree. The trial compared the water efficiency and production of flood irrigation, bank less channel, drip and lateral irrigation systems for cotton production. The trial continued in its second-year, 2011-2012. Management and measurement of the trial has been revised following the lessons learnt during the first season. The project expanded to include monitoring of on-farm energy use and the resources of labour.

Through this project GVIA1302 supported by the CRDC, the GVIA, Sundown Pastoral Co and Auscott were able to continue the commercial assessment of irrigation efficiency on the Gwydir Valley. In 2013-2014 Sundown Pastoral Co planted the system comparison trial for the third time. This enabled the industry to continue to capitalise on the investment and to develop a longer term perspective of each of the irrigation systems under investigation.

In 2014-2015 an “off-season” (when the “Keytah” system comparison site is in fallow) trial was planted at Auscott Watervale and at Keytah. This trial explored ways to optimise water-use efficiency and help growers adapt to less water.

A canvas of growers in the Gwydir Valley determined that the majority of irrigators are set up with Furrow irrigation and are unlikely to readily redevelop for an alternative system. The steering committee has identified ‘Optimised Furrow Irrigation – Row Configuration’ as the “off-season” trial. This trial aimed at investigating the relative yield potential of a number of row configurations under optimal irrigation. A more detailed understanding of the potential of each of these different row configurations to produce under optimal water will be beneficial in times of limited water. The intention was to water each configuration as required with the aim to maximise the yield of each of the row configurations. The row configurations to be investigated are 75cm (30 inch), 100cm (40 inch), 150cm (60 inch) and 200cm (80 inch).

Objectives

- 1. List the project objectives and the extent to which these have been achieved, with reference to the Milestones and Performance indicators.**

Part 1: Keytah System Comparison Trial:

Demonstrate best practice of each system at “Keytah” – initiate and manage trial. 1.2 Report on Comparative WUE overtime. 1.3 Communicate and promote project results. 2.1 Demonstrate furrow, bankless, drip and lateral irrigation systems at Keytah. 2.2 Report on comparative performance data over-time. 2.3 Communicate

and promote project results. 3.1 Demonstrate methods to assess irrigation performance at Keytah. 3.2 Communicate and promote project results.

Trial Management and Reporting

- System Comparison Trial was initiated for the third time in 2013-2014.
- Comparison water use data and crop production data was collated and analysed;
 - Industry indices for water use efficiency and crop production were calculated for each system for the 2013-2014 season.
 - Seasonal comparisons of system performance established over three seasons 2009-2010, 2011-2012 and 2013-2014.
- Reporting of results;
 - Final system comparison trial report was completed detailing the trial management program and results for the 2013-2014 season. Report updated following input from CRDC in 2015.
 - Summary flier of season and trial program results prepared and provided for comment November 2014.
 - Powerpoint presentation prepared for Gwydir Valley Irrigators Association AGM and proposed for the Gwydir Valley CGA AGM.

GVIA Irrigation Field Day on 26th February 2014 (130 attended)

- Analysis of grower and student feedback forms collected showed that;
 - 85% of growers indicated that they would like to see the commercial grower led research into irrigation alternatives continue (growers were from across the industry including Gwydir, Barwon/Darling Macintyre, Namoi, Macquarie).
 - 50% of growers indicated that they would utilise information from the project in their operations.

Reports, Media and Promotion

- Individual data from irrigation systems has been consolidated into the final system comparison trial report. Report has been updated following comment from CRDC (attached). Flier containing summary information was prepared.
- Presentations and events provided a wonderful opportunity for two way flow of information between growers, consultants and irrigation researchers. Presentations included;
 - Presentation prepared for Gwydir Valley CGA (Dec 2013).
 - Irricom – Tools for Irrigating the Field forum in March 2014.
 - Presentation by Nick Gillingham at the CCA Moree forum May 2014.
 - System Comparison Trial update presentation prepared for the GVIA – AGM on 25th September 2014 (40 present).
 - Presentation prepared for research forum at the Gwydir Valley CGA AGM in early December 2014.
 - Presentation at the Irrigation Australia Limited Conference June 2014 (approx 15 present). Paper prepared for the proceedings.

- Presentation at Australian Cotton Conference August 2014 (over 100 present). Trial data displayed at Gwydir Valley Irrigators Association booth in the trade hall.
- Articles in the Land 24th October 2013 and Australian Cotton Grower June 2013.
- Posters and brochures displayed at Moree Cotton Trade Show May 2013.
- Field Day articles in Border News, Country Leader, Cotton Outlook and the Land (Feb/March 2014).
- Feature in Spring 2014 Spotlight Magazine.
- Trial update in November and December 2014 Gwydir Valley CottonInfo newsletter.
- Communication Strategy updated in Nov 2014.

5.1 Demonstrate best practice and optimisation techniques of one system at another property, initiate and manage trial. 5.2 Report on trial/crop performance. 5.3 Communicate and promote project results.

Part 2: Optimised Furrow Irrigation – Row Configuration Trial;

Trial Management and Reporting

- The 2014 - 2015 Optimised Row Configuration trial was planted at two locations, Keytah west of Moree and Auscott Watervale north of Moree. (protocol attached)
- The trials enabled the investigation of water-use efficiency optimisation techniques of furrow irrigation under different row configurations.
 - The dual locations increased the exposure of the research.
 - Two sites provided growers an increased level of understanding of the pros and cons associated with different row configurations under furrow irrigation.
- The trials identified best practice and optimisation techniques for the various row configurations.
- Final trial results are still pending (ginning not yet complete). The trial report will evaluate the results in terms of water use, practical implementation and efficiency of resource utilisation (draft attached).

Field Day, Reports, Media and Promotion

- The updated status of the trial program was presented at the GVIA AGM (40 present) on the 25th of September 2014 and at the Gwydir Valley CGA AGM in early December 2014.
- 2015 Gwydir Valley Irrigation Technology Field Day on 11th February. In partnership with CRDC and Cotton Info.
 - Visited trial site at Auscott Watervale. Presentation from both growers involved in row configuration trial. Good interaction from growers present.
 - There were 87 attendees, 34 of whom were growers and 20 consultants.
 - 49 attendees completed the evaluation form, 50% of which were growers or farm managers and 38% were consultants. The following responses support the continuing investment in commercial grower led research.
 - 83% were interested in further research on yield potential of different row spacing.
 - All respondents wanted to see more grower led research. 100%
 - 94% wanted to see continued commercial research into irrigation system comparisons (Keytah Trial).

- Field day booklet prepared.
- Field day and trial media in February 2015 Cotton Outlook, Border News 2nd March 2015 and North West Magazine 23rd February 2015 (attached).

4.1 Develop grower partnerships for delivery.

- July 2014 Area Wide Management group meetings at Ashley, Telleraga and Rowena discussed options for Optimisation trial.
- Optimisation trial co-operators (steering committee) meeting 3rd September 2014, including representation from DPI, Auscott and Keytah.
- Optimisation trial co-operators meeting 16th October 2014, including representation from DPI, Auscott and Keytah. Included discussion on how to measure minimal run off from each treatment. Resulted in ongoing consultation on the design and fabrication of specific drop boxes for tail drain water measurements.
- December 2014: Auscott, GVIA and DPI visited Keytah to discuss irrigation and management of the row configuration trial.
- Gwydir Valley Field Day trial presentation made by representatives of both Auscott and Keytah.
- Participated in the Auscott Agronomy team review of the Auscott row optimisation trial site in January (20 in attendance).

Methods

2. Detail the methodology and justify the methodology used. Include any discoveries in methods that may benefit other related research.

Part 1: Keytah System Comparison Trial

System Water Use = Soil moisture prior to irrigation + (water applied – water off) + in season rainfall – soil moisture after defoliation.

Each system is measured using a holistic approach recording all and only the water used in the system, therefore not including the water lost getting to each system or in storage before irrigation.

Rainfall and Temperature:

Rainfall, Temperature and humidity information collected from the on farm weather station situated in the area of the trial.

Soil Moisture Measures:

Soil Core samples were taken at three to five GPS locations on each block prior to the first irrigation. Soil core samples were taken on 12th September 2013. Samples were oven dried at 105°C over a 48 hour time frame. Soil profile water content was calculated to a depth of 120cm. The results from these measurements were quite variable giving only an indication of the soil moisture status. This information was utilised in the calculation of water use.

Issues associated with taking timely soil cores at picking meant that end of season soil cores were not able to be taken. Soil deficit values were determine by using C-probe data, agronomic observations and a weather based water balance calculation.

Meters:

All water on and water off the overland flow systems; bankless channel (field K29) and furrow fields (field K28) was measured with Mace meters at the head and tail drain of the field. The tail drain mace used in conjunction with rainfall data was used to measure rainfall runoff. All mace meters were fitted with telemetry to aid in easy data collection.

Water supplied to the drip system was measured with an ARAD meter on the pump delivery. Mace meter in the tail drain measured any runoff events.

A Mace EcoFlo meter installed on the tail drain monitored run off from the lateral systems (fields L1 and L3). A correction factor of 1.2 was applied to the total water applied; this was based on the most recent calibration of the lateral system in August 2012.

C-Probes:

C-probes were installed in each field in early November. These were used throughout the growing season to schedule irrigations and monitor the plants uptake of water.

Agronomics:

Nick Gillingham, Keytah Manager and Duncan Hill, Keytah Agronomist in consultation with Nathaniel Phillis, Keytah Irrigation Manager, optimised the management for each system separately and made all agronomic decisions to maximise crop yield.

Gross Production Water Use Index (GPWUI): combines total seasonal water use and the production indices. This index allows for standardised comparisons to be made between results, but also between other farms, regions and seasons. The higher the GPWUI the more water efficient the crop.

Seasonal Water Use: The total mega litres of water per hectare that the crop has the potential to utilise throughout the season. This includes a calculation for the starting soil moisture, irrigation water applied, effective rainfall (how much of the total rainfall entered the soil profile) minus the soil moisture at defoliation.

Part 2: Optimised Furrow Irrigation – Row Configuration Trial

System Water Use = Soil moisture prior to irrigation + (water applied – water off) + in season rainfall – soil moisture after defoliation.

Yield = Picked using bale pickers. Each treatment ginned separately.

Water Assessments

- All treatments were planted dry and watered up
- C-probes were installed early season and used by the irrigation teams to monitor crop water use.
- C-probes were removed prior to picking.
- The sum of all water on each treatment less all water off totalled the water used.

Plant Assessments

- Plant establishment was recorded for each farm.

Rainfall and Temperature:

Rainfall information was collected on farm using Irrisat rain gauge at Keytah. Rainfall back up at Keytah airstrip.

Auscott installed a C-Probe with rainfall measuring capacity in trial.

Temperature and humidity information was sourced from the Moree Bureau of Meteorology (BOM).

Meters:

All water on and water off for each treatment was measured with Mace meters at the head and tail drain of the field. The tail drain mace used in conjunction with rainfall data measured rainfall runoff. Specially designed drop boxes were installed in tail drains to enable measurement of very small flows.

C-Probes:

C-probes were installed in two reps of each treatment. These were used throughout the growing season to schedule irrigations and monitor the plants uptake of water.

All probes and core samples were taken from locations using EM and topography maps. Only post season soil core were taken from Auscott as past experience has found the information of little value.

Agronomics:

Farm agronomist optimized management for each treatment with the objective to maximise the potential with regard yield and water.

Results

3. Detail and discuss the results for each objective including the statistical analysis of results.

Part 1: Keytah System Comparison Trial

Statistical analysis of the results was not possible given the huge variability of seasonal conditions. Additionally the 2009-2010 bankless channel field had issues associated with development and should not be included in any scientific analysis.

Trial results are included in the updated 'Comparison Trial Scientific Report November14' attached. Spreadsheets and raw data are available on request.

Part 2: Optimised Furrow Irrigation – Row Configuration Trial

The two trials were picked in late May and early June. Ginning is not yet completed.

Trial results to date are included in the preliminary draft Optimised Trial Report June 2015 attached. A final report will be prepared once ginning has been completed.

Outcomes

4. Describe how the project's outputs will contribute to the planned outcomes identified in the project application. Describe the planned outcomes achieved to date.

The GVIA project has clearly demonstrated the importance of grower led commercial research. The evaluation from the Gwydir Valley irrigation technology field day clearly indicated that;

- growers and consultants wanted grower led research to continue,
- that they wanted to see the continuation of commercial system comparisons and
- continued analysis of yield potential from different row configurations.

The project has enabled a strong working partnership to develop between GVIA, the CRDC, the NSW DPI, CSIRO, CottonInfo and most importantly the two grower partners; Sundown pastoral company at Keytah and Auscott Watervale.

The project provided the opportunity to research optimisation of farm inputs, processes and capacities on a commercial basis. It has enabled the development of a set of comparative commercial data on four irrigation systems. The data set is replicated over three seasons which will enable growers to utilise the information with more confidence in decision making for their operations. The results have identified the pros and cons associated with the set-up, running and maintenance of each of the four systems.

Additionally the project has developed data on the yield potential of a number of different row configurations. It has highlighted some of the issues which could potentially be encountered when growers adapt planting configurations with changing seasonal conditions.

GVIA1302 has established a benchmark for irrigation water use indices which will become an invaluable tool for the industry. Importantly this dataset will enable the comparison of the water use efficiency of the various irrigation options investigated during the project.

Through the communication of the results at industry events and in industry publications the project has helped to increase grower knowledge and understanding of the four different irrigation systems trialled. Increasing the awareness of the water use efficiencies which can be achieved will enhance grower focus on adoption of best management practice. It will provide a clearer commercial picture of the benefits associated with different row spacings and different irrigation systems.

Finally the project has demonstrated the commitment of the cotton industry to continuously move towards improved efficiency in water use. Critically the project has identified that water use efficiency is not an isolated challenge. Water use efficiency does need to be balanced with the key resources of energy and labour to ensure the long term viability of irrigated cotton in the region.

Investment in alternative irrigation systems is extremely expensive. Growers considering changes will be able to include information from the project to make decisions which offer improvements in water use efficiency. Critically investment can now be made with a clearer understanding of the limitations of the alternatives, as well as the potential opportunities available from optimising existing furrow systems.

5. Please describe any:-

- a) technical advances achieved (e.g. commercially significant developments, patents applied for or granted licenses, etc.);**
- b) other information developed from research (e.g. discoveries in methodology, equipment design, etc.); and**
- c) required changes to the Intellectual Property register.**

Conclusion

6. Provide an assessment of the likely impact of the results and conclusions of the research project for the cotton industry. What are the take home messages?

Part 1: Keytah System Comparison Trial

The research project GVIA1302 has been able to add to the commercial data set initiated through the 2009 National Water Commission project. There are now three years of comparative commercial data on four different irrigation systems; syphon or furrow, bankless channel, lateral move and sub-surface drip.

The project found that when the data is considered as an average of the three quite different seasons, that all four irrigation systems perform very well from a gross production water use perspective. This suggests that all have a viable place as irrigation alternatives for cotton growers in Australia.

However a review of the results in more detail highlights some important findings. The three seasons when the trial was conducted showed how variable climatic conditions can be. 2009-2010 was a more typical season with rainfall during peak growth and slightly higher than average day degrees. 2011-2012 was a cooler, wet season with significant cloud cover and two flood events. The final season 2013-2014 was a dry season, with a cold start and warmer than average grower season.

When considered on a bales per hectare basis, the lateral system was the strongest performer and the drip system the weakest performer over three seasons. The poorer yield under drip was exacerbated in the hotter dryer season. The most consistent yield performer was the furrow system. The data from 2011-2012 suggests that the bankless channel and the lateral system handled the cooler, wet season better. Possibly because neither system was water logged following the February flood event.

When the data is considered using the gross production water use index (GPWUI) it showed that over the three seasons the lateral had the highest GPWUI. The different seasonal conditions did however identify that in a hot dry season with little rainfall the efficiency of the lateral system was lower. The surface irrigation systems of the furrow and the bankless channel were more efficient in such a season as the irrigation team were able to maintain sufficient water to avoid stress.

An assessment of the resource requirements of each system clearly showed that water use efficiency must be balanced with the other essential resources of energy and labour.

In some regions labour shortages are critical, growers in these regions will be more oriented towards systems which require less labour. The two least labour intensive systems are the bankless channel and the drip, while the furrow system is the most labour intensive. The lateral system was more labour intensive than originally anticipated. It also required a degree of expertise to manage it.

All irrigators are monitoring the rising energy costs associated with moving water. The price of both electricity and fuel has increased in recent years. Data from the first two seasons of the Keytah comparison trial showed that the lateral and the drip systems could significantly increase energy requirements.

Another important consideration for growers is the set up and maintenance costs associated with each of the systems. As there is considerable investment in infrastructure the costs associated with installing and maintaining either the drip or lateral systems can be significant. Both these systems are fixed costs in the farm budget and as such are more suited to irrigation areas where there is a reliable water supply which enables them to be used in the majority of seasons.

Similar costs may also be incurred in ground re-levelling in situations where changes are made between furrow and bankless channel systems. The costs and the challenges associated with moving large amounts of top soil will be important considerations in decisions to change systems. In some situations they may be too great to justify the change.

In summary the Keytah comparison trial has provided some much needed commercial insight into the management and set up of four different irrigation systems. All systems have been shown to be suitable systems to efficiently irrigate cotton in Australia. The yield, seasonal water use and the GPWUI have shown that the performance of each system will vary with the seasons.

Part 2: Optimised Furrow Irrigation – Row Configuration Trial

This part of the project has clearly identified seed bed stability as a factor in optimised furrow irrigation. Planting into an established seed bed, which has been stabilised was found to enable more efficient irrigation.

Until final data is received it is not possible to summarise findings or draw conclusions.

Extension Opportunities

7. Detail a plan for the activities or other steps that may be taken:

- (a) to further develop or to exploit the project technology.**
- (b) for the future presentation and dissemination of the project outcomes.**
- (c) for future research.**

a) The GVIA applied to continue the research under 15-16FRP194. The application has been accepted and the project will continue as part of the Smarter Irrigation for Profit project in partnership with the CRDC, RIRDC, and the dairy, rice and sugar industries. This project will allow for a fourth set of data to be collected from the Keytah system comparison site. Additionally it will allow for a second set of data to be collected from an alternative site in the Gwydir Valley.

The Gwydir Valley CGA will be supporting a Grass roots grant application for further investigation of the maximum yield potential from different row configurations.

b) The trial report from the 2014-2015 season is still to be completed. It will be completed once the trial modules have been ginned. Once the report is completed a number of stories will be developed for distribution to the following publications; Spotlight magazine, Cotton Outlook, Australian Cotton Grower and the NSW Irrigators Council's Productive Water Journal.

The GVIA will be having a stand at the 2015 cotton trade show where the data collated from the Gwydir Valley Irrigators Association Irrigation Efficiency trials will be displayed.

9. A. List the publications arising from the research project and/or a publication plan. (NB: Where possible, please provide a copy of any publication/s)

Articles previously provided:

- Articles in the Land 24th October 2013 and Australian Cotton Grower June 2013.
- Field Day articles in Border News, Country Leader, Cotton Outlook and the Land (Feb/March 2014).
- Feature in Spring 2014 Spotlight Magazine.
- Trial update in November and December 2014 Gwydir Valley CottonInfo newsletter.
- Presentation at the Irrigation Australia Limited Conference June 2014. Paper prepared for the proceedings.

Articles included in this report:

- Trial summary prepared for 2015 Gwydir Valley Irrigation Technology Field Day booklet.
- 2015 Field day and trial media in February 2015 cotton Outlook, Border news 2nd March 2015 and North West Magazine 23rd February 2015.
- GVIA Irrigation Efficiency Folder (under development)

B. Have you developed any online resources and what is the website address?

The GVIA website is under review and once completed a segment will be dedicated to irrigation efficiency. Brochures are in development for the GVIA Irrigation Efficiency folder.

Part 4 – Final Report Executive Summary

Provide a one page Summary of your research that is not commercial in confidence, and that can be published on the World Wide Web. Explain the main outcomes of the research and provide contact details for more information. It is important that the Executive Summary highlights concisely the key outputs from the project and, when they are adopted, what this will mean to the cotton industry.

Grower led research in irrigation system comparison in the Gwydir Valley

Part 1: Keytah System Comparison Trial

The project investigated the water, energy and labour resource requirements of four commonly used irrigation systems. All four systems, furrow or syphon, bankless channel, lateral move and sub-surface drip, were establish in adjacent fields at Keytah in 2009. During the comparison trial each system was managed to optimise performance, with the objective of maximising yield per mega litre.

The trial was run over three very different climatic seasons. The 2009-2010 season was more typical with rainfall during the peak growth stages and cumulative day degrees slightly above the long term average. 2011-2012 was noticeably cooler and wetter punctuated by two flood events and significant cloud cover. While 2013-2014 was much warmer and dryer with very limited in season rainfall.

From a yield perspective the most consistent performer regardless of seasonal conditions, was the standard furrow system, with the lateral move producing the highest average yield over the three seasons. The drip system was the weakest yield performer.

When compared using the Gross Production Water Use Index (GPWUI), the three year averaged showed the lateral move to be the strongest performer. However it was found that in the dryer, hotter conditions the GPWUI for the lateral was much lower.

The project highlighted that the energy requirements of the lateral move and the drip systems were significant. This was further exaggerated in the 2013-2014 season where they had to be run for extended periods. Both these systems require significant investment in infrastructure and ongoing maintenance cost which add to the fixed asset base of the farming operations. This means both systems are more suitable in regions where there is a reliable water supply which would enable these fixed assets to be utilised in most years.

The labour requirement of the furrow system is one of the driving forces behind the adoption of the bankless channel system in the northern cotton regions. The project confirmed the high labour resource requirement of the furrow system, but also found that the lateral system could also be quite labour intensive.

In summary the Keytah comparison trial has provided some much needed commercial insight into the management and set up of four different irrigation systems. All systems have been shown to be suitable systems to efficiently irrigate cotton in Australia. The yield, seasonal water use and the GPWUI have shown that the performance of each system will vary with the seasons.

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GVIA1302

Grower led research in irrigation system comparison in the Gwydir Valley

Part 1: Keytah System Comparison Trial

Project Team

Nick Gillingham:	Sundown Pastoral Company Pty Ltd
Nathaniel Phillis:	Sundown Pastoral Company Pty Ltd
Duncan Hill:	Sundown Pastoral Company Pty Ltd
Janelle Montgomery:	NSW Department of Agriculture
Zara Lowien:	Gwydir Valley Irrigators Association
Louise Gall:	Gwydir Valley Irrigators Association

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Abstract:

The Grower led Keytah system comparison trial has run for three years. The trial compares the water, energy and labour resource requirements of four different irrigation systems for the production of cotton. The systems investigated were; the industry standard furrow, bankless channel, lateral more and subsurface drip. Each of the irrigation systems were managed to optimise performance. The intention was to maximise the yield per mega litre of each of the systems.

The trial was located in one section of the property Keytah, west of Moree in northern NSW, where the systems were positioned adjacent to each other. The comparisons were first tested in the 2009-2010 season, then again in 2011-2012 and 2013-2014.

The trial was run over three very different climatic seasons. The 2009-2010 season was more typical with rainfall during the peak growth stages and cumulative day degrees slightly above the long term average. 2011-2012 was noticeably cooler and wetter punctuated by two flood events and significant cloud cover. While 2013-2014 was much warmer and dryer with very limited in season rainfall.

When the three data sets are averaged, it shows that all four irrigation systems perform very well. The lateral move system performed very well in a typical season, but was less water efficient and noticeably more costly to run in a warmer dryer season. The drip system also struggled in the warmer, dryer conditions. The Furrow and bankless channel systems were competitive in all seasons.

Although the Gross Production Water Use Index (GPWUI) was comparable to other systems, the yields achieved with the drip system were below those of all other systems.

The comparison trial clearly showed that water use efficiency, is not the only consideration. System setup, maintenance and the resources of energy and labour are all of critical importance in irrigation system selection and management. The two least labour intensive systems are the bankless channel and the drip, while the furrow system is the most labour intensive. When compared on an energy basis, it was found that the lateral and the drip systems could significantly increase energy requirements.

The costs associated with installing and maintaining the drip and lateral systems increase fixed costs in the farm budget. They are most suitable in regions where there is a reliable water supply which enables them to be used in the majority of seasons.

The Keytah comparison trial has provided some much needed commercial insight into the management and set up of four different irrigation systems. All systems have been shown to be suitable systems to efficiently irrigate cotton in Australia and are viable alternatives for producers. The yield, seasonal water use and the GPWUI have shown that the performance of each system will vary with the seasons. Energy costs may also vary by season.

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GVIA1302

Grower led research in irrigation system comparison in the Gwydir Valley

Part 1: Keytah System Comparison Trial

Introduction:

The Keytah system comparison trial component of the 'Grower led research in irrigation system comparison in the Gwydir Valley' concluded its third year in 2014. The 2013-2014 season trial utilised the same fields as in the 2009-2010 and 2011-2012 trials.

The system comparison trial compared the yield and water utilisation of four different irrigation systems; furrow or syphon, bankless channel, lateral move and drip. The four systems are all located in one section of Keytah to minimise any variability in rainfall and soil.

Objective:

To increase the awareness and understanding of the four cotton irrigation systems; furrow, bankless, channel, lateral move and drip to help achieve a more resilient and competitive cotton farming system and an environmentally sustainable cotton industry.

Primary Goals:

Each of the irrigation systems under review were managed to optimise to the specific needs of the individual systems. The intention was to maximise the yield per mega litre of each of the systems.

Trial Features

Location:

The trial is located on Sundown Pastoral's "Keytah". Keytah is located approximately 45Km West of Moree on the Watercourse road.

System Knowledge and Management

The Sundown Pastoral Company staff at Keytah has developed a good understanding of and appreciation of the issues associated with each of the irrigation systems.

They have worked with furrow systems for over 20 years and have worked to optimise its performance. Their experience with the alternative systems is less, although lateral moves have been in use on Keytah for almost 10 years.

Figure 1 shows that all four systems are located directly adjacent to one another. They are also located in close proximity to the storage.

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Figure 1: Trial Map



Variables:

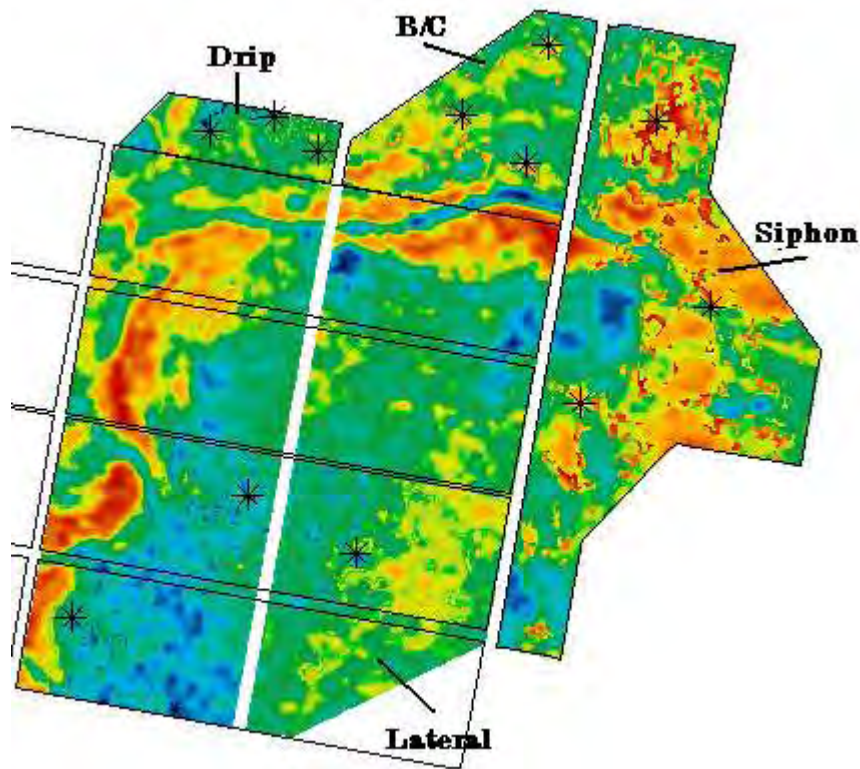
Soil Type:

Having the four systems located directly adjacent to one another will reduce any significant soil variations. The soils are heavy black cracking vertisols, which hold moisture. They do however crack open when moisture is limited. The EM Survey shown in figure 2 indicated soil variations do exist.

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Figure 2: EM Survey of the trial area.



Monitoring method and equipment:

System Water Use = Soil moisture prior to irrigation + (water applied – water off) + in season rainfall – soil moisture after defoliation.

Gross Production Water Use Index (GPWUI):

Is the combination of the total seasonal water use and the production indices.

This index allows for standardised comparisons to be made between results, but also between other farms, regions and seasons.

The higher the GPWUI the more water efficient the crop.

Seasonal Water Use:

The total megalitres of water per hectare that the crop has the potential to utilise throughout the season.

This includes a calculation for the starting soil moisture, irrigation water applied, effective rainfall (how much of the total rainfall entered the soil profile) minus the soil moisture at defoliation.

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Method:

Each system is measured using a holistic approach recording all and only the water used in the system, therefore not including the water lost getting to each system or in storage before irrigation.

Rainfall and Temperature:

Rainfall, Temperature and humidity information collected from the on farm weather station situated in the area of the trial.

Soil Moisture Measures:

Soil Core samples were taken at three to five GPS locations on each block prior to the first irrigation. Soil core samples were taken on 12th September 2013. Samples were oven dried at 105°C over a 48 hour time frame. Soil profile water content was calculated to a depth of 120cm. The results from these measurements were quite variable but did give an indication of the soil moisture status. This information was utilised in the calculation of water use.

Issues associated with taking timely soil cores at picking meant that end of season soil cores were not able to be taken. Soil deficit values were determined by using C-probe data, agronomic observations and a weather based water balance calculation.

Meters:

All water on and water off the overland flow systems; bankless channel (field K29) and furrow fields (field K28) was measured with Mace meters at the head and tail drain of the field.

The tail drain mace used in conjunction with rainfall data was used to measure rainfall runoff. Minimal effective in season rainfall meant that there was negligible rainfall runoff.

All mace meters were fitted with telemetry to aid in easy data collection. The web cards were supplied to the GVIA by WaterQuip Moree as part of a Mace trial program at a reduced price.

During peak flowering there was an issue with one of the Bankless Channel supply meters (K29Nsupp). The meter did not accurately record the data for the irrigation on the 23rd of December. The volume was estimated based on the irrigation on the 3rd December.

Water supplied to the drip system was measured with an ARAD meter on the pump delivery. Mace meter in the tail drain measured any runoff events.

A Mace EcoFlo meter installed on the tail drain monitored run off from the lateral systems (fields L1 and L3). A correction factor of 1.2 was applied to the total water applied; this was based on the most recent calibration of the lateral system in August 2012. A further audit of the system was outside the budgetary constraints of the trial.

C-Probes:

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C-probes were installed in each field in early November. These were used throughout the growing season to schedule irrigations and monitor the plants uptake of water.

Water Track™ Optimiser:

The WaterTrack Optimiser daily water balance model was not used as the cost was outside the budgetary constraints of the trial.

Agronomics:

Nick Gillingham, Keytah Manager and Duncan Hill, Keytah Agronomist in consultation with Nathaniel Phillis, Keytah Irrigation Manager, optimised the management for each system separately and made all agronomic decisions to maximise crop yield.

Data collected:

- Field history.
- Fertiliser.
- Variety.
- Planting date.
- In season activities: cultivation, Soil PAM, herbicide and pesticide usage.
- Irrigation volumes and times.
- Defoliation timing.
- Picking.

Issues and considerations:

Resources:

On farm resources are critical and incorporate labour, water and infrastructure to maximize the potential of each system throughout the season.

- Infrastructure.
- Sufficient water to supply all systems for the duration of the trial.
- Understanding of each system to ensure maximum production as efficiently as the system allows.
- Installed Meters to measure water on and off fields.
- People
- Clear understanding of roles and responsibilities associated with decision making, measurement, data records and equipment repairs.
- Data interpretation.

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System Information:

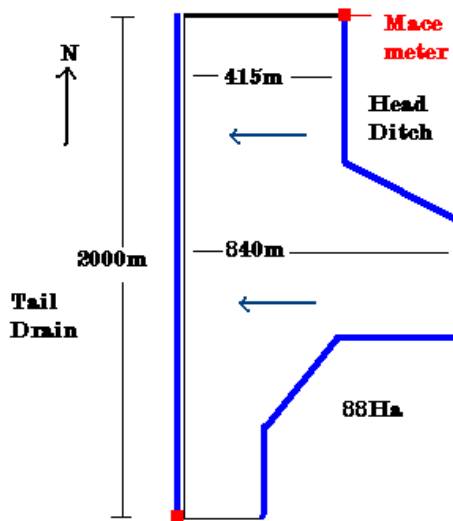
Furrow / Siphon / K28:

Field K28 is typical of the furrow irrigation field in the Gwydir Valley. It includes a mixture of longer and shorter runs which is not uncommon on irrigation farms in northern NSW.

An area of Pigeon Peas was planted at the southern end of field K28 as a Bollgard II refuge. They were irrigated separately to the trial.

Crop establishment was slower than ideal.

Field Layout:



Technical Information and Experience:

Keytah utilises an optimised furrow irrigation system, it is an example of some of the very best furrow irrigation techniques in the industry. This is of importance when comparing results between the four systems.

Instillation cost:	\$800 – \$1,200
Siphon diameter:	3 inch
Monitoring Method:	Total water on total water off

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Lateral L1 and L3:

Mist nozzles were used for establishment. Once the canopy began to fill bubblers were used to minimize evaporation and apply water directly to the base of the plant.

The lateral system enabled the easy application of water in controlled volumes early season. This provided an ideal environment for the establishment of the fields.

Technical Information and Experience:

Keytah staff have 5-10 years of experience with lateral move irrigation.

Pressurizing Cost: 38.65L (151L/Ha@\$1.30) \$196/Ha

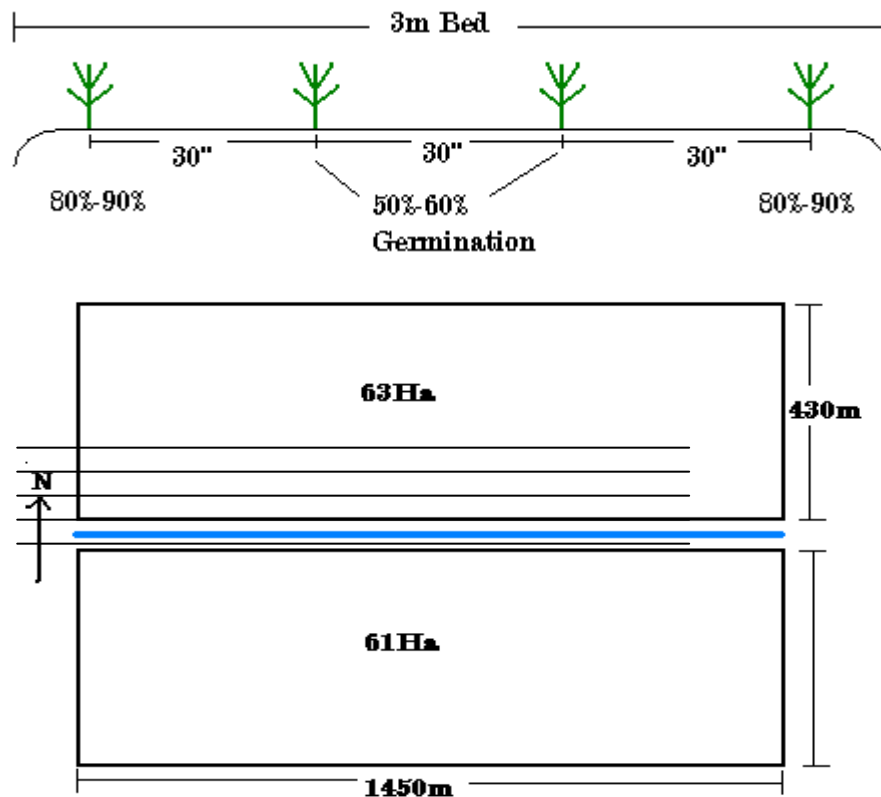
Instillation cost: \$3,880/Ha (2006)

Hose length: 2.5m.

Monitoring Method: Total water on through in line meter

Field Layout:

3m Beds



In season Considerations:

- Irrigation:

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During the season the irrigation team noticed that the lateral L3 was not travelling at a consistent speed. This is believed to have been caused by an issue with the guide line. As such L3 has not been included in the 2013-2014 data sets.

Bankless Channel / K29:

The Bankless Channel system has been adopted in southern New South Wales and in parts of southern Queensland. There are many variations of the system, the Keytah site has **a rooftop variation where water is pushed "up" from each end of the field as depicted in the diagram below.** Each subsequent bay is 3-4 inches lower enabling the previous bay to drain completely.

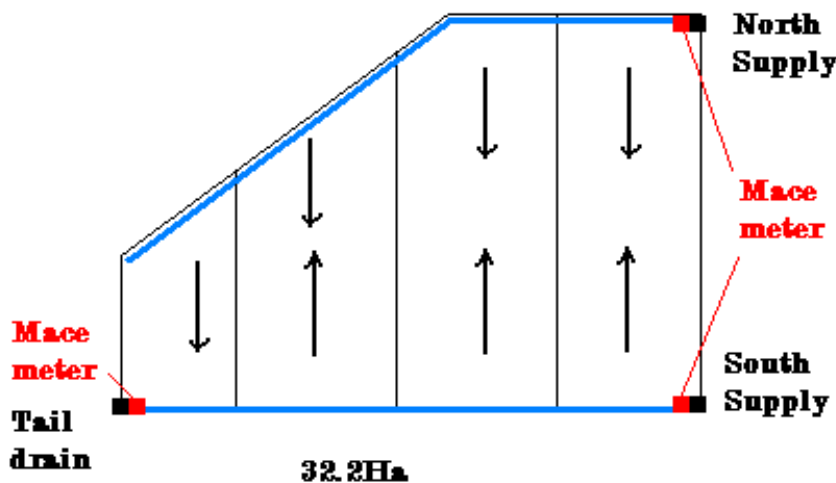
Technical Information and Experience:

The Keytah staff first utilised the roof top bankless channel system in 2009.

Instillation cost: \$1,000 - \$1,500/Ha

Monitoring Method: Total water on less total water off

Field layout:



In season Considerations:

- Germination/Establishment:

Cool temperature prevailed in October and November which slowed the establishment of the crop. This was quite noticeable in the bankless channel where the pre irrigation on the 26th September did not fully wet the profile. A second irrigation was required on the 26th October, 18 days after planting.

- Irrigation:

In the irrigation on the 3rd of January it became apparent that there were problems with the irrigation in the third bay of the Bankless system. Nathaniel found it difficult to effectively sub up the whole field. There is too much variation between the wheel

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tracks and the other furrows, the furrows are too high compared to the wheel tracks. Furrow height variation is the issue.

There were no visual signs of this problem previously. Bay one is fine and appears to wet up evenly. There is some variation starting to appear in bay two where the water is staying in the wheel tracks longer than in the high furrows.

The problem could not be easily addressed during the season. The irrigation team monitored the situation closely to ensure the whole field irrigated effectively. Ideally the bankless field will need to be re levelled before being planted again.

Drip / K30:

At the request of Netafim the drip has been split into two fields. The variation between the two fields is in the emitter and the spacing. The Northern field has a standard Ozline 25250 emitter at 0.5m spacing. The southern block has a pressure compensated nozzle set at 0.3m. The pressure compensated nozzle is used to improve distribution uniformity. Only at a certain pressure will the nozzle begin to emit water.

Technical Information and Experience:

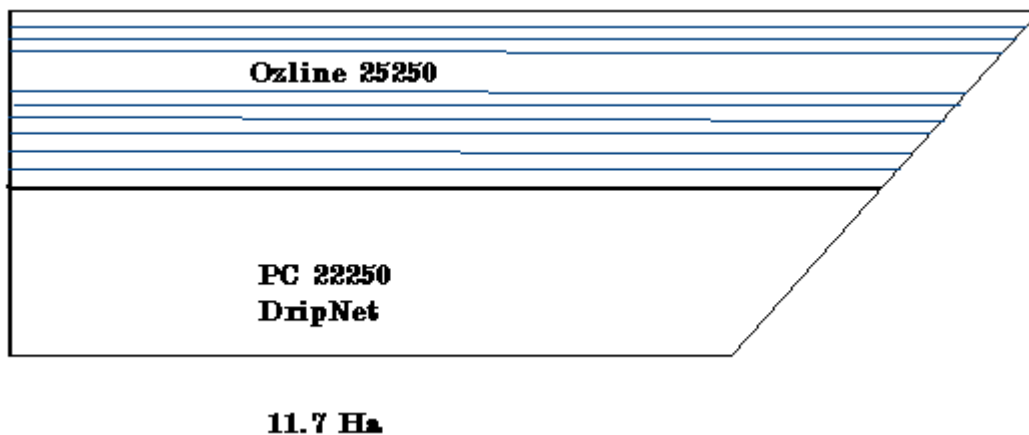
Pressurizing Cost: \$42/Meg (181L/Ha@\$1.30) \$235/Ha

Instillation cost: \$8547/Ha (2009)

Monitoring Method: Total water applied

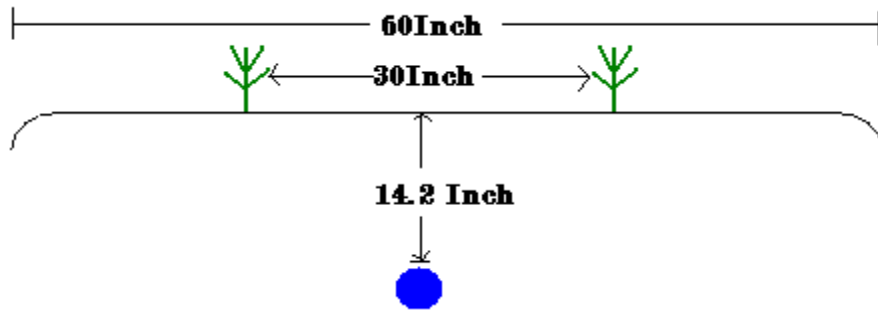
Capacity: 15mm/day application capacity

Field Layout:



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Pre and In season Considerations:

- Tape maintenance,
- Depth
- Seasonal Conditions

The warmer temperatures and lack of rainfall during the season made it more challenging to maintain sufficient soil moisture in the drip field.

- Out of season soil moisture:

Due to the movement in the heavy black soil as it losses moisture it was advised by Netafim that the area around the line be kept moist. This may mean that the supply channel will have to be filled out of season for a minor watering.

- Insufficient water mid-season:

When the plant is starved for water it will search for it. The last moist place in a sub-surface drip system is in the lines. In seasons short on water this must be seriously considered in the management process. Is there enough water to see the crop out without blocking the system? If blocked it is possible to flush the lines with acid.

- Algae build up:

Algae present in the lines during the season can usually be cleared when the lines were flushed at the start of each irrigation. At the end of the season a low rate of chlorine should be applied to the system.

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Results

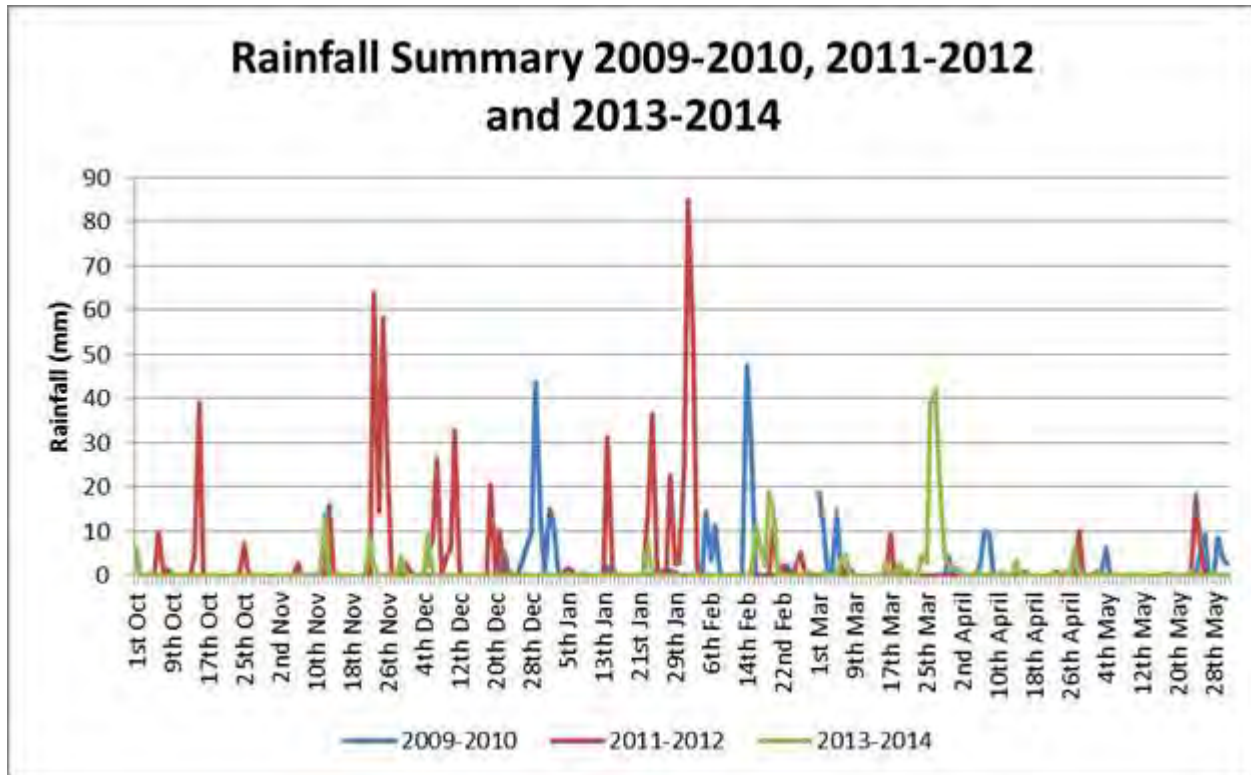
Seasonal data

Rainfall summary shows that there were noticeable differences in rainfall over the three years of the trial.

In the 2009-2010 season rainfall was reasonably typical with a number of effective rainfall events during the peak growth stage.

The 2011-2012 season is punctuated by rather more rainfall events two of which were widespread (late Nov and Early Feb) and resulted in flooding across much of the valley.

The 2013-2014 season was much dryer with very limited in season rainfall. The only significant event was in late March when the drip and the lateral fields were approaching cut-out.



The summary of cumulative day degree in the graph following shows that the 2009-2010 and the 2013-2014 seasons had similar temperatures, although 2013 saw a colder start to the season. The principle difference in these two seasons was the rainfall.

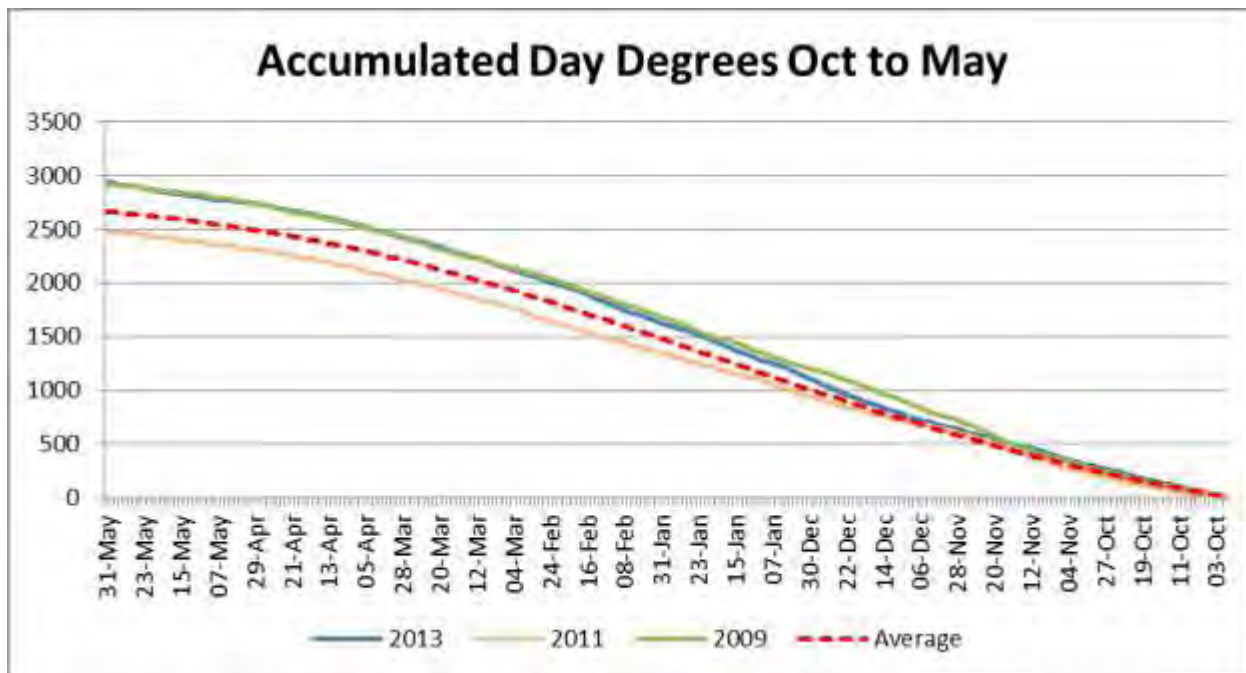
In 2009-2010 there were 20 cold shock days and 38 hot days from planting to picking (1st Oct 2009 to 30th April 2010). The 2013-2014 season had 23 cold shock days to the end of April and a further 21 during May. There were 42 Hot Days from the beginning

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October to the end of April. For both seasons the cumulative day degrees were above the long term average (1957-1914).

In contrast the 2011-2012 season was well below average. It had 52 cold shock days from 1st Oct to 31st May (compared to an average of 49) and only 4 hot days (average 23). There was also considerable cloud cover during this wetter than average season.



Furrow / Siphon / K28:

2009-2010:

There were some early season issues with germination possibly due to planting depth.

The mace meter broke down early season. All water off field measured with flume meters. Five flume readings were taken for each of the irrigations on varying rows of different lengths. Readings included a wheel track in each irrigation.

Defoliation was done in two parts to manage differences in plant development. The yields were combined to give an accurate yield per ha figure.

2011-2012:

Soil crusting meant 5Ha had to be replanted.

Water measurements were made with Mace meters and Watertrack Optimiser. The Mace meter failed. The applied irrigation water calculation using Watertrack Optimiser may have been inaccurate; we believe applied water was closer to 5.46.ML/ha. Without the

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information from the Mace meter we cannot confirm this so have utilised the Watertrack Optimiser calculation of 6.14 ML/Ha.

2013-2014:

Cool conditions during October and November slowed establishment. This was followed by a hot dry season with no rainfall until late in the season.

There were no issues with measuring the water on and water off using the Mace meters fitted with telemetry. The telemetry enabled the GVIA to monitor each of the irrigations as it was taking place.

Seasonal Statistics:	2009-2010	2011-2012	2013-2014
Establishment method:	Watered up	Rain Moisture	Watered up
Planting:	7 th October 2009	14 th October 2011	7 th October 2013
Number of irrigations:	7	6	10
Irrigation water applied/Ha:	5.22 ML/Ha	6.14 ML/Ha	8.57 ML/Ha
Total seasonal water use:	9.50 ML/Ha	13.46 ML/Ha	11.37 ML/ha
Gross Production Water Index:	1.27 Bales/ML	1.05 Bales/ML	1.10 Bales/ML
Picking:	27 th April 2010	15 th May 2012	29 th May 2014
Yield:	12.06 Bales/Ha	11.60 Bales/Ha	11.46 Bales/ha

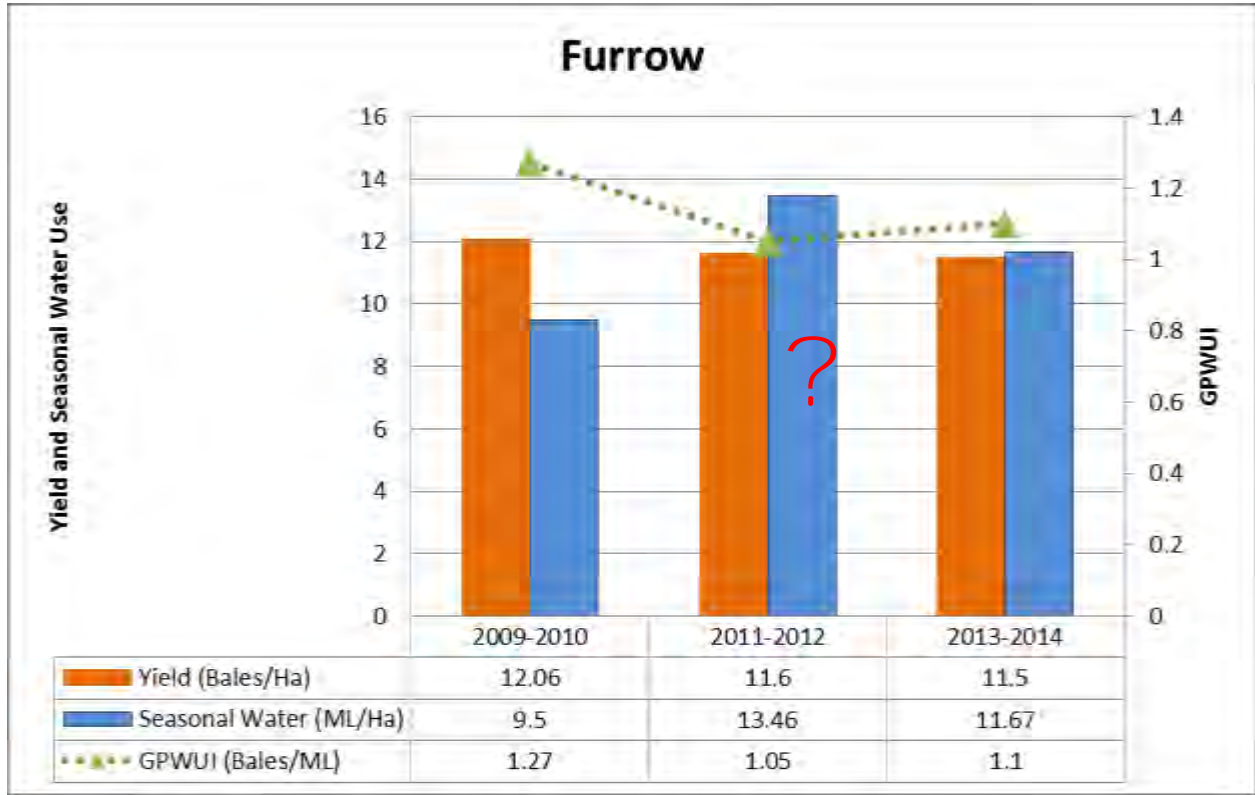
The furrow consistently produced good yields in all years. The seasonal water use in the 2011-2012 season is quite high and may be inaccurate as a result of a failed meter. Interestingly the seasonal water use in the hot dry 2013-2014 season is 2ML/Ha less than that recorded in the 2011-2012 season. As such the furrow GPWUI for 2011-2012 is potentially incorrect.

Furrow irrigation is the most widely utilised system in the cotton industry at present; it has reliably performed for many years. This trial has confirmed that it is an efficient system, which can be optimised to produce good yields and water use efficiency. One of the most significant draw backs of the system is the tendency to produce significant volumes of tail water compared to other systems.

Furrow irrigation is also quite labour intense. This is seen by most growers as the primary constraint for the furrow siphon system.

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Lateral L1 and L3:

2009-2010:

There were some early season issue with germination possibly due to a cold snap and planting depth. As a result of the poorer plant establishment, the early season water requirements were less than other systems.

2011-2012:

Soil crusting meant 30Ha had to be replanted. There was some waterlogging due to the 3 meter bed configuration.

A tailored fertiliser system used in-line delivery.

2013-2014:

There were issues with the speed of Lateral 3, and hence the water applied. Only data associated with Lateral 1 has been included this season.

The field managed the cool start well, but used more water than in previous years in the hot dry conditions which followed from December until March.

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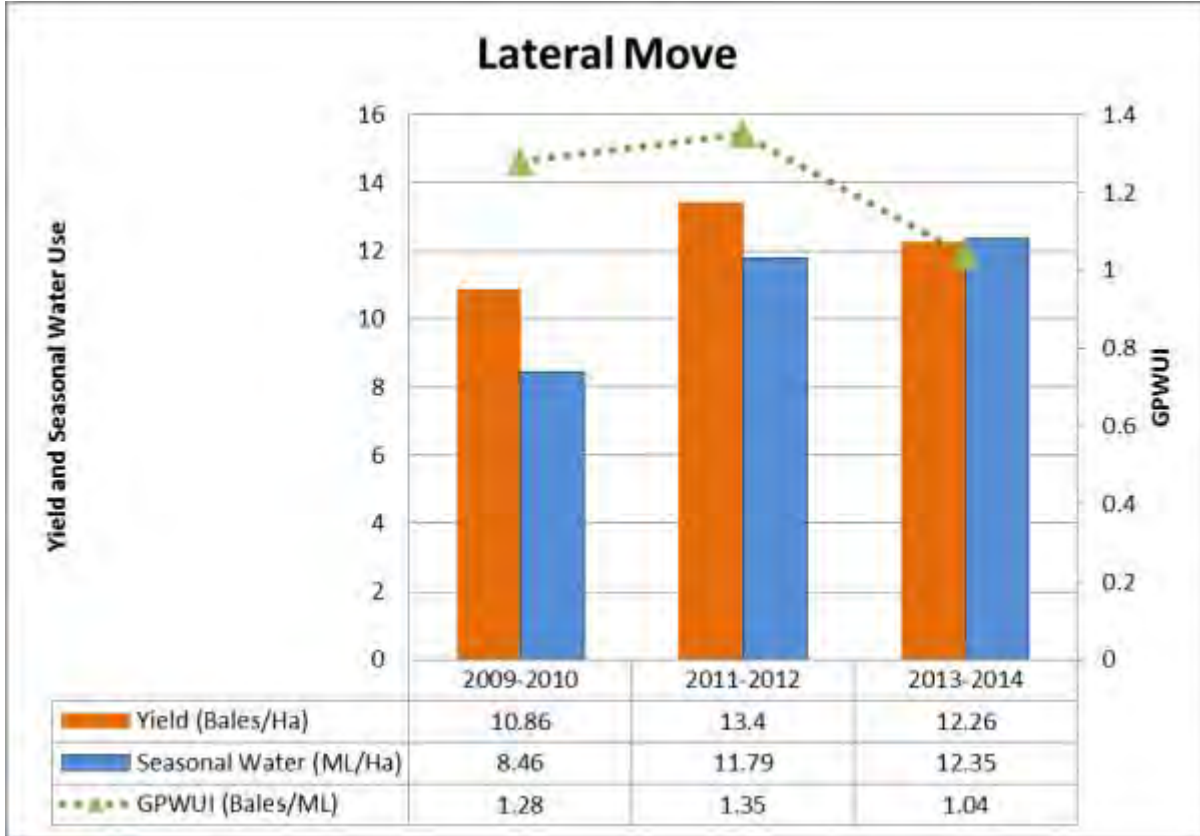
Seasonal Statistics:	2009-2010	2011-2012	2013-2014
Establishment method:	Watered up	Rain Moisture	Pre Irrigated
Planting:	1 st October 2009	14 th October 2011	10 th October 2013
Number of irrigations:	10	10	19
Irrigation water applied/Ha:	3.90 ML/Ha	4.32 ML/Ha	8.34 ML/Ha
Total seasonal water use:	8.46 ML/Ha	11.79 ML/Ha	12.65 ML/ha
Gross Production Water Index:	1.28 Bales/ML	1.35 Bales/ML	1.04 Bales/ML
Picking:	3 rd May 2010	15 th May 2012	22 nd May 2014
Yield:	10.86 Bales/Ha	13.40 Bales/Ha	12.26 Bales/Ha

The water use efficiency of the lateral system appears to have been impacted most significantly by the hot dry 2013-2014 season, the GPWUI dropped to 1.04, well below the 1.28 and 1.35 recorded in the previous two seasons.

The lateral is well suited to typical seasons where the system is able to take advantage of in-crop rainfall. Applying smaller irrigation volumes more frequently means that when there is rainfall, the soil has the ability to capture this rainfall. There was no rainfall to take advantage of in the 2013-2014 season.

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Bankless Channel / K29:

2009-2010:

The trial was planted immediately after the field had been redesigned into the bankless channel design. This caused several issues during the season and would have impacted on the performance of the bankless channel.

The soil cracked heavily which hindered early crop development. The seed beds held little shape, leaving plants on the side of beds, this caused significant waterlogging during irrigation. Additionally there were issues with the ability of irrigation water to flow freely, which impacted evaporation and the potential for deep drainage.

2011-2012:

Soil crusting meant 5Ha had to be replanted. The irrigation team were still learning how to maximise water on/off without excess bed-topping. More experience is needed to minimise tail water and carryover bay water. Flooding rainfall was received in late November and early February.

2013-2014:

Cool conditions during October and November slowed establishment. The season was hot and dry with no rainfall until late February. The pre irrigation did not fully wet the profile and a second irrigation was required 18 days after planting.

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In January it became difficult to effectively sub up a section of the third bay of the bankless system. The furrows were too high compared to the wheel tracks. The irrigation team carefully managed this for the remainder of the season. There will need to be some re-levelling of this field prior to planting another crop.

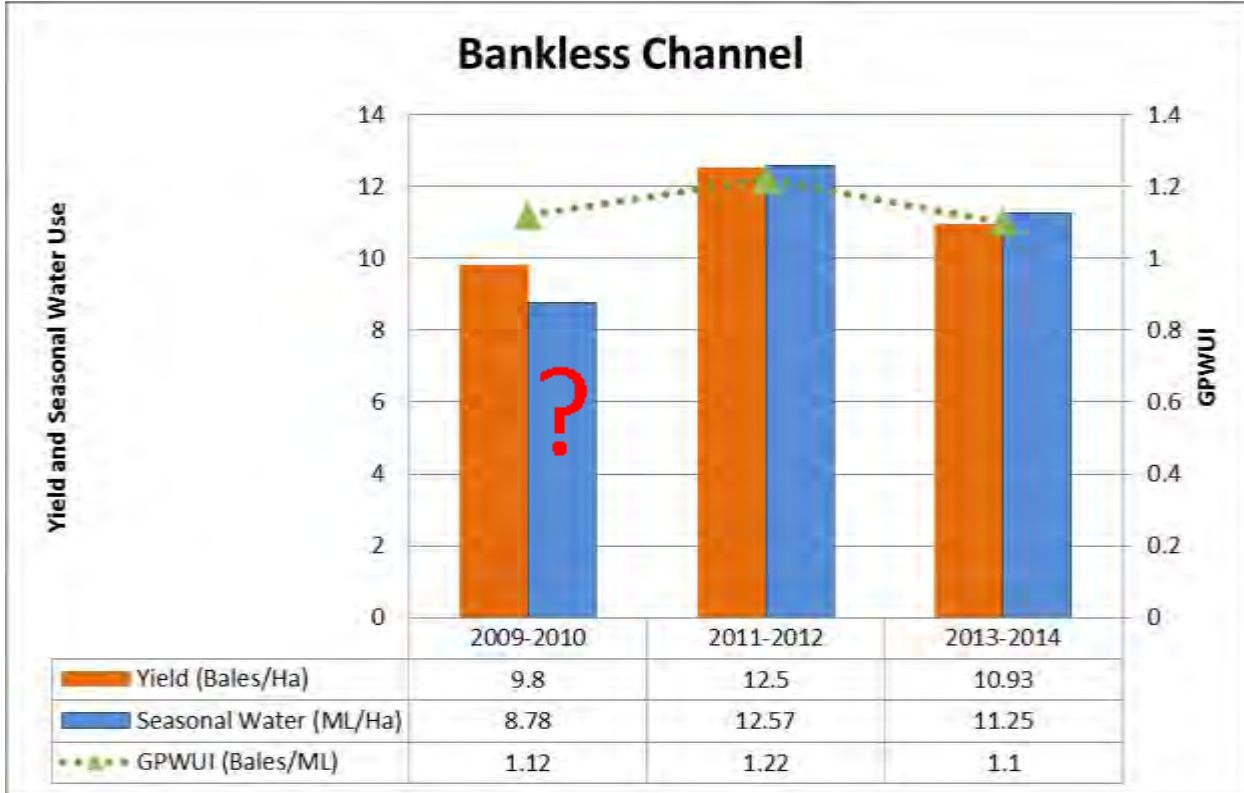
Seasonal Statistics:	2009-2010	2011-2012	2013-2014
Establishment method:	Watered up	Rain Moisture	Pre-Irrigated
Planting:	Re-sown 12 th October 2009	14 th October 2011	8 th October 2013
Number of irrigations:	6	5	11
Irrigation water applied/Ha:	4.89 ML/Ha	5.22 ML/Ha	7.90 ML/Ha
Total seasonal water use:	8.78 ML/Ha	12.51 ML/Ha	10.95 ML/ha
Gross Production Water Index:	1.12 Bales/ML	1.22 Bales/ML	1.10 Bales/ML
Picking:	22nd April 2010	15th May 2012	11 th May 2014
Yield:	9.80 Bales/Ha	12.50 Bales/Ha	10.93 Bales/ha

The results for the 2009-2010 season do not accurately represent the potential of the bankless channel irrigation system. The delay in development and subsequent establishment problems are believed to have impacted the yield.

The bankless channel was one of the strongest performing systems in the 2013-2014 season. The system was easy to manage and resulted in very little tail water.

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Drip / K30:

2009-2010:

The drip system had the best early season germination and began using water earlier.

There were several issues with the programming, pressure management and mechanical breaks. This caused complications in irrigation scheduling during peak season. Stress on the plants and may have affected the yield.

2011-2012:

Mechanical issues were also experienced in 2011-2012, again causing plant stress. There was some waterlogging due to the 3 meter bed configuration.

A tailored fertiliser system used in-line delivery.

2013-2014:

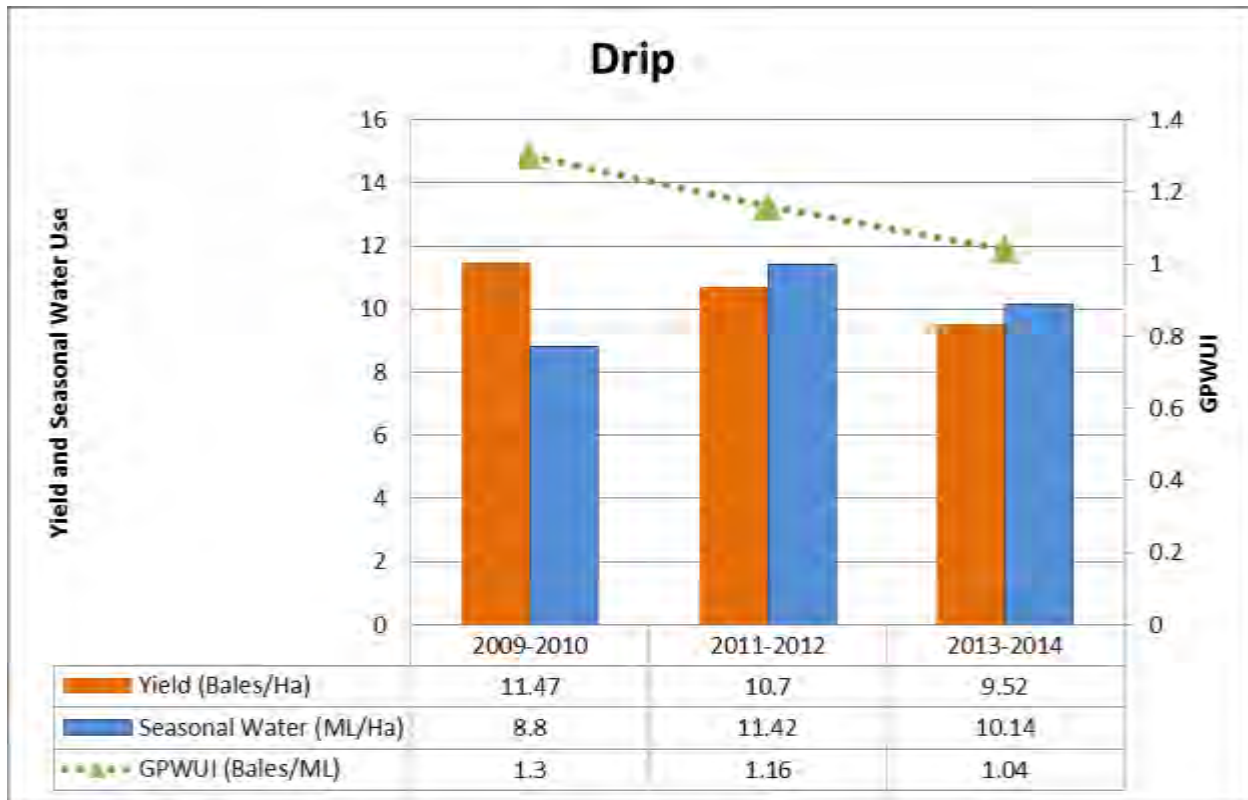
The drip field cut out before the bankless channel and furrow systems, but defoliation and picking were delayed by rainfall in late March. The drip system yielded less than the other systems.

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Seasonal Statistics:	2009-2010	2011-2012	2013-2014
Establishment method:	Watered up	Rain Moisture	Watered up
Planting:	1 st October 2009	14 th October 2011	7 th October 2013
Number of irrigations:	15	12	16
Irrigation water applied/Ha:	4.14 ML/Ha	3.80 ML/Ha	6.96 ML/Ha
Total seasonal water use:	8.80 ML/Ha	11.42 ML/Ha	9.84 ML/ha
Gross Production Water Index:	1.30 Bales/ML	1.16 Bales/ML	1.05 Bales/ML
Picking:	22nd April 2010	15th May 2012	22nd May 2014
Yield:	11.46 Bales/Ha	10.70 Bales/Ha	9.52 Bales/ha

The heavy black vertisols of the Gwydir Valley are not ideally suited to drip irrigation.



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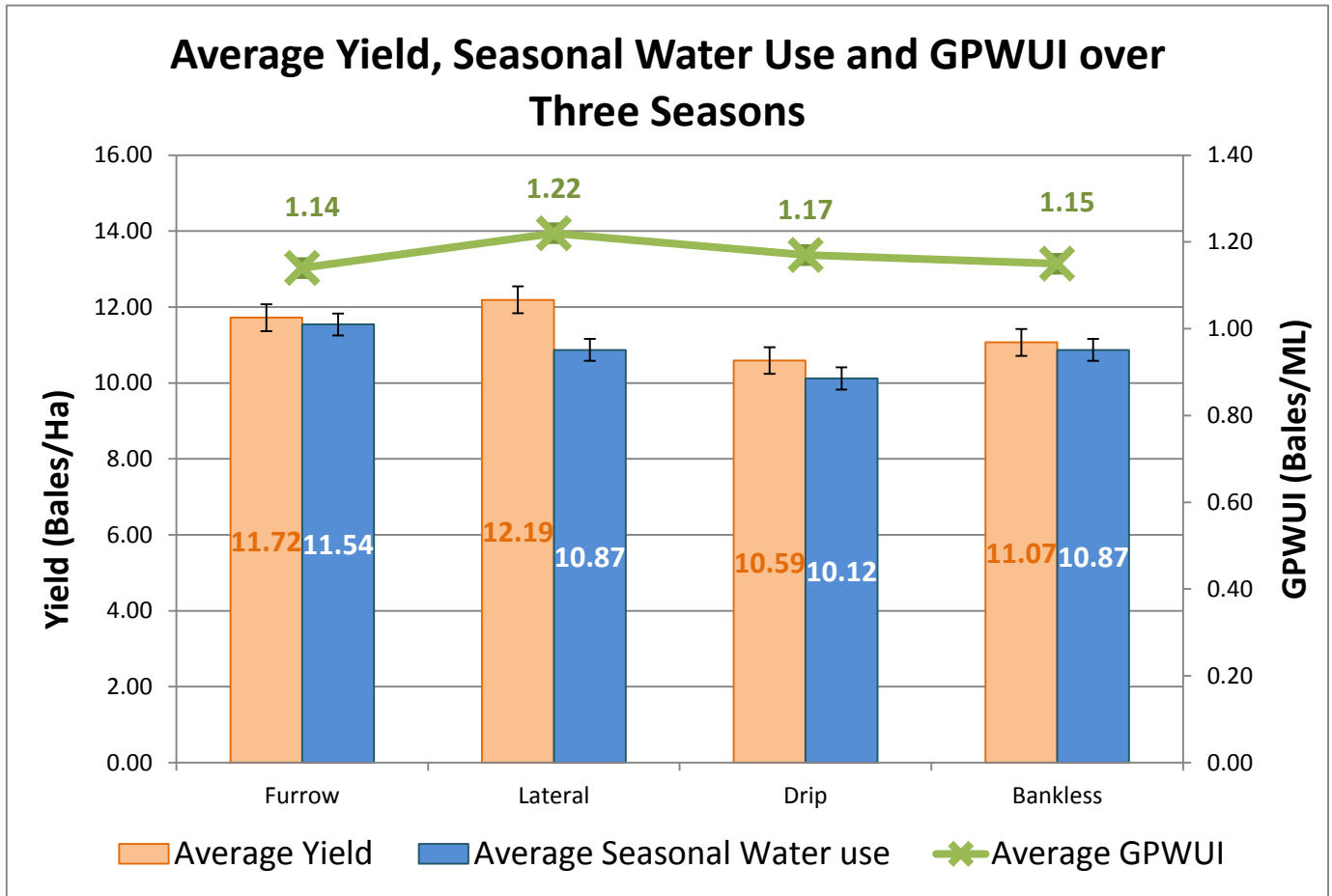
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Performance Over Three Seasons:

When the data is considered as an average of the three quite different seasons it shows that all four irrigation systems perform very well when compared using the GPWUI.

The data suggests that the lateral may be the most efficient with regard water use efficiency as it produced the highest GPWUI over the three years.

The average seasonal water use from the drip system was the lowest, but the average yield achieved under drip irrigation was consistently below the other systems.



To gain more insight it is important to look at the individual systems under different seasonal conditions. As can be seen in the comparison graph below, there has been quite a lot of variation between seasons.

In 2009-2010: a more typical season with rainfall during peak growth and slightly higher than average day degrees. All systems were able to perform very well. (NB: Bankless not representative due to field development issues).

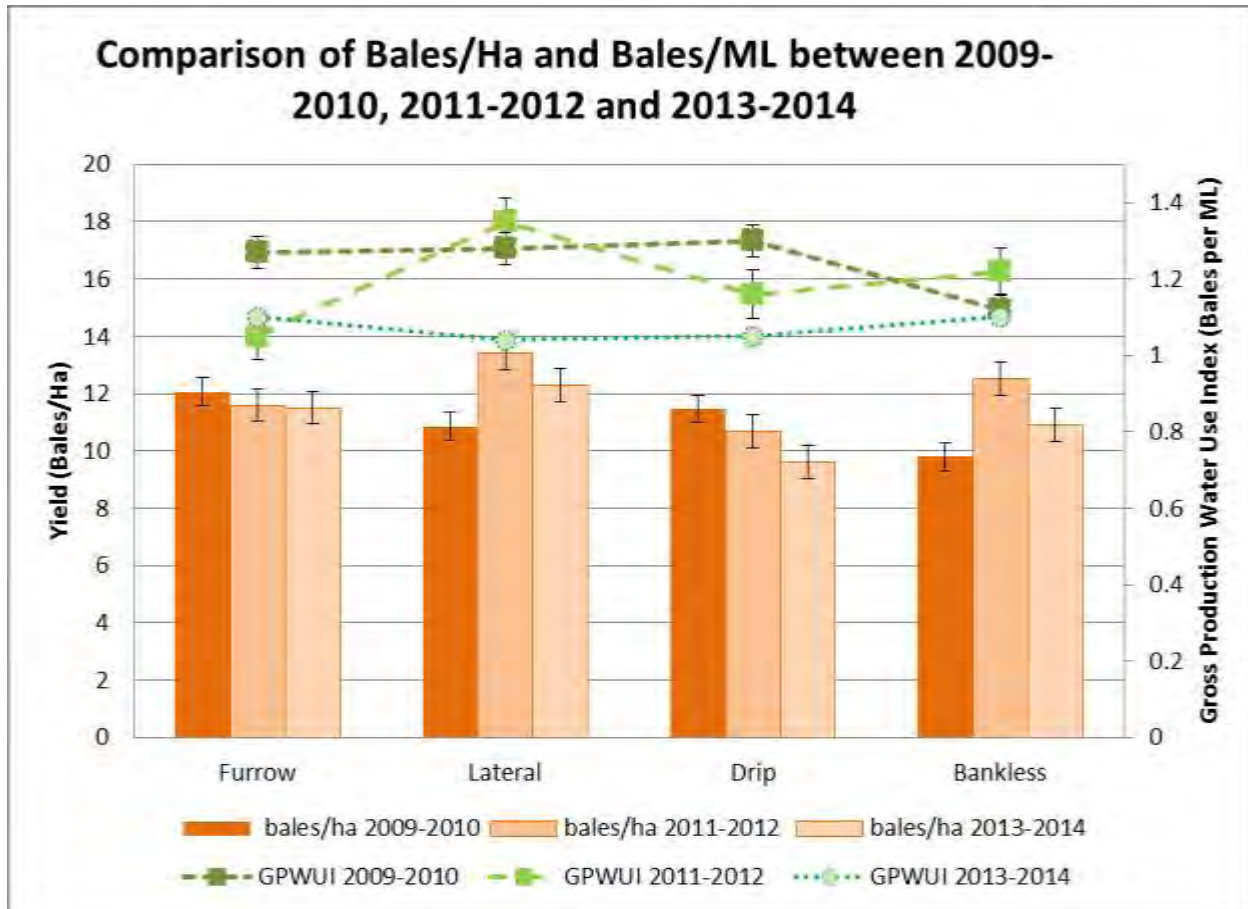
In 2011-2012: a cooler and wetter season, with significant cloud cover. The performance of the lateral appeared to be the best with regard yield and GPWUI. This may be due to

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the ability to manage irrigations more precisely, an important benefit in a wet overcast season.

In 2013-2014: a dry season punctuated by a cool start, a hot growing season and a cool finish. The water use efficiency of all systems was impacted by the lack of rainfall. The two strongest performing systems were the furrow and bankless channel both had GPWUI of 1.1. The Laterals performance appears to have been impacted most significantly with regard GPWUI (1.04), it did however manage to maintain its strong yield performance.



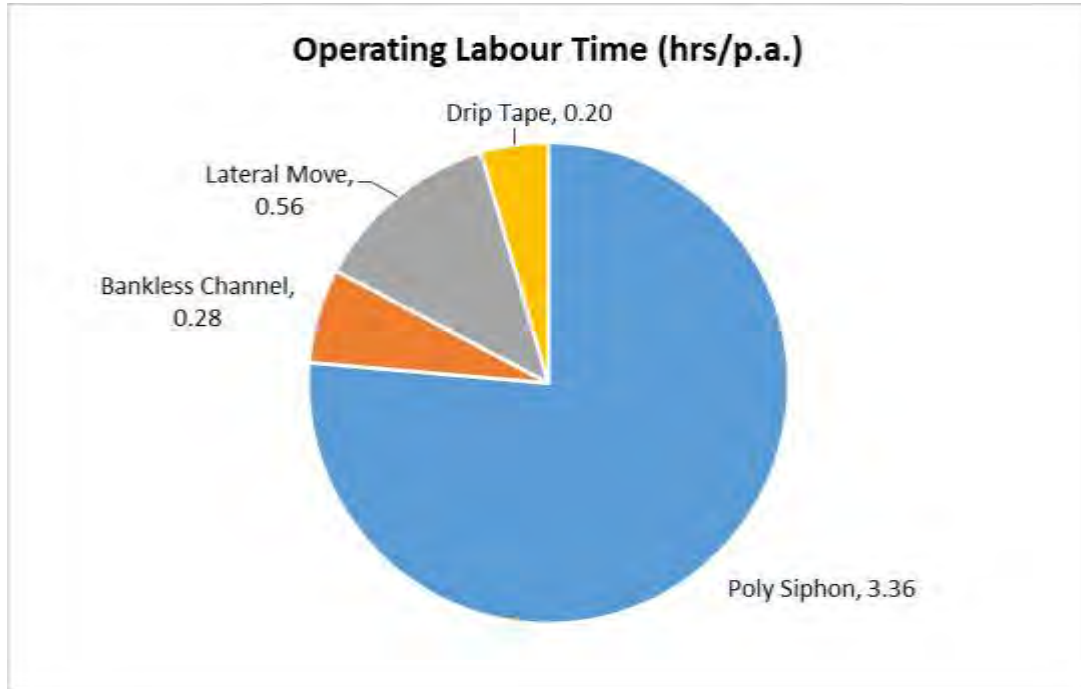
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Management Data

Over the last two seasons the project expanded to capture more information on management and resourcing of the individual systems. This enabled the project to capture data on labour and energy requirements of the systems.

Operating Labour Time (hours per annum)

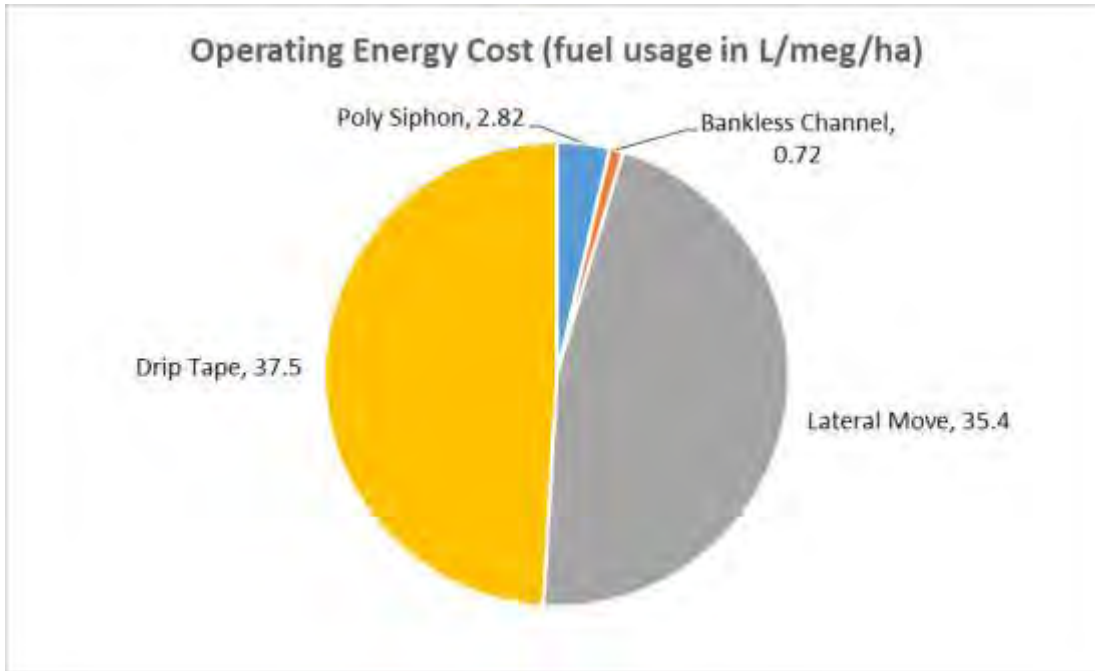


A review of the initial input comparison of the labour requirements of the systems confirmed the labour intensive nature of the furrow siphon system compared to the other options.

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Operating Energy Costs

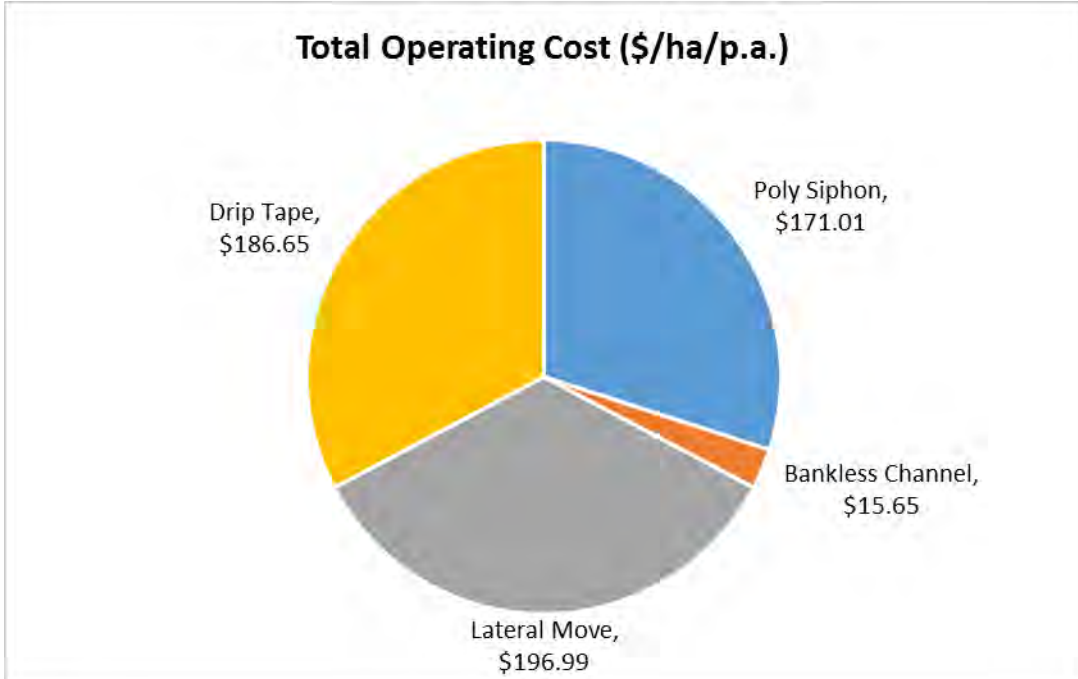


In contrast to the labour costs of the furrow system the lateral and the drip system have significantly higher energy costs. The systems at Keytah are run with diesel engines, but similar costs would be expected where electric systems are in place.

Initial Input Comparison of Total Operating Costs

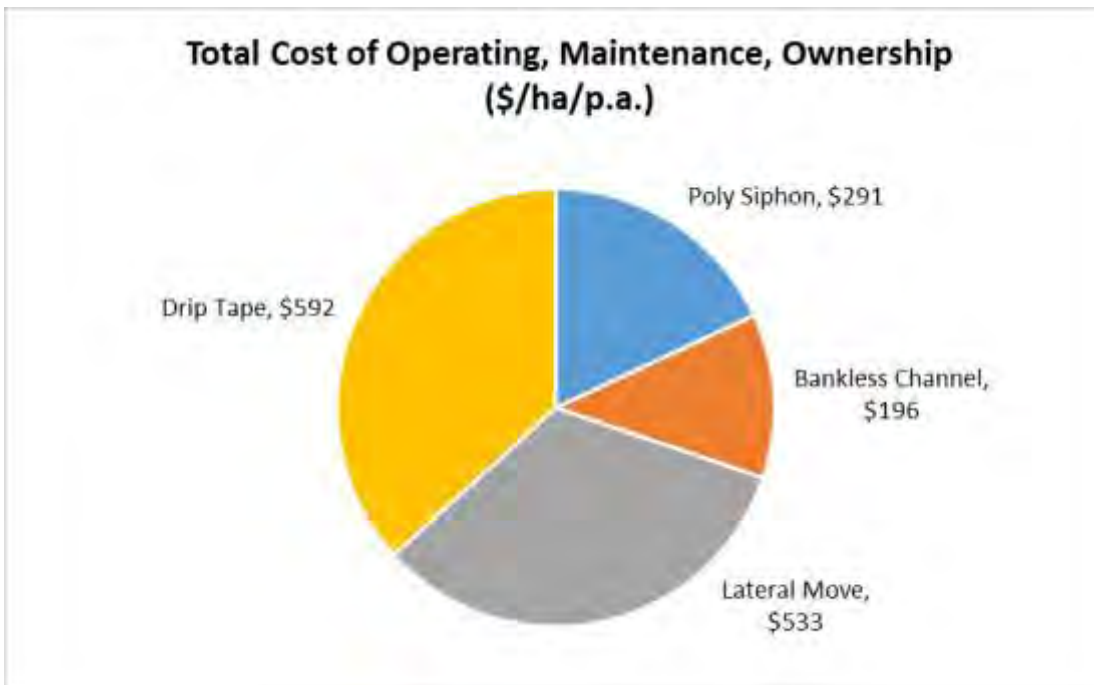
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When the operating costs including labour and energy are compared the Furrow, Lateral and drip systems are found to have similar costs per hectare per annum. The bankless channel is the most cost effective in these calculations.

Grand Total Cost of Operating, Maintenance, Ownership



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This final pie chart shows the overall cost comparisons associated with the operation, maintenance and ownership of the four irrigation systems. The individual figures will vary by farm and region, but the trends identified in this comparison are an important consideration for growers who are considering a change to their irrigation systems.

Conclusions

When the data is considered as an average of the three quite different seasons it shows that all four irrigation systems perform very well. As such all have a viable place as irrigation alternatives for cotton growers in Australia.

It is however important to consider the seasonal differences and the other limited resources which impact management on irrigated cotton properties in Australia.

As the three trial years have demonstrated there can be significant variation in climatic conditions, with extremes of rainfall and temperature not uncommon.

Managers must not only focus on water use efficiency, but must also consider the other essential resources of energy and labour.

In some regions labour shortages are critical and they will be more oriented towards systems which require less labour. The two least labour intensive systems are the bankless channel and the drip, while the furrow system is the most labour intensive.

All irrigators are monitoring the rising energy costs associated with moving water. The price of both electricity and fuel has increased in recent years. Data from the first two seasons of the Keytah comparison trial showed that the lateral and the drip systems could significantly increase energy requirements.

Another important consideration for growers is the set up and maintenance costs associated with each of the systems. As there is considerable investment in infrastructure the costs associated with installing and maintaining either the drip or lateral systems can be significant. Both these systems are fixed costs in the farm budget and as such are more suited to irrigation areas where there is a reliable water supply which enables them to be used in the majority of seasons.

Similar costs may also be incurred in ground re levelling in situations where changes are made between furrow and bankless channel systems. The costs and the challenges associated with moving large amounts of top soil will be important considerations in decisions to change systems. In some situations they may be too great to justify the change.

In summary the Keytah comparison trial has provided some much needed commercial insight into the management and set up of four different irrigation systems. All systems have been shown to be suitable systems to efficiently irrigate cotton in Australia. The yield, seasonal water use and the GPWUI have shown that the performance of each system will vary with the seasons.

Preliminary Draft

GVIA1302

Grower led research in irrigation system comparison in the Gwydir Valley

Part 2: Optimised Furrow Irrigation Row Configuration Trial.

Project Team

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Nathanial Phillis:	Sundown Pastoral Company
Darren Hart:	Sundown Pastoral Company
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Owen Berry:	Auscott Limited
Amy Johnson:	Auscott Limited
Louise Gall:	Gwydir Valley Irrigators Association
Zara Lowien:	Gwydir Valley Irrigators Association

With support from:

Janelle Montgomery:	NSW Department of Agriculture
James Quinn:	CSD
Rose Brodrick:	CSIRO
Oniroide Coast:	CSIRO
Joseph Foley:	University of Southern Qld

Gwydir Valley Irrigators Association Inc.

458 Frome St, PO Box 1451, Moree NSW 2400 (02) 6752 1399

Abstract:

Part 2 of the Grower Led Research into Irrigation Efficiency; Optimised Furrow Irrigation Row Configuration Trial was conducted in the 2014-2015 season. The trial was established at two locations in the Gwydir Valley, Keytah and Auscott Watervale.

This part of the GVIA1302 project was designed to investigate water-use efficiency optimisation techniques of the siphon or furrow irrigation system which is the standard industry practice. The trial investigated the relative yield potential of different row configurations under optimal irrigation. A more detailed understanding of the potential of each of these row configurations to produce under optimal water will be beneficial in times of limited water.

The objectives were to investigate water-use efficiency optimisation techniques of furrow irrigation under different row configurations. The project evaluated the trial in terms of water-use efficiency and considered the best practice management needed to adjust row configurations.

Through the project the GVIA will be able to increase the level of understanding of the pros and cons associated with different row configurations under furrow irrigation. Additionally the project will provide a data set which growers can use to make better informed decisions on row configurations when faced with limited water.

Results for the project are still being collated; once all the data is received the report will be completed.

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GVIA1302

Grower led research in irrigation system comparison in the Gwydir Valley

Part 2: Optimised Furrow Irrigation Row Configuration Trial

Introduction:

In 2012/13 GVIA was successful in sourcing funding through the CRDC to continue to investigate water use efficiency in the Gwydir Valley. A component of the project was to conduct an off-season trial to further explore ways to optimise water use efficiency and help growers adapt to less water. This report summarises the findings from part two of the CRDC project; Optimised Furrow Irrigation Row Configuration.

Irrigation application methods are essential to maximizing yield and water use efficiency in the irrigated cotton industry. Part two of this project investigated water-use efficiency optimisation techniques of the siphon or furrow irrigation system which is the standard industry practice. The trial investigated the relative yield potential of different row configurations under optimal irrigation. A more detailed understanding of the potential of each of these row configurations to produce under optimal water will be beneficial in times of limited water.

Project Objective:

To increase the awareness and understanding to help achieve a more resilient and competitive cotton farming system and an environmentally sustainable cotton industry.

Specific Aims:

1. Increase the understanding and adoption of practices that optimise the furrow irrigation system.
2. Increase the awareness and understanding of furrow irrigation row configurations and their potential benefits.
3. To help growers to maintain productivity but adapt to less water.
4. Increase the number of irrigators that assess their own irrigation performance through demonstrating practical methods to assess irrigation performance on farm.
5. Increase grower ownership of research by developing grower and industry partnerships throughout the project.

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Primary Goals:

This trial is intended to investigate the relative yield potential of a number of row configurations under optimal irrigation. A more detailed understanding of the potential of each of these different row configurations to produce under optimal water will be beneficial in times of limited water.

Objectives of Optimisation Trial

Investigate water-use efficiency optimisation techniques of furrow irrigation under different row configurations.

Demonstrate best practice and optimisation techniques of furrow irrigation.

Evaluate in terms of water-use efficiency and resource requirements.

Increase the level of understanding of the pros and cons associated with different row configurations under furrow irrigation.

Actual Trial

The trial was planted at two locations. At Auscott Watervale the trial was planted in field L1, and at Keytah it was planted in K8. The trial involved the comparison of 75cm (30 inch), 100cm (40 inch), 150cm (60 inch) and 200cm (80 inch) in a replicated trial formation. Each row configurations was watered as required with the aim to maximise the yield of each treatment. Measurements were made of total water applied and total water off each of the row spacings.

Trial Design

Split plot randomised block design. 24m plots, 3 replicates per row spacing. Total of 12 plots

Keytah Field Design

Plot	Treatment	24 Meters	Probes
1	75cm spacing	32 rows	
2	150cm spacing	16 rows	
3	75cm spacing	32 rows	
4	150cm spacing	16 rows	
5	150cm spacing	16 rows	C-probe and Canopy Sensor
6	75cm spacing	32 rows	C-probe and Canopy Sensor
7	200cm spacing	12 rows	C-probe and Canopy Sensor

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8	100cm spacing	24 rows	C-probe and Canopy Sensor
9	100cm spacing	24 rows	
10	200cm spacing	12 rows	
11	200cm spacing	12 rows	
12	100cm spacing	24 rows	

Auscott Field Design

Plot	Treatment	Meters	Probes
1	75cm spacing	32 rows	
2	200cm spacing	12 rows	
3	100cm spacing	24 rows	
4	150cm spacing	12 rows	
5	150cm spacing	16 rows	
6	200cm spacing	24 rows	
7	100cm spacing	24 rows	
8	75cm spacing	32 rows	
9	150cm spacing	16 rows	
10	200cm spacing	12 rows	
11	75cm spacing	32 rows	
12	200cm spacing	12 rows	

Trial Features

The choice of Auscott and Keytah as trial partners was very valuable. The Keytah operation utilises a 75cm (30 inch) system where cotton is planted on 3m beds. An important aspect of this setup is the stability of the bed structure. In contrast Auscott utilises a 1m (40 inch) system where cotton is planted on standard 1m beds.

Both organisations developed areas of the trial to represent the alternate bed structure not typically used in their operations. The alternate bed structure was more difficult to manage for both organisations.

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Plant Population

All treatments targeted an even linear plant stand. Records of plant stand achieved were recorded.

Location:

1. Keytah K8
2. Auscott Watervale L1.

Variables:

Where ever it was practical all treatments were watered as they required. The timing of irrigations was determined by the on farm agronomy team based on information from C-probes, crop observation. Canopy temperature sensors were installed in the trial, but we were unable to utilise them to aid in scheduling. To streamline irrigation management across the farms the broader row spacings and the narrow row spacings where generally irrigated at similar timings.

Total water on and total water off was measured for each treatment for each irrigation using Mace meters. To achieve this with the small size of the irrigated plots both farms had to design and fabricate drop boxes specifically for the trial. This enabled the most accurate measure of the water off each treatment.

System Knowledge and Management

The trial required careful management and observations by the irrigation managers. The timing of syphon start-up and observation of when water finished flowing from the field were some of the details which had to be recorded by the irrigation teams. Additionally they recorded MACE readings for all irrigations steps. This coupled with down loaded MACE meter readings enabled the determination of water use by each treatment.

The Keytah team were more comfortable with the 75cm while the Auscott team were more comfortable with the 1m spacing.

Soil Type:

An EM survey existed for both fields. The survey showed that there was little variability in soil type for both fields; <5% for L1 at Auscott and <9% for K8 at Keytah.

Monitoring method and equipment:

System Water Use = Soil moisture prior to irrigation + (water applied – water off) + in season rainfall – soil moisture after defoliation.

Each treatment to be assessed individually

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Yield = To be picked using bale pickers. Each treatment ginned separately. Lint quality to be recorded.

Method:

Water Assessments

- All treatments were planted dry and watered up
- C-probes were installed early season and used by the irrigation teams to monitor crop water use.
- C-probes were removed prior to picking.
- The sum of all water on each treatment less all water off totalled the water used.

Plant Assessments

- Plant establishment was recorded for each farm.

Rainfall and Temperature:

Rainfall information was collected on farm using Irrisat rain gauge at Keytah. Rainfall back up at Keytah airstrip.

Auscott installed a C-Probe with rainfall measuring capacity in trial.

Temperature and humidity information was be sourced from the Moree Bureau of Meteorology (BOM).

Meters:

All water on and water off for each treatment was measured with Mace meters at the head and tail drain of the field.

The tail drain mace used in conjunction with rainfall data measured rainfall runoff.

Two meters from the Keytah comparison site were utilised at Auscott. Telemetry was included.

There were some issues with the Mace meters at Auscott, and some early season measures were not as accurate as we had hoped.

C-Probes:

C-probes were installed in each treatment. These were used throughout the growing season to schedule irrigations and monitor the plants uptake of water.

All probes and core samples were taken from locations using EM and topography maps. Only post season soil core were taken from Auscott as past experience has found the information of little value.

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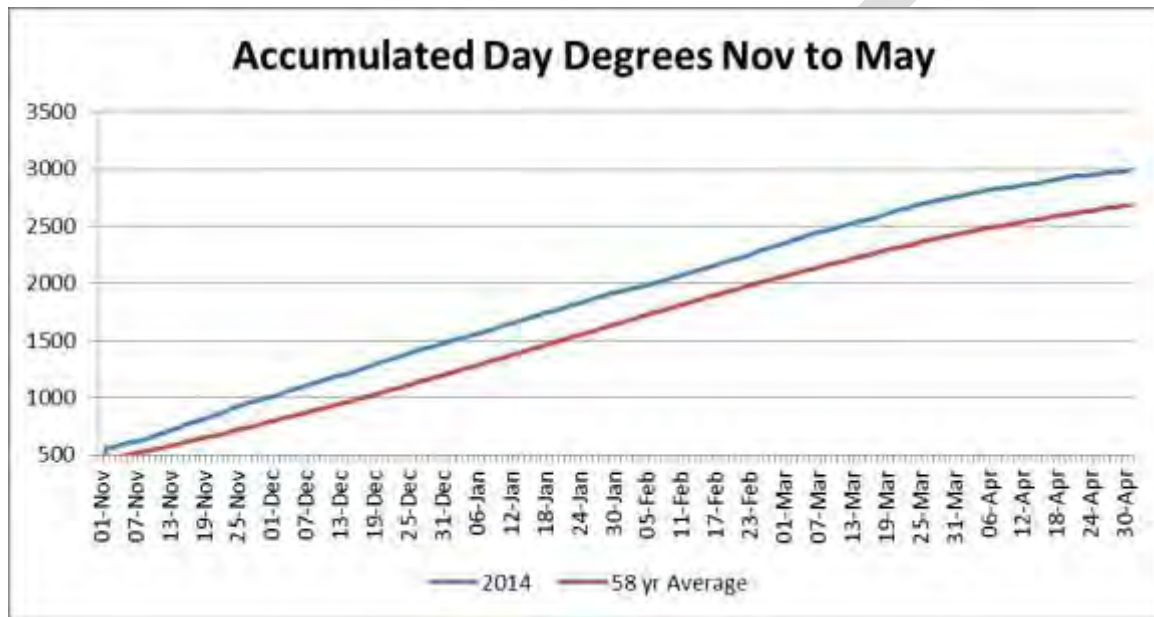
Agronomics:

Farm agronomist optimized management for each treatment with the objective to maximise the potential with regard yield and water.

Results:

Seasonal Data:

Accumulated Day Degrees



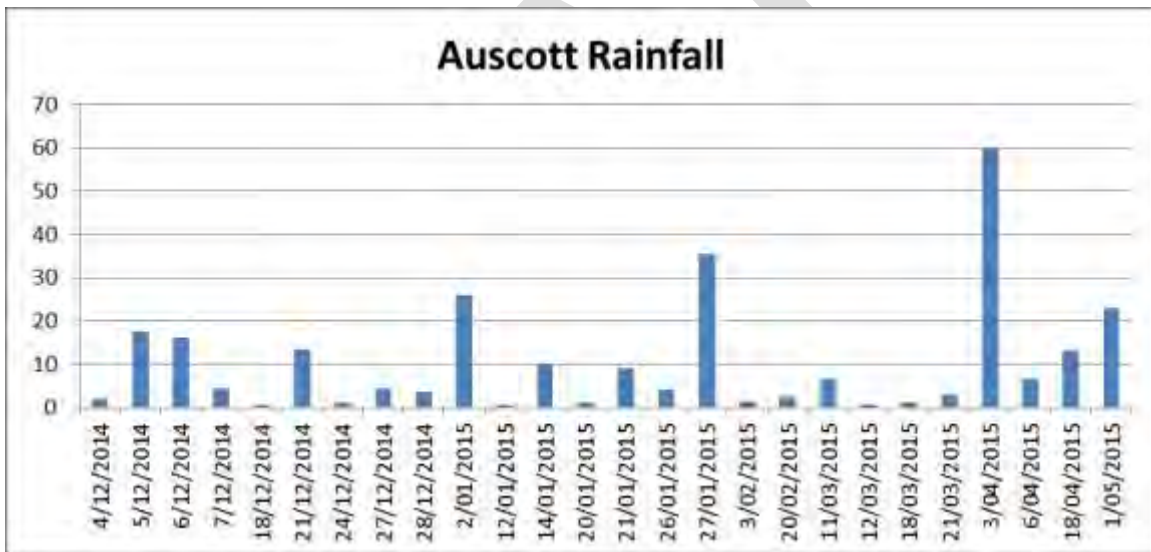
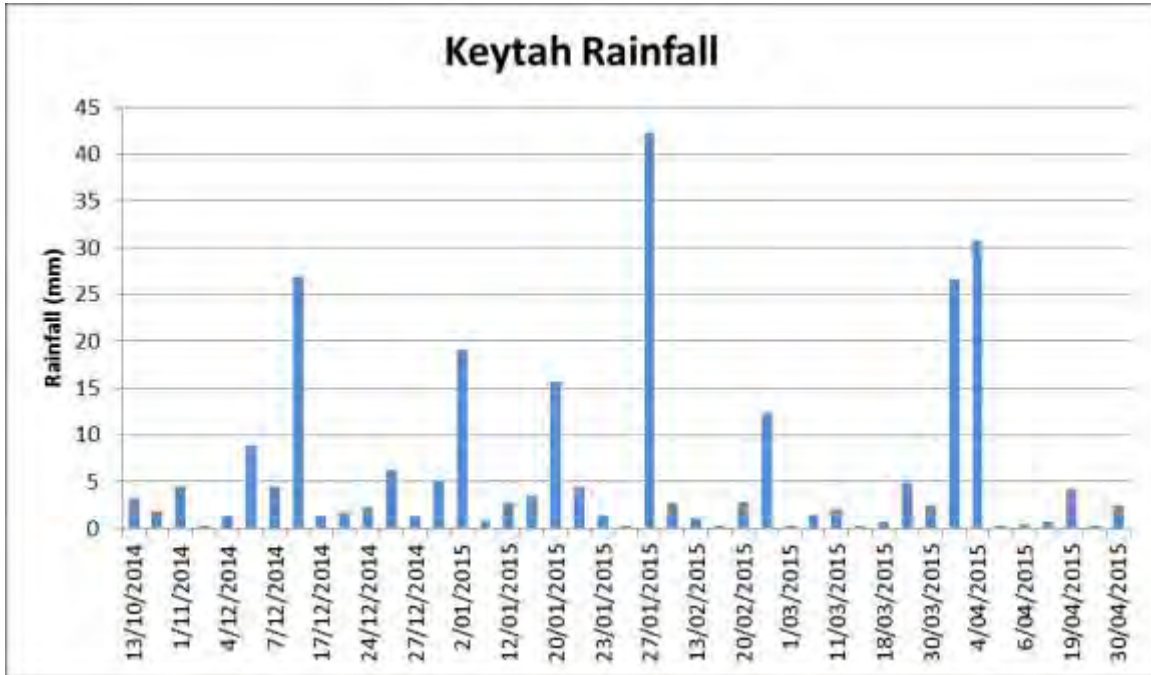
The accumulated day degrees for the 2014-2015 season shows the season to have been warmer than the 58 year average from September 2014 to April 2015. Both the Keytah and the Auscot row configuration trials were planted in November and avoided the early cold shock days.

Seasonal Rainfall

The following graphs show the seasonal rainfall for Auscott and Keytah. Both sites received a total of 243mm from the beginning of December 2014 to the end of April 2015.

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Irrigation information

Both sites were planted dry and watered up.

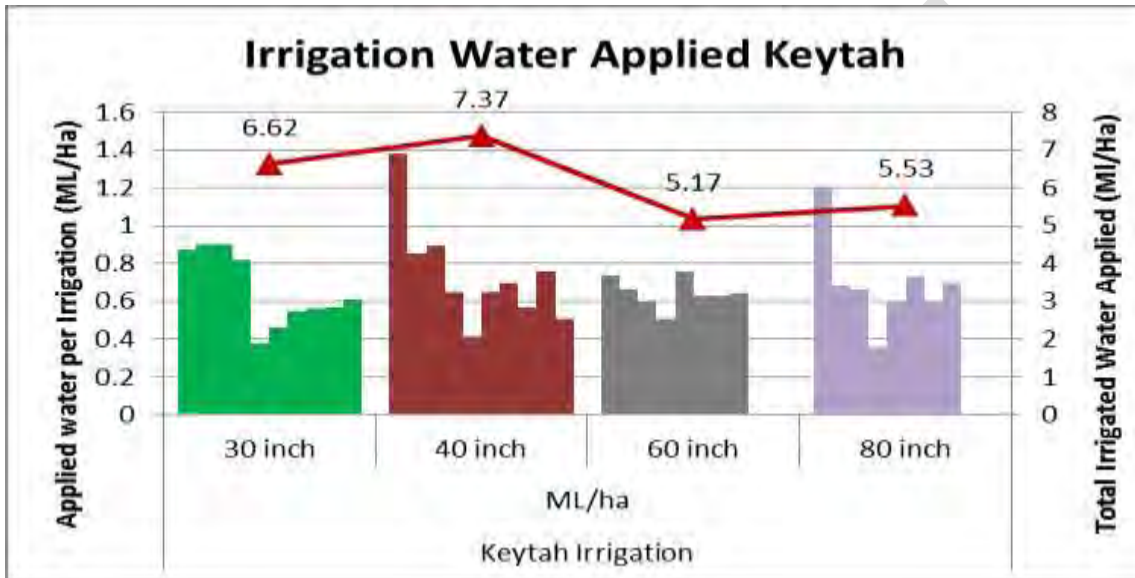
Keytah was planted on the 27th of October. The 75cm (30 inch) and the 100cm (40 inch) configurations were watered up on the 28th of October and the 150cm (60 inch) and 200cm (80 inch) were watered up in the 29th October.

There were significant subbing issues with the 100cm plots, and to a lesser degree with the 200cm plots at the Keytah site. The 1m beds had not stabilised

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adequately and the irrigation water did not run evenly down the furrows. The water readily subbed across to neighbouring treatments. In order to ensure that the profile in both the 100cm and the 200cm plots was wet up evenly the water was run for longer than would normally be the case. In contrast the water ran evenly down the established 3m beds where the 75cm and 150cm plots had been planted. In both cases the seed beds were wet evenly but the soil profiles may not have been as wet as in the 100 and 200cm plots.



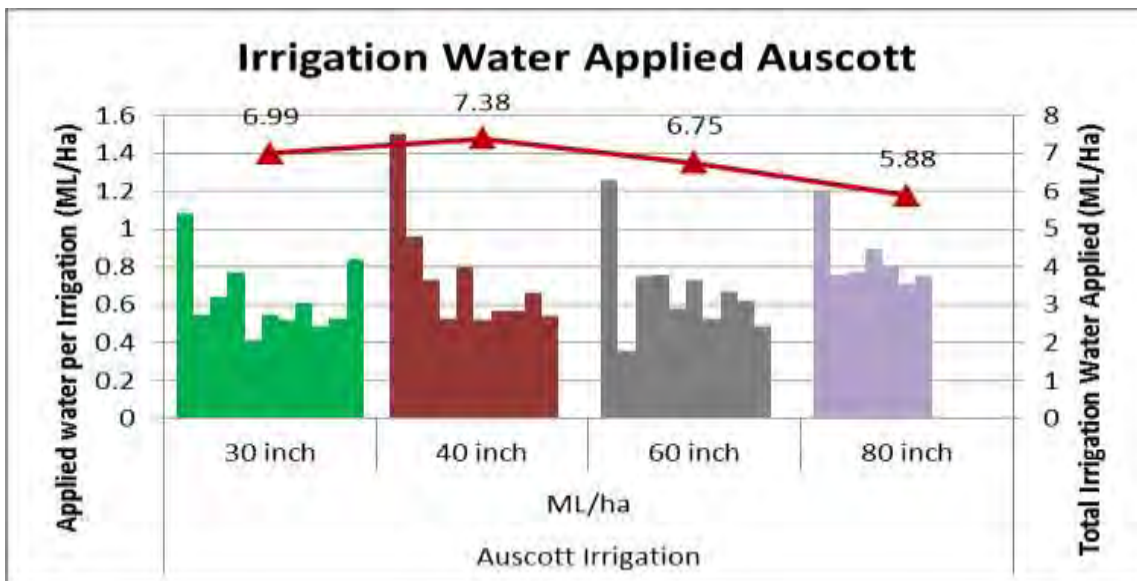
Auscott was planted on the 9th of November. The 100cm (40 inch) plots were watered on the 11th November, the 200cm plots (80 inch) on the 12th November, the 75cm (30 inch) plots on the 13th November and the 150cm (60 inch) plots on the 14th November.

There were several issues with the 75cm plots. The 3m bed structure had not stabilised as well as was ideal and there was significant slumping along the sides of the beds. This meant there were areas with very poor establishment and two of the replicants were replanted on the 27th of November, and flushed with an additional 0.55 ML/ha. There were also establishment issues in one of the 150cm plots, which was replanted on the 21st November and flushed with 0.36ML/ha.

Past experience at Keytah has found that the edges of the 3m beds used in the narrow row plantings must be firm. Considerable effort is put into ensuring bed edges are rolled well to minimise slumping.

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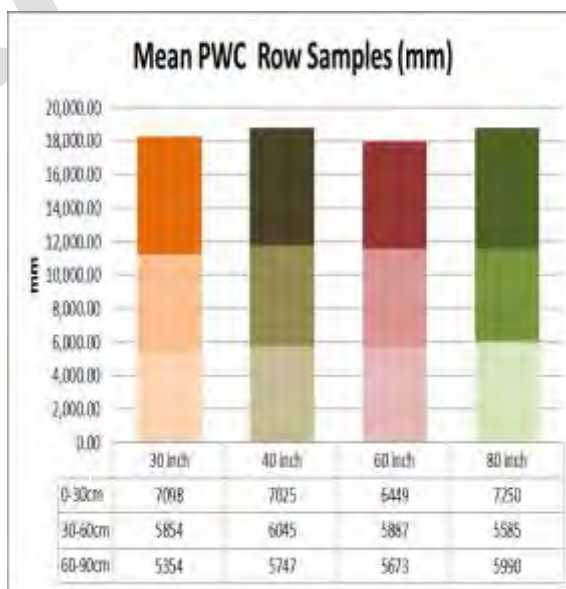
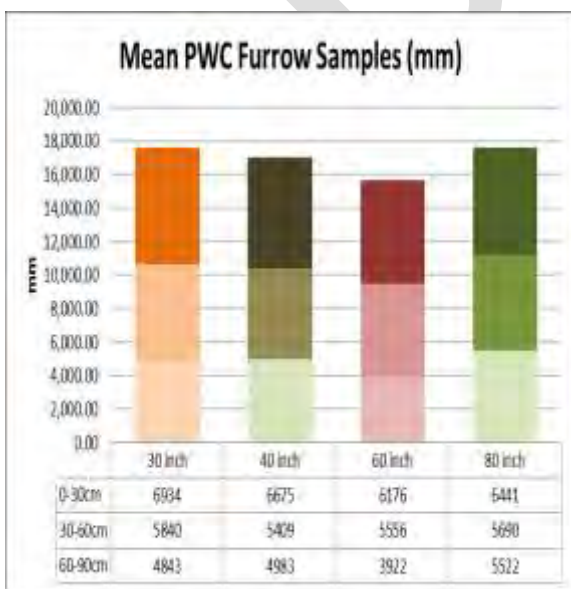
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The challenges identified with the bed structure and the implications for irrigation are important findings of the trial. It has highlighted the critical role that bed preparation plays in crop establishment and hence water use efficiency. Having to replant areas or having to run irrigation water for longer than ideal to ensure an even wetting of the seed bed is in efficient use of water.

Soil core samples were taken in the row and the furrow for each row configuration at the Auscott site. The samples were dried to determine the water content of the soil.

The following graphs show the findings from these samples.



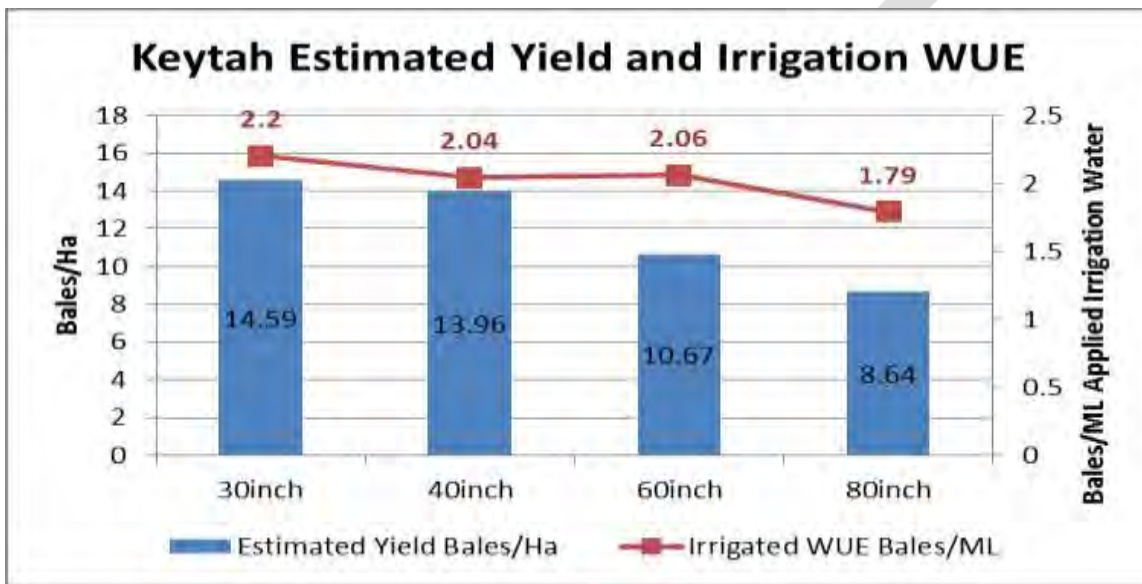
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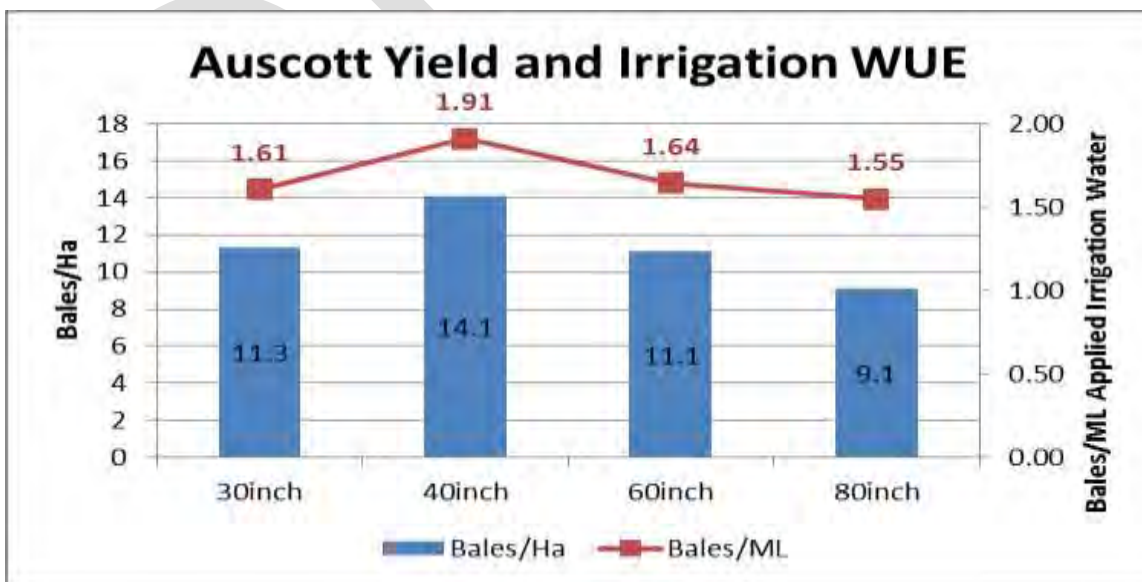
Yield and Water Use Efficiency

The yield results below show that at both sites the standard row configuration used on farm produced both the highest yield and the best irrigated water use efficiency.

Importantly the Keytah figures are estimates as the trial has not yet been ginned.



There were issues with getting an even seed bed in the 40 inch plots at Keytah. This meant that water was run for longer than for other treatments.



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At Auscott a large proportion of the 30 inch plots were replanted. This delayed development and meant that an additional 0.55 ML/ha was applied. It is believed that this may have had a detrimental impact on the performance of the 30 inch at Auscott.

A through comparison of the results will not be possible until all ginning information is received and further analysis is conducted between the treatments at both sites.

Conclusions:

Not conclusions have been made as the trial data is not all available.

DRAFT

Trial data to help growers



Neil Lyon

Editor, Toowoomba

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A GROWER-RUN cotton trial comparing a range of different row spacings aims to give growers a comprehensive suite of data to help them decide which configuration best suits their operations.

The trial on two sites in the Gwydir Valley – at Auscott's Midkin farm and Sundown Pastoral Company's Keytab Station – features replicated furrow irrigation blocks of four different row-spacing configurations: 75cm, 100cm, 150cm and 200cm.

Gwydir Valley Irrigators Association project manager Lou Gall said the broad aim of the trial was to determine the relative yield potential of each of the row configurations.

"We will be looking at that from a bales/megalitre and a bales/hectare perspective," she said.

"We will collect a lot of data that growers will be able to utilise to make decisions on planting when they are faced with potential limits of water during the season.

"We will have data for growers to determine which configuration is the best one, depending on their water availability or production expectations. Growers will have different needs depending on factors such as different soil types."

At the trial sites, C-probes and canopy temperature sensors have



Gwydir Valley Irrigators Association project manager Lou Gall checks cotton growing on 150cm row spacings at an Auscott trial site.

been set up to determine plant stress levels and the timing of irrigations. Each of the row configurations is irrigated independently to maximise yields.

While this is the first season for the trial, Ms Gall said the aim was to run it over several years to build up a resource of data that would be useful for growers.

"The more data we can get, the more confidence growers can have in making the decisions they make."

Ms Gall said the results would give growers the ability to adapt efficiently and effectively to less water if the need arose.

"At the moment a lot of growers in this valley don't know what water they will have for next year.

"Some may not have any, some will have it on certain farms and not others. They will be faced with critical decisions about what to plant, what happens if they get a good rainfall event and supple-

mentary flows during the season, and what will give them the best outcome across the board."

Auscott Midkin farm manager Owen Berry said the trial would provide valuable information for Auscott's cotton-growing enterprise.

"We are looking specifically at water use efficiency on each of the (row configuration) systems so we can make decisions and changes based on the bales/megalitre," he said. "We want to realise what the yield potential of the wider row spacings is because there is not a lot of data about what is the maximum production you can get out of the wider row spacing.

"People know what it can do if you don't give it its maximum water, but what can it really do if you give it its maximum water and aim to optimise the yield?"

The trial is funded by the CRDC through the Gwydir Valley Irrigators Association.



Industry remembers founding

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gwydir valley

irrigation technology field day

Moree - Wednesday 11 February

GVIA and CottonInfo invite you to attend the 2015 Gwydir Valley irrigation field day.

The field day is a combined event incorporating the 2015 GVIA grower-led trials, CRDC projects and the CottonInfo 2015 cotton irrigation technology tour.

Leading irrigation researchers and grower-led research coordinators will discuss the practical application of new technologies and trial results, including irrigation scheduling, automation and system design. Topics include:

- **Maximising yield under different row spacings** - Auscott and Keytah, GVIA grower trial.
- **IrriSAT** - Weather-based irrigation scheduling - Dr John Hornbuckle (CSIRO)
- **Canopy temperature sensors** - Plant based scheduling - Dr Onoriode Coast (CSIRO)
- **Dynamic deficit scheduling** - Dr Rose Brodrick (CSIRO)
- **EM38** - Soil-moisture monitoring - Jenny Foley (QLD DNRM)
- **VARIwise** - Variable rate irrigation and fertigation - Dr Alison McCarthy (NCEA)
- **Smart automation in furrow irrigation** - Dr Malcolm Gillies (NCEA), Dr Jasim Uddin (NCEA), David Robson (Rubicon).
- **Nitrogen loss pathways** - Ben Macdonald (CSIRO)
- **Sap flow meters and stem psychrometers** - Alec Downey (ICT)

Hear about the practical application of innovative irrigation technology on cotton farms.

Details:

Date:

Wednesday 11 February 2015

Time:

Meet bus at Moree Racecourse at 7:45am, for an 8am sharp departure and 2:30pm return.

Location:

The bus will travel to 'Auscott' and 'Red Mill', Moree

Catering:

Morning tea and lunch provided.

RSVP:

For more information or to RSVP, contact:

- Lou Gall, GVIA
lou.gall@gvia.com.au
0427 521 498
- Alice Devlin, CottonInfo
alice.devlin@cottoninfo.net.au
0427 207 167
- Janelle Montgomery, CottonInfo
janelle.montgomery@dpi.nsw.gov.au
0428 640 990



Gwydir irrigation technology tour



LEFT: The NCEA's Dr Alison McCarthy outlines site-specific surface irrigation and fertigation using adaptive controls at the Gwydir field day.

THE Gwydir Valley leg of the Cotton Irrigation Technology Tour gave 100 growers and consultants from Moree, Mungindi, Goondiwindi and St George the opportunity to hear from some of Australia's leading irrigation researchers.

Hosted by the Gwydir Valley Irrigators Association (GVIA) and CottonInfo, the field day started at Auscott where GVIA trial co-operators Sundown Pastoral Company and Auscott discussed the optimised row configuration research which is currently under way.

GVIA project manager Lou Gall said this was an ideal introduction to the range of tools and techniques which were becoming available to aid irrigation scheduling.

"Water-use efficiency is critical to the long-term viability of our industry, growers are constantly looking at tools or techniques which can help them utilise their water resources efficiently and maximise production," she said.

The tour gave researchers an opportunity to demonstrate some of these new irrigation technologies such as VARIwise – a package which utilises hydraulic modelling and data from soil and plant sensors to determine site-specific irrigation and fertiliser requirements.

Visitors heard about advances which are being made with tools such as IrrisAT the weather-based scheduling tool.

There was also good discussion on the practical benefits of plant-based irrigation scheduling techniques including Dynamic deficit scheduling and the use of canopy temperature sensors.

The discussions also included the research taking place using sap flow or stem diameter as tools to measure plant water stress.



St George cotton grower and CRDC board director Cleave Rogan tries out the EM38.

Used in conjunction with canopy sensors this technology will provide a more detailed understanding of plant water use.

Jenny Foley outlined the practical use of the EM38, a portable hand-held device which provides instantaneous soil moisture readings which are valuable measures of crop water use and plant-available water.

The field day then moved to Red Mill to look at some of the many trials Australian Food and Fibre are running this year. The first stop was at the nitrogen loss pathways trial where CottonInfo are working with Ben Macdonald from CSIRO to collect data on the fate of nitrogen fertiliser.

One point of discussion was the nitrous oxide movement in irrigation water which raised some good questions from growers who are interested in maximising nitrogen use efficiency.

The final site was the Smart automation furrow installation on Red Mill.

Here Jasim Uddin and Malcolm Gillies from NCEA and the team from Rubicon provided some insight into the installation and use of the automated technology.

Given the high labour costs



CottonInfo's regional development officer for the Gwydir, Alice Devlin, discusses the nitrogen loss pathways trial on Red Mill.

associated with furrow irrigation there were some good questions from growers.

St George cotton grower Cleave Rogan said: "Australian cotton farmers are some of the most innovative so I relished the opportunity to see in-field science innovation at the field day to further optimise our water conversion to bales. With many of the technologies presented I can picture practical use on-farm to optimise our farming systems."



Taking a closer look at an in-field weather station.

Cotton champions star at Hillston field day

THE National Cotton Grower of the Year Field Day is set to attract large numbers of cotton growers and industry representatives from across NSW and Queensland to Hillston in southern NSW.

The field day – to be held on Thursday, March 12 – will be hosted by the recipients of the 2014 Monsanto Cotton Grower of the Year Award, Tim and Sally Watson.

Cotton Australia regional manager for the Riverina Honi Anderson said the Watsons had been growing cotton in the Riverina for 14 years, and had been recognised for their innovative cotton growing techniques.

"Tim and Sally Watson are achieving outstanding results and they are not confined by conventional thinking," Ms Anderson said.

"In the average season, the Watsons grow more than 1100 hectares of irrigated cotton. 2013/14 crop yields of 12.8 bales per hectare were recorded at Sunland Agriculture, 25 percent higher than Australia's already world-leading cotton yield averages.

"This event gives growers a chance to see first-hand a current model of best practice and take a great deal of knowledge back to their own farm. The Field Day committee is in the process of

finalising the list of speakers and presenters which will be distributed in the coming weeks."

The event will run from 10am to 4pm at Sunland Agriculture, River Road, Hillston, NSW.

Registration must be received by February 28. Contact Honi Anderson on 0437 700 300 or email honia@cotton.org.au

The field day is an initiative of Cotton Australia with support from the Australian cotton industry's joint extension program, CottonInfo, and is sponsored by Monsanto Australia, AgriRisk, Cotton Seed Distributors, Incitec Pivot Fertilisers and Bayer CropScience.

Successful Gwydir Valley field day

ON February 11 the Gwydir Valley Irrigators Association (GVIA) and CottonInfo hosted the Gwydir leg of the Cotton Irrigation Technology Tour.

One hundred growers and consultants from Moree, Mungindi, Goondiwindi and St George had the opportunity to hear from some of Australia's leading irrigation researchers on the day.

Grower-led research is an important aspect of the cotton industry.

The field day started at Auscott where GVIA trial co-operators Sundown Pastoral Company and Auscott discussed the optimised row configuration research which is underway.

This was an ideal introduction to the range of tools and techniques which are becoming available to aid in irrigation scheduling.

GVIA project manager Lou Gall said water use efficiency was critical to the long-term viability of the industry.

"Growers are constantly looking at tools or techniques which can help them utilise their water resources efficiently and maximise production," she said.

The tour gave researchers an opportunity to demonstrate some of these new irrigation technologies such as VARIwise; a package which utilises hydraulic modelling and data from soil and plant sensors to determine site specific irrigation and fertiliser requirements.

Attendants heard about advances which were being made with tools such as IrriSAT the weather-based scheduling tool.

There was also good discussion on the practical



benefits of plant-based irrigation scheduling techniques including dynamic deficit scheduling and the use of canopy temperature sensors.

Alec Downey and Ben Dawson then discussed some of the research taking place using sap flow or stem diameter as tools to measure plant water stress.

Used in conjunction with canopy sensors this technology will provide a more detailed understanding of plant water use.

Jenny Foley outlined the practical use of the EM38, a portable hand-held device which provides instantaneous soil moisture readings which are valuable measures of crop water use and plant available water.

The field day then moved to "Red Mill" to look at some of the many trials Australian Food and Fibre were running this year.

The first stop was at the nitrogen loss pathways site where CottonInfo were working with Ben Macdonald from CSIRO to collect data on the fate of nitrogen fertiliser.

One point of discussion was the nitrous oxide movement in irrigation water, which raised some good questions from growers who were interested in maximising nitrogen use efficiency.

The final site was the smart

automation furrow installation on Red Mill.

Here Jasim Uddin and Malcolm Gillies from NCEA and the team from Rubicon provided some insight into the installation and the use of the automated technology.

Given the high labour costs associated with furrow irrigation there were some good questions from growers.

Cleave Rogan from St George said it was brilliant to see the researchers presenting their work to such a large group of growers.

"I was particularly interested in the practical application of the technology and wanted to see it working in the paddock," he said.

"I think there are some good ideas which will be most valuable to growers if they can be integrated into a platform which is accessible in real time."

The Gwydir Valley field day was run by CottonInfo, in conjunction with the Gwydir Valley Irrigators Association, with support from Cotton Research and Development Corporation (CRDC), the researchers and their research organisations: NSW DPI, QLD DAFF, QLD DNRM, CSIRO and NCEA.

The research showcased in the tour was funded by CRDC and the respective research organisations.

Irrigation Technology tour a great success

Gwydir Valley Irrigators Association (GVIA) and CottonInfo hosted the Gwydir leg of the Cotton Irrigation Technology Tour earlier this month.

"It was a fantastic day where 100 growers and consultants from Moree, Mungindi, Goondiwindi and St George had the opportunity to hear from some of Australia's leading irrigation researchers," Lou Gall, Project Officer and Regional Facilitator Gwydir Valley Irrigators Association said in a post-event media release.

"It was a very informative day covering a wide range of irrigation scheduling methods," Glenn Price from Mungindi, one of the many growers who attended, said.

"It increased our knowledge as growers of new technologies and tools which will help improve the efficiency of irrigation and ultimately save water."

Grower led research was an important aspect of the field day, with the GVIA optimised row configuration trial at Auscott the first stop.

Trial co-operators Sean Boland and Owen Berry from Auscott and Nick Gillinham from Sundown Pastoral Company discussed the trial which is looking to see what the yield potential of a number of different row configurations is.

This was an ideal introduction to the range of tools and techniques which are becoming available to aid in irrigation scheduling.

The tour gave researchers an opportunity to demonstrate some of these new irrigation technologies such as the EM38; a portable hand held device which provides instantaneous soil moisture readings which are valuable measures of crop water use and plant available water.

There was also good discussion on the practical benefits of plant based irrigation scheduling techniques including a summary on Dynamic deficit scheduling by Rose Brodrick and the use of Canopy temperature sensors by Onoriode Coast.

This was followed by the introduction of research into the use of sap flow or stem diameter to measure plant water stress.

Used in conjunction with Canopy sensors this technology will provide

a more detailed understanding of plant water use.

Alison McCarthy provided an update on VARIwise; a package which utilises hydraulic modelling and data from soil and plant sensors to determine site specific irrigation and fertiliser requirements.

John Hornbuckle detailed the advances which are being made with IriSAT, the weather-based scheduling tool.

The Field Day then moved to Red Mill to look at some of the many trials Australian Food and Fibre are running this year.

The first stop was at the Nitrogen Loss pathways site where CottonInfo are working with Ben Macdonald from CSIRO to collect data on the fate of nitrogen fertiliser.

One point of discussion was the nitrous oxide movement in irrigation water, which raised some good questions from growers who are interested in maximising nitrogen use efficiency.

The final site was the Smart automation furrow installation on Red Mill.

Here Jasim Uddin and Malcolm Gillies from NCEA and the team from Rubicon provided some insight into the installation and the use of the automated technology.

Given the high labour costs associated with furrow irrigation there were some good questions from growers.

Sean Boland said, "Water use efficiency especially when we are facing limited water availability, growers are constantly looking at tools or techniques which can help them utilise their water resources efficiently and maximise production."

"The irrigation field day gave a good overview of how some of these technologies may fit in production systems."

The Gwydir Valley Field day was run by CottonInfo, in conjunction with the Gwydir Valley Irrigators Association, with support from Cotton Research and Development Corporation (CRDC), the researchers and their research organisations: NSW DPI, QLD DAFF, QLD DNRM, CSIRO and NCEA. The research showcased in the tour is funded by CRDC and the respective research organisations.



TOP: Crowd photo at Auscott and ABOVE: In-crop demonstration of the EM38.