Australian Government
Cotton Research and Development Corporation

TRAVEL, CONFERENCE or SCIENTIFIC EXCHANGE REPORT 2014

Part 1 - Summary Details

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

CRDC Project Number: CRDC1521

Project Title: 2015 Cotton Irrigation Technology Tour

Project Commencement Date: 10/02/15 **Project Completion Date:** 12/02/15

CRDC Research Program: 1 Farmers

Part 2 – Contact Details

Administrator:	Ms Cara Brooks, Manager External Funding		
Organisation:	NSW Department Primary Industries		
Postal Address:	Locked Bag 21 Orange NSW 2800		
Ph: 02 63913651	**Fax:** 02 63913134	**E-mail:**	external.funding@dpi.nsw.gov.au
Principal Researcher:	Janelle Montgomery, Project Officer - Irrigation		
Organisation:	NSW Department Primary Industries		
Postal Address:	PO Box 209 Moree NSW 2400		
Ph: 02 67506476	**Fax:** n/a	**E-mail:**	janelle.montgomery@dpi.nsw.gov.au
Supervisor:	Anthea McClintock, Team Leader Water Policy Planning and Development		
Organisation:	NSW Department Primary Industries		
Postal Address:	Locked Bag 21 Orange NSW 2800		
Ph: 02 63913423	**Fax:** 0263913899	**E-mail:**	anthea.mcclintock@dpi.nsw.gov.au

Signature of Research Provider Representative: _____

Date Submitted: _____

Part 3 – Travel, Conference or Scientific Exchange Report

(Maximum two pages)

1. A brief description of the purpose of the travel.

2015 Cotton Irrigation Technology Tour – 7 researchers travelled to three cotton regions (Central Qld, Gwydir and Macquarie Valleys) to showcase the latest irrigation scheduling and automation technologies.

2. What were the:

a) major findings and outcomes

b) other highlights

SEE ATTACHED REPORT

3. Detail the persons and institutions visited, giving full title, position details, location, duration of visit and purpose of visit to these people/places. (NB:- Please provide full names of institutions, not just acronyms.)

n/a

4. a) Are there any potential areas worth following up as a result of the travel?

b) Any relevance or possible impact on the Australian Cotton Industry?

SEE ATTACHED REPORT

5. How do you intend to share the knowledge you have gained with other people in the cotton industry?

SEE ATTACHED REPORT

6. Please list expenditure incurred. ***(Double click inside the table to enter the data)***

SEE ATTACHED FINANCIAL REPORT

Date	Description	Amount excl GST	GST	Total
				0.00
				0.00
				0.00
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				0.00
				0.00
				0.00
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				0.00
				0.00
				0.00
			TOTAL	**0.00**

Please email your report 30 days after travel/conference to: research@crdc.com.au

2015 Cotton Irrigation Technology Tour
10-12 February 2015

Abstract

New irrigation research is offering exciting options for growers to improve water use efficiency and yield through more precise scheduling and application technology.

In February 2015, seven researchers travelled to three cotton regions (Central Queensland, the Gwydir and Macquarie Valleys), providing the opportunity for growers and consultants to hear about, question and see the latest Cotton Research and Development Corporation (CRDC)-funded irrigation research in action.

A comprehensive evaluation of the tour was undertaken to provide feedback on current irrigation research and plans for its adoption, and emerging technologies. In addition it provided a valuable forum for discussion of research gaps in scheduling and application information.

Janelle Montgomery
NSW Water Use Efficiency Technical Specialist, CottonInfo/Irrigation Officer, NSW DPI

17 April 2015

Janelle Montgomery | CottonInfo | **P 0428 640 990** | janelle.montgomery@dpi.nsw.gov.au | www.cottoninfo.net.au

Acknowledgements

The 2015 Cotton Irrigation Technology Tour was undertaken by CottonInfo with significant support from CRDC, along with the NSW Department of Primary Industries, QLD Department of Agriculture and Forestry, CSIRO, QLD Department of Natural Resources and Mines, the National Centre for Engineering in Agriculture (NCEA) and Gwydir Valley Irrigators Association.

Thanks go to:

- The cotton irrigators that hosted the field days including Cam Geddes, Wills Rd, Emerald; Ray Fox and Toby Makim, AFF, Redmill, Moree; and Tom Quigley, The Wilgas, Nevertire.
- The seven irrigation researchers who shared their knowledge with the field day participants over the course of the tour
- The small tour committee and CottonInfo RDO's that were involved in the organisation of the event; and
- The funding partners (as outlined above)

Pictured overleaf: **The irrigation researchers on farm at 'The Wilgas' Nevertire with CottonInfo technical specialist Janelle Montgomery, farm owners Tony, Tom, Richie and George Quigley and CottonInfo regional development officer Amanda Thomas.**
(LtoR: Back row – Richie Quigley, Jenny Foley, Malcolm Gillies, Alison McCarthy, Onoriode Coast, Tony Quigley, Rose Broderick, George Quigley, Amanda Thomas. Front row – Janelle Montgomery, John Hornbuckle, Jasim Uddin, Tom Quigley). Image Ruth Redfern

Janelle Montgomery | CottonInfo | **P 0428 640 990** | janelle.montgomery@dpi.nsw.gov.au | www.cottoninfo.net.au

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Tour Information

Background

In June 2014, irrigation researchers met in Narrabri for IrriCOMM. This workshop arose from discussion between CSIRO, CRDC and NSW DPI about irrigation research. The tools that irrigators are using to manage their irrigations have not changed dramatically over the last 20 years – despite investment in, and resulting advances to, R&D. The dominant tools being used by irrigators are capacitance based soil moisture measurement devices, and, more often than not, growers are making irrigation decisions based on their experience: years of irrigating and knowledge of their irrigation system, field, and soils, and most appropriate time to irrigate that crop under those specific circumstances.

Researchers have been developing weather and plant based scheduling methods, however, uptake of these technologies by growers has been limited due to a lack of local readily available evapotranspiration data, suitable crop coefficients, and the complexity of plant based methods when applying this to large scale broad-acre cropping systems in a highly variable climate.

The IrriCOM workshop enabled researchers to interact and discuss these issues, gaining a better understanding of current and future technologies and tools for irrigation management in cotton. It was found that significant progress has been made with a variety of irrigation technologies and that much of the research was at a point where it was needing to be extended to the wider cotton community – hence the 2015 Cotton Irrigation Technology Tour evolved.

The purpose of the 2015 Cotton Irrigation Technology Tour was to showcase the latest irrigation scheduling and automation field scale irrigation research. New irrigation research is offering opportunities for growers to improve water use efficiency and yield through more precise scheduling and application technology.

The tour was comprised of three field days: one at Emerald in Central Queensland; one at Moree in the Gwydir Valley; and one at Nevertire in the Macquarie Valley.

The tour showcased the following technologies at each field day:

- IrriSAT – Weather-based irrigation scheduling - Dr John Hornbuckle (CSIRO), Dr Janelle Montgomery (NSW DPI & CottonInfo NSW Water Use Efficiency Technical Specialist)
- Canopy temperature sensors - Dr Onoriode Coast (CSIRO) and Dr Lance Pendergast (DAF and CottonInfo QLD Water Use Efficiency Technical Specialist)
- Scheduling with dynamic deficits - Dr Rose Brodrick (CSIRO)
- EM38 surveys - For soil-moisture measurements and the potential for future use - Jenny Foley (QLD DERM)
- VARIwise - Optimal, adaptive irrigation - Dr Alison McCarthy (NCEA)
- Smart automation in furrow irrigation - Dr Malcolm Gillies (NCEA), Dr Jasim Uddin (NCEA), David Robson (Rubicon)

In addition, the Gwydir field day was a collaborative event with Gwydir Valley Irrigators Association, and as such, it showcased three additional research trials:

- Maximising yield under different row spacings – Auscott and Keytah, GVIA Grower Trial.
- Sap flow meters and stem psychrometers – Dr Alec Downey, ICT.
- Nitrogen loss pathways – Dr Ben MacDonald, CSIRO and Alice Devlin, CottonInfo.

The tour was promoted heavily through the CottonInfo extension network and local media, promoting positive response from irrigators across the three valleys. A booklet was created to showcase each of the irrigation technologies for growers, with a focus on how the tools could directly benefit growers on farm.

Copies of the field day flyers and programs are attached in Appendix 1.

The irrigation researchers, pictured on farm at the 'Wills Rd, Emerald,' trial site with CottonInfo technical specialists Lance Pendergast and Ngaire Roughly and farm owner Cam Geddes. Absent: Geoff Hunter, CottonInfo RDO, Emerald/Namoi.
(LtoR: Back row – Cam Geddes, Jenny Foley, Onoriode Coast, Alison McCarthy, Rose Broderick, John Hornbuckle, Malcolm Gillies, Lance Pendergast, Jasim Uddin and Ngaire Roughly. Image Ruth Redfern

Participant Responses

A comprehensive evaluation was conducted to provide evidence of changes in KASA (knowledge, aspirations, skills and attitudes) as a result of attending the field days. Participants completed an anonymous feedback sheet at the end of each workshop. The CottonInfo team members in attendance also completed a "silent witness" evaluation sheet which captured comments, questions and mood of participants throughout the field day. The evaluation templates are provided in Appendix 2. A total of 90 evaluations were received over the three field days, where 173 people attended – a 52 percent response rate.

The results of the evaluation are summarised in this section.

Demographics

There were a total of 173 participants registered and participated in the irrigation technology tour field days, including 67 growers, 39 consultants, 21 industry representatives (industry organisations, media and the rural finance sector) and 10 unknown as shown in Figure 1. Not all participants completed the evaluation feedback sheet, 90 sheets were returned (52 percent of participants), with their classification provided in Figure 2. The irrigators and consultants (106) who responded to the evaluation managed 181,732 ha land developed for irrigated cotton production.

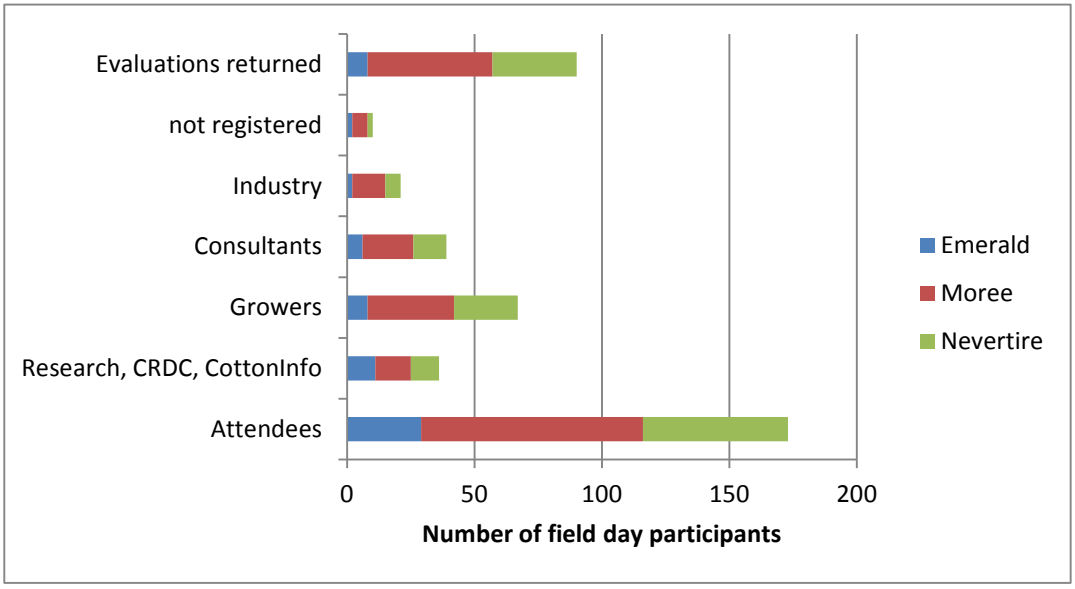


Figure 1: Classification of evaluation respondents who attended the 2015 Cotton Irrigation Research Tour

Event Publicity

The participants heard about this field day mostly through CottonInfo and through conversations with friends, family and advisors as shown in Figure 2.

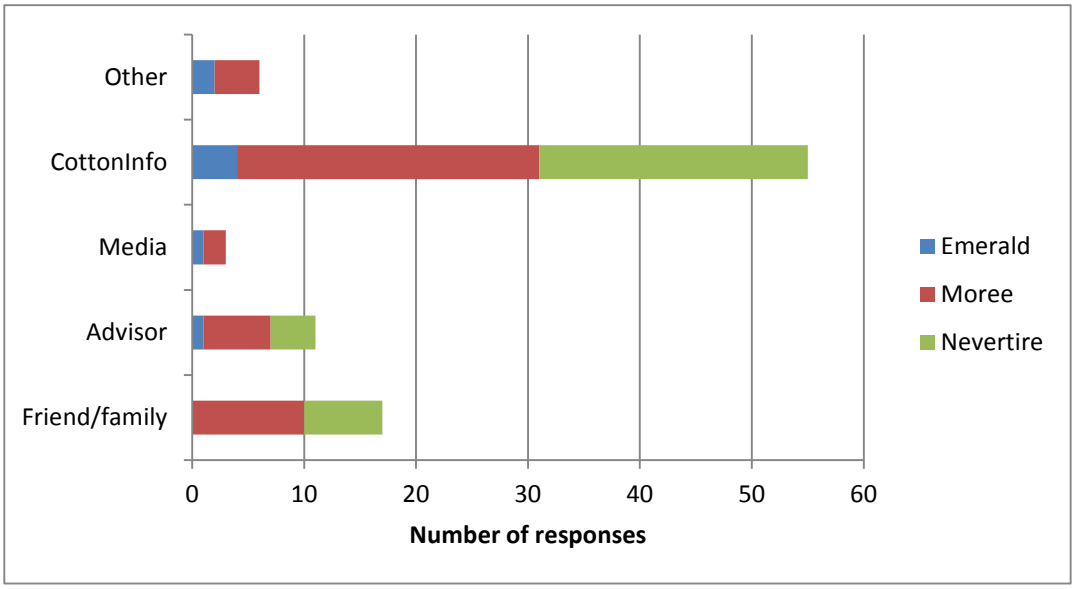


Figure 2: How participants heard about the 2015 Cotton Irrigation Technology Tour

Field day aims and expectations

Overall, participants indicated that the field days had met their aims and expectations. Over 90 percent of respondents either agreed of strongly agreed that their aims and expectations of the field day had been met as shown in Figure 3.

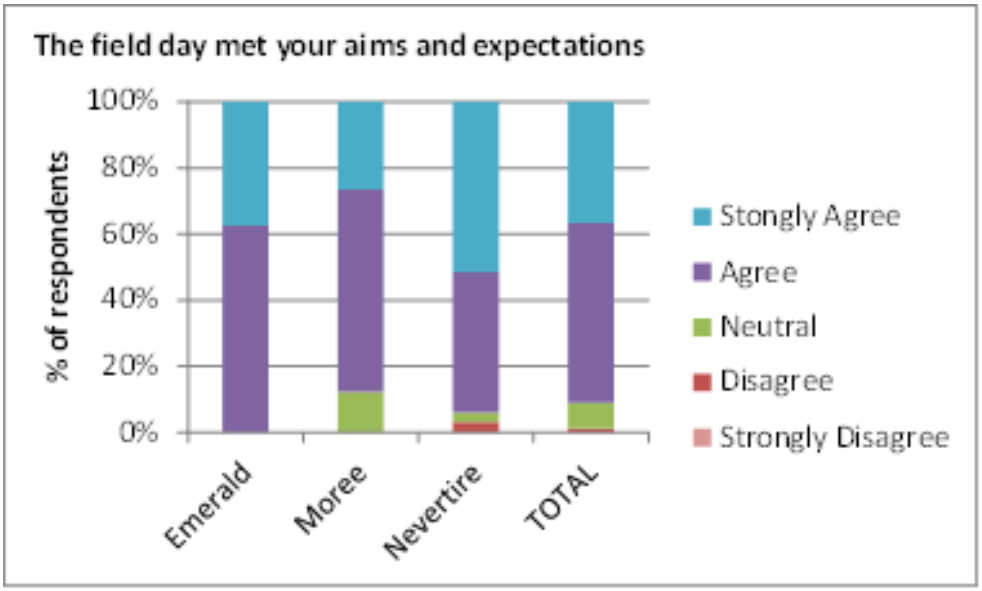


Figure 3: Usefulness of the field days in meeting aims and expectations

Field day presentations

Field day participants found the presentations to be of a high standard (Figure 4) and delivered at a level that field day participants could understand (Figure 5).

Respondents were asked to provide suggestions on what improvements could be made to make the field days more useful to them. These comments are listed in Table 1. In summary participants wanted greater technical detail on each of the technologies and they felt that this type of information would be better presented indoors.

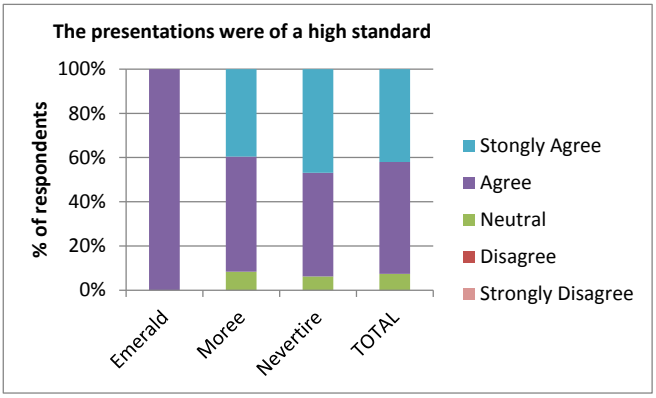


Figure 4: Standard of presentations

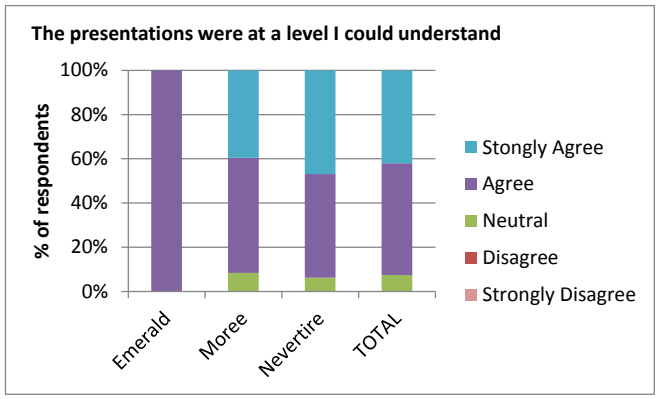


Figure 5: Presentation delivery

Table 1: Responses from participants - How could we have improved the day to be more useful for you?

• Really useful when we had practical example/experience and comment from Cam. Maybe need more trial/project partners in our area
• Presentation of seasonal data from this site.
• Supporting data from projects/technologies
• More interaction of practical users and implementation
• Go to shed for presentations and only in field for short time
• Some presenters struggled in a field situation to extend info
• Better microphone for speakers
• A bit more data and explanation in fact sheet form
• Little more information on application, hearing from growers on usefulness, infield change, adoption
• Talk more about previous results and results so far in current trials
• Would like more specific information on each topic
• The day was useful but there are a lot of unanswered questions regarding new technologies
• Ask speakers to repeat questions from audience before answering
• This needed to be inside. We did not have to be in the paddock
• More question time, researchers can get carried away, want more specific data and take home messages.
• In a conference room

New knowledge gained

Field day participants were asked if the field days improved their knowldege of each of the irrigation technolgies and how they could be used on their farms (Figure 6). There was a resounding 'yes' to this question with 97 percent of particpants indicating that they had gained new knowledge as a result of attending the field days.

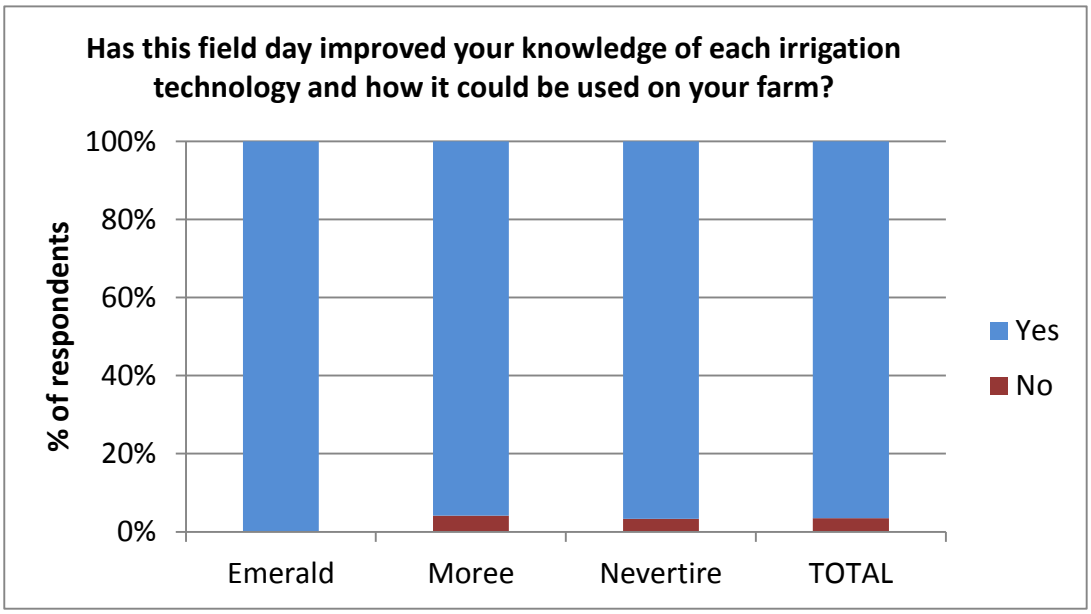


Figure 6: Has this field day improved your knowledge of each irrigation technology and how it could be used on your farm?

Changes in KASA (knowledge, awareness, skills and aspirations)

Gains in understanding

A summary of KASA changes from all three field days (Figure 7) indicated an overall increase in the level of understanding of each irrigation technology. Participants indicated that they knew least about Dynamic Deficits and VARIwise technologies. However, these technologies also had the greatest increase in understanding. Participants had a fair understanding of Crop Canopy Sensors and EM38 prior to the field days, but again, there was an increase in understanding as a result of attending the field days.

The results for individual regions, Emerald, Moree and Nevertire (Figure 8) show the technologies in which each region is most familiar and where greatest increases in knowledge occurred. For example, Emerald participants indicated a good knowledge of EM38, however there was a large increase in knowledge of all other technologies, indicating less knowledge about these before the field day. Whereas it would appear from the responses that Gwydir irrigators are more familiar with crop canopy sensors and dynamic deficits.

A Silent Witness Observation sheet was completed for each technology at each event and presented in Appendix 4. They include the questions asked and comments made during each presentation and provide further insight into changes in KASA and identify further extension requirements of the various irrigation

technologies, ie parts of presentations that they had difficulty in understanding or were further information was required.

Need for further extension

Participants were asked if they would like to see more extension of any of the irrigation technologies in their region (Figure 9). In particular, Emerald would like further extension on IrriSAT, canopy sensors, variwise and smart automation. Whereas in Moree and Nevertire, the largest response for greater extension was for EM38, along with IrriSAT and Crop canopy temperature sensors.

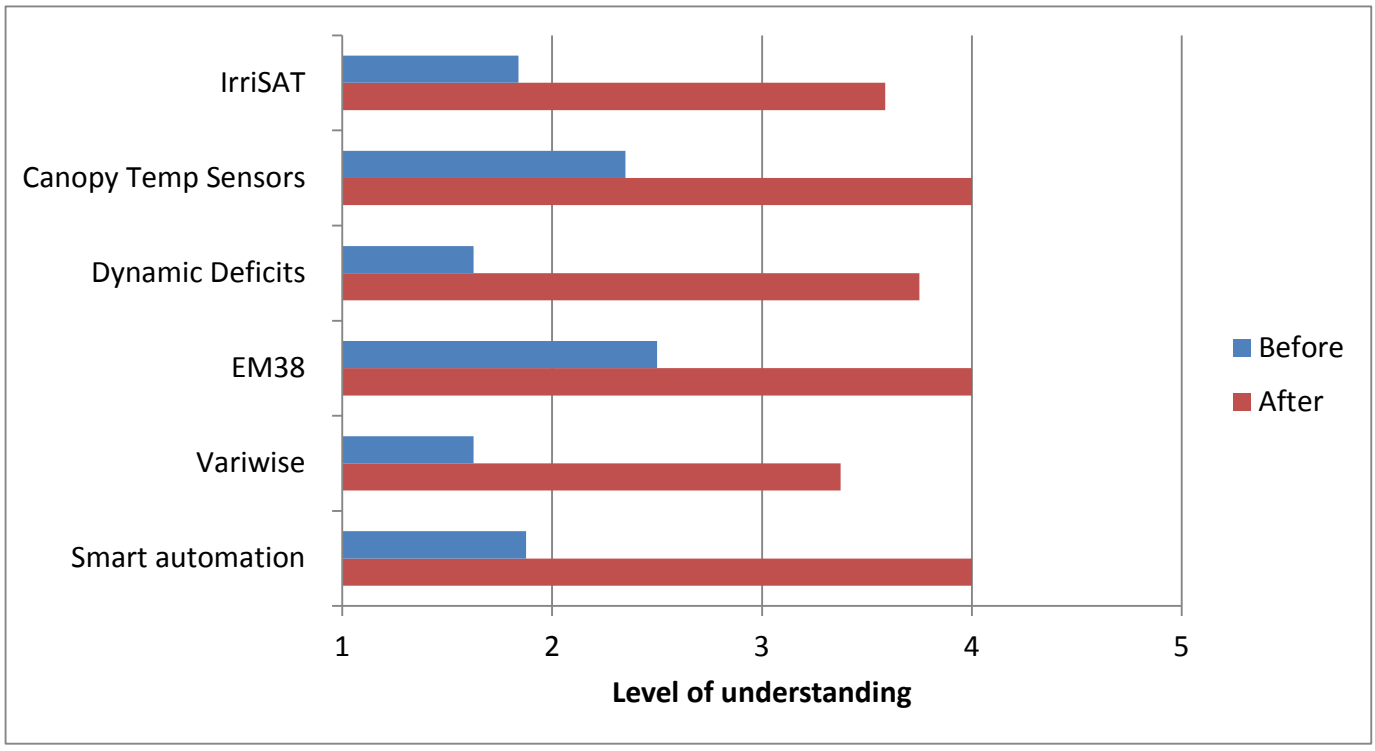


Figure 7: Average level of understanding of each irrigation technology before and after field days, total of three field days, where 1 is very basic and 5 is very good.

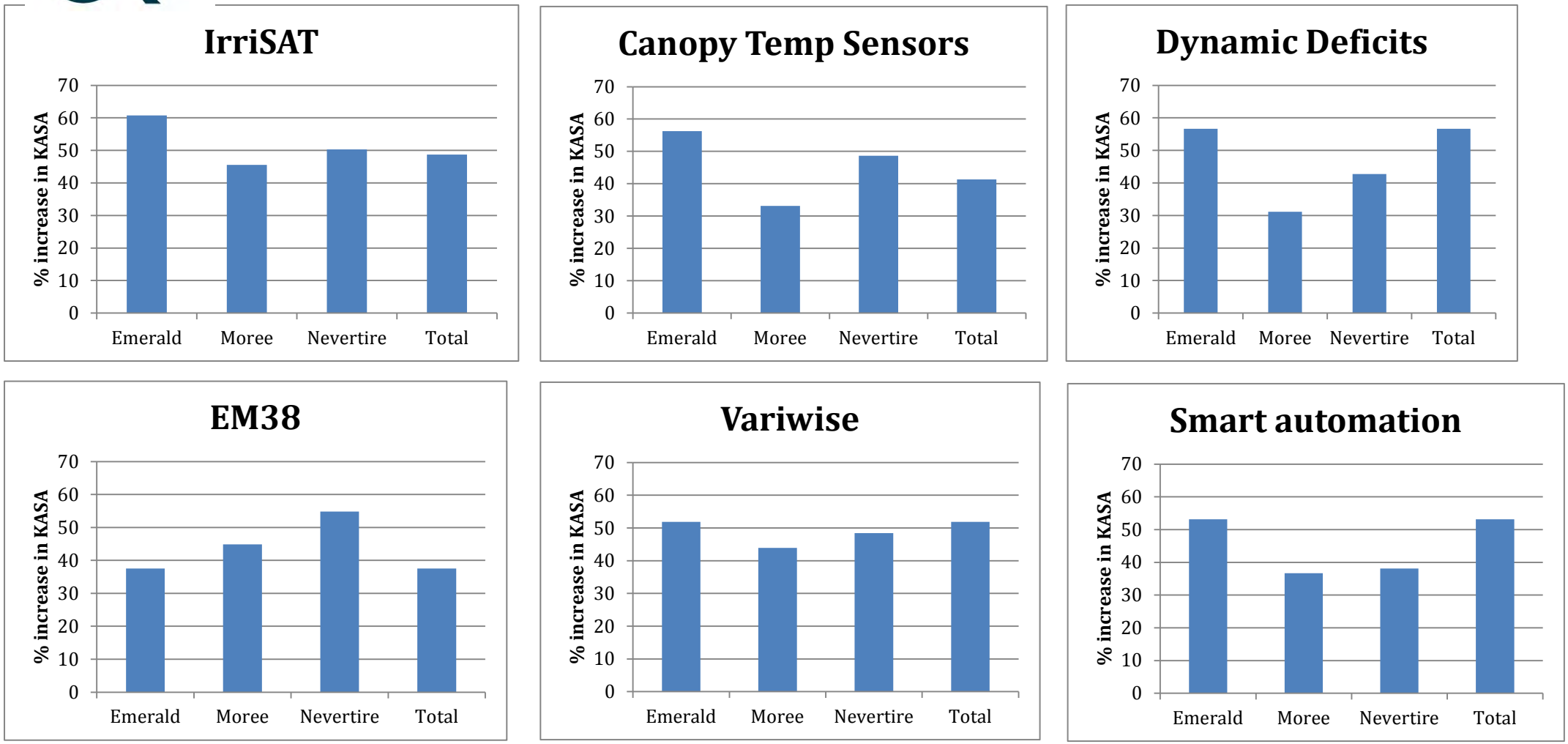
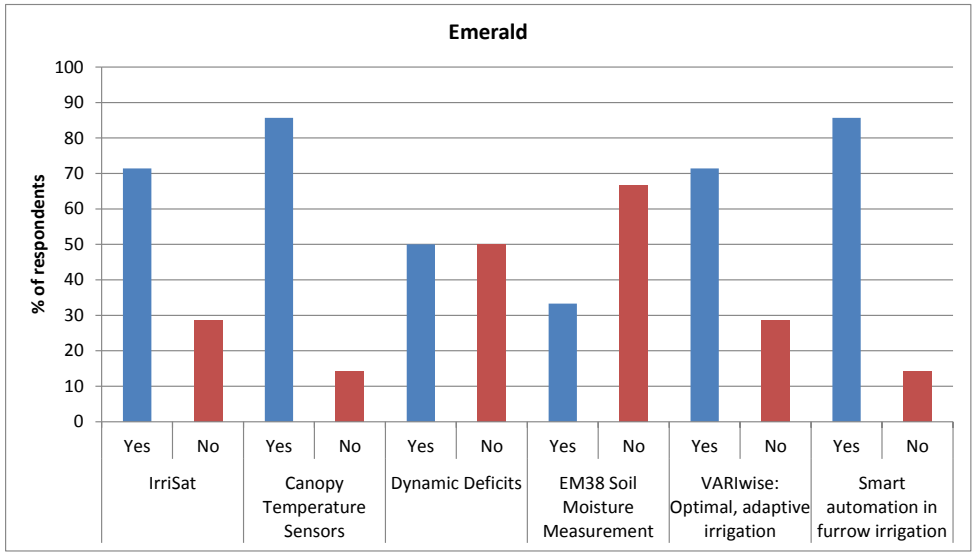
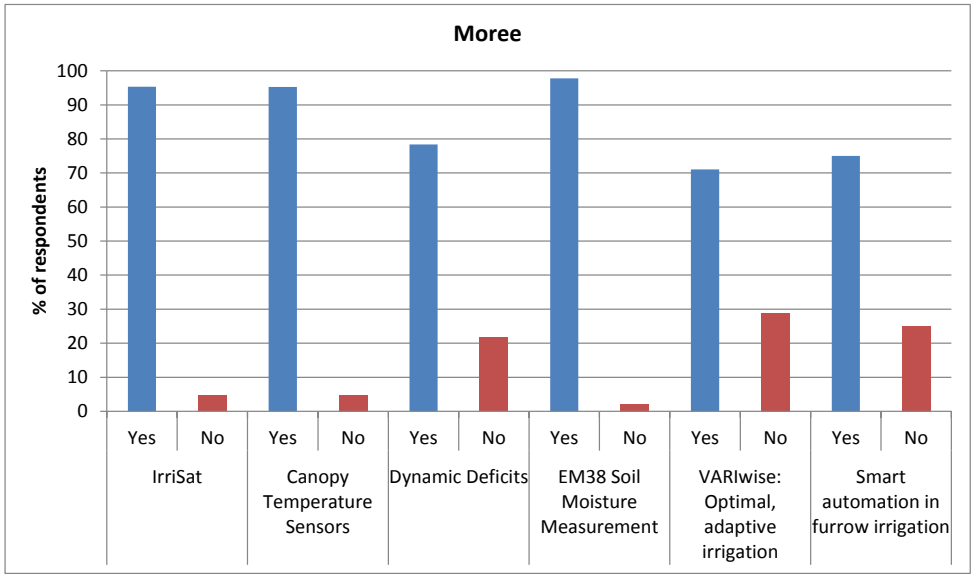


Figure 8: Percentage increase in level of understanding of each irrigation technology as a result of attending each field day (Emerald, Moree and Nevertire) and total increase across all three field days.

Janelle Montgomery | CottonInfo | **P 0428 640 990** | janelle.montgomery@dpi.nsw.gov.au | www.cottoninfo.net.au





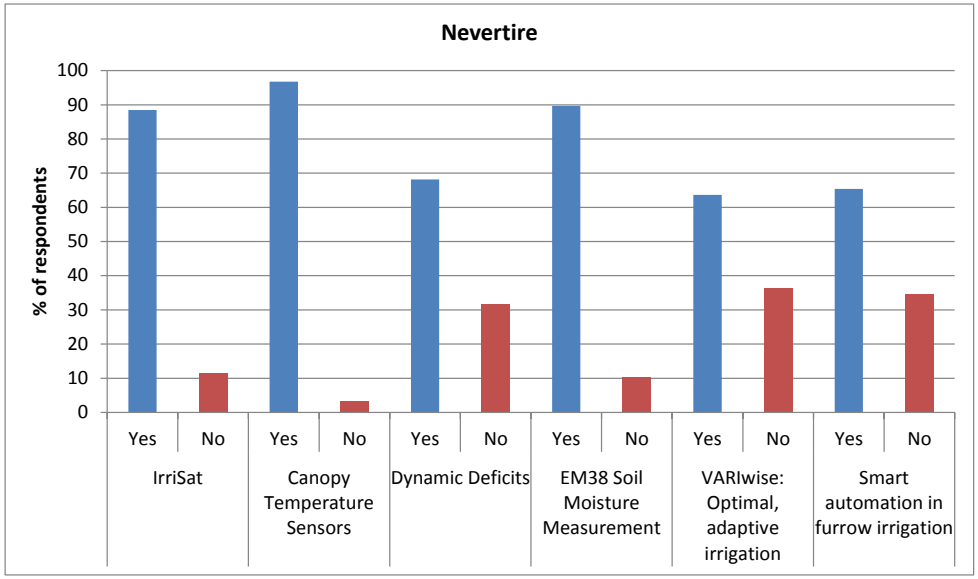


Figure 9: Would you like to see more extension of any of the irrigation technologies in your regions?

Preferred method of extension

Overall, for those technologies that participants indicated further extension was require, the preferred method of extension was field days and farm trials (over 76 percent of respondents). Other suggestions for extension included an off-season seminar and workshop where more detail can be presented.

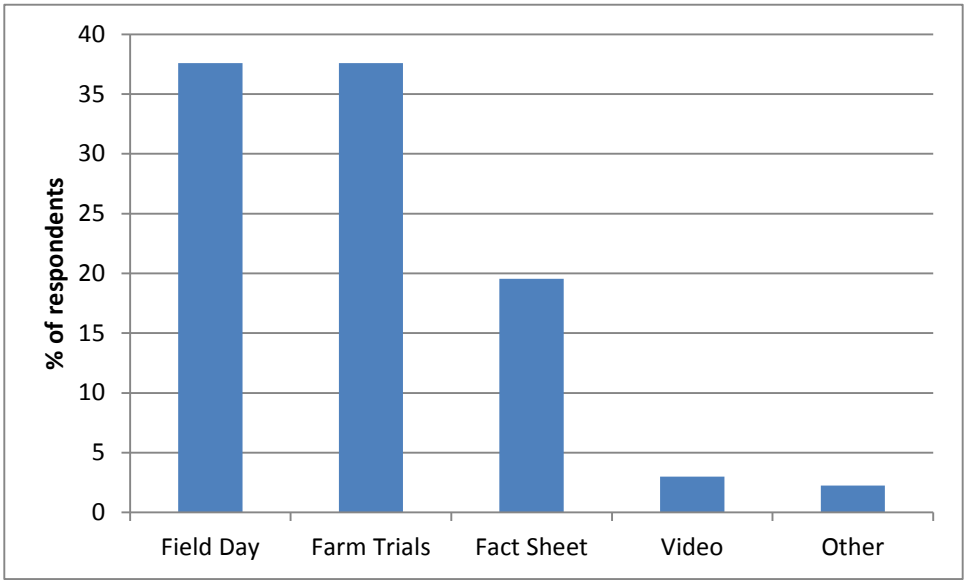


Figure 10: Preferred extension method for irrigation technologies

Irrigator Actions Prompted

Likelihood of adoption

The current level and likelihood of future adoption for each irrigation technology by field day participants is illustrated in Figure 11. The results for individual regions, Emerald, Moree and Nevertire are provided in Figure 12.

There is currently a small level of adoption of each technology across the cotton industry. In particular, canopy temperature sensor (23 percent respondents) and dynamic deficits (16 percent respondents).

The data points to a good deal of interest across all the technologies, with the participants intending to adopt ranging between 42 percent (VARIwise) and 80 percent (IrriSAT) of respondents.

There is some variation in plans for adoption between regions (Figure 11).

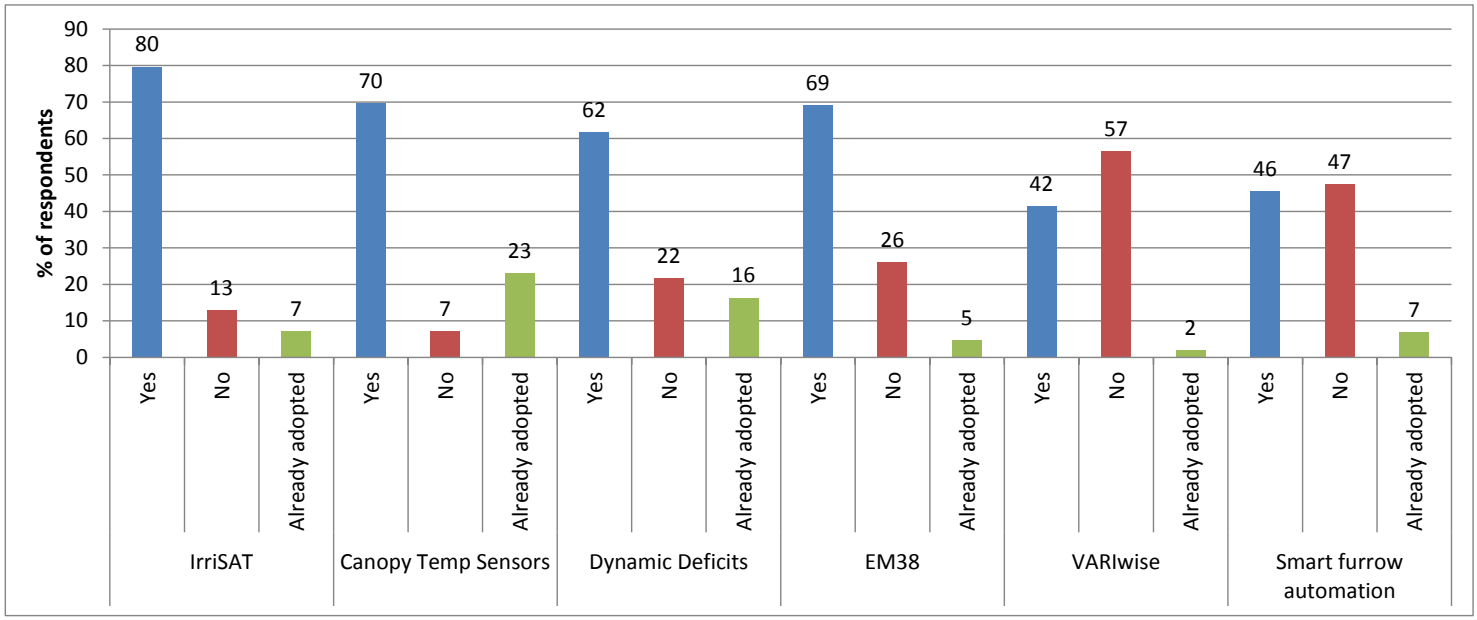


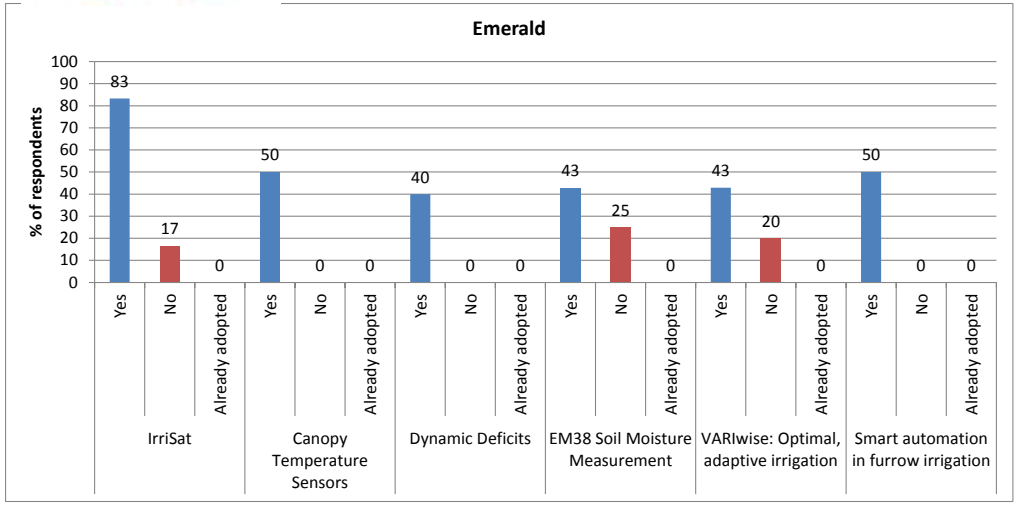
Figure 11: Likelihood of adoption of irrigation technologies across all three regions

The highest level of adoption in irrigation technologies indicated by **Emerald** field day participants was with IrriSAT (83 percent of respondents), crop canopy sensors and smart furrow automation (both 50percent) as shown on Figure 12.

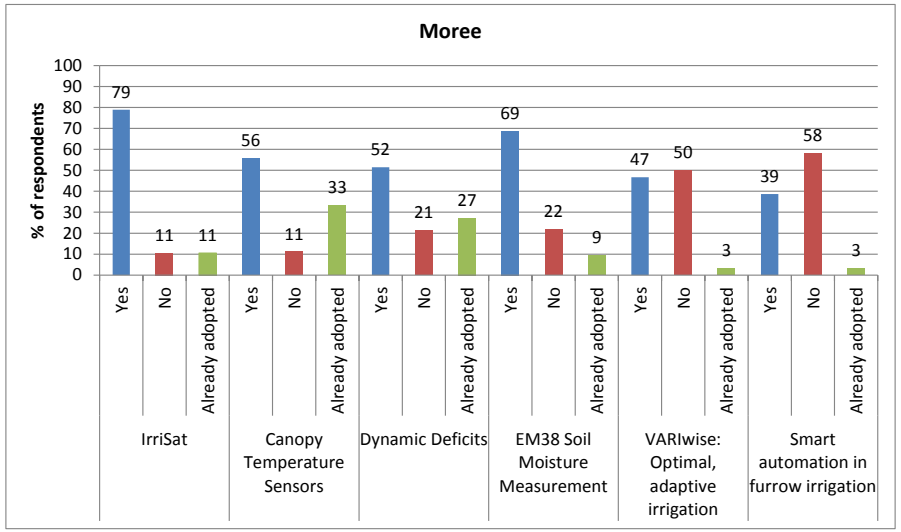
For **Moree**, participants were most interested in adoption of IrriSAT (79 percent), EM 38 (69 percent) and crop canopy temperature sensors (56 percent).

Narromine field day participants indicated interest in adopting crop canopy temperature sensors (81 percent), IrriSAT (80 percent) and dynamic deficits (72 percent).

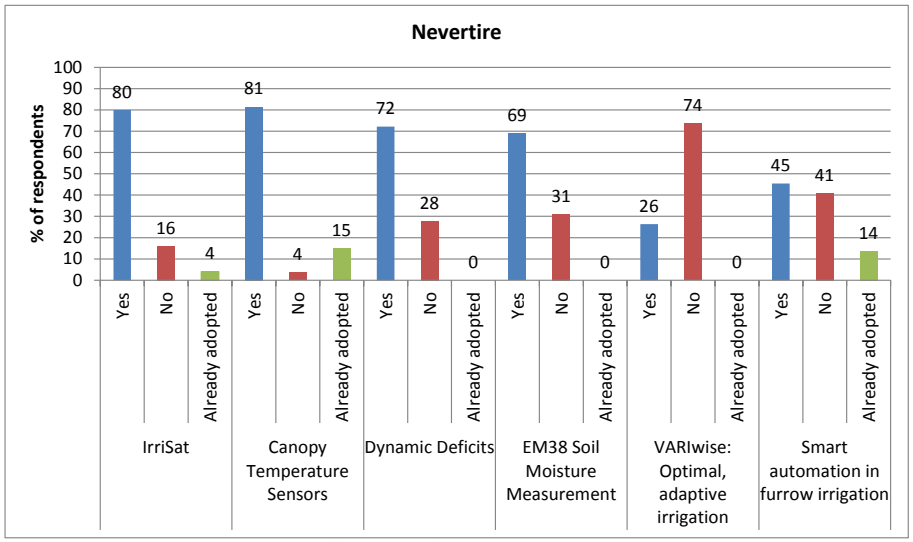
While the highest level of adoption was indicated for the scheduling technologies, there was good interest in application technologies, around 42 percent of field day participants indicating they would adopt VARIwise and 46 percent adopting smart automated furrow technologies (Figure 11).



a) Emerald



b) Moree



c) Nevertire

Figure 12: Are you likely to adopt any of these irrigation technologies on your farm (or in your consultancy)? a) Emerald, b) Moree, c) Nevertire

Research and Development

Participants were asked to rate the importance of irrigation research and development (R&D) to their consulting or farm business where 1 was very low and 5 a very high importance (Figure 13). 95 percent of respondents believed that R&D was very important to their business.

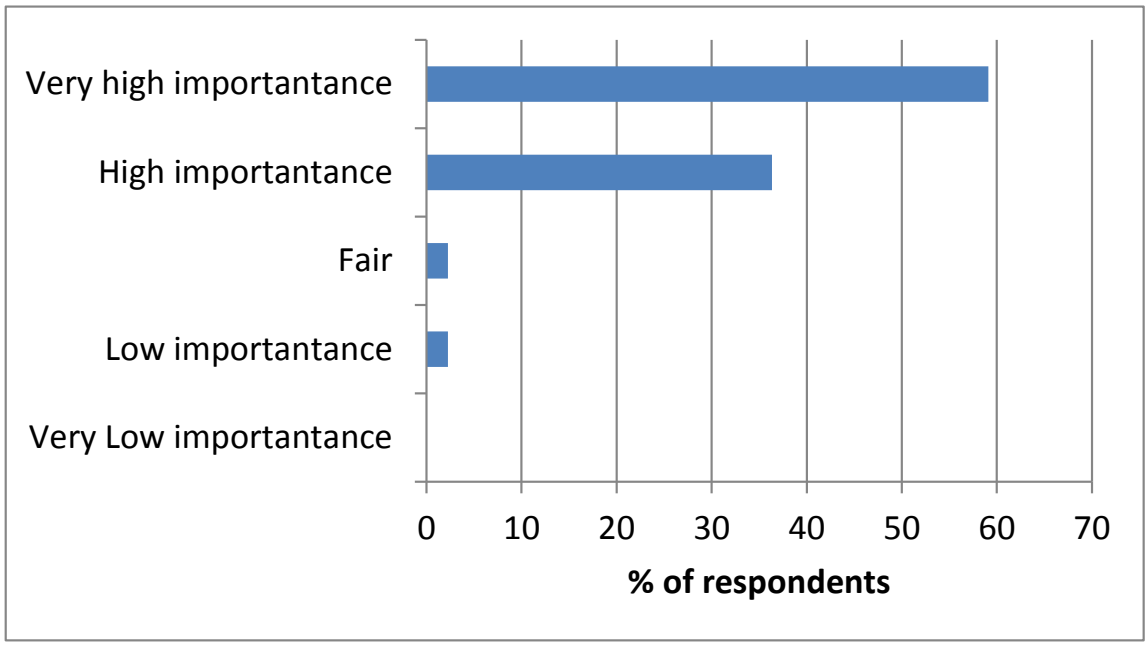


Figure 13: Rate the importance of irrigation R&D to your business, where 1 is very low and 5 is very high.

"There is discovery in all research; we've got to support it," Joe Robinson, AFF.

Further Research

Field day participants were asked if there were other irrigation technologies that should be researched. 59 percent of respondents believed there were other irrigation technologies that could be researched (Figure 14). A list of research needs is provided in Table 2. The key areas mentioned for further research include alternative irrigation systems (bankless, centre pivot, lateral move and drip), soil moisture and plants based monitoring tools and automation.

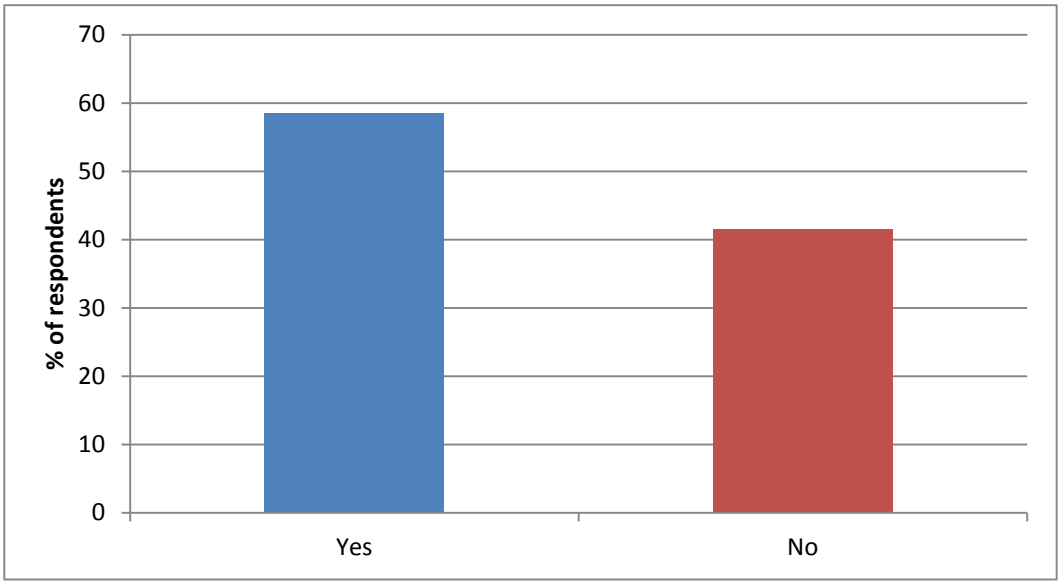


Figure 14: Are there other irrigation technologies that you think should be researched further?

Table 2: Irrigation research needs

Research needs
Commercial availability of crop sensors
Relation to elevation, yield, EM etc
Anything to aid water use efficiency
Plant sap flow
Automation, infiltration across field and length of run
Imagery and overhead watering
Drip/overhead
Soil moisture probes - compare placement of sensors for best representative reading and installation variances (slurry vs direct), cross referencing other spatial mapping (EM data) to point specific (c-probes) and use of crop sensors.
Canopy temp, row spacing and stem elongation
Irrigation Automation
PTB's and PTB automation
Zim sensor and others
Bankless channel
Capacitance Probes for scheduling
Bankless channel and continues studies on overhead sprinkler vs lateral WUE
However some of the current research has a way to go
Bankless v's LM vs CP vs labour on conventional. Need costs and return on investment on funds invested. Bankless automation.
High Flows
Flood
Infiltration of applied water on different soils and application systems. How important is a full profile in overhead irrigation.
Application efficiency in overhead irrigation systems
Keep going on automation

General Comments

The evaluation provided an opportunity for field day participants to provide general comments regarding the field day or the research technologies. A list of these comments is provided in Table 3.

Table 3: Further feedback from field day participants

Further Feedback
Thankyou for an informative interactive day
Great day, thank you
Very valuable day, well done! Will come again!
Bit hard to hear some speakers
Good variety - well done. Lots of land holder involvement in organising, good attendance
Still struggling to get some growers to irrigate on time. Down the track would probably adopt automation
All these tehcnologies have a place. Probably need to have a more reliable use for the data (eg temp sensors) before extending it
Well Done!
Talks of this nature need to be indoors
Very interesting, learned a lot about cotton and its irrigation challenges.
Great work
Thankyou for an informative interactive day
Great day, thank you

Post field day evaluation material

Emails and phone calls

A number of emails and phone calls from field day participants were received. A selection is provided below:

12 Feb

Louise Gall <lou.gall@gvia.org.au>
to Alice, me, Zara, Ruth, Jane

Ladies,
Some good feedback. I have also had other calls from consultants and growers, one in particular who had not been to a field day for a number of years.
Thank you all for your contribution to the day.
Kind Regards
Lou Gall
Project Officer and Regional Facilitator
Gwydir Valley Irrigators Association

From: George Truman [mailto:george.truman@lls.nsw.gov.au]
Sent: Thursday, 12 February 2015 11:21 AM
To: lou.gall@gvia.org.au
Subject: Thanks for a great day
Hi Lou.
Well done to you and you team and all those involved with setting up etc.
Thanks for organising a good informative day - was good opportunity for me to meet some of the researchers and talk to some agronomists and others.
Was good program with lots of good info from researchers and obviously there is that type of interest in the valley given the turn out.
Even finished bang on 2.30!!
Thanks again
George
George Truman I Senior Land Services Officer - Mixed Farming Systems
North West Local Land Services
PO Box 546 |35-37 Abbott Street | Gunnedah NSW 2380
T: +61 2 6742 9213 | **F**:+61 2 6742 4022
M: 0428 165923
E: george.truman@lls.nsw.gov.au
W: northwest.lls.nsw.gov.au

SMS: "Thanks for Wednesday (Moree Fieldday), great day – bloody interesting. Joe Robinson AFF.

Sam <sam@agromaxconsulting.com.au> 22 Feb

to me

Hi Janelle,
Good workshop the other day.
Sorry didn't get to catch up at the irrigation tech meeting at Moree the other week.
I was wondering if I could get more info in the irrisat workshops with John and yourself? Would be keen to attend
Also I was wondering if you had the website where John said we could get the satellite imagery from google I think for free….? I tried theirrisat_cloud.appspot.com and couldn't get it loaded?
Cheers,
Sam
Agromax Consulting
Office: 108 Bulls Rd, Garoo NSW 2340
Sam Mobile: 0417729031
Email: sam@agromaxconsulting.com.au

Anthea Mcclintock <anthea.mcclintock@trade.nsw.gov.au> 6 Mar
to #PI, Abigail, Luke, Rebecca

Hello All
When you have a spare moment, do have a read through Janelle's DPI active article below. The excellent booklet prepared as part of this tour (see link in article) presented research info to growers with some great key questions:

- What is the research/technology?
- Why do I want to adopt this?
- How will it benefit me?
- Why is this important?
- How do I set this up on my farm?
- Who do I ask for more info?

The booklet and the tour were so well organised. Thanks for posting this Janelle and thanks to you and others in the team who helped make it a successful tour.
Kind regards, Anthea
Anthea McClintock | Leader Water Policy, Planning and Development | Agriculture NSW
NSW Department of Primary Industries | Locked Bag 21 | Kite St | ORANGE | NSW | 2800

Post Tour CottonInfo Review

A review of the 2015 Cotton Irrigation Tour was held at a fortnightly CottonInfo Teleconference (20 Feb 2015). A summary of the discussion points is provided below.

- Better without whiteboard – felt it caused a disconnection between the group as not all participants could view information in the whiteboard.
- Practical demonstration was great eg EM 38.
- Leaving space for social time is important at field days.
    - On the way out to the first Moree field site, the bus was pretty quiet, but between trial sites the bus was really noisy with great loud lively discussion between people on the bus.
- Lacking practical examples of the benefits of each of the technologies. Eg adoption of crop canopy sensors, what is the likely improvement in yield, WUE and profitability.
    - Need to develop a case study on each of the technologies.
- Good attendance, possibly as not much cotton in this season, irrigators have more time, relevant topic.
- Needing more information and research relating to cotton agronomic response to water management and manipulation.
- Good idea to follow up on automation with proposed tour to Rubicon and southern farmers that have already implemented automation on farm.
- Have more chairs and possibly hold presentations indoors.
- Two sites in one day at Moree field day made logistics more complicated, went overtime and had to serve lunch during final speakers presentations which was not ideal.

Actions as a Result of Attending the Irrigation Research Tour

- Andrew Greste from Waverley, Wee Waa is looking at automation. He contacted Janelle Montgomery and David Robson, Rubicon and was interested in seeing farms with a similar layout with permanent siphons. Contact details of a farm in St George where they have permanent siphons were provided and Andrew was planning on contacting the irrigator.

- Emails from researchers:

  On 23 February 2015 at 14:16, FOLEY Jenny<Jenny.Foley@dnrm.qld.gov.au> wrote:

  Heath Estens (Moree Irrigator) is going to get an EM38. David Thompson (Crop Consultant) is also very interested ...and Stuart MCFayden (Crop Consultant, Moree) is purchasing one too (see email forwarded to you).
  Cheers
  Jenny

  Jenny Foley
  Senior Scientist (Soil Hydrology)
  Email: jenny.foley@dnrm.qld.gov.au

  From: Stuart Mcfadyen [mailto:stuart.george.mcfadyen@gmail.com]
  Sent: Monday, 23 February 2015 12:50 PM
  To: FOLEY Jenny
  Subject: EM38 reseller?

  Hi Jenny, after your presentation at the Moree irrigation technology field day I have been asked to get a quote for an EM 38 and a couple add on's. Could you tell me where I could purchase one, is there an Australian reseller? I did a quick search yesterday but struggled to locate one.
  Thanks for your help on this,
  Stuart Mcfadyen

  Uddin Md 13 Feb
  Jasim <Uddin.MdJasim@usq.edu.au>
  to me, Malcolm, Rod, peter.moller

  Hello Janelle,
  Thanks for organising such an successful event. We had an brief discussion in last day at Trangie with Tony (Quigley farms) who had expressed his interest to modify his existing furrow irrigation to some extent in some fields with the automation technology in order to save the water. We will follow up with him.

  Regards,
  Jasim

- Campbell Muldoon, cotton consultant Macquarie Valley & Mike Stone (Consultant, Moree) is very interested in using the IrriSAT technology, keen to go to IrriSAT workshop in July.

- Tony Quigley, Irrigator, Macquarie Valley. *"It''s good to get the science from the labs and from the researchers into the field. It's the only way that growers will get confidence that it has some use to them, and get them introduced to it. Especially where they can demonstrate the research, like the EM38 right there in te field. It allows you to envisage what it might be able to do in your business"*.

- Campbell Muldoon, Consultant, Macquarie Valley. *"I came along to the see the latest research that was happening. I was pleasantly surprised, there are some very good projects, some I had a bit of basic information, but was able to get more in depth (information), and I want to explore some of those further"*.

- As a result of the interest in EM38 during the 2015 Cotton Irrigation Tour and further requests for information from consultants and irrigatros, Qld DERM (Jenny Foley) is organising a 2 day workshop "Measuring Soil Water Using EM38 Technology to be held 20-21st July 2015, Toowoomba.

- John Smith, RDO Darling Downs would like to hold a similar event looking at some of the scheduling technologies at 3 pre-season field days across the Darling Downs in September 2015.

- IrriSAT workshops will be held in Griffith, Narromine, Moree and Emerald in July. Over 10 consultants and growers indicated interest in attending these workshops during the Irrigation Research Tour.

- An Irrigation Automation Tour is being organised. A draft itinerary is being developed in conjunction with Rubicon to showcase the latest automation technology. It will involve a Rubicon Factory to field tour. Once the itinerary is developed and invitation will extended to cotton irrigators to gauge interest before a final tour plans are completed.

- 31st March 2015 Warwick Waters, Program Manager, CottonInfo held a forum to examine how cotton profits could be increased by $500/ha. This forum arose out of the Irrigation research tour to examine what the potential improvements in profitability could be expected through the adoption of irrigation technologies.

Communications

Field Day Booklet

A field day booklet was produced and includes a summary of each technology. It has been published on the CottonInfo webite.

- Montgomery, J., Redfern, R & Trindall, J. (eds) 2015. *2015 Cotton Irrigation Technology Tour*, http://www.cottoninfo.com.au/publications/cotton-irrigation-technology-tour-booklet.

A number of communications have been developed post field day. A list is provided below with hard copies included in Appendix 3.

Media – Magazine, newspaper and website articles

- CRDC website article: http://www.crdc.com.au/content/irrigation-tour-takes-research-farm-growers-17-february-2015

- Foley, J. 2015. Measuring soil water using an EM38, Australian Cotton Grower, Volume 36, No. 2 April – May 2015 pg 30-33 .

- Gall, L. 2015. A successful Gwydir Field Day, Border News, Monday 2nd March 2015.

- Gall, L. 2015. Irrigation Technology Tour a great success, North West Magazine, 23rd February 2015.

- Gall, L. & Lyon, N. 2015. Gwydir Irrigation technology tour. Cotton and Grains Outlook, February 2015, pg 10 http://resources.farmonline.com.au/qcl/ACG/201502/3dissue/index.html.

- Jensen, M. & Redfern, R. 2015. Taking Research to Growers, CRDC Spotlight on Cotton R&D, Autumn 2015. http://www.crdc.com.au/sites/default/files/pdf/SpotAut15_8%20WEB2.pdf .

- Montgomery, J & Redfern, R. 2015. Irrigation tour takes research on-farm to growers. Article published in the Sustaining the Basin Update Bulletin No. 23. http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/558671/Update-Bulletin-23.pdf

- Montgomery, J. 2015. 2015 Cotton Irrigation Technology Tour – A research and development partnership, DPI Active 06/03/15.

- Pendergast L & Lyon, N. 2015. Emerald homes in on water use. Cotton and Grains Outlook, February 2015, pg 10 http://resources.farmonline.com.au/qcl/ACG/201502/3dissue/index.html.

- Redfern, R. 2015. Irrigation tour media alert: "Cotton irrigation technology tour - Leading irrigation researchers take technology to Central QLD, Gwydir and Macquarie cotton growers"

- Redfern, R. 2015. Cotton technology tour takes irrigation researchers on farm, Australian Cotton Grower, Volume 36, No. 2 April – May 2015 pg 34-35.

- Thomas, A . 2015. Irrigation tour takes research on-farm to growers at Nevertire, Warren Weekly

- Thomas, A. and Lyon, N. 2015 Irrigators Nevertire. Cotton and Grains Outlook, March 2015, pg 10 http://resources.farmonline.com.au/qcl/ACG/201503/3dissue/index.html

Social Media

- Twitter – a number of tweets related to the event were sent from members of the CottonInfo team. A selection is provided in Appendix 3.
- A selection of photographs of the event are available on-line https://www.flickr.com/photos/cottoninfoaust/sets/72157651143095398/

Video

Completed:

- **2015 Cotton Irrigation Technology Tour "The Flying Drs"**
  Producer: Stuart Bray
  Editor: Nick Lee
  Background: Overview of the 2015 Cotton Irrigation Technology Tour including a selection of interviews with researchers, consultants and growers.
  Duration: 4'
  Proposed Dissemination:
    - Posted on CottonInfo website
    - Transcript and audio available to develop fact sheets, newspaper stories, radio stories etc.
- **2015 Cotton Irrigation Technology Tour - Nevertire Field Day**
  Producer: Stuart Bray
  Editor: Nick Lee
  Background: Footage and still photographs capturing the essencse of the Nevertire, Cotton Irrigation Technology Field Day.
  Duration: 2'
  Proposed Dissemination:
    - Amanda Thomas, RDO, CottonInfo Macquarie Valley will distribute through her networks.
    - Posted on CottonInfo website
- Paul Grundy is currently developing short videos to showcase each irrigation technology.

Conclusion

The 2013 Cotton Irrigation Technology Tour was a successful capacity building activity. The first initiative of its kind for the cotton industry, the 2015 Cotton Irrigation Technology Tour took seven CRDC funded irrigation-specific researchers to Emerald, Moree and Nevertire in mid-February to showcase their research and technologies. The tour provided irrigators and consultants with the opportunity to hear first-hand from researchers about their technologies and how they could be applied on-farm.

Importantly, the evaluation material collected during the tour found that the field day participants increased their awareness and understanding of the irrigation scheduling and application technologies. There is currently a small level of adoption of each technology across the cotton industry, in particular, canopy temperature sensors and dynamic deficits. The evaluation shows significant interest in current irrigation research, with participants indicating future adoption of the showcased technologies.

The field day participants indicated interest in further extension of the technologies in the form of field days and on-farm trials. Greater technical detail is also sought, ideally during an indoor workshop.

This tour was an example of how the CottonInfo team can connect growers and researchers, not only to provide an avenue for growers to learn about the latest irrigation research, but for researchers to receive feedback about their current and future irrigation research.

APPENDICIES

Appendix 1: Field Day Flyers and Programs

CottonInfo Information *when you need it*

2015 cotton irrigation technology tour

The 2015 cotton irrigation technology tour will visit Central QLD, the Gwydir Valley and the Macquarie Valley in February.

Local cotton growers are invited to field days in Emerald, Moree and Nevertire.

Meet with the industry's leading irrigation researchers to learn about innovative irrigation scheduling and automation technology, including:

- **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** - Optimal, adaptive irrigation - Dr Alison McCarthy (NCEA)
- **Smart automation in furrow irrigation** - Dr Malcolm Gillies (NCEA), Dr Jasim Uddin (NCEA), David Robson (Rubicon).

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

TOUR DATES:

CENTRAL QLD (EMERALD) - TUESDAY 10 FEB
Wills Rd, Emerald
8:30am–1:30pm

GWYDIR (MOREE) - WEDNESDAY 11 FEB
Joint field day with CottonInfo & Gwydir Valley Irrigators Association
'Auscott' & 'Red Mill', Moree
7:45am–2:30pm

MACQUARIE (NEVERTIRE) - THURSDAY 12 FEB
'The Wilgas', Nevertire
8:30am–1:30pm

For more information or to RSVP, contact:

- Janelle Montgomery - 0428 640 990
- *Central QLD:*
  Lance Pendergast - 0448 601 842
- *Gwydir:*
  Alice Devlin - 0427 207 167 or
  Lou Gall - 0427 521 498
- *Macquarie:*
  Amanda Thomas - 0417 226 411

Emerald	Moree	Nevertire
10 Feb	11 Feb	12 Feb

Best Practice

CottonInfo Information *when you need it*

2015 cotton irrigation technology tour

Central QLD (Emerald) field day - Tues 10 Feb 2015

The 2015 cotton irrigation technology tour will visit Emerald on Tuesday 10 February for the Central QLD irrigation field day.

Meet with the industry's leading irrigation researchers to learn about innovative irrigation scheduling and automation technology, including:

- **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** - Optimal, adaptive irrigation - Dr Alison McCarthy (NCEA)
- **Smart automation in furrow irrigation** - Dr Malcolm Gillies (NCEA), Dr Jasim Uddin (NCEA), David Robson (Rubicon).

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

Details:

Date:
Tuesday 10 February 2015
Time:
8:30am to 1:30pm
Location:
Wills Rd, Emerald
Catering:
Morning tea and lunch provided. You are invited to join the researchers for lunch at the Mayfair Tavern, Emerald following the field day.

RSVP:

For more information or to RSVP, contact:

- Lance Pendergast, CottonInfo
  0448 601 842
  lance.pendergast@daff.qld.gov.au

- Ngaire Roughley, CottonInfo
  0477 394 116
  ngaire.roughley@daff.qld.gov.au

Best Practice

Gwydir Valley Irrigators Association Inc.
458 Frome St, PO Box 1451, Moree, NSW 2400

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

Best Practice

CottonInfo Information *when you need it*

2015 cotton irrigation technology tour

Macquarie (Nevertire) field day - Thurs 12 Feb 2015

The 2015 cotton irrigation technology tour will visit Nevertire on Thursday 12 February for the Macquarie irrigation field day.

Meet with the industry's leading irrigation researchers to learn about innovative irrigation scheduling and automation technology, including:

- **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** - Optimal, adaptive irrigation - Dr Alison McCarthy (NCEA)
- **Smart automation in furrow irrigation** - Dr Malcolm Gillies (NCEA), Dr Jasim Uddin (NCEA), David Robson (Rubicon).

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

Details:

Date:
Thursday 12 February 2015
Time:
8:30am to 1:30pm
Location:
'The Wilgas,' Nevertire
Catering:
Morning tea and lunch provided. You are invited to join the researchers for lunch at the Nevertire Hotel following the field day.

RSVP:

For more information or to RSVP, contact:

- Amanda Thomas, CottonInfo
  0417 226 411
  amanda.thomas@cottoninfo.net.au
- Janelle Montgomery, CottonInfo
  0428 640 990
  janelle.montgomery@dpi.nsw.gov.au

Best Practice

Emerald Program

MC: Ngaire Roughley, Development Extension Officer (Cotton), QDAFF, CottonInfo

Time	Presentation	Presenter
8:00	Researchers arrive at Wills Rd	Ngaire: Attendance sheet
8:30 – 8:40am	Welcome & Introduction	Lance Pendergast / Jane Trindall
8:40 – 9:00am	IrriSAT – Weather-based irrigation scheduling	John Hornbuckle
9:00 – 9:20 am	Canopy Temperature Sensors	Onoride Coast
9:20 – 9:40 am	Scheduling with dynamic deficits	Rose Broderick
9:40 – 10:00 am	EM38 surveys - For soil-moisture measurements and the potential for future use	Jenny Foley
10:00 – 10:30 am	Morning Tea	Lance/ Ngaire
10:30 – 10:50 am	VARIwise - Optimal, adaptive irrigation	Alison McCarthy
10:50 – 11:15 am	Smart automation in furrow irrigation	Dr Malcolm Gillies, Jasim Uddin,
11:15 – 11:30 am	Evaluation and discussion of technologies	Facilitated discussion Jane
LUNCH 12:30	Mayfield Tavern	Lance

Moree Program

MC: Lou Gall, Gwydir Valley Irrigators Association

Time	Presentation	Presenter
7:30am–8:00am	Meet at race course for bus to Auscott	Janelle: Attendance sheets, 2 in each bus. Must be filled out before getting off bus at Auscott.
8:30 – 8:40am	Welcome & Introduction	Jane Trindall & Zara Lowien
8:40 – 9:10 am	GVIA Row spacing trials	Lou Gall / Owen Berry / Nick Gillingham
9:10 - 9:30 am	EM For soil-moisture measurements and the potential for future use	Jenny Foley
9:30 – 9:50 am	IrriSAT – Weather-based irrigation scheduling	John Hornbuckle
9:50 – 10:00 am	Plant based irrigation scheduling	Alex Downey
10:00– 10:20am	Canopy Temperature Sensors	Onoride Coast
10:20– 10:30am	Scheduling with dynamic deficits	Rose Brodrick
10:30– 10:40am	Evaluation and discussion of technologies	Facilitated discussion Janelle
10:40–10:45am	MC Lou Gall to wrap up and thank Auscott	
10:45–10:55am	Morning Tea and walk through trial	
10:55– 11:20am	Board buses and travel to Red Mill via MILO	
11:20–11:30am	Intro to Red Mill and background to involvement in trial work and 2014/15 operations	Ray Fox/Toby Seccombe/Alice
11:30–11:50am	Nitrogen Loss Pathways	Ben McDonald/ Alice Devlin
11:50– 12:00am	Bus to second site	
12:00–12:20pm	VARIwise - Optimal, adaptive irrigation	Alison McCarthy
12:20– 12:50pm	Smart automation in furrow irrigation	Dr Malcolm Gillies, Jasim Uddin, NCEA, David Robson, Rubicon, Peter Moller, Rubicon
12:50 – 1:00pm	Evaluation and discussion of technologies	Facilitated discussion Janelle
1:00 – 1:10pm	MC Lou Gall to Wrap up. Thankyou's	
1:00 – 2:00pm	LUNCH	BBQ Lunch
2:00 – 2:30pm	bus to racecourse by 2:30pm	
2:30 – 3.30pm	Afternoon with AFF and others Morten Plains	
4:00pm	Charter flight leave Moree	

Nevertire Program

MC: Amanda Thomas, Regional Development Officer, CottonInfo

Time	Presentation	Presenter
8:00	Researchers arrive at The Wilgas	Amanda: Attendance sheet
8:30 – 8:40am	Welcome & Introduction	Amanda and Janelle
8:40 – 9:00am	IrriSAT – Weather-based irrigation scheduling	John Hornbuckle
9:00 – 9:20 am	Canopy Temperature Sensors	Onoride Coast
9:20 – 9:40 am	Scheduling with dynamic deficits	Rose Broderick
9:40 – 10:00 am	EM38 - For soil-moisture measurements and the potential for future use	Jenny Foley
10:00 – 10:30 am	Morning Tea	Amanda/Janelle
10:30 – 10:50 am	VARIwise - Optimal, adaptive irrigation	Alison McCarthy
10:50 – 11:15 am	Smart automation in furrow irrigation	Dr Malcolm Gillies, Jasim Uddin
11:15 – 11:30 am	Evaluation and discussion of technologies	Facilitated discussion Janelle
LUNCH – 12:30	Nevertire Hotel	

Appendix 2: Evaluation Sheet and Silent Witness Observation Template

CottonInfo Information when you need it

2015 Cotton Irrigation Technology Tour Evaluation

We would appreciate your comments on the field day you have just attended Emerald Moree Nevertire

		Disagree				Agree
1) The field day met your aims and expectations.		1	2	3	4	5
2) The presentations were of a high standard.	(None)	1	2	3	4	5 (All)
3) The presentations were at a level I could understand	(None)	1	2	3	4	5 (All)

4) How could we have improved the day to be more useful for you?

_____

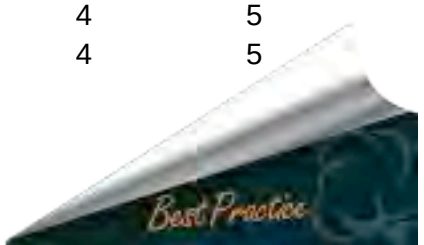
_____

5) Has this field day improved your knowledge of each irrigation technology and how it could be used on your farm?

Yes **No**

6) Please rate **your level of understanding** of each irrigation technology (where **1 is very basic** and **5 is very good**) before and after the field day.

IrriSat	**Basic**				**Very Good**
Before the field day	1	2	3	4	5
After the field day	1	2	3	4	5
Crop Canopy Sensors					
Before the field day	1	2	3	4	5
After the field day	1	2	3	4	5
Dynamic Deficits					
Before the field day	1	2	3	4	5
After the field day	1	2	3	4	5
EM38 Soil Moisture Measurement					
Before the field day	1	2	3	4	5
After the field day	1	2	3	4	5
VARIwise: Optimal, adaptive irrigation					
Before the field day	1	2	3	4	5
After the field day	1	2	3	4	5
Smart automation in furrow irrigation					
Before the field day	1	2	3	4	5
After the field day	1	2	3	4	5



CottonInfo Information when you need it

7) Would you like to see more extension of any of the following technologies in your region?

IrriSat…… Yes No

Crop Canopy Sensors…… Yes No

Dynamic Deficits…….. Yes No

EM38 Soil Moisture Measurement…… Yes No

VARIwise: Optimal, adaptive irrigation…… Yes No

Smart automation in furrow irrigation…… Yes No

If yes, what is your preferred extension method? (tick)

field day ☐ farm trials ☐ fact sheet ☐ video ☐ Other_____

8) Are you likely to adopt any of these irrigation technologies on your farm (or in your consultancy)?

IrriSat…….. Yes No Already adopted

Crop Canopy Sensors…… Yes No Already adopted

Dynamic Deficits…….. Yes No Already adopted

EM38 Soil Moisture Measurement……Yes No Already adopted

VARIwise: Optimal, adaptive irrigation…….. Yes No Already adopted

Smart automation in furrow irrigation……Yes No Already adopted

9) Are there other irrigation technologies that you think should be researched further?

Yes No

If yes, what are they and why? _____

_____

10) Rate the importance of irrigation R&D to your business (where **1 is low** and **5 is very high**)

Low importance **Very high importance**

1 2 3 4 5

11) How did you hear about this field day? Tick

Friend/family/other farmer ☐ Advisor ☐ Media eg radio ☐ CottonInfo ☐

Other ☐ please specify_____

12) How would you classify yourself? Tick

Grower/Farm Manager ☐ Farm Staff ☐ Consultant ☐ Retailer ☐

Agency ☐ Other ☐_____

13) How much land do you have developed (manage, if consultant) for cotton irrigation? _____ ha

Any further feedback_____

Thank you

CottonInfo Information when you need it

Reflection/Observation Guidelines and template

The purpose of this template is to assist in structuring observations and reflections by group facilitators or silent witnesses about group meetings and processes to capture impacts as they occur, and to identify areas for improvement.

This template should be used during the meeting by a silent witness or immediately after the meeting or event by the facilitator.

Please fill out one sheet for each technology:

1) IrriSat
2) Crop Canopy Sensors
3) Dynamic Deficits
4) EM38 Soil Moisture Measurement
5) VARIwise: Optimal, adaptive irrigation
6) Smart automation in furrow irrigation
7) Evaluation Session

CottonInfo Information when you need it

Observation Template: Irrigation Technology Tour

Date:	Location:	Number of participants:
Reason for the event/meeting:		
Client groups represented:		
Mood of the meeting (e.g. positive, negative, agitated, cautious etc) also record any significant body language (e.g fidgety, asleep, closed body position, animated):		
Questions asked:		
Comments made:		
Information requested:		
Resultant actions or follow up needed:		

Appendix 3: Communications

CottonInfo Information *when you need it*

Media Alert **29 January 2015**

Cotton irrigation technology tour

Leading irrigation researchers take technology to Central QLD, Gwydir and Macquarie cotton growers

The Australian cotton industry's leading irrigation researchers will go on-farm in February to demonstrate new and emerging irrigation technologies to cotton growers.

The 2015 Cotton Irrigation Technology Tour will visit Central QLD (Emerald), the Gwydir Valley (Moree) and the Macquarie Valley (Nevertire) from Tuesday 10 February to Thursday 12 February, and will feature eight of the industry's key irrigation researchers.

The tour aims to highlight the advances and practical benefits of each technology for optimising yield and water use efficiency across the three valleys. It will showcase some of the innovative technologies available to growers: from sensing and satellite imagery to assess crop stress, to optimising and automating irrigation applications.

Central QLD (Emerald) field day
Date: Tuesday 10 February
Time: 8:30am to 1:30pm
Location: Wills Road, Emerald
Contact: Lance Pendergast, CottonInfo (0448 601 842), Ngaire Roughley, CottonInfo (0477 394 116)

Gwydir Valley (Moree) field day (with Gwydir Valley Irrigators Association)
Date: Wednesday 11 February
Time: 7:45am to 2:30pm
Location: 'Auscott' and 'Red Mill', Moree
Contact: Lou Gall, GVIA (0427 521 498), Alice Devlin, CottonInfo (0427 207 167), Janelle Montgomery, CottonInfo (0428 640 990)

Macquarie Valley (Nevertire) field day
Date: Thursday 12 February
Time: 8:30am to 1:30pm
Location: 'The Wilgas', Nevertire
Contact: Amanda Thomas, CottonInfo (0417 226 411), Janelle Montgomery, CottonInfo (0428 640 990)

The tour is being run by CottonInfo, the cotton industry's joint extension program, with support from CottonInfo partner Cotton Research and Development Corporation (CRDC), the researchers and their research organisations: NSW DPI, QLD DAFF, QLD DNRM, CSIRO and NCEA. In addition, the Gwydir Valley field day is being run in conjunction with the Gwydir Valley Irrigators Association. The research showcased in the tour is funded by CRDC and the respective research organisations.

Ends.
For more, contact: Ruth Redfern, CottonInfo communications manager, 02 6792 4088 or 0408 476 341.

LEFT: CRDC R&D manager Jane Trindall with Amanda Noone and Steve Yeates.

Emerald homes in on water use

CENTRAL Queensland irrigators took the opportunity to meet eight scientists to hear about and discuss recent developments during the Cotton Irrigation Technology Tour field day at Emerald.

The CRDC-funded research site located on Cameron Geddes' property provided the perfect venue as the results of several of the new technologies under evaluation could be viewed in the adjoining cotton field.

Over the past two seasons Department of Agriculture, Forestry and Fisheries (DAFF) researcher Lance Pendergast has been evaluating a range of new technologies focused on improving irrigation efficiencies.

"The Optimising Water and Energy Use in the CQ Irrigation Sector program has worked in close collaboration with other scientists to explore potential methods to improve the profitability and sustainability of irrigation enterprises," he said.

"This field day was an excellent opportunity to get other researchers and the local growers together as both parties benefited from hearing from each other."

A number of scheduling tools were presented and discussed as this aspect of irrigation is so critical to a crop's success.

These included Irrisat, a weather-based irrigation scheduling tool that uses remote sensing (satellites) to provide site-specific crop management information, and Biotic whereby infield infrared sensors focused on the plant canopy provide sufficient information to assist in determining the best timing for irrigation.

A third methodology, Dynamic deficit scheduling, increases growers' ability to match irrigations with potential crop stress and short-term forecast climactic conditions.

"This year was the second time we have evaluated the Biotic and the Dynamic deficit scheduling approach here in Emerald," Dr Pendergast said.

"Although the crop has yet to be picked all indications again suggest that both have a definite potential to assist growers increase their productivity."

The smart automation of furrow irrigation has increasing interest from growers as there are often difficulties sourcing sufficient labour to run syphon-fed furrow irrigation.

Dr Malcolm Gillies and Dr Jasim Uddin demonstrate the automated irrigation system.

Local grower Ian Burnett takes a look at the automated irrigation system.

Jenny Foley (right) demonstrates the EM38 soil moisture monitor to consultant and CRDC board director Greg Kauter and grower Nigel Burnett.

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.

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

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 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 use of the automated technology.

Given the high labour costs 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 per cent 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.

Irrigators never tire

MACQUARIE Valley cotton growers met leading irrigation researchers at a field day at the Quigley family's Nevertire farm, The Wilgas, in mid-February.

The event was one of three irrigation technology field days that took place from central Queensland to central west NSW, hosted by cotton extension program CottonInfo.

About 50 local growers, agronomists and consultants attended the field day to meet with the seven irrigation researchers, all of whom are conducting cotton irrigation research through funding from the Cotton Research and Development Corporation (CRDC).

The field day demonstrated new and emerging irrigation scheduling and management technology to growers, highlighting the advantages and practical benefits for optimising yield and water use efficiency.

CottonInfo regional development officer for the Macquarie, Amanda Thomas, said the day was an opportunity to get local growers face-to-face with leading researchers.

"Through CRDC, the cotton industry invests more than $1.5 million a year into irrigation technology research, so this field day was a great opportunity to get the researchers out into the field with local growers," she said.

"The researchers talked about, and demonstrated, their research into irrigation scheduling, tools to measure soil moisture and even automated irrigation, and the growers had the chance to chat to them about how practical and adaptable the technology would be for their specific farms.

RIGHT: Bill Tyrwhitt, Auscott, Warren, Tom Quigley, Quigley Farms, Trangie, CottonInfo regional development officer Amanda Thomas, Warren, Brett Cumberland, Australian Food and Fibre, Narromine, and Pat Hulme, Sustainable Soils Management, Warren.

The Quigley boys Richie, Tom and George at Quigley Farms, Trangie.

Ivan Truscott, Darling Irrigation, Narromine, with DPI economist Anthea McClintock, Orange, and CSIRO crop physiologist Onoriode Coast, Narrabri.

Brett Sherwood, Narromine, and Max Simmons, Nevertire, with CSIRO researcher Rose Brodrick, Narrabri, and USQ National Centre for Engineering in Agriculture researcher Alison McCarthy, Toowoomba.

DPI irrigation extension delivery officer Janelle Montgomery addresses the crowd.

Scientist fills new job spot

COTTON Australia has made three staff appointments, replacing existing roles in Sydney and Toowoomba.

Award-winning cotton scientist and expert on cotton heat stress Dr Nicola Cottee has been appointed policy officer for research direction stewardship.

She will focus on research and stewardship, resistance management and biosecurity, as part of her role to advocate on behalf of cotton growers.

Before joining Cotton Australia Ms Cottee was a post-doctoral research fellow at CSIRO's cotton management and physiology unit where she worked to identify heat stress tolerance of cotton cultivars.

She also undertook a two-year exchange with Texas A&M University to undertake cotton experiments.

Rick Kowitz has been appointed myBMP manager, and is responsible for the leadership and management of the cotton industry's best practice initiative.

He will focus on the adoption and development of the myBMP system, with a focus on encouraging participation.

Mr Kowitz has extensive experience in sustainable agriculture and best management practices.

He has developed and managed sustainable agriculture programs for community, industry and government organisations.

Before joining Cotton Australia Mr Kowitz developed an Australian dairy industry fertiliser and nutrient management program.

He was also previously the Queensland state landcare co-ordinator, managing the National Landcare Program and supporting sustainable agriculture projects across Queensland and the Torres Strait.

He also owned and managed a broad-acre farming operation on the Western Darling Downs, and holds a degree in environmental science.

Felicity Muller has been appointed policy officer and will advocate for growers with a focus on electricity and energy, transport (in NSW), foreign trade and export, and will also cover mining and coal seam gas issues.

Ms Muller has worked in Australia and overseas and before joining Cotton Australia was an agriculture and natural resources consultant with GHD, working with government agencies and industry bodies.

She has also worked in south-east Asia on research projects.

"There's enormous conjecture even within the science community about water connectivity, and we've seen that highlighted this week.

"In this electorate we don't have any CSG activity.

"We've got a number of sleeper licences which were granted many, many years ago and the NSW Plan... provides very clear pathways to buy those back or require the companies to hand them back, unless they do any substantive activity."

Mr Marshall said it was all about location and regulation.

He said the industries were needed for the NSW economy, but they needed to go on the 'goat country', on the rubbish country where they have

will ever be a situation where it will ever be safe," Ms O'Brien said.

"I feel very strongly about separating mining from farming, and I would definitely stand up to my party if they said anything else, but at the moment I'm quite happy with their stance on this.

Mr Goldstein said there was too much doubt and were too many doors left open by the National and Labor candidates.

"I utterly reject that there is any such thing in Australia as rubbish country.

"All of the land is what we need to protect our biodiversity and is part of our natural heritage," Mr Goldstein said.

He went on to say renewable

for very quick extractions," he said.

"We shouldn't risk what is a sustainable industry for a short-term gain.

"We've seen a swathe of protest by our constituents against extractive industries, against the risk to aquifers, against the risk to agricultural production, and that's what this is all about; we need to restore that social contract between the politicians and our constituents.

"At the moment we're seeing a 'top down' approach from Macquarie Street that's not relevant to this electorate."

The meeting was organised by NSW Farmers and held at Inverell's Riverside Centre.

days.

"With fuel, oil and electricity costs now the third biggest input cost for cotton farms, there is growing demand for information on alternative and renewable energy sources," Mrs Trindall said.

"The CottonInfo Big Days Out allowed growers to tap into the experience of our two host farmers and specialists working in all aspects of the energy sector."

Ian and Anne Brimblecombe hosted the first day at their St George farm, "Burgorah", while day two was on Scott Morgan's property "Kensal Green", Gunnedah.

AgriRisk High Achiever of the Year, Narrabri farmer Brendon Warnock featured at the days, sharing insights into his farm operation including strategic planning, human resource management and expansion.

CottonInfo and its associated partners, CRDC, Cotton Australia and Cotton Seed Distributors (CSD), ran the events, with funding assistance from the Commonwealth Department of Industry and Science.

A donated Oz Forecast weather station was auctioned at the Gunnedah day to raise money to support the treatment of Narrabri boy Zander Simmonds.

For more information, visit www.cottoninfo.net.au

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 them 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.

Member for Tamworth Kevin Anderson MP with members of the Nundle and District Lions Club at the Nundle Courthouse Museum.

Historic Nundle Courthouse Museum's funding windfall

Historic Nundle Courthouse Museum has received a $23,620 the grant through the Community Building Partnership Program.

Member for Tamworth Kevin Anderson announced the grant last week, saying that the program is one of the most popular of its kind and that he was delighted that the Nundle Courthouse Museum is one of the worthy recipients.

"There was a high level of interest from the community and there was strong competition for the available funds and I would like to congratulate the Nundle and District Lions Club on behalf of the Nundle Courthouse Museum who were successful," Mr Anderson said.

Nundle and District Lions Club Secretary Susan Trist said the grant will allow the club to undertake internal repairs to the building.

"We will be able to redecorate the walls and ceiling of the main part of the building, as well as install electric blinds," Mrs Trist said.

"The electric blinds will make the interior a lot brighter but will ultimately provide protection for the artefacts when the museum is not in use."

Mr Anderson said the Nundle Courthouse Museum houses a wide range historical items, from miming artefacts to old photos from around the Nundle area.

"It was a pleasure to visit the Courthouse Museum to announce the grant and I look forward to seeing the project get underway soon," Mr Anderson said.

Sesquicentennial year for Baradine community

The community of Baradine is celebrating 150 years this year with a big weekend is now being organised for the October long weekend.

Friday night will be a street party, with a country and western band playing.

On Saturday the schools, Forestry, Discovery Centre, and MPS will also be open for people to check and see the improvements that have been made int he town and district.

On Saturday night a Ball will be held at the Memorial Hall while on Sunday morning a recovery breakfast for those who enjoyed Saturday night, will be on at the Bowlo.

Anyone interested in being involved can find look on Facebook.

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 IrriSAT, the weather-based scheduling tool.

The Field Day them 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.

NEXT

Cotton technology tour takes irrigation researchers on farm

LEADING irrigation researchers toured cotton regions in February to showcase innovative scheduling and automation technology to cotton growers.

In the first initiative of its kind for the cotton industry, the 2015 Cotton Irrigation Technology Tour took seven CRDC-funded irrigation-specific researchers to Emerald, Moree and Nevertire in mid-February to showcase their research and technologies.

More than 200 growers and consultants attended field days across the three valleys, hosted at properties where irrigation research is taking place to meet the researchers and see the research and technologies in action.

New irrigation research is offering exciting options for growers to improve efficiency and yield through more precise scheduling and application technology. The researchers explained how their technology works and how it may be applied on individual growers' farms.

The tour showcased:

- Dr Rose Brodrick's (CSIRO) scheduling with dynamic deficits;
- Dr Onoriode Coast's (CSIRO) canopy temperature sensor research;
- Dr John Hornbuckle's (CSIRO) IrriSAT weather based irrigation scheduling;
- Jenny Foley's (QLD DERM) EM38 soil moisture monitoring;
- Dr Alison McCarthy's (NCEA) VARIwise site-specific surface irrigation and fertigation using adaptive control; and.
- Smart automation in furrow irrigation with Dr Malcolm Gillies (NCEA), Dr Jasim Uddin (NCEA) and commercial providers David Robson and Peter Moller (Rubicon).

The tour was hosted by CottonInfo, with funding from CottonInfo partner CRDC, researchers and the research organisations, and was designed to extend CRDC's irrigation research projects to growers. The Moree field day was co-hosted with the Gwydir Valley Irrigators Association (GVIA) and also looked at GVIA's optimised furrow row configuration research, CSIRO and CottonInfo's nitrogen loss pathways trials, and sap flow metres and stem psychrometers.

CRDC R&D Manager Jane Trindall said CRDC had gained valuable feedback on what growers think about current irrigation research and areas where they see gaps in scheduling and application information and technology.

"Taking researchers into the paddock to talk to the people who ultimately use their research is extremely valuable for both growers and researchers," Jane said.

"Growers get to interact directly with the researcher to understand more about the tools and technologies they're developing; and researchers get first hand feedback from the end users of their science. It's a win-win scenario.

"We've learned that 97 per cent of attendees have an improved knowledge of the irrigation technologies and how they can be used on their farms as a result of the field days."

Jenny Foley of QLD DERM demonstrates the EM38 soil moisture monitor to cotton consultant (and CRDC board director) Greg Kauter and grower Nigel Burnett at the Emerald Irrigation Technology Tour field day.

Cam Geddes, Greg Kauter and Aaron Kiely at the Emerald Irrigation Technology Tour field day, which was held on Cam's property just prior to picking.

NEXT

The 2015 Irrigation Technology Tour field day at Moree, hosted by CottonInfo and Gwydir Valley Irrigators Association.

St George cotton grower (and CRDC director) Cleave Rogan, Auscott Narrabri's Bernie George, and researcher Guy Roth at the Moree field day.

CottonInfo's Water Use Efficiency Technical Specialist for NSW, Janelle Montgomery – a researcher, extension officer and organiser of the 2015 Cotton Irrigation Technology Tour – agrees.

"CottonInfo's mandate is to connect growers with research," Janelle said.

"We're essentially the conduit of information, providing a two-way street for researchers and growers to connect and to ensure research gets to where it is needed: on the ground.

"Our role is to provide an avenue for those involved in managing cotton crops to speak directly to researchers – to find out more about how their technology works, how best to apply it on farm and discussing what they see as potential barriers to adoption.

"This tour was a great example of this: taking CRDC-funded researchers out into the field, via a CottonInfo tour, to growers. And the feedback from growers has been really positive, with 60 per cent of growers at the field days saying they would be likely to adopt the irrigation technologies on farm.

"As one cotton grower at the Moree field day said 'There's discovery in all research, we've just got to support it'."

Growers interested in reading more about all of the technologies showcased at the field days can download the 2015 Cotton Irrigation Technology Tour booklet from the CottonInfo website: www.cottoninfo.com.au/publications

The Quigley brothers, Richie, Tom and George at 'The Wilgas' Nevertire.

The irrigation researchers, pictured on farm at 'The Wilgas' Nevertire. (LtoR: back row – Richie Quigley, Jenny Foley, Malcolm Gillies, Alison McCarthy, Onoriode Coast, Tony Quigley, Rose Broderick, George Quigley, Amanda Thomas. Front row – Janelle Montgomery, John Hornbuckle, Jasim Uddin, Tom Quigley).

Bill Tyrwhitt (Auscott, Warren); Tom Quigley (Quigley Farms, Trangie), CottonInfo regional development officer Amanda Thomas (Warren), Brett Cumberland (AFF Narromine) and Dr Pat Hulme (Sustainable Soils Management, Warren).

Water Matters...

Series supported by Valmont

Measuring soil water using an EM38

By Jenny Foley, Department of Natural Resources and Mines, QLD

AT A GLANCE ....

- EM38s are instruments used by researchers, agronomists and growers to provide rapid and reliable information on soil water within the root zone
- They are recommended for use in the industry after many years of successful use in research trials, either as a stand-alone method to monitor soil water or as part of an integrated combination of methods
- They provide accurate estimates of soil plant available water (PAW) so that informed management decisions can be made eg. the application, timing and conservation of irrigation water and fertiliser.

DESPITE an extensive range of monitoring instruments now available to us, measuring paddock soil moisture is still a considerable challenge. Among the suite of instruments currently available, one that stands out and is increasingly being used by researchers and agronomists is the EM38 (Geonics Ltd, Ontario, Canada).

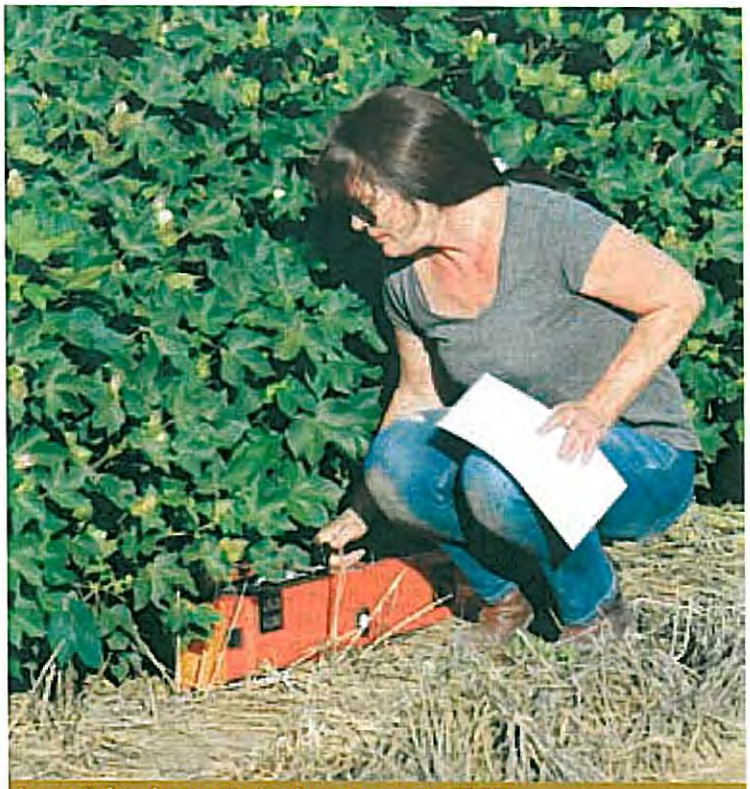
For many of us, when we hear the word EM38 we think of those green and yellow soil management zone maps. For many years EM38s have been used to generate maps for precision agriculture and yield mapping applications.

But DNRM, DAFF and CSIRO scientists in Toowoomba have been quietly using EM38s to monitor soil water in a range of irrigated and dryland crop and pasture studies. And the news is these instruments have a truly impressive ability to provide accurate estimates of soil water.

They are particularly good at estimating soil water in heavy clay soils, like those found extensively in the cotton growing regions of northern Australia. Because they have a sensing depth to 1.5 metres, they are ideal for monitoring crop water use and plant available water (PAW) throughout a growing season.

They could be used by a grower to determine how much and how often to irrigate. And post-irrigation, they could assess application efficiency and uniformity and find problem areas due to waterlogging or under watering. Figure 1 shows calibrated data from an EM38 that tracked soil water in different parts of the paddock throughout part of a cotton season.

So why do we like these devices so much? Very simply – they are easy to use, lightweight, and provide rapid, numerous measurements over large areas without the need for ground



Jenny Foley demonstrates how to use an EM38. (Photo by Ruth Redfern)

NEXT

An EM38 and handheld Archer PC.

Denis Orange takes a soil core for a soil calibration.

installations or destructive sampling. They also have none of the wiring, electronic logging or access tube requirements of other monitoring technologies. Information can be gathered rapidly for a large number of sites. With new advances in EM38 technology, survey and GPS receiver information can also be recorded in the paddock using handheld computer acquisition systems (see the Archer PC leaning against the EM38 in the photo above).

What do EM38s actually measure?

Like all other soil water monitoring devices on the market, EM38s do not directly measure soil water. The only way to directly measure soil water is to take a soil core. Soil water monitoring devices actually measure other attributes of the soil, which can be related to soil water via a soil calibration.

Capacitance probes (eg. C- Probes, EnviroPro) measure the soil dielectric, or the ability of the soil to store a charge; neutron probes measure neutron scattering; TDR probes measure the transmission time of the soil to return a current; and EM38s measure the size of the magnetic field induced by transmitting a current through the soil, called the *apparent electrical conductivity (ECa)*.

The amount of water, clay and salt in a soil mostly determines the way a soil will transmit or store an electric current. Wet soils conduct a current better than dry soils. Clay soils are better conductors than sandy soils because they naturally hold more water and the pore spaces within the soil are mostly small and water filled. Whereas the pore spaces in sandy soils are mostly large and air filled (and air is not a conductor). Salts in the soil water also increase the conductivity because they turn the water into a highly conductive electrolyte.

How do we measure soil water with an EM38?

The EM38 sends a current into the soil and the depth measured is determined by the choice of instrument orientation and coil offsets. To track water movement and re-distribution throughout a growing season, repeated measures at the same locations within the paddock (with salt and clay remaining constant) allow for any changes in ECa to be attributed to changes in soil water content. We can convert this to mm of stored water by using a simple linear soil calibration.

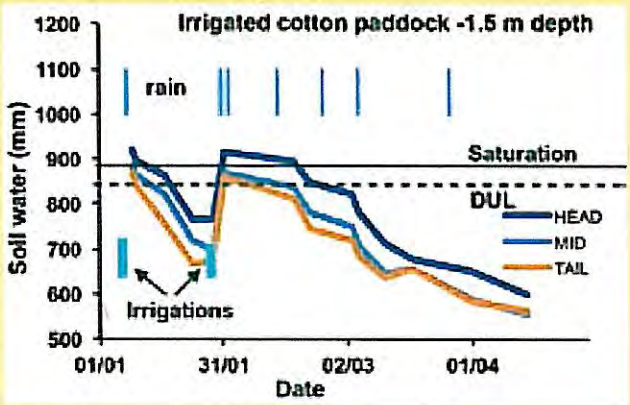
The EM38 can be towed along a survey line in a paddock while the PC records the GPS and ECa data. A map of soil texture can then be generated using free software available on the web. This map can also be converted to a map of stored water in the soil (mm) by using the soil calibration.

There is a labour component required to taking EM38 readings. The instrument cannot be used remotely. But this means it is also mobile and the advantage of this mobility is that it allows numerous readings to be taken across a paddock. Instantaneous readings can be viewed on-screen as the operator walks through the paddock and literally hundreds of reading can be taken in a short time.

One of the main problems growers run into with capacitance devices is that only small volumes of soil are being measured at a few locations in a paddock. These values may have to represent

A homemade buggy is used to tow an EM38 behind a Quad bike over irrigated dairy paddocks in Victoria.
(Buggy and Photo provided by Stewart Spilsbury)

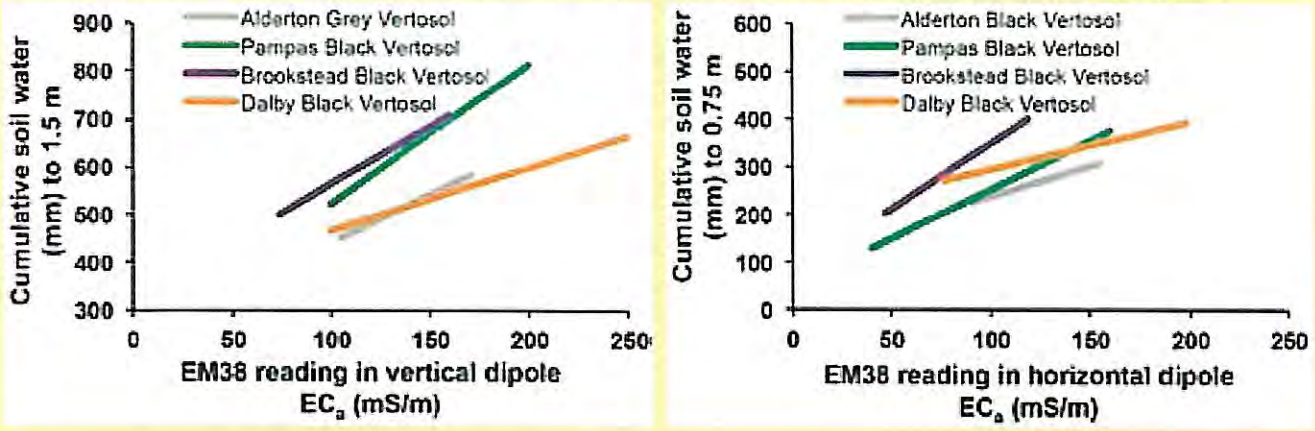
FIGURE 1: EM38 readings are converted to stored soil water.



Soil water, distribution of irrigation water and paddock variability is monitored for an irrigated cotton crop on a Black Vertosol soil. Note the variability in total infiltration after irrigations (head gets more water than mid or tail), the degree of over watering (at head of paddock and this was accompanied by visible plant stress from water logging), and the total crop water use over the growing season.

NEXT

FIGURE 2: EM38 readings calibrated against soil water for southern QLD Vertosols – showing variation between sites and soil types for both vertical (1.5 m) and horizontal (0.75 m) dipoles



what is going on across the whole paddock (so probe positioning is very important). They may also have problems on clay soils with cracking around the access tubes which can create artefacts in the readings. Air gaps and cracks around the access tube prevent the device from 'seeing' soil and may result in null readings. Over-wetting the soil may also happen during irrigation because water runs down the cracks. The EM38 avoids these problems because it doesn't need to be installed in the paddock. And each reading is an average for a large soil volume (one metre length).

How do I get a soil/paddock calibration for estimating soil water?

The soil calibration curve is a simple linear curve that allows us to take a reading and then look up the corresponding mm of soil water to a certain depth in the soil profile. It varies from one soil type to the next as we can see in Figure 2. It changes with soil texture and other properties.

To get a soil calibration, EM38 readings and soil cores are collected together. Volumetric water content is measured from the soil cores. Sampling at a range of wet to dry paddock conditions provides the best calibration eg. after irrigation and after harvest. A single calibration can be used for each paddock or the whole farm if the soil is reasonably uniform. As few as six sampling points gathered across a range of soil moistures may be sufficient to develop a calibration that provides a very good estimate of soil water.

Once we get a calibration for a paddock, or whole farm, we have it for life. The calibration will only be affected by things that significantly vary the soil texture (major earth works) or the amount of salt in the soil (for example – switching irrigation water supplies from clean to salty water, or vice versa).

Maria Harris taking EM38 readings in the crop.

What if I don't have a paddock calibration?

The EM38 can be used to enhance and support our instinct, experience and knowledge. By simply walking in the paddock during fallow and cropped conditions with the EM38, changes in soil water and ECa can be observed. Over time we come to know both the degree of paddock variability, and the expected ECa for a range of moisture conditions for a particular paddock or whole farm. This range will include typical readings for when the soil is drier (eg. harvest and potentially at crop lower limit – CLL), and typical readings when for the soil is wetter (eg. after irrigation when the soil is wet). From this, a very useful estimate can be made about the PAW and how full the 'bucket' is.

What about soil texture variability in my paddock?

When we measure ECa across a paddock with variable soil texture, differentiating soil water content from other attributes becomes increasingly difficult. An increase in ECa may be due to an increase in water content, or salinity or it may be due to an increase in clay. Some care must be taken when interpreting readings in these conditions. Applying a paddock calibration to derive soil water becomes hazardous unless detailed mapping of soil zones, verified by soil surveying, is undertaken and separate calibrations developed for the different soil zones. This would also be required when using any method of soil water measurement, not just EM.

EM38s are ideal for use on clay soils. They are not suitable for use on iron rich soils, as the iron in the soil interferes with the instrument's electromagnetic frequency. Most red soils are rich in iron.

ECa readings need to be corrected for soil temperature variations throughout the year. Tables of representative temperature correction factors have been published for a range of eastern Australian sites.

EM38 TRAINING WORKSHOP

Jenny Foley and Mark Crawford will be running a free two day EM38 training workshop in Toowoomba in mid-2015. If you would like to attend, for details please contact – Jenny Foley at the Department of Natural Resources and Mines, Toowoomba, QLD. Ph: 0745291270, Mob: 0428113502 or Email: jenny.foley@dnrm.qld.gov.au

NSW SUSTAINING THE BASIN *Irrigated farm modernisation*

Update Bulletin 23

February 2015

This bulletin provides updates on the NSW Sustaining the Basin: Irrigated Farm Modernisation (STBIFM) project. This project is funded by the Australian Government's *'Sustainable Rural Water Use and Infrastructure'* Program.

The bulletin will keep interested stakeholders informed of key dates and activities for the duration of the project. It will also alert you to opportunities for training and learning more about emerging issues and technologies.

DPI encourages you to be involved and stay informed using this service. You can, of course, unsubscribe at any time.

For more detailed information on any aspects of the project please send an email to IFM.info@dpi.nsw.gov.au or visit www.dpi.nsw.gov.au/info/sustainingthebasin

Round 3 completed

Round 3 of infrastructure funding closed on Friday 17 October 2014. There were nine successful applicants that will share in more than $6.5M. There were a wide range of activities across the program area including:

- Upgrading existing spray irrigation systems
- Converting surface irrigation systems to overhead systems
- Increasing capacity within storages
- Field and storage reconfigurations
- Delivery system upgrades.

New funding rounds

Funding for Rounds 4 and 5 opens on Monday 2 March 2015 and closes 13 May 2015 and 29 July 2015, respectively.

Under the new funding rounds, this program has expanded the eligible areas to include the Barwon – Darling catchment and expanded eligible entitlement types to include:

- General security (B Class), high security and supplementary entitlement in the NSW Border Rivers
- General security, high security and supplementary entitlement in the Lower Namoi, and
- Unregulated (B and C Class) entitlement in the Barwon Darling.

Compliant metering is required before projects can be finalised. STBIFM provides an excellent opportunity for irrigators to get their metering compliant with the future requirements of the National Watering Initiative.

The only difference between Round 4 and Round 5 is the length of the round. Infrastructure Applications which relate to projects that are ready to proceed as soon as possible should be submitted under Round 4. Round 5 is intended for those projects which require further preparation before proceeding.

Centre Pivot. Image S. Bray.

highlighting the advantages and practical benefits of each technology for optimising yield and water use efficiency in each environment.

The technologies showcased included:

- Scheduling with dynamic deficits - Dr Rose Brodrick, CSIRO
- Canopy temperature sensors - Dr Onoriode Coast, CSIRO
- IrriSAT weather-based irrigation scheduling - Dr John Hornbuckle, CSIRO
- EM38 surveys (soil-moisture measurements and the potential for future use) -
- VARIwise optimal, adaptive irrigation - Dr Alison McCarthy, NCEA
- Smart automation in furrow irrigation - Dr Malcolm Gillies, NCEA; Dr Jasim

The tour was funded by CRDC, the researchers and their respective research organisations.

The irrigation researchers, pictured on farm at 'The Wilgas' Nevertire with CottonInfo technical specialist Janelle Montgomery, farm owners Tony, Tom, Richie and George Quigley and CottonInfo regional development officer Amanda Thomas.(LtoR: back row – Richie Quigley, Jenny Foley, Malcolm Gillies, Alison McCarthy, Onoriode Coast, Tony Quigley, Rose Broderick, George Quigley, Amanda Thomas. Front row – Janelle Montgomery, John Hornbuckle, Jasim Uddin, Tom Quigley). Jenny Foley, Qld DNRMUddin, NCEA; David Robson, Rubicon. Image- Ruth Redfern - CRDC

'Golden Tonsils' calls it a day

Stuart Bray, Project Officer based at Gunnedah has announced his retirement, his last day at NSW DPI was on Monday 23rd February.

Stuart who is fondly referred to by the STBIFM Team as 'Golden Tonsils' because of the golden velvet tone of his voice, heard on many of our project video and audio recordings.

Stuart was a great ambassador for our project in the Peel and Namoi Valleys and will be greatly missed.

We wish Stuart all the best for his retirement, and hope he enjoys playing golf, touring France, and spoiling his grandchildren.

Stuart Bray filming. Image J. Montgomery

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2015 Cotton Irrigation Technology Tour – a research and development partnership

by Janelle Montgomery | 6 Mar, 2015 | 2 comments GROW

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CottonInfo is the Australian cotton industry's joint extension program which connects growers with research http://www.cottoninfo.com.au/. A joint initiative between Cotton Australia, Cotton Research Development Corporation and Cotton Seed Distributors, CottonInfo is made up of Regional Development Officers located in most of the cotton valleys who are supported by technical specialists. Importantly, Ag NSW provide three technical specialists towards the CottonInfo team: David Larsen – Technical Specialist, Web and Information Management, Peter Verwey – Technical Specialist, Geospatial Technology and Mobile Apps and Janelle Montgomery, Technical Specialist, Water Use Efficiency.

CottonInfo's mandate is to connect growers with research. It's essentially the conduit of information, providing a two-way street for researchers and growers to connect and to ensure research gets to where it is needed: on the ground. CottonInfo's role is to provide an avenue for those involved in managing cotton crops to speak directly to researchers – to find out more about how their technology works, how best to apply it on farm and discussing what they see as potential barriers to adoption. An example of this is the 2015 Cotton Irrigation Technology Tour, organised by Janelle Montgomery, Ag NSW, who has 20 per cent of her time dedicated to CottonInfo.

The Irrigation Technology Tour took seven CRDC-funded irrigation-specific researchers to Emerald, Moree and Nevertire in mid-February to showcase their research and technologies. New irrigation research is offering exciting options for growers to improve efficiency and yield through more precise scheduling and application technology.

The tour was hosted by CottonInfo, with funding from CottonInfo partner CRDC, researchers and the research organisations, and was designed to extend CRDC's irrigation research projects to growers.

More than 100 growers and consultants attended field days across the three valleys, hosted at properties where irrigation research is taking place to meet the researchers and see the research and technologies in action. The researchers explained how their technology works and how it may be applied on individual grower's farms.

The tour showcased Dr Rose Brodrick's (CSIRO) scheduling with dynamic deficits; Dr Onoriode Coast's (CSIRO) canopy

LATEST COMMENTS

Congratulations to the Watson's and to the DPI... – Tracey MacDonald | 20 Apr

This is a great initiative. Congratulations to all... – Glenda Briggs | 20 Apr

Congratulations Peter, Janelle and team. Great to see... – Stephen Kimber | 20 Apr

Securing this high profile visit highlights the great... – Glenda Briggs | 16 Apr

The STBIFM team thanks the Executive for their... – Tracey MacDonald | 13 Apr

Well done all, what a great achievement for... – Leonie Martin | 08 Apr

MOST LIKED

Well done, Michelle!... by Cara Brooks
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The race to save the Bellinger turtle... by Sarah Britton
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Setting the standard for weed management... by Scott Charlton
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Eye on DPI as fisheries officers star on TV... by Patrick Tully
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Education Delivery completes Herrmann Whole B... by Michael Ison
46 likes

Record for sales of Tocal College publication... by Vicki Gow
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Tocal students gain UK travel awards... by Bill Kinsey

Auscott Ltd Macquarie's Bill Tyrwhitt; Tom Quigley, Quigley Farms Trangie; CottonInfo Macquarie RDO Amanda Thomas; Brett Cumberland of AFF Narromine; and Dr Pat Hulme of Sustainable Soils Management, Warren, at the 2015 Irrigation Technology Tour's Nevertire event.

RUTH REDFERN

TAKING RESEARCH TO GROWERS

LEADING IRRIGATION RESEARCHERS TOURED COTTON REGIONS IN FEBRUARY TO SHOWCASE INNOVATIVE SCHEDULING AND AUTOMATION TECHNOLOGY TO COTTON GROWERS.

In the first initiative of its kind for the cotton industry, the 2015 Cotton Irrigation Technology Tour took seven CRDC-funded irrigation-specific researchers to Emerald, Moree and Nevertire in mid-February to showcase their research and technologies.

More than 200 growers and consultants attended field days across the three valleys, hosted at properties where irrigation research is taking place to meet the researchers and see the research and technologies in action.

New irrigation research is offering exciting options for growers to improve efficiency and yield through more precise scheduling and application technology. The researchers explained how their technology works and how it may be applied on individual grower's farms.

The tour showcased Dr Rose Brodrick's (CSIRO) scheduling with dynamic deficits; Dr Onoriode Coast's (CSIRO) canopy temperature sensor research; Dr John Hornbuckle's (CSIRO) IrriSAT weather based irrigation scheduling; Jenny Foley's (QLD DERM) EM38 soil moisture monitoring; Dr Alison McCarthy's (NCEA) VARIwise site-specific surface irrigation and fertigation using adaptive control; and smart automation in furrow irrigation with Dr Malcolm Gillies (NCEA), Dr Jasim Uddin (NCEA) and commercial providers David Robson and Peter Moller (Rubicon).

The tour was hosted by CottonInfo, with funding from CottonInfo partner CRDC, researchers and the research organisations, and was designed to extend CRDC's irrigation research projects to growers. The Moree field day was co-hosted with the Gwydir Valley Irrigators Association (GVIA) and also looked at GVIA's optimised furrow row configuration research, CSIRO and CottonInfo's nitrogen loss pathways trials, and sap flow metres and stem psychrometers.

CRDC R&D Manager Jane Trindall said CRDC had gained valuable feedback on what growers think about current irrigation research and areas where they see gaps in scheduling and application information and technology.

"Taking researchers into the paddock to talk to the people who ultimately use their research is extremely valuable for both growers and researchers," Jane said.

"Growers get to interact directly with the researcher to understand more about the tools and technologies they're developing; and researchers get first hand feedback from the end users of their science. It's a win-win scenario.

"We've learned that 97 percent of attendees have an improved knowledge of the irrigation technologies and how they can be used on their farms as a result of the field days."

CottonInfo's Water Use Efficiency Technical Specialist for NSW, Janelle Montgomery – a researcher, extension officer and organiser of the 2015 Cotton Irrigation Technology Tour – agrees.

"CottonInfo's mandate is to connect growers with research," Janelle said.

"We're essentially the conduit of information, providing a two-way street for researchers and growers to connect and to ensure research gets to where it is needed: on the ground.

"Our role is to provide an avenue for those involved in managing cotton crops to speak directly to researchers – to find out more about how their technology works, how best to apply it on farm and discussing what they see as potential barriers to adoption.

"This tour was a great example of this: taking CRDC-funded researchers out into the field, via a CottonInfo tour, to growers. And the feedback from growers has been really positive, with 60 percent of growers at the field days saying they would be likely to adopt the irrigation technologies on farm.

"As one cotton grower at the Moree field day said 'There's discovery in all research, we've just got to support it.'."

Growers interested in reading more about all of the technologies showcased at the field days can download the 2015 Cotton Irrigation Technology Tour booklet here: www.cottoninfo.com.au/publications/cotton-irrigation-technology-tour-booklet

WHAT DID THE PARTICIPANTS THINK?

- 97 percent of participants said their knowledge of each irrigation technology and how it could be used on-farm had improved as a result of the field day.
- 81 percent would like to see more extension of the irrigation technologies in their region, generally preferring field days and farm trials as their preferred extension method.
- 61 percent of participants are likely to adopt the irrigation technologies on farm (on average across all six irrigation technologies featured).
- 95 percent of participants rated irrigation R&D as being important to their business.

More information

Janelle Montgomery, CottonInfo Water Use Efficiency Technical Specialist (NSW) 0428 640 990
janelle.montgomery@dpi.nsw.gov.au

Lance Pendergast, CottonInfo Water Use Efficiency Technical Specialist (QLD) 0448 601 842
lance.pendergast@daf.qld.gov.au

email us

Appendix 4: Silent Witness Observations for each Technology

Silent Witness Observations

IRRISAT	Location: Emerald, Moree, Nevertire

Mood of the meeting (e.g. positive, negative, agitated, cautious etc) also record any significant body language (e.g fidgety, asleep, closed body position, animated):

Engaged, good eye contact, relaxed and interested
Positive, interested
Attentive

Questions asked:

- How often are images taken?
- How far back does the data go?
- What sort of network does this area have? DO weather maps stop at the Border?
- Given use of probes, is there a way to integrate Cloudy day impact on satellite).
- Questions on data? Ownership/use, what constraints, protect privacy (could organisations like Greenpeace access it?
- Can you re-cap on Kc. How do your account for irrigation/row system?
- Can cloud cover be an issue?
- Is there issues with NDVI at high biomass/with crop development? (Less sensitivity after full canopy closure since Kc is driven by sunlight interception).
- If a crop is waterlogged, it's not performing so will NDVI be affected?
- Are you using drones to get data on a daily basis? (NDVI doesn't change a lot in 2 weeks, what does change is the ETo and we measure this with weather stations).
- Can we look at the data retrospectively?
- Are you running IrriSAT over local trials? What are you seeing re the difference in Kc?
- Is it commercial? (Not yet, demonstrating the technique, anyone can look at website).
- Interval between sat data is fairly long. May not be picking up info quickly enough for growers. Can the time interval be decreased?
- CPLM on figure vs low deficit irrigation?
- How do you get NDVI? Straight line?
- 30m x 30m pixel, is it small enough to show differences?
- Is Kc measured at field scale

Comments made:

- Won't replace probes, but value add
- "Measuring crop water use if difficult. Having a site specific Kc is a great advantage. Being able to estimate crop water use is very powerful stuff" Rose Brodrick CSIRO.

Observation/Silent Witness Template

CROP CANOPY TEMP SENSORS	Location: Emerald, Moree, Nevertire

Mood of the meeting (e.g. positive, negative, agitated, cautious etc) also record any significant body language (e.g fidgety, asleep, closed body position, animated):

A bit nervous, fairly engages, a few people asking questions
Engaged and interested
Positive and intrigued, engaged. Lots of discussion

Questions asked:

- There are a few canopy sensors being used, How many and where?
- How do you structure data collection from a field?
- How many observations per field?
- How critical is the distance between the canopy and the sensor? (Full canopy, doesn't matter, close early in season, Lance moved them up three times during the season).
- How are you determining critical values (accumulated stress time). One of the key components is accumulated stress time – work has established trigger point and that's when you need to irrigate. The trigger will change through the season. First square to cut-out is most interesting.
- When will they be commercially available?
- Where do we find the hardware?
- Where to find the regional stress thresholds?
- Does it matter what way you point the sensor?
- Position of the sensor, does it matter?
- How far from the leaf? (30cm to 1m – higher the larger field of view)
- Are there precursors of prediction?
- What is the optimum temp for the plant?
- This year being milder, does the model account for hotter/milder seasons?
- One grower had used canopy sensors but hasn't seen real value yet as he hasn't been able to make sense of the data.
- Is there a difference between crop temps between irrigation systems?
- Potential for many sensors and average data for crop?
- Thermal imaging camera v's biotic, how does it compare?
- What is the relationship between soil deficit and canopy temperature? (Canopy temp increases as soil deficit decreases). When soil dries out, canopy temp roses to match air temp.
- What is the tipping point? Break point for yield is 29oC (whole season), optimum temp.
- How often do we see 32oC?
- Sensor placement? Minimum of 3 per paddock, site them in the field the way you site your c-probe (eg majority soil type)
- How high in the canopy are the sensors?
- How high before canopy closure?
- Are you seeing improvements in WUE? b/ML (didn't measure actual water, just number of irrigations. Measured water this year, some small savings.

Comments made: • "I'm interested in these scheduling tools, such as canopy temperature sensors to give me more confidence with my scheduling decisions" Glenn Price, Mungindi Irrigator. • In terms of what we have seen, we are using proxy to measure soil moisture. When we learn how to use the scheduling and application systems exciting gains to be made. • I would have them situated with the soil moisture probes. The site chosen is very important. • Last year scheduling quite complex and time consuming. Thing it taught me is visual assessment of the crop is not as accurate as I thought it to be. The ease of the decision and the results are similar. • Plant October, confidently using temp sensors by December. Before this, some bare earth. Need to account for this. Higher thresholds.

Observation/Silent Witness Template

Dynamic Deficits	Location: Emerald, Moree, Nevertire

Mood of the meeting (e.g. positive, negative, agitated, cautious etc) also record any significant body language (e.g fidgety, asleep, closed body position, animated):

Positive
Engaged and interested
Positive and inquisitive. Interested, questioning.

Questions asked:

- Where you up to are in the decision support network around this? (A tool is in development).
- Are you integrating the scheduling technologies?
- Are we backing temperature sensors? Is it the most reliable, cheapest, easiest?
- What's the plan for adoption/extension of the research?
- Have you tried to correlate rainfall predictions? Temp, ETo and RH predictions are good, rainfall predictions not so good.
- Are you considering root depth/size of the bucket? As well as temperature you look at the size of the bucket. Ie where plant roots are getting water. Use in conjunction with canopy temp sensors.
- Do you use a c-probe or dig roots?
- Wider row spacing not accessing any more water?
- Yield/management/strategy if it doesn't rain.
- Row spacing, area & rain?

Comments made:

- It's like diagnosing your sick child? You need to know their temp, how were they yesterday? Ambient temp etc
- Biggest area of help is the forecast.
- Just by pushing the irrigation back a few days we captured some rainfall and saved an irrigation.
- One of the practical difficulties is managing an irrigation system on a farm – is the practical issues of trying to irrigate within a time period. Getting water around the farm in a way that doesn't hurt the crop in another sense, if it rains, knowing when to start again.
- Soil Moisture probe important, canopy temp gives feedback instantly.
- Need to work together and integrate research.
- Stress every day that we can do nothing about. Hot extreme temps, low evaporative demand, might rain.
- 7 day forecast is improving the prediction for irrigation date.
- Most people are dynamic. This research is just quantifying conditions under which irrigations can be moved.
- IrriSAT can be used for ETo

Observation/Silent Witness Template

EM38	Location: Emerald, Moree, Nevertire
Mood of the meeting (e.g. positive, negative, agitated, cautious etc) also record any significant body language (e.g fidgety, asleep, closed body position, animated): Engaged and interested Positive and inquisitive	
Questions asked: • There was to be a service for free EM38 surveys. Is that service still available? • Can it tell you where to core? • Do they require calibration (referring to old ones owned by Dept.)? • Do they require regular calibration? • How many cores are required for initial calibration? (6 cores at each soil moisture content need extremes, wet and dry range). • Do you have to have a different calibration for different soil types? (yes, texture differences and salinity levels). • What's the sphere of influence? Is it affected by your body? • Seeing an effect of temp on c-probes, does it affect EM readings (yes, very temp sensitive. You'll have seasonal variations. Neil Huth has developed tables for different regions where you apply a multiplier/factor to your reading back in the office. • What's the potential to replace c-probe? • How much does it cost? • What depth does it sense to? • How many cores and what size cores are needed for calibration? • Is there a body of calibration over different soil types?	
Comments made: • You can build a farm calibration if uniform soil types. A day's work, but have calibration for a lifetime. • EM 38 really interesting, every grower should have one. • To look at root zone soil water, we use EM38. • Biggest disadvantage is you have to be out there. Biggest advantage is you can measure the variability across the whole field. • It will tell you how much water you have lost and how much to apply. • Used in dairy for variable N application.	

Observation/Silent Witness Template

VARIwise: Optimal adaptive irrigation	Location: Emerald, Moree, Nevertire
Mood of the meeting (e.g. positive, negative, agitated, cautious etc) also record any significant body language (e.g fidgety, asleep, closed body position, animated): Small number engaged. Unfortunately lunch was provided during this season so a number were lost. Positive and interested	
Questions asked: • Do you find the infiltration characteristic of the soil? Do they change with moisture? • Sometimes if you are late, cracks can extend your run time with the same amount of volume – can the model take that into account? • What inputs does the strategy need? (Soil moisture and weather data). • What is the model that you use? • How much better was your crop to the growers – b/ML, yield? • Is there an optimum flow rate and advance rate? • Much difference in how long you run siphons for? • How small a field can be managed? • How flash are the cameras that you use? • Do you need a lot of computing support	
Comments made: Benefits really lie in variation in soil per field. Can use fruit count if imagery technology isn't available.	

Observation/Silent Witness Template

Smart automation in furrow irrigation	Location: Emerald, Moree, Nevertire

Mood of the meeting (e.g. positive, negative, agitated, cautious etc) also record any significant body language (e.g fidgety, asleep, closed body position, animated):

Small number engaged. Unfortunately lunch was provided during this season so a number were lost.
Positive and interested

Questions asked:

- How do you see it working on a hill farm?
- What are the potential water savings?
- Can you manipulate heights?
- What is the paddock sensor sensing? IN the furrow or in the soil?
- What do you see as the major thing for upkeep with the system?
- Can you vary the size of the pipe?
- Why aren't we using fluming?
- Are you seeing water usage cut prior to the end of the furrow? Sensor placement?
- What about uniformity between rows?
- In the Moree set-up, how many furrows per siphon?
- What is the ROI? Is there an increase in yield?
- Do you need advance probes in every bay?
- How do you get the rotobucks to marry up with the small PTB's?
- Is the biggest issue maintenance?

Comments made:
Discussion in field re practicality of how to achieve uniformity.
What has been the take-up with bankless channels?