

# Spotlight.

ON COTTON R&D

Autumn 2016

World-first cotton  
climate change facility

Taking nutrition on tour

Reducing risk through  
raingrown research



Australian Government

Cotton Research and  
Development Corporation





Bruce Finney

# In the Spotlight

As growers in many regions experience a hot and dry end to the season, attention turns to water and heat stress in both raingrown and irrigated crops.

In this edition of *Spotlight* we look at some of the ground breaking work CRDC is investing in with research partners to develop ways to make cotton production more reliable and profitable.

CRDC and our research partners are leading the way in exploring climate change science, the role of novel plant hormones and practical solutions within the farming system to better deal with Australian conditions. A new Climate Change Facility at the Australian Cotton Research Institute will put the Australian cotton industry ahead of the curve globally, as no experiments exist like it in the world. This article is also a great story about the value of investment in young scientists and PhD students.

At the national level CRDC works collaboratively with the 14 other rural RDCs and our research partners to co-ordinate research for efficiency and effectiveness. Through this collaboration our co-investment in cross sectoral issues of soils, water use, biosecurity, climate change and digital agricultural technologies has now grown to 25 per cent of CRDC's total R&D investment. We are pleased to report, by example, on CRDC's proactive role in setting and delivering national water research priorities, through the National Water Use in Agriculture Research, Development & Extension (RD&E) Strategy to accelerate water research and establish Australia as a world-leader in irrigation efficiency, which has led to the Smarter Irrigation for Profit project to deliver benefits to cotton, rice, sugar and dairy farmers.

In response to strong interest in dryland cotton production the CRDC has expanded its investments to address grower research priorities including testing the role of novel plant hormones in overcoming crop stresses and on-farm practices to better integrate cotton within the farming system. These investments are a start towards delivering more farming systems research outcomes with and for growers.

Crop nutrition involves critical decisions by growers and their consultants in successfully managing risks in achieving high yielding and profitable cotton crops. From all reports the recent CottonInfo Cotton Nutrition Tour has been a great success, and we thank the CRDC-funded researchers who took part to share and discuss research results with growers and consultants. Much of that information is shared in this issue. Whilst there is a strong knowledge base for best practice crop nutrition it is also clear that new tools are required to enable confidence in measuring levels of crop nutrition and fertiliser decisions in real time. As part of CRDC's Future's Research we are investing in new sensor technology in partnership with the Grains Research and Development Corporation (GRDC) that seeks to make this possible.

This edition also includes highlights from our report on investments in 2014-15. In highlighting the outcomes of grower and Australian government investment through CRDC we wish to thank and acknowledge the support we receive from our research partners, from growers and consultants for on-farm trials. In performing our organisation role we appreciate the support of Cotton Australia and its R&D advisory panels in assisting CRDC to meet the R&D needs of the Australian cotton industry.

On behalf of the CRDC Board and staff I wish you a safe and highly successful harvest.

A stylized, handwritten signature in black ink that reads "Bruce Finney". The signature is fluid and cursive, with a large, sweeping flourish at the end.

Bruce Finney  
CRDC Executive Director



RUTH REDFERN

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**Our mission:** To invest in RD&E for the world-leading Australian cotton industry.

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## Want to see more of Spotlight?

This edition can be viewed online at: [www.crdc.com.au](http://www.crdc.com.au)



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## Fast Facts

**\$210**

Per hectare difference in gross margins achieved in experiments into different rates of nitrogen application and irrigation deficits (see pages 18-19).

**\$22.826**

million was invested by CRDC in 239 RD&E projects on behalf of Australia's cotton growers and the Australian Government in 2014-15 (see pages 32-35).

**\$14.98**

is the cost per hectare of applying defoliant using a ground rig, which takes into account losses from machinery damage to the crop.

**17**

Percent (on average) of the annual total Australian cotton planting is raingrown.



## Award for young innovator



**YVONNE** Chang, a cotton research assistant with CSIRO in Narrabri, has been awarded a prestigious ABARES Science and Innovation Award for Young People in Agriculture by the Minister for Agriculture and Water Resources in Canberra.

Yvonne was selected as the recipient of the award, which is proudly supported by CRDC, for her novel approach to the issue of soil organic carbon. Yvonne's project will look at the use of melanised root-associated fungi to increase long-lived soil organic carbon.

As part of the Award, Yvonne will receive a grant of \$22,000 to undertake this research project.

"The award will allow me to undertake a glasshouse or field project to examine the effect of this fungi on soil organic carbon under irrigated cotton," Yvonne said.

"If the result is a significant increase in soil organic carbon, then this could help to address the long-standing issue of declining carbon in soil, and as a result, enable increased production and sustainability for cotton growers.

"Essentially, my project looks at three things: improving the soil, increasing cotton yields and reducing the impact of greenhouse gases."

Yvonne, who grew up in Sydney and studied science at the University of Sydney, says her career in the fields of plant ecology and plant-soil microbe interactions was driven by an interest in understanding how living systems function.

CRDC Executive Director Bruce Finney congratulated Yvonne on winning the Award.

"Yvonne was selected as the recipient of the cotton Science and Innovation Award from a very strong field of young researchers, and we congratulate her on her success," Bruce said.

"Yvonne is already contributing to cotton RD&E: in her current role with CSIRO, she works as part of the team that is looking at nitrogen losses from irrigated cotton.

"Her research project has the potential to make a real, tangible contribution to the field of cotton research, and help growers improve their productivity and sustainability.

"CRDC continues to be a strong supporter of the ABARES Science and Innovation Awards as a pathway to developing future research leaders, like Yvonne."

# CRDC research published in leading journals

**CRDC** supported research is achieving worldwide recognition with two recent journal articles being published in high impact international journals.

University of New South Wales' Associate Professor Bryce Kelly's research project on evaluating the extent of hydraulic connectivity between the Condamine Alluvium, the Great Artesian Basin and the Walloon Coal Measures was published in *Nature Scientific Reports*, in November.

Tracking of references to the article on Twitter and in the media has placed interest in the outcomes of the research in the top three percent of research articles published worldwide.

To achieve this high level outcome Bryce co-ordinated an international team to assess the potential for impacts from coal seam gas production on groundwater and air in regions adjacent to CSG production in the Darling Downs. Dr Dioni Cendon of ANSTO led the groundwater-sampling portion of the research. He used novel methods to date the age of the groundwater and examine the organic content of the groundwater. Dr Dave Lowry led a team from Royal Holloway, University of London, to measure methane in the near surface atmosphere. PhD candidate Charlotte Iverach then integrated the air chemistry and groundwater data to demonstrate connectivity via gas migration between the Walloon Coal Measures and the Condamine alluvium.

A second outstanding achievement of CRDC-supported research is that of



MELANIE JENSON

Nancy Schellhorn

CSIRO's Dr Nancy Schellhorn and Dr Vesna Gagic's paper on ecosystem services, which was published in *Trends in Ecology and Evolution*, the international ecology journal known to have the "highest impact factor", in September. Nancy's paper looks at how to support ecosystem services at a time when demands for agricultural products limits the amount of arable land set aside for natural habitats.

Nancy and her team proposed a research agenda that identifies resource bottlenecks and interruptions over time to identify targeted measures to secure the continuity of resources throughout the life-cycle of beneficial microorganisms and insects in agricultural landscapes.

Bryce Kelly's paper is freely available [www.nature.com/articles/srep15996](http://www.nature.com/articles/srep15996), while Nancy Schellhorn's paper is available (with cost) at [www.sciencedirect.com/science/article/pii/S0169534715001585](http://www.sciencedirect.com/science/article/pii/S0169534715001585).

## New year, new projects!

**THE** year has started with a flurry of activity at CRDC, with a host of new research projects kicking off on January 1. These projects – which involve research students from undergraduate to PhD level – are aimed at building research capacity within the Australian cotton industry.

This year, CRDC has invested in three new PhD students, who will be delving into the diverse research areas of big data, plant physiology and cotton crop nutrition.

In addition, CRDC has supported 10 new summer and honours scholarships, which provide university students with an opportunity to work on a real project in a working environment as part of their professional development. The students will be conducting short research, extension or industry projects under the supervision of a researcher or extension officer – helping them to hone their skills and their passion for cotton.

CRDC and the Association of Australian Cotton Scientists have also jointly funded a number of Australian cotton researchers to attend the World Cotton Conference, taking place in Brazil in May. Fourteen researchers will travel to South America to the important world conference: an opportunity to showcase Australia's leading cotton RD&E on the international stage and build relationships with the international cotton research community.

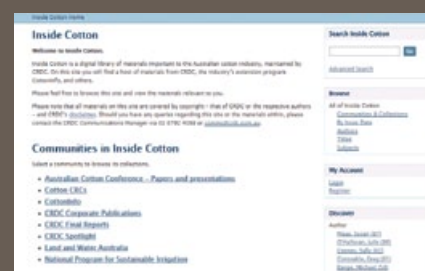
## Final reports now on-line

**OVER** 1100 final reports of RD&E projects invested in by CRDC are now available via CRDC's online library, Inside Cotton.

The reports - which range from 1986 to 2012 - are easily searchable via date, researcher, subject and title.

More recent reports, from 2012 to 2015, are undergoing a final review by CRDC and will be uploaded to the site soon.

The reports join a host of other cotton industry materials available on Inside Cotton, including previous editions of the Spotlight magazine (from 2007 to today); CRDC corporate publications; papers and presentations from the Australian Cotton Conferences (from 1984 to today); and achieved materials from the former Cotton CRCs, Land and Water Australia and the National Program for Sustainable Irrigation.



To access Inside Cotton go to:  
[www.insidecotton.com](http://www.insidecotton.com)

## Monitor birds on your farm



**THE** Birds on Cotton Farms app is designed to help cotton growers identify the common bird species found on cotton farms, and understand how to manage their habitats.

An exciting feature of the app is a monitoring tool, which will help growers monitor the diversity and abundance of birds that can be found on their farms and in surrounding landscapes. It also includes bird call sounds, to make the process of identifying birds that much easier.

The app turns the original Birds on Cotton Farms book into an interactive, online app. It's available on both apple and android smart phone devices and is available to download for free at [www.cottoninfo.com.au/birds-cotton-farms-app](http://www.cottoninfo.com.au/birds-cotton-farms-app).

## Have your say: grower survey now open!

**CRDC** is currently seeking grower input into the annual Cotton Growing Practices Survey. This year's survey focuses on the impact of research, development and extension and the role of CRDC, plus how growers manage their crop for seasonal conditions. There are also questions on mining exploration wells on or near growers' properties, which relates to CRDC-funded research being undertaken by Associate Professor Bryce Kelly (you can read more about his research on page 23 of this *Spotlight*).

The survey is conducted independently and responses are confidential. For more information, or to take part, visit [www.crdc.com.au/growersurvey](http://www.crdc.com.au/growersurvey).

For results from the previous CRDC Cotton Growing Practices Surveys, or the recent CRDC-CCA surveys of consultants, please visit [www.crdc.com.au/publications](http://www.crdc.com.au/publications).

## Get the low-down on cotton nutrition



**IN** February CottonInfo took 10 CRDC-funded researchers out to cotton farms in five cotton growing valleys across five days, to deliver the latest outcomes from cotton nutrition research. This Cotton Nutrition Tour contains a comprehensive summary of the research presented by the researchers (including handouts) and a profile on each of the cotton growers who hosted field days in each valley. It makes a great reference tool for those wishing to better understand nutrition, nitrogen and irrigation in our cotton systems. For more on the tour, see our story on page 10. To download the booklet visit: [www.cottoninfo.com.au/publications](http://www.cottoninfo.com.au/publications).

## What does cotton do at night?

**THIS** is just one of the topics covered in the CottonInfo video series. CottonInfo has available a range of videos for growers via the CottonInfo youtube channel: from pre-season planter maintenance to sampling for spider mites in cotton and the latest in nutrition research.

Dr Paul Grundy, who is well known in the cotton industry, has been busy travelling the length and breadth of production valleys making these videos and was in Moree recently for the Nutrition Tour to interview speakers and participants. Paul knows cotton and has undertaken myriad trials with growers and researchers – so he knows what you want to know and the right questions to ask!

These short, informative videos are a great way to get up to speed on all things cotton. Whether an experienced or new grower, there is something for everyone: [www.youtube.com/cottoninfoaustr](http://www.youtube.com/cottoninfoaustr).

## Be disease aware

**PLANTS** expressing symptoms of wilt diseases are still able to be diagnosed this season to allow proper post-harvest management.

"Correct identification is essential for successful management. Stubble management for example differs greatly between Verticillium and Fusarium and this information is also vital for selecting next season's variety in terms of V or F Rank," QLD DAF Pathologist Linda Smith says.

Both NSW DPI and QLD DAF provide free and confidential cotton pathology diagnostics.

### What to send:

Several sections of stem about 10cm in length exhibiting vascular discolouration should be collected and placed in a paper bag and kept cool (via refrigeration) until posting.

### What to include:

Please provide information on symptoms observed, number of plants affected, variety etc – a form and checklist on sending plant samples for diagnosis is available on page 123 of the *2015-16 Cotton Pest Management Guide*.

### How to send:

Send samples in an overnight Postpak to ensure quick delivery. Avoid sending samples late in the week when they may be delayed over the weekend.

### Where to send:

Please phone first before sending samples to confirm the address and to ensure that the sample is appropriately processed on arrival.

#### Queensland:

Dr Linda Smith, DAF QLD  
07 3255 4356, 0457 547 617  
[linda.smith@daf.qld.gov.au](mailto:linda.smith@daf.qld.gov.au)

#### NSW:

Dr Karen Kirkby  
02 6799 2454, 0428 944 500  
[karen.kirkby@dpi.nsw.gov.au](mailto:karen.kirkby@dpi.nsw.gov.au)



# Leading the world in cotton future climate studies

CSIRO and CRDC have invested in the new 'Climate Change Facility' at the Australian Cotton Research Institute, which is the first of its kind in the world.

**THE** Climate Change Facility consists of dedicated in-crop chambers that modify atmospheric carbon dioxide concentration CO<sub>2</sub> and temperature together to study the integrated effects of elevated CO<sub>2</sub> and warmer temperatures on cotton grown in the field.

A major part of this investment is supporting Katie Broughton, a postdoctoral fellow in crop physiology, to undertake these world-first experiments.

"It is especially challenging undertaking these studies in a summer crop, as controlling temperature in chambers with our summer heat requires significant cooling," Katie says.

"While there have been some studies in other industries, my research is a first for the cotton industry globally.

"This research continues on from my PhD studies, also supported by CRDC to study the physiology and growth of cotton in elevated CO<sub>2</sub> and temperature scenarios."

Now in its second year, Katie's Climate Change Facility project has included constructing four chambers which control temperature and CO<sub>2</sub> in a field at ACRI, to replicate potential future scenarios of different CO<sub>2</sub> and temperature levels.

With current CO<sub>2</sub> air levels at around 400 parts per million (ppm), the treatment with the most 'extreme' levels is injecting 550 ppm CO<sub>2</sub> into the chamber and temperature is set to between two and four degrees higher than the ambient temperature compared with the conditions in the control plots outside the chambers. With current rates of CO<sub>2</sub> and warming increases, it is expected that the levels replicated in the trial will be realised in around 30 to 50 years. The effects on the plants are immediately visible.



Postdoctoral fellow  
Katie Broughton  
inside the Climate  
Change Facility at  
ACRI.

MELANIE JENSON

"It's lucky I'm not claustrophobic," Katie says as she enters the chamber, with cotton plants towering above her, around twice the height of the surrounding crop outside the chamber.

While increased growth was expected, Katie is still surprised by just how much.

"The plants didn't get this big last year, but last year we only took them through to 64 days after planting," she said.

"We are attempting to take this experiment through to yield to ascertain whether this growth is translated into higher yields and quantify the effect on fibre quality.

"Last year, elevated CO<sub>2</sub> increased total vegetative biomass by 57 percent compared with plants in the ambient CO<sub>2</sub> chamber, but there were no effects on fruit number or fruit biomass, so it will be very interesting to see what happens this season."

Previous studies have shown positive effects on yield, but Katie is particularly interested in crop water use.

"It is conceivable that the larger plants could use more water early in the season, leaving less water for fruit growth, which is a concern if water is limited" she said.

"Once we determine the effects we will look at management strategies such as irrigation and growth management in next season's trials, so we can be ahead of

the curve in terms of how we are going to manage crops in a changing climate."

Collaborations with scientists in other organisations continue to be important in these studies. The experiments are being undertaken with support from Professor David Tissue of Western Sydney University and Paxton Payton who works for the United States Department of Agriculture in Lubbock, Texas.

CRDC R&D Manager Allan Williams and CSIRO Agriculture's Mike Bange were instrumental in supporting the establishment of the Climate Change Facility and say this research is vital if the Australian cotton industry wants to be prepared for future climate.

"As well as investigating the implications of increased levels of CO<sub>2</sub> for managing cotton, the chambers will be also useful for systematically studying the effects of other stresses, especially temperature," Allan said.

"Currently our ability to investigate, in a field setting, how to manage extreme temperatures is limited by reliance on whatever the seasonal conditions are each year of the project."

## For more

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Requirements around quad bike safety are changing.

## Conference of 'new frontiers'

**THE** 2016 Australian Cotton Conference has been launched, with this year's theme 'Cotton's New Frontiers'.

Conference topics and speakers will be organised around this theme to take an in-depth look at the challenges and future of the industry.

Running from August 2-4 at the Gold Coast Convention Centre, the event will feature three days packed full of expert speakers, panel discussions, practical workshops, trade displays and fun social events to get the industry talking.

"Our volunteer committee continues to work on the program and we'll definitely be covering topics like the introduction of Bollgard 3, new classing methods, branding and digital agriculture," Conference Committee Chairman and cotton grower Stuart Armitage said.

"The committee is determined to produce a conference with 'something for everyone', where new delegates feel comfortable, families and the next generation is welcome and registration investment is well worthwhile.

"Especially in challenging years, the conference is a great place to get away from the farm or the business and invest in yourself and your staff for a couple of days.

"We want delegates to travel home with a different outlook, a willingness to keep improving and potentially to move in a different direction than before.

"All of that is made possible by the support of our sponsors and again we already have major commitments from CRDC, Cotton Seed Distributors, Monsanto and ANZ."

Conference registrations open in March. To sponsor or book a trade show space contact the Secretariat on (07) 3848 3823.

## Raising the bar on quad safety

**IN** response to the number of deaths caused by quad bike accidents on farms, Victoria has become the first state in Australia to recognise crush protection devices (CPDs) as an appropriate means to control risk from rollovers.

CRDC has worked for many years to improve work health and safety on cotton farms; undertaking projects with the Australian Centre for Agricultural Health and Safety as well as investing in the Primary Industries Health and Safety Partnership (PIHSP).

Across Australia, quad bikes accounted for 15 on-farm deaths in 2015 and were the leading cause of injury deaths for the fifth consecutive year.

"Deaths resulting from rollovers, crush injuries and asphyxiation are the dominant feature of farm incidents," Centre Director Dr Tony Lower says.

"This decision by Worksafe Victoria builds on evidence presented at coronial inquests in NSW and Queensland completed in 2015 and Victoria's action will likely have implications across Australia and internationally."

Research by the Centre found that in 2015, 15 of 69 (nearly a quarter) of on-farm injury deaths involved quad bikes. It also found that of 92 non-fatal incidents on farms, quads were the main cause, involved in 41 (45 percent) of incidents. Quads and

tractors alone accounted for 40 percent of deaths. Overall, six fatalities were children, with quads again being the main cause.

Tony says these figures are naturally disappointing and distressing and there are measures that can be taken to reduce risk.

"Recommendations to reduce deaths and injury start with selecting the safest vehicle for the task.

"However, if quads are still to be used, then a suitably tested crush protection device must be fitted to increase rider safety," Tony said.

"Keeping children off quads of any size, basic rider training and supervision, regular maintenance, not carrying passengers or loads and spray tanks are important preventive actions. With one-third of deaths involving injury to the head, helmets are essential,"

A wide range of materials to assist those working and living on farms to reduce risks to themselves, farm workers, family members and visitors is available from myBMP and the Australian Centre for Agricultural Health and Safety.

### For more

**w** [www.myBMP.com.au](http://www.myBMP.com.au)

**w** [www.aghealth.org.au](http://www.aghealth.org.au)

**w** [www.rirdc.gov.au/PIHSP](http://www.rirdc.gov.au/PIHSP)

### For more

**w** [www.australiancottonconference.com.au](http://www.australiancottonconference.com.au)



# National focus on improving water use

**GOOD** news for growers of both raingrown and irrigated cotton is the launch of the updated National Water Use in Agriculture Research, Development & Extension (RD&E) Strategy to accelerate water research and establish Australia as a world-leader in irrigation efficiency.

The strategy was launched late last year by the Federal Minister for Agriculture and Water Resources, Barnaby Joyce.

"The updated National Water Use in Agriculture RD&E Strategy is designed to ensure that all stakeholders have a seat at the table as we work to establish a smarter approach to developing water strategies that increase productivity and improve returns at the farm gate," the Minister said.

"The focus of this strategy will be on activities that help farmers maximise water efficiency and establish world-leading farm water productivity."

Guy Roth has a long history in the cotton industry and coordinates and chairs the strategy committee which is made up of nine RDCs, state and federal departments of agriculture, CSIRO, leading universities and the National Farmers' Federation.

He says the increased focus should lead to more research and development at the national scale, as well as speeding up the pathway from research to grower adoption.

"Research capability will become more collaborative. This strategy will provide a forum where cotton research leaders can learn from other agricultural industries and regions in Australia, which in turn should accelerate innovation as well as lead to more efficient investments.



Cotton industry consultant Guy Roth and Minister for Agriculture and Water Resources and Deputy Prime Minister Barnaby Joyce launch the National Water Use in Agriculture Research, Development & Extension (RD&E) Strategy.

"This is also the first time there has been an irrigated and raingrown water use in agriculture strategy targeting increased productivity and water use efficiency improvements in farming systems."

Guy says this involves on-ground support to modernise irrigation systems and practices by developing flexible irrigation strategies that are designed around soil, crop, irrigation supply (quantity and quality) and management constraints.

"We aim to increase the productivity of water in raingrown and irrigated agriculture by better adapting to seasonal variability in rainfall and maximising its use. We are also facilitating getting knowledge into practice and building human capacity by designing and implementing programs that reduce the

cost and increase the rate of adoption of new technologies by farmers," he said.

"The updated RD&E strategy inspired the \$4 million Smarter Irrigation for Profit project managed by CRDC.

"It aims to improve farm gate returns to cotton growers through better water management by targeting 3000 irrigators nationally across the cotton, dairy, rice and sugar sectors, through the Australian Government's \$200 million Rural R&D for Profit programme."

## For more

[www.agriculture.gov.au/ag-farm-food/innovation/national-primary-industries](http://www.agriculture.gov.au/ag-farm-food/innovation/national-primary-industries)

## Put forward an achiever

**NOMINATIONS** are open for the 2016 Australian Cotton Industry Awards.

The annual awards recognise the achievement and contribution of people in Australia's cotton industry - from growers and ginners to product suppliers, consultants, agronomists, researchers and more.

"The awards are a great way to celebrate our industry's achievements and share the tremendous work and commitment of people throughout the

cotton supply chain," Cotton Australia Chair Adam Kay said.

"I encourage people to nominate others around them in the industry who deserve recognition.

"Importantly, the awards program does not aim to indicate who is 'best', it's simply a way to recognise those who have made enormous contributions to our industry." There are five categories:

- Monsanto Grower of the Year
- AgriRisk High Achiever of the Year

- Chris Lehmann Trust Young Achiever of the Year, sponsored by Bayer CropScience
- Cotton Seed Distributors Researcher of the Year
- Incitec Pivot Fertilisers Service to Industry Award

Recipients will be announced at the awards dinner on August 4 2016, held in conjunction with the Australian Cotton Conference. Entries close April 1. [www.australiancottonawards.com](http://www.australiancottonawards.com)



A close-up photograph of a person's hand holding a white soil testing strip, dipping it into a small pool of water in a cotton field. The background shows green cotton leaves and dark, moist soil. The title 'Taking cotton nutrition to the field' is overlaid in large white text.

# Taking cotton nutrition to the field

Cotton nutrition is always a hot topic among growers and consultants as they strive to realise optimal yields and fibre quality, reduce costs and increase margins.





To share the latest research, the 2016 Cotton Nutrition Tour, hosted by CottonInfo, took 10 CRDC-supported researchers to farmers in the Upper Namoi, Macquarie, Southern NSW, Central QLD and Gwydir Valleys in February. Around 360 growers and consultants attended the event over the five days.

The tour focused on a range of topics – from reducing inputs and improving nitrogen use efficiency to the role of irrigation, soil health, phosphorus and crop rotations. Researchers included Dr Oliver Knox, Dr Brendan Griffiths (UNE), Dr Ben MacDonald, Dr Gupta Vadakattu (CSIRO), Dr Graeme Schwenke, Jon Baird (NSW DPI), Dr Chris Dowling (Back Paddock), Dr Dio Antille (USQ) and Dr Francois Visser (UQ). CRDC and Cotton Australia-supported Nuffield scholar and cotton grower Nigel Corish also joined the tour to share his learnings from Nuffield and how he has put nutrition research to the test on his Goondiwindi farm.

CottonInfo technical specialist and tour organiser Jon Welsh says there are many reasons for addressing nutrition and finding a strategy that works for each farm.

“Too little nutrition will reduce the crop’s yield potential, while too much fertiliser can impact profitability through increased costs, contamination of groundwater, excessive vegetative growth in the crop, related insect, disease and harvest problems.

“Too much fertiliser – particularly nitrogen – can be lost to the environment

in certain climatic conditions. Carefully monitoring soil N stocks is critical for informing fertiliser management decisions to increase yield and reduce the carbon footprint of the fibre.

“That’s why this year’s tour was critical: to connect cotton growers with researchers, to help them make the best decisions for their farming systems, answer their questions and concerns and identify where we can better direct research and extension.”

The tour was run with support from UNE, USQ, UQ, CSIRO, NSW DPI, and sponsors Yara, Fertilizer Australia, Koch Fertilizer, SST Software and Incitec Pivot. The Moree event was held in conjunction with the Gwydir Valley Irrigators Association. The tour was also supported by funding from the Australian Government.

### Main messages

There were some common themes emerging among the 10 nutrition and soil experts over the tour.

Nitrogen rates are always a hot topic, and many questions from participants were centred on how to better match nitrogen supply with crop demand, along with the role of other micro nutrients in achieving maximum yield. However the overarching message was that ‘knowing your soil and trust your soil tests’; building and maintaining overall soil health is key to managing nutrition and getting the most out of applied nutrients.

“The late Ian Rochester used to say ‘we have to stop treating our soil like dirt’,” says

organiser Jon Welsh.

“While there is plentiful research, practice and advice, growers heard there are no hard and fast rules in terms of an ‘optimal rate’, especially for nitrogen, due to variable factors such as soil type, irrigation methods and weather that all have a role to play in how nutrients are taken up by the crop and held in the soil.

“The link between managing irrigation deficits and nitrogen use efficiency is really being revealed, as is our knowledge of pathways and amount of loss from the field and through irrigation water.

“For example through research looking into soil, carbon and plant physiology we are beginning to get a better picture of the interactions happening in the soil and through this the answers to the questions that remain will come into focus.

“It is a case of understanding the research and using the tools available.

“We have more tools at our disposal than ever before with soil, leaf, petiole and water testing. Investment is also occurring in cutting edge technology to measure live plant nitrates and improve irrigation management through remote sensing.

“I think the overarching message was that getting nutrition ‘right’ is about understanding your soil types, and knowing what is going on in – and off the soil – it is the key to balancing nutrient requirements.

“The research is saying that the most efficient systems not only have the best returns in terms of gross margins, they also have the least impact environmentally.”



# Regional trials yielding surprising data

According to soil scientist Dr Oliver Knox, regional nitrogen (N) fertiliser trials results continue to support the message that optimising N application rates improves profitability, reduces environmental losses, and improves nitrogen fertiliser use efficiency.

The aim of these trials, conducted by the CottonInfo Regional Development Officers (RDOs) is to increase confidence in the science behind fertiliser application decisions.

"Our recent Nutrition Tour researchers confirmed what the RDOs are finding through the regional trials," Oliver said.

"Applying the correct amount of N fertiliser to cotton is important, because, up to a point, it is a controllable driver of yield whereas excess use can result in environmental pollution and reduced production returns," says Oliver, who is based at the University of New England's Cotton Hub.

CottonInfo RDOs, with the assistance of growers, undertook the second season of N fertiliser-use trials across cotton growing regions in 2014-15.

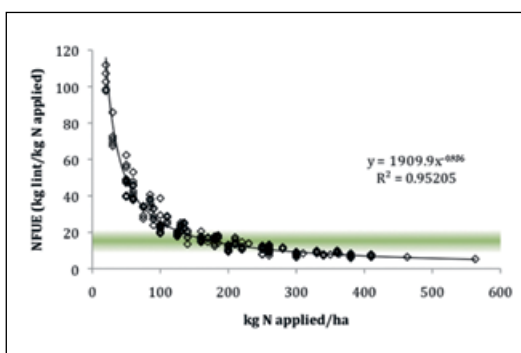
"Again the focus was on determining optimal N application rates for yield, with the addition of leaf and petiole testing to determine how the crop was performing during the season," Oliver said.

"In some trials N losses from the system were also monitored.

"In analysing the trial results it's great to see that many of the trials have achieved a N fertiliser use efficiency (NFUE) in the optimal range found by the late Ian Rochester's research. (Figure 1).

"We are also hearing some of the farms we are

Figure 1. NFUE plotted against kg N applied/ha for the RDO trials undertaken in 2014-15. The regions of optimal NFUE (13 to 18kg lint/kg N applied) is highlighted in green and occurred between 148 and 208kg N/ha application rates. Values falling below this area represent an excessive use of N, while values above this imply that these plots could have profited from more N.



## Key findings

- There is still a propensity to over-use N fertiliser to avoid the risk of a bad season, but in general the results in this last year showed that there is no benefit to adding this extra nitrogen as a precaution.
- Post-season soil assessment indicated excess N isn't being stored in the soil profile for the follow-on crop. The majority of this N is lost to the environment and affects profitability.
- Trust and belief in the science is growing and although some areas still struggle to achieve the recommended NFUE of 13-18 kg lint/kg N applied, all regions are moving closer to it through improved N use.
- Leaf and petiole testing is not always easy, but provides an effective way to ensure that the crop is adequately fertilised.

working with are changing practice and showing improved confidence in getting the N application levels right.

"There's still a way to go, but the interest in the trials and the feedback we are receiving suggests we're moving in the right direction."

### Few benefits of too much N

There is general consensus across industry that, where water was available, the 2014-15 season was a good one for growing cotton.

"To some extent good growing conditions and lack of disease across the trial sites meant we had a better chance of seeing just how far N could push yield," Oliver said.

"The answer, as expected, was that after a certain point, more N simply did not add more yield.

"A surprise to many was that no further increase in yield was seen in the trials in Southern NSW and the Darling Downs after total applications of around 100 kg N/ha was applied, while in the Namoi and Dirranbandi trials, lower rates of total N applied, which were between 160 and 250 units, often optimised yields."

A similar situation was observed in the Macquarie.

In the Macquarie upfront rates were varied, as





MELANIE JENSON

Soil scientist Oliver Knox (centre) discusses calculating nitrogen requirements with Crop Consultants Australia President Dallas King (left) of St George and board member Stuart Doyle (second from right) during the CottonInfo Cotton Nutrition Tour. Oliver leads the University of New England Cotton Hub and analysed the data from the regional nitrogen trials.

urea was run in irrigation water to achieve total N applications of 160 (nil upfront), 220, 260, 300, 340 and 380kg N/ha applications.

Macquarie RDO Amanda Thomas said the average yield was 12.1 bales/ha and there was no difference between the treatments (Figure 2) with the best NFUE of 15.4kg lint/kg N obtained for the 160 kg N treatment.

"The result was surprising, but when the pre-season soil N test was taken into account with the 160 kg N applied, then according to the science, there should have been enough N in the system for a good crop and this is what we saw," Amanda says.

"I, like others, was putting the research aside when growing our own crop, as I wanted to eliminate as much risk of not reaching our target yield as possible, but if we get some water for the next season I will definitely look to change our practice and reduce our rates."

### You don't store it in the soil

All of the 2014-15 trials applied N well above the amount recommended by the science to produce the optimal yield in that season and field.

"We often hear feedback that the over-application of N in the cotton phase of a rotation will be of benefit to the follow-on crop," Oliver said.

"However, with all the possible losses of N from soil, is this really the case?"

"Post-cotton soil assessments across the trials continued to support the research that says this is not an effective way to fertilise a follow-on crop," he said.

Trials in the Gwydir used total in-crop application rates of 363, 463 and 563 kg N/ha. All the crops in this trial produced  $13.1 \pm 0.1$  bales/ha and showed no response to more N. The post season soil test revealed 10, 16 and 21 kg N/ha

respectively in the zero to 30cm soil profile.

"Despite adding 100kg or even 200 kilograms excess N to some of the plots there was no change in yield and post-season soil testing showed there was only an additional six to 11 kilograms of N per hectare left from these over-applications," Gwydir RDO Alice Devlin said.

"Given that the crop did not take more N off the field and being there was roughly the same amount of N left in the soil then this shows that the excess applied is almost entirely lost to the environment.

"In hindsight not applying this excessive N could have left a few hundred dollars in the farmer's pocket."

### Where does the N go?

Alice has also been sampling gas emissions in the Gwydir with NSW DPI Soils Research Officer Dr Graeme Schwenke as part of the 'Action on the Ground' project. They are finding much of this excess N is lost to the atmosphere as nitrous oxide ( $N_2O$ ) and  $N_2$  gas.

This research has seen Alice heading into the field several times a day to recover gas samples from gas traps in fields which are placed in irrigated and

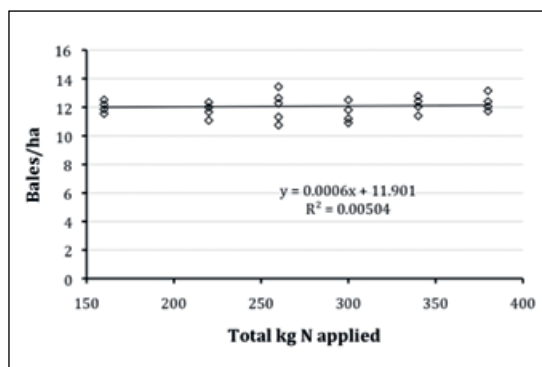


Figure 2. Yield of six replicated plots for each total N applied treatment undertaken in the Macquarie trial. A line of best fit is plotted through the points highlighting that there is no improvement to be gained in yield from increasing applied N beyond the initial 160 kg N/ha.

non-irrigated furrows and on the plant line during irrigation.

It has been well worthwhile, Alice says, as gaseous losses are one of the biggest pathway of N loss from our farming systems.

"These measurements were really needed to establish how much N is being returned to the atmosphere instead of being taken up by the crop," she said.

Following N application Alice and Graeme recorded high  $N_2O$  emissions in the non-irrigated furrows in the highest N rate treatment, and also in the hill and non-irrigated furrow of the middle N rate treatment.

"Emissions in these areas started to decline a week after N application, but increased again at the next sampling, which was after a water-run urea application," Graeme said.

"The daily emissions from the 563 kg N/ha rate at their highest were above 2.5 kg N/ha/day for a short period from the non-irrigated furrow.

"Unfortunately, the chamber method cannot easily measure  $N_2$  loss, but to give an idea, an average ratio of  $N_2:N_2O$  loss for alkaline vertosol soils (as in these trials) is around 40:1 during denitrification, so many tens of kilos of total N would have been lost from the paddock during January based on Alice's measurements."

### The effect on profitability

Because there is a point at which the value of the lint return was less than the cost of the N applied, using too much N also affects profitability (Figure 3). The 2013-14 RDO trials clearly showed this; and in this past season's trials on the Darling Downs in Queensland it was again evident.

In terms of NFUE however, former Downs RDO John Smith said this was varied across the trials, but close to the 13 to 18kg lint/kg N applied values that Ian Rochester's research suggests are optimal for profitable cotton production.

Three of the four trials undertaken on the Downs showed no difference in yield between the varied N application rates. The exception to this was a site where the 50 and 90kg N/ha treatment yielded marginally less than the 130, 170, 210, 250, 330 and 410 kg N/ha treatments, which were similar and averaged 11.8 bales/ha (Figure 3 - crosses and black line).

"This highlights that we generally need some N for optimal cotton production, but that the amount for optimal yield production is probably lower than most of us would currently feel comfortable with," John said.

### Leaf and petiole testing improve confidence

To determine the nutritional status of the plant during the growing season leaf and petiole testing was included in all the trials. The growers in the

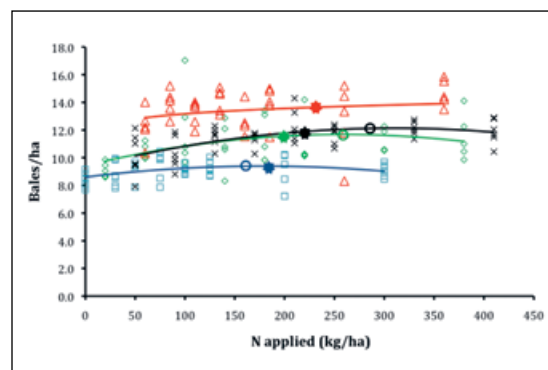


Figure 3. A plot of yield against the N applied for the four trials on the Darling Downs. The lines represent the best fit between the data points. Stars indicate the point at which an NFUE of 18 was exceeded in each trial and the circles are the point at which the value of the lint being produced was exceeded by the cost of N applied. The red line has no circle, as there was no mathematical difference between the yields across the treatments.

Dirranbandi area had the additional benefit of a presentation by Dr Chris Dowling at their end of season review in May 2014.

RDO Sally Dickinson says on the back of Chris's talk a number of growers became interested in conducting in-season leaf and petiole tests in order to better understand what was happening in their crops and across the valley.

"One year on and there was recognition that while this assessment took a bit more organisation and time due to where Dirranbandi is logistically, the actual in-crop testing wasn't overly hard or time consuming and the results provided confidence that the crop was accessing adequate nutrition," Sally said.

"It was really exciting to see this group of growers initiated such a valuable project and it provided a good indication that the crops were accessing adequate N.

"The group really benefited from the advice and support given by Chris and I'm hopeful next year we will use the tissue test data with more confidence to tailor our in crop N applications when they are needed and to improve our NFUE."

### The system is important

Interpreting data from these type of trials is complicated without control strips with zero N application, which were missing from the 2013-14 trials.

"This year we were lucky enough some of our co-operating growers agreed to run these for us, which we are really appreciative of," Oliver says.

"In most areas as expected, there was a clear yield penalty to zero application, although some of the crops still returned above 8.3 bales/ha.

"However there was one trial that contradicted this."





MELANIE JENSON

In the Southern Region Kieran O'Keefe ran a trial in a bankless system where the zero treatment produced 13.6 bales/ha, with no difference in yield across the experiment, with N application rates of 100, 200, 250 and 300kg N/ha.

So what does this suggest?

Kieran believes that, "looking at the other experiments it's clear to see that N is needed to optimise yield, however, we got a great crop off the zero treatment".

"The biggest difference is that my trials were in a bankless system and given what we are hearing about how N moves around in irrigation water, from the work being done by the likes of CSIRO's Dr Ben Macdonald (in conjunction with CRDC), it's quite possible that in our system the zero treatment received adequate fertiliser simply from mobile nitrate moved around the field during each irrigation.

"The good news was the best NFUE of 15.2kg of lint/kg N applied was in the 200kg N/ha treatment, which was reasonably close to the farmer's own application rates, although it also highlighted that we're still learning about these alternative production systems."

### Overall success

Oliver Knox says all in all the 2014-15 trials were a great success.

"For me, it's great to see the RDO network extending the science on the ground, via trials with some brilliant collaborators, and I am extremely encouraged by the practice changes we've heard of in response to the demonstrations of the science in crop," he said.

"There are still areas where there is work to be done, but the current approach appears to be providing the impetus for growers to place a greater belief in the science and improve their N fertiliser use efficiency and crop profitability."

The 2015-16 trials will add more valuable data to this picture.

Namoi and Central Queensland RDO Geoff Hunter says "we've made some good progress with two years of data showing higher N is not always contributing to yield or profitability, but there is still work to be done around understanding the losses from the system and the variability of these.

"This season we are making attempts to address this and continue to focus on improving NFUE, while also addressing the issue of upfront versus in-crop applications.

"We are including lower N rates than we used last year and zero N strips to clearly show where the yield benefits from N application really start.

"Our continued use of pre and post season soil tests as well as in-crop leaf and petiole testing ensures we can monitor N levels through the season to get it right and show growers that the science and research is believable."

Growers keen to seek further information on the N trials in their area or who would like to visit the trial sites in 2015-16 to see the science in practise should contact their local RDO.

"Similarly, if you are running or thinking of running N response trials we'd love to hear from you and include your data, so please get in contact and don't be scared," Oliver said.

"Many of our collaborating growers have become much happier with running replicated trials and have found that they are easier to undertake than they initially thought."

Picking nitrogen trials in the Gwydir Valley.

### For more

**Dr Oliver Knox**

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or your local RDO [www.cottoninfo.com.au/contact-us](http://www.cottoninfo.com.au/contact-us)





Methods to improve soil organic matter include the use of cover crops and retaining plant material on-farm for decomposition.

# Focus on the importance of soil health

MELANIE JENSON

Professor Brajesh Singh of the Global Centre for Land-based Innovation at Western Sydney University says his research shows that improving soil health can improve farm productivity by 15 to 20 percent.

At a workshop in Narrabri late last year run by the Centre in partnership with CRDC, NSW DPI, CSIRO and CottonInfo, cotton growers and researchers came together to discuss benefits of improving soil health. Guests included global leader in soil health Professor Karl Ritz (University of Nottingham, UK), and leading soil scientists from Australia.

The workshop outlined five components needed to ensure good soil health - water, structure, nutrients, organic matter and biota including soil fauna and microbes - which can in turn ensure improved efficiency and productivity.

"Healthy soil contains billions of microbes including bacteria and fungi that support soil structure leading to improved nutrient availability and acquisition, disease resistance, water filtration, and aeration," Professor Singh says.

"Due to their role in providing plants with growth limiting nutrients, evidence was presented that nurturing soils and the microbes within them will reduce our reliance on synthetic chemical fertilisers and could also reduce our reliance on pesticides, saving costs for growers and leading to more sustainable farming methods."

The workshop identified approaches to achieve healthy soils, with careful management of soil organic matter (SOM) a good starting point.

"Microbes use SOM as a food source and higher levels of quality SOM will support

a greater diversity of microbes," Braj said.

"This diverse population of microbes will then aid plant growth, nutrient supply, disease resistance and, ultimately, will positively impact yield.

"Methods to improve SOM levels include the use of cover crops and retaining plant material on-farm for decomposition.

"Measuring soil health is then a simple matter of monitoring the SOM levels in paddocks over time. This will provide an indication if SOM levels are dropping, being maintained or are increasing over time."

"The importance of the quality of SOM is also important."

Backing up industry research, further methods to increase soil health are through using less destructive methods of tillage to minimise soil structural damage and help to support soil biota.

"The move away from mono-cropping will also help increase both soil biological and structural health and provide some natural resilience to agricultural pests and diseases," Braj said.

"Careful consideration of crop rotations can significantly reduce the reliance on synthetic fertilisers and pesticides - for example, rotation with an appropriate legume crop can provide a significant portion of the N requirements for cotton crops."

## Future directions

There is a feeling that what stops many farmers doing something more

microbially-friendly is the fear of the unknown - while they know their current system may be degrading carbon - they have a fair knowledge of what their crop outcome will be that year.

"If they were to change their system, they aren't clear on what the outcome might be and so they opt to do what they know," Braj says.

"Some growers said they struggle to demonstrate short and long-term economic return and until this information is available to them, only a few will take the risk of spending money on improving soil health without knowing the long-term benefits (including financial) that may be gained."

CRDC R&D Manager Allan Williams said the workshop was an excellent initiative where growers, consultants and researchers came together to discuss new innovations and technologies and how they can be improved and adopted in order to increase farm productivity and profitability.

"It was great to see the enthusiastic participation and discussion from growers and consultants.

"We know there are some barriers in the adoption of research knowledge and this workshop provided a great opportunity to identify those barriers, but also to discuss some solutions.

"I was extremely pleased to note that all participants were keen to improve their soil health, however it was suggested that industries should achieve this using a step-wise approach to systematically incorporate soil health in management practices."

## For more

Professor Brajesh Singh

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# Getting back to your roots

Leading international researchers say understanding and harnessing soil-microbial interactions in the rhizosphere zone can increase productivity, alleviate disease impacts and improve the resilience of farming systems.

The rhizosphere is the region directly surrounding plant roots. It contains root secretions and a highly diverse range of micro-organisms and soil fauna.

Bacteria and fungi contained within the rhizosphere are directly linked to plant productivity. A 'bi-directional dialogue' occurs where plants provide carbon to the rhizosphere microbes, and microbes in-turn, provide access to nutrients (including nitrogen and phosphorus) and resistance to soil-borne diseases.

The interaction between plant roots and soil microbes (fungi and bacteria) has a central role in determining how crop plants react to different stressors.

Certain classes of soil microbes, known as 'beneficial' microbes, are responsible for recycling and altering nutrients into a format usable by plants - they act as nutrient and



Bacteria and fungi contained within the rhizosphere are directly linked to plant productivity.

signal conduits between plants, they break down or immobilise toxic compounds and protect the plant from pathogens.

Identifying currently available rhizosphere knowledge could also be used to increase farm productivity and resilience

of farming systems by minimising the effect of soil-borne diseases. Using seed dressing and inoculation with beneficial microbes is already being used and or trialled for other crops.

## Keep soil free of disease, pests and weeds

Come Clean. Go Clean is one of the simplest yet most effective strategies for minimising the spread of disease, weeds and pests on and between farms.

Many diseases of cotton, for example verticillium, are soil-borne. Last season this disease showed the potential to cause heavy yield loss and spread quickly across and between farms. It is particularly important at harvest, due to increased traffic, that a farm hygiene protocol is established and enforced.

CottonInfo's Technical Specialist Sharna Holman said this is a reminder of the importance of ensuring that all vehicles and equipment entering farms are thoroughly

washed down with Farmcleanse or Bio-Cleanse and again when leaving.

"This is an across-industry issue, so individual growers really need to be vigilant and have a strategy for ensuring the movement of clean machinery on and off the farm and around the farm.

"Look for practical solutions that work for your farm – for example if cleaning every vehicle isn't practical, establish a visitor parking area away from production areas and consider having a vehicle available for regular visitors such as consultants to use.

"Preventing a problem is much more cost effective and easier to manage than

having the problem after it has spread onto your property, and as an industry it is important that we all take responsibility to make sure we are not contributing to the spread of any disease, pest or weed."

myBMP outlines the types of practices that are recommended by the industry, such as signage and proper wash down procedures and links to useful resources to help with planning.

### For more

**w** [www.cottoninfo.com.au](http://www.cottoninfo.com.au)

**w** [www.myBMP.com.au](http://www.myBMP.com.au)

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# ‘More’ is not always better...

While there has been a considerable amount of research investigating nutrition and irrigation practices in Australian cotton systems, it has generally focused on each of these issues separately, meaning that the interaction and influence these two resources have on each other is not always well understood.

To address this, CRDC supported a research trial at ‘Ruvigne’ in the Upper Namoi Valley investigating a combination of nitrogen fertiliser rates and irrigation deficits and the effect of different combinations on yield and gross margins.

It has found that ‘more’ is not necessarily ‘better’. The first year of this research demonstrated that growers can optimise input efficiency while at the same time reach full lint yield potential; and importantly, improve returns.

The trials were undertaken by NSW DPI research agronomist Jon Baird and the late Ian Rochester of CSIRO Agriculture, in conjunction with grower Rod Smith at “Ruvigne” and determined the impact of various irrigation and nitrogen rates on plant growth, lint yield, nitrogen use efficiency (NUE) and water use efficiency (WUE).

Three nitrogen and water input management strategies, classed as ‘low’, ‘moderate’ and ‘high’ were applied. Of the strategies, the moderate was optimal as it resulted in good WUE and NUE and importantly for growers, higher gross

margins per hectare, with a gain of \$210/ha over the highest input strategy.

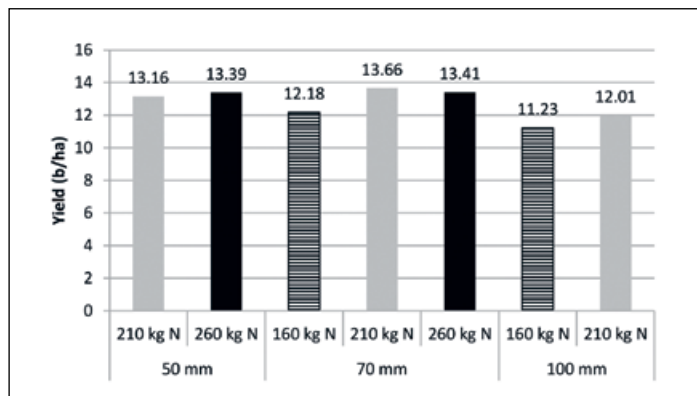
The trial also backed up data from other research, as it found that irrigation management can play a major role in the cotton plant’s ability to take up nitrogen.

The researchers incorporated typical irrigated cotton management strategies, irrigating on soil water deficits of 50mm, 70mm and 100mm, and applying nitrogen at rates of 160kg, 210kg and 260kg N/Ha. Seasonal plant available nitrogen was 200, 250 and 300kg N/ha respectively after mineralised nitrogen was found to be 40kg N/ha.

“Acknowledging that the experiment has only one year of data and is specific to the Upper Namoi region, the moderate management strategy (210kg N/ha - 70mm deficit) was clearly the most optimal system,” Jon said.

“This reiterates that it is possible for cotton growers in Australia to apply N and water with efficiency in mind and continue to produce yields that are considered high and profitable.”

**Figure 1:**  
Experiment Yield  
(LSD>1.07 b/ha)



RUTH REDFERN

Plant mapping throughout the growing season showed the high input strategy (50mm deficit; 260kg N/ha) produced a plant with higher boll numbers and fruiting positions compared to the other two systems, yet this trend did not continue to realise the highest yield.

The moderate strategy resulted in the highest yield of 13.66b/ha, 0.2 b/ha greater than the next two most intensive treatments (260kg N/ha at both 50 and 70mm deficit).

The higher applied N rates of 210 and 260 kg N/ha (at both 50 and 70mm deficits) had significantly higher yields than the lower N rate of 160kg N/ha.

The low input strategy’s (100mm deficit with 160 and 210 kg N/ha applied) lint yields were significantly lower (LSD>1.07 b/ha at  $p \leq 0.001$  - see Figure 1).

## The role of irrigation management

N use efficiency was evaluated by calculating the internal crop NUE (iNUE). iNUE was determined by dividing lint yield





Growers on site at 'Ruvigne' during the CottonInfo Cotton Nutrition Tour in February.

by crop nitrogen uptake.

"Evaluating iNUE allows for the determination of the amount of under or over-fertilisation that occurred in respect to the economic optimum nitrogen rate," Jon said.

"From this we found that the optimum rates for nitrogen and irrigation application was 210 kg N/ha and the 70 mm deficit.

"But what was most interesting was that trial results suggest that irrigation management had a greater influence in the plant's ability to uptake nitrogen compared to the varied nitrogen application rates.

"The intensive 50mm irrigation deficit improved the variability of nitrogen uptake by the cotton plant when compared to the larger irrigation deficits of 70 and 100mm (see figure 2).

"This highlighted to us that the level of plant available water content of the soil (PAWC) can influence the cotton plant's ability to uptake nitrogen.

"These results support the argument

that not only can irrigation impact NUE it can also be utilised to improve the NUE of the cotton plant."

### Water use efficiency

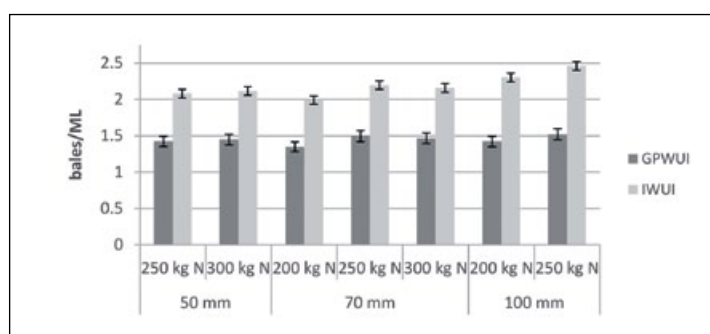
The three irrigation strategies of 50, 70 and 100mm deficits resulted in water use of 6.33, 6.22 and 4.7ML/ha respectively.

Interestingly, Jon says, the 50mm deficit had 10 irrigations yet used similar amounts of water to the 70mm strategy with eight irrigations. As a result of the similar water use between these two treatments the final

water use index were highly influenced by lint yield, shown by the IWUI (applied water efficiency) results. The 100mm deficit with six irrigations and the lowest applied water meant that its GPWUI (total crop available water) was significantly higher than the 50 and 70mm deficit irrigation strategies. A 100mm deficit is the traditional figure in the Upper Namoi.

### Gross margins

While it is always important to highlight and improve efficiency of a management



**Figure 2.** GPWUI (total crop WUE) & IWUI (applied WUE)

system, gross margins play a huge part in establishing the savings and financial benefits for growers.

"The high yields experienced in 2014-15 give us an opportunity to evaluate the greater benefit of optimising a cotton management strategy," Jon said.

"Crop gross margins from our trial showed a remarkable \$4555/ha return for the moderate strategy, while the intensive strategy returned a margin of \$4345/ha.

"The low input strategy was used as a base for gross margin comparisons (Figure 3).

"As this figure highlights, there was a gain of \$210/ha by the moderate strategy over the intensive, and a \$1000/ha increase compared to the returns of the low input strategy.

"These findings highlight that by optimising your cotton management inputs such as nitrogen and irrigation, this can result in greater on-farm productivity and more importantly results in greater crop returns."

### In times of low water availability

A gross margin calculated on a per megalitre basis was also evaluated and the moderate

strategy shone through again - with the higher lint yield resulting in a megalitre margin equal to the low input treatment even though it had extra two irrigations.

The 50 mm irrigation strategy resulted in a \$50/ML decrease, while the worst performing treatment was the 160kg N/ha at 70mm deficit which returned \$105/ML less than the moderate treatment.

In light of the first season's results, and in recognition of the diversity of soil and climatic conditions in different cotton growing regions, further trials are being undertaken this season.

"To implement nitrogen best management practice, growers should start by conducting regular fallow soil sampling for background soil nitrate levels, consider available irrigation water when nitrogen budgeting and follow best management irrigation practices."

### For more

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## Grower view

"Ruvigne" manager Rod Smith says the challenge for him is how to get his back-to-back cotton fields to produce as closely as possible to fallowed or rotated fields.

Working on a two thirds in, one third out rotation at "Ruvigne" means between 350 and 450 hectares of irrigated cotton is planted annually. Cotton is grown for two years back-to-back then into cereals for one year. Irrigation water is sourced from bores and the Mooki River when possible.

While the advice coming from all sectors of the industry is to avoid back-to-back cotton, Rod says this isn't really economical on farms in the Upper Namoi.

"Down here sorghum would be the next best option after cotton, but the returns compared to cotton just aren't there," he says.

"Added to this, due to our cooler climate, short season and planting window, even if I wanted to I can't even sneak a wheat crop in if we get some flow in the river to bring in a one to one rotation, because it would push our planting date back and down this way we couldn't start growing cotton that late.

"We work really hard to look after soil health here at Ruvigne and I'd love to include rotations to improve organic nitrogen and carbon, but at this stage we will stick with our rotations, given we keep disease free, that would definitely change things."

In regard to the trial, Rod says what he found most interesting was the large difference in the 'low' and 'high' input trials.

"I knew there would be an obvious difference, but I didn't expect it to be that much," he says.

"I think the returns speak for themselves in the gross margins. What I've taken from it is if you've got the water you're better off to come back to a smaller area and irrigate it on smaller deficits, and have more fallow.

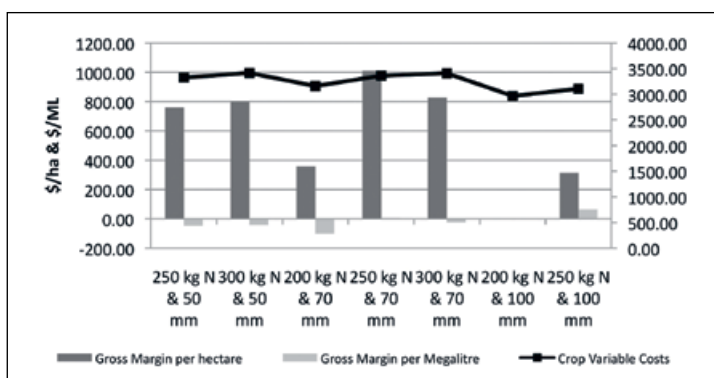
"This would help avoid disease issues down the track, give fields a spell or even allow us take advantage of a flow in the river to plant an opportunistic rotation crop.

"It was amazing how far behind the 200 units of N at 100mm deficit trial was and it really showed how much low water intervals hurt the final outcome."

Figure 3. Treatment

Gross Margins compared to the low input strategy (160 kg N/ha & 100 mm deficit).

(A gross margin is not indicative of farm profit because it does not include the overhead or operating costs such as administration, permanent labour, depreciation and finance expenses, which have to be met regardless of enterprise size or mix).



## Key points to consider

- Soil tests are crucial in calculating nitrogen budgets for your crop.
- Consider the available water for your crops when applying nitrogen – don't apply large amounts of nitrogen in a conservative water situation.
- Irrigations do have an impact on nitrogen uptake efficiency, so optimising your irrigation practices will improve your nitrogen use efficiency.
- It's crucial to have level/ even fields with adequate irrigation infrastructure if you apply an intensive irrigation strategy as poor application will exacerbate plant stress.
- The high input strategies do produce a plant with greater fruit potential, but plant stress events will have a greater effect on yield potential and therefore this strategy leads to more risk in a farming system.
- The pre-water event accounted for 20 percent of total water applied in this trial, improving this figure would greatly improve water use efficiency in an irrigated system.



# Compaction: easier than you think

Soil moisture is the greatest influencer on compaction and new research shows that it happens more easily than previously thought.

Recently completed CRDC research to better understand compaction from John Deere 7760 round bale pickers has found that the optimal moisture level needed to avoid compaction is well below previous recommendations of being near "plasticity". Plasticity refers to the point at which the soil goes from being able to break up in a brittle manner to one where it is more the consistency of plasticine.

The research was undertaken by the National Centre for Engineering in Agriculture and the University of Southern Queensland under researcher Dr John McLean Bennett.

"A major recommendation of this work it is to avoid heavy traffic if the soil moisture content is anywhere near or even just above the plastic limit," John said.

"Past recommendations have been that 'near' the plastic limit is acceptable, however we found compaction is maximised in that scenario.

"Research suggests that the wheel load and contact stress of the JD7760 causes substantial damage to the soil even at considerably low moisture contents in comparison to the plastic limit.

## Determine plasticity

John says the simplest way for growers to determine plasticity is to take samples to around the depth of the major rooting zone and squeeze it between thumb and forefinger. If it does not deform to feel like plasticine then it is lower than the plastic limit. If breaking it up and moulding results in some of the soil feeling like plasticine then the soil is approaching this limit, but is still drier than it.



There is concern about the long term effects of heavy traffic on cotton fields, which can be alleviated by controlled traffic farming.

MELANIE JENSON

"This was observed for every site the JD7760 traversed in our research.

"The challenge for growers is to integrate heavy machinery with high field efficiency into the system while minimising impact. Our research indicates that controlled traffic farming (CTF) is a very sound practice.

"And CTF doesn't just mean driving up the same rows, it entails machinery with single wheels front and back with the same distance between the wheels on an individual axle across all farm machinery.

"The difference is 66 percent of all furrows trafficked (non-CTF) versus 50 percent and as low as 33 percent of furrows trafficked (CTF) which results in significantly less impact on the soil," John said.

"If we don't apply CTF we're concerned there could be a substantial compaction legacy and a future challenge if the issue is not addressed.

"Based on our results we found that at one of our sites at Warren in NSW that the cost of CTF conversion would be recovered in system gains in approximately two to three seasons.

"Bio-ripping (wetting and drying of the soil with rotation crops) and conventional cultivation cannot be relied upon for short-term fallow systems, and cultivation can't reach sufficient depth to avoid long-term

## Key points

- Traffic when soil is near, or above, the soil 'plastic limit' should be avoided with the JD7760, especially in dual wheel configuration. Traffic should only occur well below the plastic limit.
- Controlled traffic farming should be considered best management practice for limiting compaction, increasing yield potential and decreasing environmental cost.
- Increases in machine weight and large traffic footprint present substantial concerns for subsequent yields and tillage energy costs.

compaction pans.

"Deep ripping will require further investigation as to the energy cost versus mitigation of long-term compaction pans and yield response, as does using the crop to dry down soil to well below plastic limit prior to harvest in an irrigated systems."

### For more

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# Weeds: Time to sit up and take notice

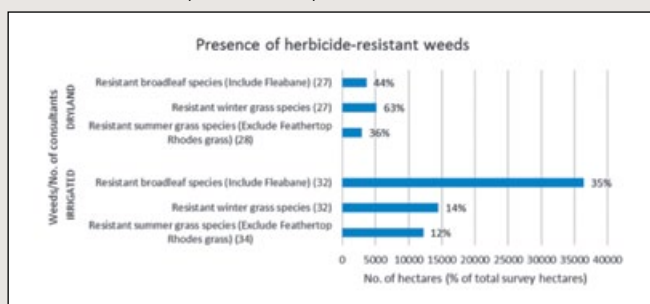
For a number of years now our industry has been cautiously sharing its concerns that the issue of herbicide resistance in weeds has the potential to become our next big hurdle, says the team at Crop Consultants Australia.

In the United States however, this concern has become their reality, and it is time for the Australian industry to sit up and take notice.

Each year, in our joint project with CRDC, Crop Consultants Australia conducts an annual survey of its members that gives a detailed insight into how the season has progressed across each of the major Australian cotton production areas. This year data was contributed by those providing advice to more than half of the total cotton production area.

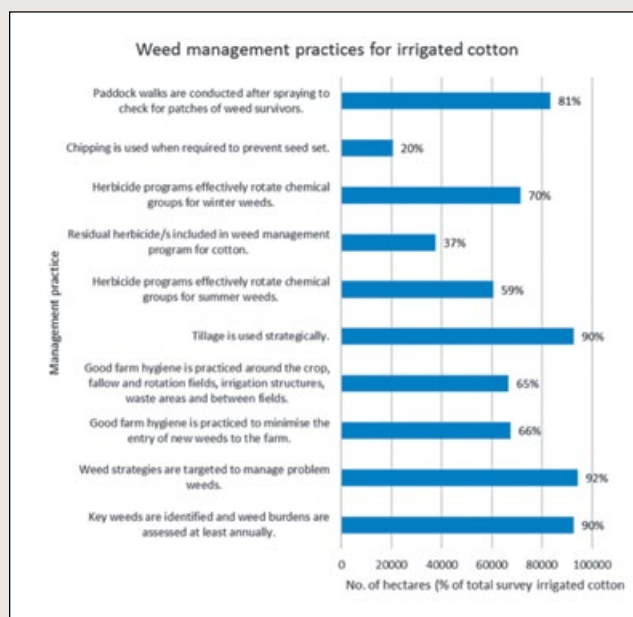
The survey has included questions around the prevalence and management of glyphosate resistance and the trends demonstrated do not paint an optimistic picture.

The figure below illustrates the responses of consultants when questioned about the presence of herbicide resistant weeds in fields under their advice. There is a clear indication of resistant winter grasses in dryland fields, and the much discussed broadleaf species in irrigated systems. It should be noted that these results come from both the northern and southern growing areas and it is evident that the problem is a prevalent one.



**Figure 1:** Presence of herbicide-resistant weeds for 2014-15 cotton season  
Source: 2014-15 Cotton Consultants Survey (CRDC, CCA)

While some in the industry appear to be placing their hopes with new and improved chemistry to tackle resistance, it is becoming increasingly evident that the tools that we need to successfully address the issue may be well within our reach already. Our survey, as illustrated in Figure 2, has shown that a broad suite of tools are already being used by industry, including increased use of residuals, mechanical control and improved farm hygiene. In short, we are reintroducing the old, in order to tackle the new.



**Figure 2:** Weed management practices for irrigated cotton for 2014-15 cotton season. Source: 2014-15 Cotton Consultants Survey (CRDC, CCA)

These practices, used in isolation or combination, are reportedly leading to effective management and ultimately a reduction in the weed seed bank. The effectiveness of the treatment is however highly dependent upon the species of weeds, the location and critical timing.

While this news is positive the downside however is the resultant increased cost to the grower and consultants across Australia have reported an increase of up to \$40 per hectare in their weed management costs over the past three years. In the United States, Monsanto made a gesture over several years to help mitigate this cost by implementing a Residual Rebate program.

It appears however that this program was short-lived and regrettably, there are no plans to replicate the program elsewhere.

The good news is that as an industry, there is much to learn from the United States example and the work that is being done locally in the field by experienced consultants, researchers and companies. As industry professionals, we take seriously the responsibility that we have to draw upon knowledge from the past, and tailor professional development opportunities for our members, and above all, improve our communication to enable those on the ground to take pre-emptive steps to cooperatively halt resistance and weed spread.

**For more**

[www.cropconsultants.com.au](http://www.cropconsultants.com.au)



# Monitoring moves to wells

Novel research supported by CRDC can now be applied around the world, which will help better understand hydraulic connections between coal seams and aquifers.

Coal Seam Gas (CSG) extraction has expanded rapidly in what is known as the Walloon Coal Measures near Dalby in South East Queensland, raising questions about future groundwater levels and quality of water used by irrigators in the region.

Led by Associate Professor Bryce Kelly of the UNSW Connected Waters Initiative Research Centre, a recent study around Dalby and Cecil Plains assessed the connectivity of aquifers. Based on bore sampling, the groundwater being extracted from the Condamine Alluvium shows no signs of mixing with water from the Walloon Coal Measures.

The team analysed the isotopic signature of the methane to detect if methane from the Walloon Coal Measures was migrating into the overlying Condamine Alluvium groundwater and air.

Near-surface microbiologically produced methane has a very different signature compared to methane released from the Walloon Coal Measures, which makes methane a useful tracer of connectivity.

"In four irrigation bores we found methane that had an isotopic signature that suggests that it was sourced from the Walloon Coal Measures, and was not produced by near surface microbiological processes," Bryce said.

"The major ion chemistry and the methane data provide different insights into connectivity because methane is buoyant and it can migrate vertically between aquifers via geological faults, fracture networks, or poorly sealed boreholes, while groundwater flow is predominantly lateral.

Gas can move via smaller gaps than water and measuring gas movement can shed insights about the future possibilities



of water moving via these same pathways if for example, wells or geological movement create gaps large enough for water.

"Further research is now required to assess the multi-decadal risk at present coal seam gas production levels, and to assess any additional impacts should the CSG industry expand."

## Future research

To better understand the role of abandoned wells in the release of methane, CRDC is funding further research in the Condamine and Lower Namoi regions to measure methane in the air near old exploration wells.

"At present if the abandoned exploration wells are very poorly sealed they provide a pathway for the upward movement of water from the Great Artesian Basin to the fresh water alluvial aquifers used to supply irrigation water," Bryce says.

"However, after decades of CSG production, as a result of depressurisation of the Walloon Coal Measures they will provide a pathway for the downward movement of fresh groundwater out of the alluvial aquifer used for irrigation towards the CSG production formation.

"To assess the risk associated with abandoned leaky exploration wells we aim

A stick marks the spot of a "leaky" exploration well in the Condamine region, demonstrating the difficulty researchers face in locating these old wells in order to study them as part of a CRDC-support project.

to do more surveying in the Condamine district in April or May and ongoing surveys in the lower Namoi over the next couple of years.

"We would really appreciate growers' help with identifying the location of old exploration wells and would love for them to contact us if they are happy for us to undertake testing.

"Government records on exploration wells from the 1960s and 70s are poor, and often farmers have better knowledge of past exploration near their properties."

## For more

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# Moving forward with raingrow

CRDC support is helping dryland growers to partner with research and extension, via CottonInfo, to generate better research outcomes.

The introduction of Bollgard 3 varieties and subsequent changes to the Resistance Management Plan is adding flexibility to dryland growers in how they manage the crop.

An extended planting window to December 30, changes around pupae busting and refuge requirements address

many challenges faced by dryland growers.

However resistance is the greatest threat to the continued availability and efficacy of this technology as well as future biotechnology products that may build on these or similar traits. The addition of a third insecticidal gene in Bollgard 3 improves the resilience of this product, however even with a three-gene product, resistance is still a very real and significant threat and it is critical that the elements of the RMP are well implemented.

These issues in the main have been around planting dates and the need to avoid heat and water stresses at peak flowering, pupae busting in no or minimum till systems and management of volunteers post-harvest.

Growing raingrown cotton comes with specific risks as growers are more at the mercy of the elements both at planting time and during the season, and often must plant when moisture is available as opposed to the most suitable time for their regional climatic conditions.

In addition to the benefits associated with Bollgard 3 is past and ongoing research around how to optimise raingrown systems.

"We have annual trials at the Australian Cotton Research Institute and on-farm trials looking at row spacing, heat and water stress and growth management throughout the regions," CSIRO Agriculture's Mike Bange says.

"Every year we undertake research comparing row configurations and their implications for yield and quality.

"We started with three row configurations and now are up to six: this

work remains relevant today as varieties and systems change brought by such advancements as the introduction of Bollgard and the new round-bale cotton pickers.

"Raingrown cotton offers a fantastic opportunity for growers in terms of profitability, and with research we are doing aimed at reducing variability and risk we feel it could become even more attractive.

"Some experiments across the industry this season are evaluating new plant hormones that improve crop resilience to address grower concerns about the timing of flowering, heat and water stress.

"Other examples being investigated include exploring the use of cover and rotation crops to improve soil health, which also can substantially raise productivity.

"The thing I most enjoy is the contact with an enthusiastic group of dryland growers who are helping us identify research priorities."

Assisted by CottonInfo Regional Development Officer Geoff Hunter dryland growers from the regions have been linked up to help identify the important areas of research.

The network of farmers ranges from those looking to start growing dryland to 20-year veterans of the game.

A survey conducted by Geoff sent to dryland growers and consultants received 42 respondents, revealing a substantial 500,000 hectares of available dryland cropping country under their management.

"This represents just a fraction of growers out there, and interestingly, the survey also showed 50,000 hectares was the total area set aside (annually) by the



# n research

respondents, however on average over the past three years, only 20,000 hectares was grown (annually)," Geoff said.

"Growers said the main reason for this was lack of moisture at planting or poor establishment and highlighted a future need for more specialised planting equipment to access soil moisture present deeper in the profile.

"These growers are highly motivated and always pushing the boundaries due to the nature of their systems, they are very much at the mercy of the elements, whether it is managing cool starts or hot finishes, delayed planting or limited rainfall.

"Benefits that have come about from this initiative have linked growers to share their approaches to crop management and identify the needs for information.

"We had a great meeting with Mike Bange and discussed our research priorities, which has already seen a great outcome in light of the trials this year to regulate plant growth.

"Now through the support of government agencies and CRDC the group is undertaking its own research, which includes an extensive cover crop trial at Moree.

"It is working closely with regional cotton grower associations and has contributed some new members as well as some joining the Cotton Australia grower panels to help inform research priorities.

"We also see that a heck of a lot of this research will also be able to be applied to irrigated and semi-irrigated situations, which is fantastic."

Field walks around trials in the Moree and Bellata region later in March are planned, contact Geoff Hunter for more details. Mike Bange has also highlighted the raingrown cotton section of the *Australian Cotton Production Manual* as an excellent source of information.

## For more

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**Australian Cotton Production Manual**

w [www.cottoninfo.com.au/publications](http://www.cottoninfo.com.au/publications)

## Researching novel plant growth regulators

Claire Welsh will begin a CRDC Scholarship PhD Project this year into using novel plant growth regulators to develop resilient future cotton systems.

Australian cotton is grown under a wide range of climatic and soil conditions, with raingrown production accounting for (on average) 17 percent of the total planted cotton area.

Raingrown cotton presents an attractive option for broadacre farmers (and irrigated cotton growers) yet in Australia is naturally more at the mercy of heat and water availability than irrigated crops.

"Abiotic stressors (water, temperature, soil constraints) are a major limiting factor to lint quantity and quality; with Australian cotton production systems being predominately driven by water availability," Claire says.

"However we are finding that there may be opportunities to use novel plant growth regulators (PGRs) to achieve increased crop efficiencies and yield outcomes, by enhancing the resilience of our crops to climatic stresses.

"These regulators have recently been demonstrated in studies in the US and Brazil to enhance overall crop performance and yield, notably under water-deficit scenarios, in lower yielding production systems.

"Recent studies here have also suggested the potential of PGRs to reduce fruit loss from waterlogging."

CSIRO Agriculture's Dr Mike Bange says a research gap exists around the use of PGRs to ameliorate the physiological effects of abiotic stressors such as water-deficit, heat, cold/chill and soil constraints to Australian cotton varieties and production systems (skip row configurations).

"Considering the significant impacts of such abiotic stressors and soil constraints to Australian cotton production systems, further investigation of the application of PGRs is warranted," Mike says.

"Claire's project aims to utilise applications of plant growth regulators to increase cotton plant resilience to abiotic stress, offer improved crop efficiencies and deliver economic improvements in yield and lint quality to Australian growers. Examples of approaches to evaluate this may include:

- Accelerating and increasing germination (including under water-deficit and cold-chill scenarios).
- Increasing root growth from early post germination to overcome compaction and to improve root foraging of soil

water (notably in skip-row configurations and under water-deficit scenarios).

- Using PGRs to prevent premature leaf senescence and/or flower and fruit abortion under short-term water deficit stress scenarios.
- Manipulation of vegetative growth and time to flowering to optimise use of available soil water (dryland and semi-irrigated) and time fruit development with favourable climatic conditions.

Research will include understanding relevant biochemical pathways informing the plant and crop responses to treatments, as well as understanding the agronomic responses within the wider farming context.

The resulting knowledge will then be used to inform the development of a predictive framework and decision support platform for the application of novel plant growth regulators to Australian cotton farming systems, to ensure their maximum efficacy.

"A great feature of this research is that it has been tailored in response to the conversations we've had with growers, to address their needs and issues they have raised with us that they are trying to overcome," Mike said.

"Australian cropping production is challenging because of its variability, but effective use of growth regulators may add one more string to a bow to build more resilience in our systems to help overcome this."

#### For more

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Claire Welsh spraying trials using plant growth regulators on rain-grown cotton.



## New RRF dryland variety ready for next season

As with irrigated cotton varieties, CSIRO Agriculture plant breeders continue to develop varieties for dryland production systems.

"We have continued to make steady improvements in varieties suited to dryland conditions," says CSIRO Agriculture Cotton Breeder Dr Warwick Stiller.

"One of the gaps we have had in recent seasons is a good Roundup Ready Flex (RRF) variety for dryland.

"The breeding team has been working hard at rectifying this and expect to release a new RRF variety specifically for dryland this coming planting season and this variety will have the best staple length of any RRF variety."

Warwick says the main advantages the new Bollgard 3 varieties will offer dryland growers relate to the changes in the Resistance Management Plan (RMP).

"These changes constitute the biggest revolution to dryland cotton production since the introduction of Bollgard II," he said.

Major changes are a relaxation of requirements around pupae busting and extension of the planting window to December 31.

In line with the need for dryland cotton to handle a variety of climatic and weather conditions, breeding also focuses on what is termed 'phenological plasticity'.

"This is the ability of a particular variety to be flexible in its growth and fruit setting, often associated with a less 'determinate' nature".

"These varieties are better able to handle the variable moisture conditions experienced in dryland systems.

"To cope with Australian conditions we also breed for high rooting potential so the plant can explore the maximum amount of the soil profile.

"Coupled with this is the ability to cope with adverse soil conditions, particularly sodicity.

"Dryland varieties also need tolerance to both heat and water stress.

"Other traits contributing to a successful dryland variety are much the same as irrigated varieties: high yield potential and a good fibre quality package, particularly long fibre length; high fibre maturity; and intermediate fineness.

"Some of these traits are not measured directly, but are captured by testing the varieties across a wide range of environments and then doing a multi-site analysis to tease out the varieties that have the best combination of traits," Warwick said.

Cotton varieties are bred by CSIRO through the Cotton Breeding Australia joint venture with Cotton Seed Distributors.





# Improving the resilience of raingrown cotton

Angus, Isabelle and Hunter Vickery inspecting the raingrown cotton trial into plant growth regulators at their property "Dobikin" Bellata in North-West NSW.

Research is investigating if plant growth regulators can be used to manipulate raingrown cotton to improve yield and water use.

One approach being explored is to capture early planting opportunities, but move timing of fruit growth of a crop into a less stressful part of the season. Other investigations are looking at means to retain a small proportion of fruit under stress.

CRDC and CSIRO are supporting research on broadacre farmer and dryland cotton grower Angus Vickery's "Dobikin", between Moree and Narrabri in North-West NSW. This 'Dryland Resilience Trial' involves treating one new Bollgard 3 variety with differing combinations of plant growth regulators, rates and timing of application to assess the effect on growth and yield.

The Vickery's have been involved in dryland cotton growing for about 15 years and Angus says the biggest hurdle for them in terms of yield and fibre quality is timing of planting and the flow on effects for the season.

"When we plant (early) in September or October, it comes with issues later in the season in terms of heat and moisture availability at crucial times for the plant where yield and quality are highly affected," Angus said.

"The later we can sow, the better it is for us in terms of yield.

"Historically we have found that crops planted middle to late November have been more productive, but if we get rain around

September or October we have to make a decision on whether to take advantage of the moisture, knowing we may not realise as high yield as we could by holding off.

"Yet holding off can be a costly decision if we don't see any more rain events, we miss our opportunity all together.

"Furthermore, in November and December we are busy harvesting broadacre grain crops, and we don't really want to be picking cotton into June or July, as wet weather could become a factor and limit our options for rotation crops.

"If we can replicate the effects of a later planting date while still planting early and then using growth regulants it would be a game changer for us and lessen the risk around early planting decisions.

"We could get through the hot summers so much easier if we can plant early on rain and/or available moisture, let it kick away and then 'switch the crop off' with regulants and 'switch it back on' later in November, it would be ideal."

CSIRO Agriculture's Mike Bange, based out of the Australian Cotton Research Institute, is currently leading this initiative.

"The aim of this particular experiment is to gain a preliminary understanding of the efficacy of a range of novel plant growth regulators to affect specific cotton

growth characteristics, in a commercial dryland production scenario," Mike said.

"We hope to identify new practices or tools that increase yield and provide resilience to crop stress in dryland systems."

There have been significant advances made in growth hormone and regulant compounds in recent years that could assist in managing water and heat stress in cotton. Farming practices are also at a point where many other constraints are now limited and thus allow for growth regulators to be re-assessed.

Participating in these studies is Claire Welsh who has recently started a CRDC-supported PhD study into improving the resilience of cotton crops by assessing the detailed physiology of cotton crops following application of the growth regulators. One of Claire's studies will be to investigate the use of growth regulators to improve water use by promoting root growth.

In the studies that delay the timing of fruit growth in raingrown cotton Claire will be studying how roots are affected.

"In most regions if cotton is planted early, raingrown cotton plants are flowering when the weather is warmest, which can lead to significant heat and water stress, which in turn hinders boll formation and development," Claire said.

"As growers know, intense heat and water stress after boll formation can lead to fruit shedding.

"If we can reduce the impact of the stress by moving the flowering period as well as improving root growth we may be able to improve yield and quality."



# Systems approach the way forward

Tulloona dryland cotton and grain farmer Nick Campion says cotton is an “extremely important part of our system and business”.

Nick considers it to be the most resilient summer crop available to him, with the best potential returns at his and wife Edwina’s property “Warrana”.

“It can yield in tough conditions and it’s much more resistant to heat than sorghum,” Nick says.

“Dryland cotton flowers for much longer than sorghum too, so increases the timeframe and chances of picking up some rain at this crucial time,” Nick told *Spotlight*.

“I’ve been growing it for six years here and the problem I’ve got is I cannot reliably get it out of the ground and I think the only way we’re going to get it going is through a change in our system.

“You have to look at growing cotton in terms of it being a part of your system, as opposed to an opportunity crop, so that means adjusting the system to suit.

“If I can get it going, the returns are certainly there.”

Nick is no stranger to the concept of soil health and has looked closely at other successful grower’s systems. He says it’s more about soil type.

“This country out here has the ability to hold a lot of soil water and we have reasonably reliable rainfall, that’s not our issue, it’s evaporation from the top five or six inches and how the soil behaves which causes my problems,” Nick says.

“By the time I get the profile full and it’s time to plant I lose the tilth which affects germination.

“It’s a case of having to build that top soil and keep it friable to generate the environment required to get the seed up.

“If we had the planting technology to drill down to the moisture that would be fantastic, but that comes with its own set of issues around germination too.

“I am thinking about changing my farming system to strip tillage and adding more ameliorants to loosen the top soil.

“I’ve seen some growers with similar issues in other regions are finding they have had to look at technology that we were using 20 years ago injecting water at planting, because they have a full profile except for the top six inches or so is letting them down in terms of moisture.

“I’d love to turn my system from grain with a cotton rotation into a cotton system with a grain rotation, but I cannot reliably get it out of the ground so it is unfortunately reduced to an opportunity crop for me until I alter my system.

“It is great to see the research going on in this space and am keen to see what comes of the trials going on this season.”

Macquarie Valley grower Andrew Gill says the main challenges to growing dryland in the region is getting an even plant stand, and then getting under enough rain in December and January to finish the crop.

He says while most soils have good water holding capacity, variable soil types within fields lead to some “tricky” planting operations and variable plant stands.

“The research coming out of the dryland group will hopefully allow collaboration between dryland growers in different valleys, and these growers to instigate their own research priorities with researchers from all different organisations.”

Broadacre farmer Nick Campion is using a strip tillage system and specialised implements to improve soil condition to create better conditions for planting cotton.



# Industry support creates careers

Sharna Holman recently began work as the DAF Development Extension Officer and also the CottonInfo Technical Specialist for Disease, Volunteer and Ratoon Cotton Management, based in Emerald.

The University of Sydney Honours graduate says it was exposure to the cotton industry while studying that attracted her to a world she'd barely heard of.

"After completing my degree, I knew I wanted to pursue a career in the Australian cotton industry," she says. Recently completing a Bachelor of Science in Agriculture, Sharna says she was fortunate to receive a Cotton Australia scholarship to attend the Australian Cotton Conference in 2014 which "pretty much sparked my love for the industry," she says.

The same year through a CRDC Summer Scholarship Sharna furthered her involvement with the industry by researching her honours project on Bt tolerance in *Helicoverpa* with Mary Whitehouse and Sharon Downes at the Australian Cotton Research Institute near Narrabri.

A PICSE cotton internship from CRDC followed, giving Sharna the chance to complete work placements with different researchers and commercial cotton industry organisations.

"Without the initial opportunity I probably wouldn't think about cotton - you go for industries you are exposed to," Sharna told *Spotlight*, "and students are also more likely to go to industries they are supported in.

"My experience through this support has been fantastic, it definitely swayed me toward the industry and I have friends who may have been veered toward cotton had they been exposed to the same opportunities."

Sharna said the Summer Scholarship at ACRI was also a highlight.

"Being a student and having that



Sharna Holman says industry support of university students can have a definite impact on career choice.

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kind of access to information, to immerse yourself in that place was such an incredible opportunity.

"There was also such good camaraderie there, and to be around all those great researchers, talking about all the different sectors of research I really enjoyed.

"It's also a good experience to figure out if you want to do research for a career."

For now, Sharna's role is communicating research to growers, but there are plans for further study, with a PhD in either agronomy or entomology.

"I want my PhD to be research that growers can put pretty much straight into action on their farms and this role gives me a good grounding for that.

"Some of the most important challenges faced in the future are related to agriculture such as improving and finding new ways to feed and clothe a growing population with limited resources.

"I'm continuously amazed by the innovative and inclusive nature of the industry, where all parts of the industry work together to improve practices to become more efficient and profitable."

Emerald though, is a long way from Sydney, in many respects.

"The move up to Emerald has been great actually, I've pretty much jumped straight into the cotton season and been kept busy.

"I'm slowly adjusting to the humidity, something I'm not that used to being from Sydney!

"I've also had a chance to meet quite a few growers and consultants around here - everyone has been really welcoming.

"I'll also be working to support growers across all regions with rogue cotton control research and develop information resources that meet the needs of growers and consultants to better eradicate rogue cotton and improve farm hygiene.

"I'm also involved in regional research projects in Central Queensland which address farming system issues."

## For more

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# Going to ground?

## Weighing up the best way to defoliate

Defoliation is a necessary aspect of cotton growing that, as well as being a cost for growers, can impact fibre quality, surrounding crops and the environment.

A recently completed CRDC study by consultant Bill Gordon investigated the costs and benefits of defoliation strategies and any efficiency gains. Large-scale field trials evaluated the defoliation costs and efficacy of ground rig (measuring crop damage caused by machinery) versus aerial application. Growers were also surveyed to determine best practice application and identify the drivers for method choice.

### Efficiency

Ground rig defoliating (using crop guards and a 36-metre boom) resulted in average damage costs of \$2.33/ha on the first pass and \$2.94/ha on the second. Based on a price of \$12/ha per ground rig application and \$16/ha for aerial, ground application costs (even with losses) were marginally lower.

Efficiency drivers are boom width and speed of travel for ground rigs; and volume for aerial application. Boom width determines efficiency and the total area at which ground rig defoliation becomes inefficient. Increased efficiency is measured in hectares sprayed per day and achieved by increasing boom widths.

A machine fitted with a 36-metre boom, defoliating 375ha per day with seven days between passes can defoliate up to 2500ha. This is reduced to 1800ha for a 24-metre boom and increased to 3600ha for a 48-metre boom.

“For larger enterprises requiring larger areas to be defoliated per day, wider booms and more rigs are needed; or aerial application is required, hence aerial application is the preferred method,” CRDC R&D Manager Susan Maas says.

As volume is a major contributor to efficiency in aerial application, the project found that further investigation was warranted into the relationship between efficacy, application volumes with various

### Best practice identified

The project identified a set of best practices for defoliation based on grower practise. These practices achieve good defoliation efficacy while minimising spray drift risk and environmental impact.

- Canopy management with plant growth regulator to enhance evenness and defoliant penetration.
- Sprayer set up which maintains efficacy while minimising environmental impact by using a coarser spray quality for example Turbo TwinJet twinjet nozzles (standard or the air induced version) for ground rigs and CP nozzles for aircraft.
- Using bigger droplets (medium to coarse spray qualities) which maintain efficacy but minimise drift risk and the downwind no spray zone distances required.
- Using ground rigs to defoliate next to sensitive areas.
- Using a pesticide application management plan to manage spray drift risk in accordance with mandatory downwind no-spray zones in accordance with new label guidelines.
- Defoliating as much as possible when wind conditions are appropriate.
- Defoliating the crop in the least number of passes which reduces the drift risk and potential impact on the environment.
- Plant permanent vegetative barriers on the predominantly downwind side of the sprayed fields to reduce spray drift onto sensitive areas.

spray qualities and canopy density.

### Label requirement changes

While cost is one factor, other important benefits of ground rig application are lower drift risk and a smaller downwind buffer zone requirement than aerial application.

“The cotton industry needs to consider changes and potential regulation that has occurred with other crop protection products, with a general reduction





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in the number of products being registered with approval for aerial application, along with restrictions such as no-spray zones on exiting products, as part of current APVMA spray drift labelling reviews," Susan says.

"We needed to understand current practices to assess the impact of any potential changes resulting from the APVMA review.

"The study found that practice change towards using a coarser spray quality to reduce drift risk and comply with label regulations and operating principles of spray drift risk is feasible based on the results of grower practices identified in the survey.

"Growers must also be aware of no-spray zones – which are the protective buffer zones required between an application area and an area downwind that needs to be protected.

"The APVMA sets the size of no-spray zones based on the inherent hazard characteristics of each product and on an assessment of the specific risk.

"Growers and consultants should refer to the APVMA website for more information on the current reviews including public consultation on the draft changes to no-spray zones."

### **Vegetative drift barriers**

Spray drift vegetative barriers are areas intentionally planted by landholders to act as filters to minimise

spray drift risk, reduce odour and noise. These barriers may be permanent, such as strips of trees and shrubs, or temporary, for example strips of forage sorghum.

However, not all barriers are created equal, and to ascertain what makes the most effective barrier, Bill Gordon investigated their efficacy under a CRDC project.

A vegetative barrier does not need to be particularly tall or wide to be effective – a good barrier filters as much as 70 percent of the airborne droplets passing through it.

Research suggests the height of a vegetative barrier should be at least one-and-a-half to two times the release height of the spray to be effective, depending on the porosity of the vegetation.

For full specifications and recommendations, go to the CottonInfo website to download the fact sheets.

#### **For more**

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# Investing in world-leading cotton RD&E

In 2014-15, CRDC invested \$22.826 million in 239 RD&E projects on behalf of Australia's cotton growers and the Australian Government, continuing our long-standing commitment to deliver real outcomes for growers and enhance the industry's performance.

In this special *Spotlight* feature, we take a look at some of the highlights of the 2014-15 year.

You can find more detail in our 2014-15 Annual Report, which is available from the publications section of our website [www.crdc.com.au/publications](http://www.crdc.com.au/publications) and you can find a full list of current research projects online at [www.crdc.com.au/research-development](http://www.crdc.com.au/research-development)



## Year in review: CRDC RD&E achievements 2014-15

### Release of the first cotton industry sustainability report

The industry's first *Australian Grown Cotton Sustainability Report*, tracking the industry's social, economic and environmental footprint, was publicly released in November 2014. The report, launched jointly by CRDC and Cotton Australia, provides a snapshot of how the industry is performing against 45 sustainability indicators - from crop yield and quality, water use and riparian land management to education levels, employment, health and social capital.

The report continues the Australian cotton industry's unique 23-year commitment to independently assessing its performance. The report is available at [www.crdc.com.au/publications](http://www.crdc.com.au/publications).

### Cotton's first Herbicide Resistance Management Strategy released

The Australian cotton industry's first ever *Herbicide*

*Resistance Management Strategy* (HRMS) was released in November 2014. The HRMS is a tool that has been formulated for weed management in irrigated and raingrown farming systems, including herbicide-tolerant cotton, to delay glyphosate resistance.

CRDC invested in this project to provide growers and agronomists with more support when making changes to weed control practices. Resistance is a significant risk to the future sustainability of the Australian cotton industry and a critical area for CRDC R&D investment. The HRMS is available to download at [www.crdc.com.au/publications](http://www.crdc.com.au/publications).

### Protecting against pests and diseases: Investment in biosecurity

Biosecurity plays a critically important role in ensuring the sustainability of the Australian cotton industry: managing the risk of pests and diseases entering, emerging, establishing or spreading to avoid



production losses, management and eradication costs, and potentially the loss of important overseas markets.

CRDC continued its investment into this critical area, with research identifying a defoliating strain of *Verticillium dahliae* in QLD and NSW in 2015 thanks to proactive disease monitoring. This follows a significant virus detection in East Timor in 2014, with the identification of cotton leaf roll dwarf virus, the causal agent of cotton blue disease - the screening of which was conducted under a CRDC-funded project.

### Benchmarking cotton irrigation systems: centre pivot and lateral move

A CRDC-funded project to benchmark centre pivot and lateral move (CPLM) systems in the Murray-Darling Basin released its report during 2014-15, finding that the number of CPLM systems has significantly increased from 2001 to 2011, with two leading factors driving adoption: water and labour savings.

The report found that the average water applied by CPLM systems in 2011-12 was 30 percent less than that applied using furrow irrigation, whilst maintaining similar yields. The report is available from CottonInfo: [www.cottoninfo.com.au/publications](http://www.cottoninfo.com.au/publications).

### On-farm energy use: benchmarking for improved efficiencies

A core area of focus for CRDC during 2014-15 was on energy use on irrigated cotton farms, helping to understand the industry's energy use footprint, improve efficiencies, reduce energy costs, and inform future research. Energy is one of the fastest growing on-farm costs.

To help growers cut costs and improve on-farm energy efficiency, CRDC invested in the *Improving energy efficiency on irrigated cotton farms* project in 2015, which included on-farm energy audits for growers. The resulting benchmarking report outlines the diesel and electricity used on cotton farms, based on the findings of 198 whole-farm energy assessments and makes recommendations as to how growers can improve their efficiency. The report is available via CottonInfo: [www.cottoninfo.com.au/publications](http://www.cottoninfo.com.au/publications).

### From laboratory to field: CRDC takes key researchers on farm

CRDC supported two initiatives designed to connect growers with research outcomes in early 2015 - the 2015 Cotton Irrigation Technology Tour and the energy efficiency focused Big Day Outs, both run by CottonInfo.

The Irrigation Technology Tour took seven CRDC-funded researchers on to farms at Emerald, Moree and Nevertire for a series of irrigation technology field days, demonstrating new and emerging



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irrigation scheduling and management technologies. The Big Day Outs were two on-farm field days at Gunnedah and St George aimed at improving grower energy use efficiency. More than 250 growers and consultants attended the events.

### People: our industry's most important resource

We continued our long-standing commitment to investing in the industry's human capacity during 2014-15, supporting cotton industry participants in a range of people-focused programs – including the: Primary Industries Education Foundation; the cotton ginning training program; the cotton industry young professionals program; the Cotton Production Course; the Field to Fabric scholarships; the Horizon scholarship program; CRDC summer, honours and PhD scholarships; the Australian Rural Leadership Program; Nuffield Farming Scholarships and the Peter Cullen Trust.

### Showcasing RD&E at the 17th Australian Cotton Conference

CRDC was proud to support the 17th Australian

Cotton Conference as a foundation sponsor. The August 2014 event was the most successful in the Conference's history, with more than 1800 delegates - including some 600 cotton growers from across every cotton growing valley attending. For CRDC, the opportunity is to extend the outcomes of research and actively support the contribution the Conference makes to an industry culture of inclusiveness, cohesion and vision. We're pleased to be supporting the event again in 2016.

### Investing in grassroots RD&E: CRDC's Grassroots Grants

CRDC's Grassroots Grants program encourages Cotton Grower Associations to apply for funding to support capacity building projects in their region. Up to \$10,000 in funding is available for CGAs to help fund a project aimed at increasing the engagement of growers in the industry, solving specific regional issues and improving their skills, knowledge base and networks. As of 2014-15, the Grassroots Grants program had supported 33 projects across the cotton growing valleys (another nine have since been supported in 2015-16).

## Year in review: CRDC organisational highlights 2014-15

### Minister for Agriculture announces new CRDC Board Directors

CRDC welcomed the appointment of five Directors to the CRDC Board in October 2014. The Minister for Agriculture, the Hon. Barnaby Joyce MP, announced that former Directors Cleave Rogan and Dr Michael Robinson, past Director Kathryn Adams, and new Directors Liz Alexander and Greg Kauter would be joining CRDC Chair Dr Mary Corbett and Executive Director Bruce Finney on the CRDC Board.

### CRDC Strategy Forum identifies cotton RD&E priorities

CRDC hosted the inaugural Strategy Forum in Sydney in May 2015, bringing together cotton growers on Cotton Australia's grower advisory panels to help determine the industry's future research priorities.

The forum was the first step in CRDC's revised procurement process for the 2016-17 funding round,



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which aims to provide greater clarity to researchers about the specific needs of the industry, to assist them in developing research proposals to meet these needs. Under this revised process, the Strategy Forum will become an annual forum at the beginning of each CRDC funding round, to help identify and synthesise the key RD&E needs of the industry.

### **\$4 million for smart irrigation: CRDC-led project receives R&D for Profit programme funding**

A CRDC-led project to improve the profit of 3,000 cotton, dairy, rice and sugar irrigators is one of 12 successful Rural R&D for Profit programme projects announced by the Minister for Agriculture in May 2015.

The project, *Smarter irrigation for profit*, is a partnership between the major irrigation industries of cotton, dairy, rice and sugar, led by CRDC in conjunction with Dairy Australia (DA), the Rural Industries Research and Development Corporation (RIRDC), Sugar Research Australia (SRA) and other research partners. The project aims to improve the profit of each individual irrigator enterprise across the four industries by \$20,000-\$40,000 per annum, with the support of 16 R&D partners and up to 19 farmer-managed learning sites. It will receive up to \$4 million in funding under the Rural R&D for Profit programme.

### **Blue-sky thinking: *Designing a Future for Australian Cotton* report**

During 2014-15, CRDC continued its work to transform the industry through blue-sky research under the Cotton Futures program. Four forums were held in late 2014 around the three futures themes - profitable futures, sustainable futures and competitive futures - bringing together stakeholders from both within and outside the industry. The resulting report, *Designing a Future for Australian Cotton*, published in December 2014, outlined the top 18 blue-sky research concepts which have the potential to add \$4 billion per annum to the gross value of Australian cotton production.

In 2015, CRDC announced the commencement of four feasibility studies into potential cotton futures projects, with additional projects set to commence in July 2015 under the Rural R&D for Profit program and CRDC's future farm collaboration with the Grains Research and Development Corporation (GRDC). In total, CRDC has budgeted to invest \$8.5 million in cotton futures research projects from 2014-15 to 2017-18.

### **Release of the *World leaders in cotton: Achievements in Australian cotton RD&E 2008-13* report**

This important report from CRDC outlines the



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achievements of the cotton industry's RD&E investment over 2008-13: the period of the previous CRDC Strategic R&D Plan. Released in August 2014, it highlights the major research developments and outcomes achieved during this time under CRDC's (then) three strategic priorities: value chain, farming systems and human capacity.

Overall, the report estimates that CRDC's \$49.8 million investment over the five years from 2008 to 2013 delivered a \$348 million benefit to cotton growers and a \$697 million benefit to society at large. The report is available at [www.crdc.com.au/publications](http://www.crdc.com.au/publications).

**For more information on all of these achievements and highlights, download your copy of our 2014-15 Annual Report from [www.crdc.com.au/publications](http://www.crdc.com.au/publications) today.**

*Spotlight* is brought to you by CRDC: the Australian cotton industry's research, development and extension investment body, jointly funded by Australian cotton growers and the Australian Government.

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