

# Spotlight<sup>®</sup>

ON COTTON R&D

Autumn 2017

CRDC research: changing  
the cotton game up north

Accolades for industry  
researchers

Growers go beneath  
the surface



Australian Government

Cotton Research and  
Development Corporation





Bruce Finney

# In the Spotlight

Despite the difficult conditions, this season is seen by many as the beginning of a significant growth phase in the Australian cotton industry on the back of changes in the planting window for Bollgard 3 cotton varieties and more broadly the continuous improvements in yield, production practices and sustainability delivered by cotton RD&E.

As CRDC looks to the future, we aim to enable growers, their consultants and the service sector to be at the cutting edge of technology and innovation. In support of this goal, CRDC has grown its investment in Australia's world leading cotton researchers and established a Futures program consisting of high risk but potentially highly rewarding blue sky innovation and 'disruptive' ideas.

In addition, we are excited to have launched the new Rural.XO microhack initiative to support the entrepreneurs, innovators and disruptors within our industry to put forward, test and potentially commercialise their ideas with financial assistance from CRDC. There has been an enthusiastic response to the initiative with participants already selected to take part in the first of two workshops.

It is wonderful to see cotton industry researchers receiving recognition with Dr Mike Bange and Dr Greg Constable recently recognised for their outstanding contributions. CRDC congratulates them on their achievements, and in recognition of the ongoing importance of research capacity, welcomes former cotton grower Steve Buster to a new NSW DPI project and Janelle Montgomery to the CottonInfo team as the Gwydir Valley regional extension officer. Strategically, CRDC continues to invest in building capacity throughout the industry – in research, industry and on-farm roles.

While the industry evolves technologically, we are also seeing great results from applied on-farm research into planting dates undertaken over the last three years in Central Queensland. The improvements to yield and quality that have been achieved – through research seeking ways to reduce cotton production risks related to the monsoonal influence in the region – have been profound. This project reinforces the importance and value of growers working closely with researchers in solving challenges at industry and regional scales.

Increasingly, CRDC investments in RD&E are being made through cross-industry collaborative research projects which, in delivering outcomes for cotton growers, are attracting new research capability and growing the scale of total investment. In this edition of *Spotlight* we are pleased to report on the CRDC-led *More Profit from Nitrogen* and *Smarter Irrigation for Profit* initiatives under the Australian Government's Rural R&D for Profit Programme.

We are also working closely with the Grains RDC on a number of research projects, which includes robotics, climate variability, soils and spray drift. In an effort to curb spray drift damage to crops, research is investigating temperature inversions for the purpose of providing growers with real-time information tools that can predict inversions which increase the likelihood of spray drift.

In closing, it is said that every season is different, and perhaps in this instance we should acknowledge that thankfully. As a very challenging cotton growing season comes to an end we wish every grower a safe and successful harvest.

Bruce Finney  
CRDC Executive Director



PAUL GRUNDY

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COVER IMAGE PAUL GRUNDY

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RUTH REDFERN

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# Fast Facts



## \$100

Million-plus is the research investment of which CRDC is a partner (Page 5).

## 97

The number of fatalities in Australia from quad bikes from 2011 to 2015. Eight of those were children under 10 years old (Page 10).



## 14

Bales per hectare achieved in the CRDC early planting trials in Central Queensland (Page 12).

## \$20

Million in drift damage was caused to Australian cotton crops last year (Page 34).



Minister for Agriculture and Water Resources Barnaby Joyce, CRDC Chair Richard Haire, Cotton Australia's Rebecca Fing and CRDC General Manager R&D Investment Ian Taylor launching the People In Agriculture website.

## Most important: people in agriculture

**THE** Australian cotton industry recognises that people are our most important resource, which is why CRDC invests heavily in capacity building.

People in Agriculture is a new resource for both employers and employees working in agriculture.

CRDC is among one of six agricultural bodies that has led the development of the People in Agriculture website which was launched late last year by the Minister for Agriculture and Water Resources Barnaby Joyce and CRDC Chair Richard Haire, along with representatives of the other bodies: Grains Research and Development Corporation, Australian Pork Limited, Dairy Australia, Meat and Livestock Australia and Food and Agribusiness Solutions.

The website offers compliance support for employers, promoting agriculture as a career choice and providing a platform for employment information sharing. It provides both an overarching agriculture perspective, as well as sector-specific content, providing resources for both employers and guides for employees via one centralised hub.

It breaks down questions commonly asked by Australia's farmers and food producers around employment law and staff management, and provides access to information on employment opportunities, entitlements and career management in agriculture. In cotton, it is designed to complement the resources available in the HR and WHS modules of *myBMP*, with links to the new site from *myBMP*.

**For more**

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



# Keeping cotton at the cutting edge

**THIS** year, CRDC has begun developing the 2018-2023 Strategic Plan – the overarching plan that guides CRDC’s investments in cotton research, development and extension (RD&E) on behalf of the industry. Scoping the plan involves preparing for the known and, equally, trying to predict the unknown.

“Keeping cotton at the cutting edge of technology and innovation is at the very heart of what we do,” says Executive Director Bruce Finney.

“In making our annual investment decisions, we look to the future to anticipate the needs of the industry.”

Robotics, automation and data analytics, for example, are all areas of current investment for CRDC.

“These technologies can provide major benefits to cotton growers and the wider industry – reducing costs and improving efficiencies,” Bruce said.

“These are the technologies of today. What we’re also interested in are the technologies of tomorrow – like whether cotton can be dissolved and reconstituted in a way that retains its core characteristics, yet allows additional functionality. And whether cotton could be used as a substrate for 3D printing, opening up a whole new market of opportunities for cotton.

“The strategic plan process is about not only predicting future needs, but actually creating the future that we want to see for cotton, and laying the groundwork necessary today to achieve this.

“We are at the very start of the strategic plan development process now, and we’ll be actively seeking input from growers and the wider industry over the coming year as we work towards the plan’s finalisation, ready for the 2018-19 year.”

The strategic plan was discussed at the CRDC board meeting in Theodore in February, at which time the board also considered the recommendations for new

*“The strategic plan process is about not only predicting future needs, but actually creating the future that we want to see.”*



RUTH REDFERN

Cotton grower Peter French (Theodore), CRDC Director Liz Alexander (Emerald), cotton grower and Cotton Australia Director Fleur Anderson (Theodore), and CRDC Chair Richard Haire (Brisbane) at the CRDC board meeting in Theodore in early February.

RD&E projects scheduled to commence in 2017-18.

“The projects that have been put forward specifically address key areas identified by growers in the Cotton Australia R&D advisory panels, and have been developed with our research partners. The board have now determined which projects will proceed, and we will be announcing these in coming months in preparation for the 2017-18 year,” Bruce said.

“On behalf of growers and the Australian Government, we have grown the total investment in cotton RD&E to more than \$100 million with our partners.”

The Theodore meeting gave the board the opportunity to get on farm with growers and to discuss research solutions to local industry needs.

“Listening to growers about how well our research investment meets their needs is a key focus for CRDC.

“In fact, over the past year, we’ve undertaken a range of surveying – of growers, of consultants, of other industry

stakeholders like researchers, Government and our industry partners – to see how we’re progressing.

“We’ve found that awareness of CRDC is very high among the industry (99.6 per cent of growers are aware of us, as are 100 per cent of consultants); as is the understanding of our role (70 per cent of growers understand our role well, as do 86 per cent of consultants); and support for our investments (88 per cent of growers are supportive of our investments, as are 92 per cent of consultants).

“Overall, across all stakeholders, you scored us 8.7 out of 10 as an organisation to trust; and ranked your overall satisfaction with us as 8.2 out of 10.

“On behalf of the team at CRDC, we would like to thank all who participated. These surveys are critically important in helping us continuously improve our performance in investing in RD&E for the Australian cotton industry. Importantly, we do not operate in isolation: our partnerships are paramount in helping us achieve outcomes for the industry.”

# Seeking innovators to challenge the status quo

**DO** you have an innovative idea you'd like to see come to life but aren't sure how to make it happen? CRDC is calling for applications from cotton industry innovators to take part in a unique series of start-up science workshops, with scholarships available to selected participants.

CRDC has partnered with a leader in start-up science, Pollenizer, and the Fisheries RDC to run two workshops, the Rural.XO microhacks, to help take innovative ideas and turn them into a reality.

Participants will develop their ideas with experts from across the industry, and watch them come to life. The best ideas will have the opportunity to be incubated into real start-up businesses.

"We're already investing \$8.5 million into our Cotton Futures program, which looks at the feasibility of technologies like dissolving cotton, utilising cotton as a substrate for carbon fibre, and using cotton for 3D printing.

"And now, through the Rural.XO microhacks, we're looking to help the disruptors, the innovators, the entrepreneurs – those people who want to challenge the status quo – to take their big ideas and turn them into reality," Bruce said.

"All innovators within the cotton industry with big ideas are encouraged to apply – individuals, pairs or small groups of cotton growers, researchers, consultants,



NCEA

and agribusiness professionals.

"XO stands for exponential opportunities; exponential opportunities for new ideas to help transform the future cotton industry."

Two microhacks will be held (March 9-10 and May 4-5) and will involve a hands-on, two-day workshop in Sydney utilising Pollenizer's famous Startup Science methodology. Thanks to CRDC's support, attendance will be free of charge for the

successful cotton industry applicants. Travel and accommodation bursaries are also available from CRDC.

Applications for the May microhacks will open March 22 and close April 12.

**For more**

**w** [www.pollenizer.com/rural-xo](http://www.pollenizer.com/rural-xo)

## Turning cotton waste into fine chemicals

**THE** Australian cotton industry is constantly looking for and researching avenues for growers to value add to their products including by-products such as cotton seed oil and gin trash.

CRDC is a key partner in a major collaborative project funded by the Department of Agriculture and Water Resources as part of its Rural R&D for Profit Programme titled *A profitable future for Australian agriculture: bio-refineries for higher-value animal feed, chemicals and fuel*. Part of the project is investigating the production of fine chemicals that can be

created from cotton lint, mote and cotton gin trash. The target compounds are 'ring-like' chemicals for drug manufacture.

Researchers from the Queensland University of Technology (QUT) have been working on the conversion of biomass to chemicals.

The project will utilise existing, proven technology to convert cotton gin trash to fine chemicals, and develop a new, economically viable process to produce these building blocks. The process will use relatively simple reagents and there is potential to reduce the number of reaction

steps, which will reduce overall cost.

The structure of cotton biomass is very different from other plant biomass; cellulose in cotton biomass is already separate from other components (lignin and hemicellulose) of the biomass. This allows simple chemicals that can be produced from cotton gin trash to be easily purified, which reduces production costs.

**For more**

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Adam McVeigh is a cotton and grain grower from the Darling Downs. An on-farm energy efficiency audit, conducted under myBMP and the Carbon Farming extension and outreach program (a CRDC and GRDC collaboration) resulted in reduced emissions and energy costs on his farm.

To learn more, visit [www.cottoninfo.com.au/energy-use-efficiency](http://www.cottoninfo.com.au/energy-use-efficiency)

## Cotton and grains increasing collaboration

The Rural Research and Development Corporations continually seek to identify synergies in research development and extension and to collaborate on research initiatives where levy payers can benefit.

**CRDC** and GRDC (Grains Research and Development Corporation) share some strategic research priorities with respect to broadacre farming systems, and where it adds value, collaborate in research to provide better research outcomes.

Obvious areas for collaboration are in areas of weed and herbicide resistance management, soil health and spray application. As we move forward into a new era of technology, such as automation, further opportunities for collaboration are

emerging. CRDC and GRDC have been working together in a number of areas of research.

"Doing the research in an integrated manner ensures the research produces the most useful and practical results for farmers managing production issues within their cotton and grains farming systems," CRDC Executive Director Bruce Finney said.

"CRDC and GRDC are committed to expanding our collaborative research and currently have eight joint projects."

Current CRDC-GRDC collaborations include:

- The Future Farm Project
- Accelerating Precision Agriculture to Decision Agriculture
- Development of a spray drift hazard reduction system
- Managing climate variability
- National Agvet collaboration
- National Soils RD&E strategy
- National Water RD&E strategy
- Carbon Farming extension and outreach

By example, the Future Farm project is a key program of research aimed at increasing farmer profitability, sustainability and competitiveness through adopting new technologies. The research will facilitate understanding and access to data-driven technologies that can boost production and identify key issues challenging the grains and cotton industries' adoption of autonomous systems. Examples of research include looking at improving crop canopy management, nutrient use efficiency and crop quality through continuous automated soil water sensing and crop surveillance.

There are also a number of new research collaborations under joint development including identifying and managing soil constraints in broadacre cropping systems; cover cropping to preserve moisture and improve soil condition; polymers to conserve moisture in rain-fed farming systems; and managing herbicide resistance and difficult to control weeds in northern cropping systems.

## Save the date: REFCOM

**THE** main focus of REFCOM 2017 will be Bt resistance management and integrated pest management (IPM) in the southern regions' cotton farming system. Day one will focus on IPM management and new research in this area, while day two will

have a Bt resistance management focus, and in particular challenges faced in the southern farming system.

More details are available through the CottonInfo Bt and Insecticide Stewardship technical specialist Sally Ceeney.

**For more**

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# Beltwide honour for Bange

CSIRO's Michael Bange has become the youngest, and only the second Australian to receive the prestigious Beltwide Award for his outstanding contribution to research related to cotton physiology and production over more than 20 years.

**MIKE** received the 2017 Outstanding Research Award in Cotton Physiology in Dallas, Texas, in January while attending the Beltwide Cotton Conference, organised by the National Cotton Council of America and attended by around 1500 scientists and industry representatives.

"This award was fantastic but unexpected," Mike said.

"I didn't know I was in the running and nearly missed the presentation as impending snow storms meant we would have to leave the conference early.

"James Mahan from the US Department of Agriculture was travelling with me so the organisers let him know we had better stay!"

Normally awarded to US citizens, the only other instance the award has been given to an Australian was in 2007 when Dr Greg Constable, also of CSIRO, received the award for his leadership over many years in cotton research and breeding.

Mike is a crop physiologist, agronomist and a systems scientist, and has brought a wide range of scientific and leadership skills to bear on many of the challenges faced by cotton production. His interest in cotton began in the 1990s when he worked as a cotton farmhand in Goondiwindi and St George. He went on to study a PhD in crop physiology and since 1995 has worked at the Australian Cotton Research Institute near Narrabri. His work spans a wide range of topics, including crop physiology, modelling, decision support tools, irrigation management, fibre quality, photosynthesis and climate change.

"Receiving this award is a humbling experience as I have been put alongside



Dr Mike Bange (centre) receives his Beltwide Award, with previous recipient, Dr James Mahan from the US Department of Agriculture and Tyson Raper, Chair of the Agronomy, Physiology and Soil, Beltwide Conferences.

those I consider some of the most outstanding researchers in the cotton world," Mike said.

"The award also acknowledges the strong collaborations we have developed over many years to support both the US and Australian cotton industries."

CRDC's Bruce Finney congratulated Mike on the depth and breadth of research he has undertaken and the benefits to the cotton industry.

"CRDC has invested with CSIRO in Mike's research since 1995 and he must be congratulated on his contribution to the success of cotton growing in Australia – and globally," he said.

"Mike's earliest work with CRDC was in dryland cotton and the physiology of long and short season cultivars, with his more recent work helping establish the world's first cotton climate change facility at ACRI, showing the breadth of his knowledge and capability.

"But it's not just his contribution though world-class research. It is also his continuous mentoring of younger scientists, the esteem he is held in among cotton growers and consultants, and his ability to create meaningful collaborative research domestically and internationally.

"His reputation as a scientist puts Australian and CRDC research at the forefront and has no doubt contributed to the success of the industry as we know it today. We look forward to continuing our partnership with Mike and CSIRO in many projects."

**For more:  
Beltwide**

**w** [www.cotton.org/beltwide/](http://www.cotton.org/beltwide/)





Dr Robert Mensah sharing his vast knowledge at the CottonInfo IPM field days late last year.

## World first with Sero X

**THE** cutting edge biopesticide Sero X has been registered for use by Australian cotton growers this 2016-17 season.

This world-first product comes after a 10-year study led by Dr Robert Mensah, NSW DPI, with support from the former Cotton CRC and CRDC. A further seven years of investment, research and product development was undertaken by Innovate Ag.

Sero X was developed for the control of *Helicoverpa* spp. and sucking pests (mirids, aphids, whitefly and small nymphs of green vegetable bugs) in conventional and Bt cotton crops. As a bio-pesticide, Sero X is derived from naturally occurring Cyclotides, defensive peptides occurring naturally in some plants which protect them against pests. Robert says the highlight of this product is that it employs three modes of action, so there is no risk of insects building resistance to it.

"Sero X works as an anti-feedant, causes direct mortality and is an ovipositing deterrent – insects don't want to eat the plant, if they do it will kill them, and it also deters egg laying. Furthermore it only work on *Phytophagous* insects – so bees and predatory beneficial insects are not impacted."

Innovate Ag's Nick Watts said Sero X has potential for international success and is a great example of research translating into a successful business opportunity.

"With so few novel active constituents being taken through the regulatory process it is a significant achievement for regional R&D, both private and publically funded, to see such an innovative product on the market," he said.

"This is a win for regional Australia as the product will be manufactured in Goondiwindi, Queensland, while Growth Agriculture based at Wee Waa, NSW will distribute the product in Australia."

### For more:

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# Award in order

A long and illustrious career in cotton breeding research has seen Dr Greg Constable recognised as an Officer in the General Division of the Order of Australia.

**GREG** is already well known and respected in the cotton industry, both in Australia and abroad.

Looking back, fortune was shining on the Australian cotton industry when, in 1969, in his final year of university Greg was awarded a cadetship with NSW Agriculture, and began work in cotton research in 1970.

In 1972 Greg moved to Narrabri to work at the Australian Cotton Research Institute. He was with NSW Agriculture (now NSW DPI) until 1991, when he began work with CSIRO in the cotton breeding facility under his predecessor Norm Thomson. As a result Greg has been involved with developing all the genetically modified of cotton strains released in Australia starting with Ingard in 1996. Greg retired from CSIRO in 2015 and still lives in Narrabri.

"It was both a shock and an honour to receive this award," he says, "but it is testament to the fact it is possible to do meaningful, high impact work in country research facilities."

"You don't have to live in the city to have a successful career in science and research."

"I've been fortunate to work with other world-class scientists while working at ACRI."

"After 46 years in cotton research there are a lot of people I can thank for a successful career, but won't mention names for fear of missing someone out. In the early years I received a lot of encouragement from other scientists – the job is like that – and so I tried to do the same."

The question of his greatest achievement is one Greg is often asked to which he replies: "successfully navigating and directing the process of the strategic planning in the research."

"It takes between 10 and 15 years to bring a new variety to the commercial field, and it is a group effort, with around 15 people working directly in the plant breeding facility of CSIRO."

"CSIRO scientists from several streams have contributed to plant breeding through physiology, biotech and post-harvest groups – there is a big effort being put into cotton research."

Greg still has an interest in cotton breeding, as a Post-Retirement Fellow with CSIRO.



"This award is testament to the fact it is possible to do meaningful, high impact work in country research facilities." – Dr Greg Constable



Cotton growers need to be aware of new laws in Queensland and of the danger presented by children riding quad bikes.

## New quad laws for kids

THE CRDC-supported Primary Industry Health and Safety Partnership (PIHSP) has welcomed Queensland's new quad bike laws which came into effect on February 1, making it illegal for children under eight to be carried as passengers. The law also prohibits children under eight travelling as passengers in utility off-road vehicles that are used on any road, and requires quad bike and off-road utility operators and passengers to wear a motorbike helmet. Failing to comply could mean the loss of licence points or fines.

The new laws also state that children of any age can't be carried as passengers in off-road vehicles if they are unable to sit with their feet flat on the floor and hands

securely on handholds.

Safe Work Australia statistics show that from 2011 to 2015 there were 97 quad bike fatalities in Australia and eight of those were children under 10 years old. Research by the Australian Centre for Agricultural Health and Safety indicates of the 63 on-farm injury deaths last year, six were caused by quads, and of 85 non-fatal farm incidents highlighted in the media in the past 12 months, 43 involved quad bikes.

**For more**  
[www.rirdc.gov.au/pihsp](http://www.rirdc.gov.au/pihsp)

## Winning with safety

Secondary and tertiary students can be in the running for \$3000 prizemoney by sharing their farm safety stories.

The competition is open to high school students, university or agricultural college students between 13 and 21 years of age. The fatality rate for those working in agriculture, fisheries and forestry is nine times higher than for people working in other industries. The challenge is to create a video about an element of farm safety to create awareness of farm safety in Australia's next generations of farmers to help bring these rates down.

The competition is being run by the Primary Industry Health and Safety Partnership, of which CRDC is a partner.

Entries close April 18, 2017. To enter visit [www.rirdc.gov.au/pihsp](http://www.rirdc.gov.au/pihsp)

## Supporting our next champions

CRDC has partnered with Art4Agriculture to find cotton's next Young Farming Champions. The Young Farming Champions are youth ambassadors and future influencers working within the agriculture sector. The Champions promote positive images and perceptions of farming, and engage in activities and innovative programs under the Art4Agriculture banner, such as the Archibull Prize, of which Cotton Australia has been an ardent supporter.

Sharna Holman, a 2016 Young Farming Champion, who works with the CottonInfo team as a technical specialist in Emerald, is a shining example of how this program can prepare young people coming into the cotton industry.

"This program has been a fantastic experience and the workshops really make you think more broadly," Sharna said.

"I feel more confident in presenting myself and speaking to people, it allows me to engage with consumers and

helps both in my role as an extension officer and when advocating my love of cotton and the broader agricultural industry.

"I would definitely recommend this program – you aren't just speaking to people from cotton backgrounds, and we can definitely learn something unique from people across all agriculture, business and agribusiness.

"Tapping into experts in a lot of different fields means you learn a lot in a very short space time, having said that the people we meet are long-term connections – it's the program that keeps on giving!"

Art4Agriculture and CRDC have been searching for the next crop of Young Farming Champions, aged between 19 and 35 to help promote the Australian cotton industry, and with applications



CottonInfo technical specialist and cotton Young Farming Champion, Sharna Holman.

having closed in February, CRDC's General Manager R&D Investment Ian Taylor says there is a very promising group of candidates.

"We are seeking people who are passionate about the Australian cotton industry and want to share stories with urban Australians to improve understanding of sustainable food and fibre production, and in turn improve their own understanding of urban

consumers," Ian said.

"We look forward to announcing the successful candidates soon and encourage other young people in the industry to apply for the 2018 intake."

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# Talking trees with the PM

Late last year, scientist and cotton industry researcher Rhiannon Smith had the opportunity to discuss her CRDC project with none other than the Prime Minister of Australia, Malcolm Turnbull and Federal Minister for Agriculture and Water Resources, and Deputy Prime Minister, Barnaby Joyce.



Dr Rhiannon Smith discusses her research with the Prime Minister Malcolm Turnbull at the University of New England.

"It was pretty exciting and a little intimidating having so many cameras focused on me!" Rhiannon told *Spotlight*, after the pair visited the University of New England in Armidale, where Rhiannon is now a research fellow and lecturer in the School of Environmental and Rural Science – her area of focus is biodiversity, landscapes and ecosystem stewardship.

"We were talking about research I've done as part of my CRDC-supported project (*Managing riparian corridors on cotton farms for multiple benefits*), the technology I'm using to measure the health of trees, how much water a tree might use on a daily basis, and how that translates into production (in terms of carbon sequestration and wood production).

*"My research is showing that carbon sequestration by river red gums trees in riparian zones may offset annual emissions from cotton production..."*

"I was impressed when I started talking about river red gums, that Mr Joyce jumped in with the scientific name, and then Mr Turnbull asked me about a close relative (forest red gum) and he knew the scientific name for that one!

"They certainly know their trees."

Last year was a big year for visiting dignitaries at UNE, with visits by the NSW Governor David Hurley and his wife Linda, the Parliamentary Inquiry into Innovation in Agriculture, the Agricultural Industries Advisory Committee (including Parliamentary Secretaries and Advisors) and finally the Prime Minister and Deputy Prime Minister, all of whom Rhiannon spoke to about her CRDC-funded research.

One particular visit resulted in a very interesting request to put her scientific skills to the test.

"I was invited to Government House in Sydney by the Governor and Mrs Hurley to install sap flow meters on historic Morton Bay fig trees to measure their water use, and to the Parliamentary Secretary of the Department of Agriculture and Water Resources' farm near Canberra to age some

large river red gums!" Rhiannon said.

Rhiannon's recent research has been investigating carbon sequestration by river red gums in the Namoi Catchment. She has recently published a paper in a high-ranking international journal on growth rates and carbon sequestration by these trees during 2008–2012 when growth rates were high due to high rainfall conditions and prolonged flood events across semi-arid Australia.

"My research is showing that carbon sequestration by river red gums trees in riparian zones may offset annual emissions from cotton production, and therefore allow cotton farmers to run a carbon-neutral enterprise.

"This fact will be of particular interest to the growing number of carbon-conscious consumers who are looking to minimise their carbon footprint."

**For more**

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# CRDC's early planting res

CRDC funded research examining how to help Queensland's Central Highlands' cotton growers overcome climate challenges has been put into practice commercially this season, with great success.

The project started in the 2013-14 season with trials led by Dr Paul Grundy and Dr Stephen Yeates, who identified that a key tactic may be to plant considerably earlier (August) than the traditional mid-September to October window in an effort to pull the boll filling period forward into spring and early summer when weather conditions are at their most reliable.

With the wider planting window afforded by Bollgard 3 this season, growers for the first time have been able to put this research to the test and plant commercial areas during August. There was 18,000 hectares of irrigated cotton and 1000 hectares of dryland planted in Central Queensland (CQ) this season. Approximately 4500 hectares was sown during August and the crops responded well.

"The key objective in the trials was to complete boll filling before mid-summer monsoonal influences take hold with either bursts of cloudy wet weather or humid heat waves that generally occur after Christmas," Paul said.

"There is still a risk of wet picking but compared to the status quo of September/October planting, early sowing mostly avoids bad weather exposure during boll filling, and halves wet picking risks."

The research demonstrated that August sowing is quite reliable due to Emerald's relatively warm days and good solar radiation which heats the ground and provides an adequate buffer against cool night temperatures. Planting with degradable film to increase ground temperature was initially investigated but found to be unnecessary, as soil temperatures over four years of the trial without film typically remain above 14°C even during bursts of cold weather when nightly minimums drop to near 0°C.

"A glance at minimum temperatures would suggest that August is too cool for sowing but it is the duration of overnight cool temperatures that has been more important," Paul said.

"Emerald nights typically remain warm until well after

midnight and then rapidly cool in the last couple of hours before dawn and this type of weather characteristically has clear skies followed by a sunny day that warms up rapidly."

Paul says crop growth has been very reliable for the August-sown cotton.

"Because flowering starts in later October, most of the boll filling occurs during November and December when conditions are cooler and sunnier than January and February," he said.

"A key factor has been that the crop cuts out in early December about three weeks before the longest day.

"The continued day lengthening and increasing radiation acts as a buffer against cloudy weather."

## Improved yields

Throughout the trials in years when conditions were clear, as they were in 2015, the extra radiation post cut-out resulted in big bolls right to the top of the plant and a high yield of 14 bales per hectare. This season, December was moderately cloudy for three weeks straight but increasing day lengths still provided a buffer which minimised boll shedding.

"The size of the upper canopy bolls was reduced yet the picked but as yet un-ginned yields still indicate a solid result likely to land somewhere around the mid to high 11 bales per hectare," Paul said.

"Over the last four years planting early has produced a crop that is agronomically easy to grow and develops into a compact 'southern looking' style plant that loads up with good sized bolls.

"The trial crop height on average has been 20 to 30 centimetres below September-sown cotton without the need for growth regulants. Compared to September-sown crops, the August treatments have used less water and produced excellent fibre characteristics."



# Research changing the game

IMAGE PAUL GRUNDY





The other option afforded by the new Bollgard 3 window is to plant during December. This tactic also serves the purpose of minimising a wet pick but can have some associated challenges around crop establishment and flowering should wet or hot humid conditions occur in January and February. Growers have been able to balance the mid-season risks that may be associated with December sowing against the opportunity to double crop following a very successful 2016 chickpea crop.

"Ultimately for CQ there is no right answer for planting window, and planting window is only one aspect of the farming system," Paul said.

The project has worked closely with growers on improving understanding of the climate risks for cotton in CQ, and how this fits with the additional opportunities that the broader window provides in terms of farming systems opportunities.

"While it does not alleviate all the potential climate risks, August sowing has resulted in very respectable yields with very few additional input costs (beyond planting more seed and using the full complement of seed dressings) and in most years will produce excellent cotton while also avoiding boll rots and rain-related lint downgrades," Paul said.

"The opportunity also exists to grow a rotation after the cotton comes off in January, should wet weather occur in February.

"We are really pleased with the reports we are getting back from growers and agronomists who have chosen to plant early.

"We can't do this research without the support of growers, so I'd like to thank Carlo Stangherlin and Neek Morowitz for hosting our trials, and agronomist Jamie Iker for looking after the day to day consulting for us."

#### For more

Paul Grundy

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## CARLO STANGHERLIN

**PLANTED** – AUGUST 13-18, 2016

**DEFOLIATED** – JANUARY 17, 2017

**PICKED** – JANUARY 30-FEBRUARY 10, 2017

When *Spotlight* spoke to Carlo Stangherlin in mid-January he said "I'm about to pick cotton while other crops don't have a first square yet," giving some perspective to the notion of an "early planting".

Carlo's has been a part of the trials over the four years and is very impressed with the outcome. The big improvement he's seen is not just in quality, but quantity.

"Last year's trial all went base grade with no colour discounts – and yield was up four bales per hectare – from 10 to 14,"

Carlo says.

"This year for me that equates to an added \$2600 per hectare, which is very pleasing.

"So this research has been fantastic for us – it hasn't just allowed us to avoid wet weather at the end of the season, we can grow a better quality, higher yielding crop, which we've been struggling with."

Having initially grown cotton in the Border Rivers region around Mungindi/Talwood where yields are higher on average, he says it has always been an aim to try to bring yields more in line with southern averages.

"When I came up here I wanted to understand why they weren't getting the yields we were at Talwood: I wondered 'did we need a more suitable variety?'

"I thought 'how is it that we are planting at the same time as down south but picking a month earlier?'

"Bringing the planting date forward has basically solved that problem for us and in my opinion is the most useful bit of research to date in helping close that yield gap for us northern growers.

"It has been great being involved in these on-farm trials: you get to see first-hand how the crop responds and understand the small tweaks needed to manage it.

"Having researchers on your farm and getting to know them and the research has

Carlo Stangherlin is extremely happy with the research and outcomes in the first year of commercially planting in early August.



IMAGE PAUL GRUNDY





PAUL GRUNDY

Neek Morawitz says improved yield potential is a bonus outcome of the research.

also been fantastic. There is nothing like being able to talk and discuss the trials and issues with them first hand."

Carlo says it would only be lack of water or cold that would deter him from early planting in future seasons.

"We didn't have a frost last year, in fact I haven't seen a frost here yet, so I have a lot of confidence in the early planting.

"While we might have a cool night, the days heat up quickly – I've thrown all my jumpers away!

"Early planting also gives us the option if we do suffer wet weather prior to picking to grow our crop on and compensate or it can allow us to bring other rotations such as mung beans into our system when we pick in January.

"I can rotate out with chickpeas or wheat or straight back into a quick mung bean crop so that we can go back to early cotton again.

"I didn't split my planting between early and late this year because you'd have a crop in the ground for 10 months – and that's a long time to be pulling syphons!"

"Having said that, if there is no water in the dam in early August, but it does rain in say November, we can still plant in December.

In terms of management, Carlo said he seems to have more time for undertaking operations early season.

"It has given us more time for management in terms of cultivation and

side dressing: the plant grows a lot slower and is not trying to jump away from you," he said.

"Then at the end of the season we only needed to put a little bit of growth regulant on at the end to shut it off.

"In terms of pests this season, we did experience some heavy mirid pressure, with shield bugs and heliothis, and put out one whitefly spray, but I would put this down to the amount of chickpeas around and rain out west rather than the early planting."

## NEEK MORAWITZ

**PLANTED** – FIRST WEEK AUGUST, 2016

**DEFOLIATED** – MID JANUARY, 2017

**PICKED** – JANUARY 30, 2017 ONWARDS

Neek Morawitz was a part of the trials for the first time last season, planting a 17 hectare test crop. This season he planted most of his farms to cotton in early August, including 55 hectares of dryland cotton which was picked at the end of January. He planted nearly 400 hectares in early August, which was defoliated in mid-January. A further 165 hectares was planted after stripping chickpeas on October 20.

He's been closely watching the trial work over the last four years and says his decision to plant in early August is based on good science.

"Commercial scale trials certainly inspire confidence and are an extremely important component for growers," he says.

"What's interesting with this research is that it primarily started with a view to beating the weather, but the things I've seen and feel that have come out of it is that the early crops have a lot of yield potential.

"This is a bonus to what we thought we would get from this research, as we are not just coming through with 10 bale (per hectare) crops, we are now seeing 12 bales, which is a strong driver to try an earlier plant date.

"I'm seeing higher rates of reproductive versus vegetative biomass in the earlier cotton – for me it has turned out to be more than just picking a date to beat the weather. I'm not sure what it is, perhaps the cool starts and slower accumulation of day degrees that lends themselves to growing higher yielding crops."

Like Carlo Stangherlin, Neek says the early planting date has other flow-on effects.

"We have found in the past planting around traditional dates that our channels have a diminished capacity for water delivery when the plant needs it most, but the water capacity this season has been good," he said.

"Our watering seems easier to manage, as in the early part of the season irrigation



demands aren't as critical.

"Everything happens slower in terms of emergence and growth, so nutrition and water demands aren't as heavy early on.

"Our crops are finished by the longest day and require minimal growth regulant, it seems to manage itself pretty well.

"By picking in late January we also have opportunities for planting crops such as mung beans, corn and sorghum, with planting windows ending mid-February so that suits us well."

In terms of altering management of the earlier crop, Neek says while there was high insect pressure early, he puts this more down to mild weather in late winter and early spring, coupled with rain in the western regions.

"I don't believe that is typical of early planted cotton going on what I've seen," he said.

Neek says in pushing the boundaries to what they thought was possible and even beyond – and doing it consistently with a favourable outcome becomes a workable concept and builds a strong base for determining a planting date to suit.

He says the effect of later planting dates is another unexplored path.

"Planting later could offer opportunities for plenty of rainfall when the plant is at high water demand, then finishing and picking through April, May and June, when conditions are mild and dry."

## NIGEL BURNETT

**PLANTED** – FIRST WEEK AUGUST, 2016  
AND MID-DECEMBER, 2016

**DEFOLIATED** – MID JANUARY, 2017  
(AUGUST SOWN)

**PICKED** – FEBRUARY 1, 2017 (AUGUST SOWN)

At the start of February Nigel and Beth Burnett were ready to pick half this season's crop, while the other half was at around the 15-node mark.

Nigel planted roughly half the farm on August 3, and the rest into double skip from December 10. It won't be picked until May.

"We would have planted it all early, but we had to wait to harvest a chickpea crop," Nigel says.

"The early crop looks fantastic – there

has been no early weather on it and the yield is looking good."

Nigel said even though he had a gut feeling an earlier plant date would suit the Central Queensland climate better, having the trial data improved their decision and confidence to go in early.

"We have wanted to plant earlier for a while to get away from the monsoonal influence," Nigel says.

"The research trials proved that even after an extreme rainfall event last year the crop could come through with impressive results.

"While I've wanted to go early I never considered the first of August would be feasible.

"Having the trial research been a fantastic opportunity to capitalise on the early planting date.

"Not having to regulate the growth we have better plant architecture, rather than growthy plants, which has resulted in a more manageable sized crop.

"For us it is giving the plant a decent opportunity for root development which will aid in late fruit retention.

"Cotton grown up here can turn from reproductive to vegetative very quickly, but the early plant seems to ensure that the energy is going into square development rather than vegetative growth.

"We can grow good yields – that's not our issue – it's just whether we harvest it or not.

"A lot of times we've seen great crops that have been affected by rain, reduced yield, boll rot, or quality downgrades.

"We haven't seen any boll rot this season.

"That is this year but who knows what will happen next year, as we all know, every season throws up its own challenges, but I think it will be a good fit for us to book end the season with some early and possibly later planted cotton.

And what of growing cotton (and pulling syphons) for 10 months of the year, along with two separate harvests?

"Well it's the same amount of country to manage and in terms of irrigation, it's just doing it at different times," Nigel said.

"As far as labour requirements go and how we cope with a long season, I'll let you know when it is over.

"It's a bit early to talk yield, but at this stage the early planted crops are looking to be one of our best yields."



PAUL GRUNDY

Ross and Nigel Burnett picked cotton in February and will be picking again in May.



Research technical officer Gail Spargo, grower Carlo Stangherlin and consultant Jamie Iker in early planted cotton, ready to pick in January.

PAUL GRUNDY



## JAMIE IKER

### CONSULTANT

Jamie Iker says having the ability to plant in early August is a game changer for Central Queensland's cotton growers.

Jamie has been involved with the trials over the four years and has also seen first-hand this season the benefits for growers, from improved yields to easier crop and pest management.

"What we are seeing in the early planted cotton is a better looking, healthier, more robust crop in general, that is easier to manage, more uniform, more resilient to insect damage and easier to pick," Jamie says.

"That's a lot of positives, and not to mention the improved yields we are seeing (generally) across the board.

"Boll rot was a big issue for us up here and we haven't had to think about it this season, which is fantastic as it was the cause of a lot of yield loss. When it was present it wouldn't be uncommon to see 10 percent or more impact on yield – or around a half to one bale per hectare loss.

"While we know every season we will not escape boll rot, we didn't see boll rot in the early planted trials, which I feel is a good indicator.

"People are also saying it is so nice to pick and is uniform from top to bottom.

"It is a breeze to manage: we plant, manage insects and water it, without the usual rush.

"In our environment when cotton is planted at the traditional time, you put a

bit of water around and just opening a bag of nitrogen makes it jump a foot!"

Jamie has been really impressed with the way the early crops have handled a season of very high insect pressure.

"Even in a year like this which is an extremely high pressure year – a one in 10 – we've had to chase the crop hard and manage these pests, but at the same time it felt easier – I don't feel like we've needed to jump 'yesterday' to stay on top of things.

"Further to that, we just haven't seen the damage you would expect from such persistently high insect numbers and I put this down to the more resilient and robust plant we've been able to grow.

"Unlike later planted cotton, the early crops aren't as 'growthy' and vigorous in an unbalanced way, with high vegetative growth and small squares, which tend to throw more fruit.

"I think as well as a more robust plant, I believe that because it is growing through a cooler time of year, the pests are not causing feeding damage as quickly.

"Heliothis for example go through their life cycle faster when it is hotter so do more damage rapidly. It would be interesting to see if that is the link – it appears damage is not being done as quickly."

A further positive is that now that some of the weather risks are being managed, if the yields are still not there growers and consultants can look at other management areas to improve on, for

example soil health or general agronomic management.

"For example normally for defoliation we get in as quickly as possible which can lead to a drawn out defoliation – but perhaps at this time of year there may be instances where we can leave the leaf on a little longer and protect the lint from heavy showers or storms and then drop the leaf quickly in the heat without delaying picking operations.

"There are a lot of things we can tweak because it is totally different – by planting earlier we are changing a range of dynamics."

With increasing yields in back to back fields, Jamie says more growers may be able to afford to fallow more country or include legume rotations.

"Last year we got 14.2 bales per hectare in the trial plots, in back-to-back cotton, and the cotton in this region has been more or less back-to-back for 20 years.

"Add to that if we can pick it, destroy the crop and have it prepped up for next season potentially before the big rains come in February, then let the soil and crop residues melt down, that's a really good spot to be in.

"I think a lot of growers will take advantage of this and see good results in doing it, rather than going straight in and getting ready for another crop."

Going forward in coming seasons, Jamie says there are other knock-on effects that will also have to be monitored.

"We will have to keep an eye on insect pests and resistance, because with cotton in the ground for 10 months of the year – we are providing hosts for an extended period and other crops grown around cotton will be treated with insecticides also used in cotton, which heightens resistance risks," he says.

"The same goes for disease and weed management and soil health.

"Overall this season though as a result of the early planting we are seeing great crops, a crop that is easy to manage with improved yields and less quality issues.

"It has been fantastic that this research was available to growers prior to this season, and was also able to inform the planting window dates.

"It was robust enough to give growers confidence to do it: it has been a game-changer."



# Irrigators go south for inspiration

Last December a group of 29 cotton growers, irrigators and consultants from Northern NSW, the Darling Downs and Kununurra in WA visited irrigated farms in Southern NSW and Northern Victoria to see innovations that maximise efficiencies in water use, energy and labour.

The three-day tour, hosted by CottonInfo and NSW DPI's Sustaining the Basin: Irrigation Farm Modernisation (STBIFM) program visited irrigation farms in the Goulburn–Murray, Coleambally and Murrumbidgee irrigation areas, covering dairy, rice, and cotton production.

"The tour provided irrigators with an opportunity to look at different systems, design and structures to see what might work on their properties," said STBIFM program leader, Dr Michael Grabham.

CottonInfo's (then) water use efficiency technical specialist, Janelle Montgomery, organised and led the tour.

"The tour gave irrigators the opportunity to hear first-hand from farmers who have fully automated surface irrigation systems and have confidence in the technology," Janelle said.

"This is important for our growers, as the cotton industry is still in its infancy in terms of automation adoption."

The tour visited 10 farms where growers and consultants met the farmers and industry experts who have already adopted some level of automation in their surface irrigation system. Participants gained important insights into the

*"Participant evaluation of the tour through showed 93 percent would undertake changes on their farms."*



Grower Ken Carrigan, Boomi, NSW; Ray Thornton, Yalca, Victoria; Sam North, NSW DPI; grower Ian Hayllor, Dalby, Qld; and tour leader Janelle Montgomery, Moree, NSW.

decision-making processes when investing in these technologies and how risk is managed. The main benefits of irrigation automation are labour savings, removing the 24-hour monitoring of conventional siphon systems and minimising tail water losses. Automating surface irrigation systems can deliver both improved efficiencies in labour and water use. The precise control of flows and water levels throughout a farm can also result in improved production and reduced costs of production improving profitability.

Participant evaluation of the tour showed 93 percent would undertake changes on their farms as a result of what they've learned. This includes trialling different surface irrigation designs, adopting remote monitoring, changing scheduling practices, being better informed and knowing what questions to ask when talking with irrigation designers. A similar tour in 2015 also resulted in a number of cotton growers implementing change on their farms.

Dalby cotton irrigator Ian Hayllor currently uses traditional siphons, which he finds labour-intensive. He was on the tour to learn how he can improve water use efficiency. After visiting Noel Baxter's cotton and maize farm at Berrigan which has a pipe through the bank system, including a distribution pontoon, Ian is interested in trialling a similar system.

"The reason I like this system is it is

so simple, cheap to install and easy to automate," Ian said.

"To trial on our farm, we would grade our rotorbucket areas out, install a pontoon and put in a pipe through the bank. I can't believe such a simple system works so well."

Cotton grower Greg Bender from Chinchilla in Queensland said he was also looking for ways to improve labour efficiency in flood irrigation, while Auscott Namoi farm manager Martin Mead of Narrabri, was impressed with the use of portable timers.

"Portable timers are terrific, especially in the cotton industry as you are not growing back-to-back cotton, your technology is not tied up and invested in only one field – you can pick it up and move it to different fields every year, which spreads the cost of innovation," he said.

The tour was supported by the Australian Government's Department of Agriculture and Water Resources as part of the Rural R&D for Profit and Sustainable Rural Water Use and Infrastructure Program, Rubicon/FarmConnect, Padman Stops, CRDC, RIRDC, Dairy Australia, Sugar Research Australia and National Centre for Engineering in Agriculture.

## Download the tour booklet:

[www.cottoninfo.com.au/publications/water-smarter-irrigation-technology-tour-booklet](http://www.cottoninfo.com.au/publications/water-smarter-irrigation-technology-tour-booklet)



Dr Andy Leung applying monolayer product to the experimental dam at St George, Qld.

# Future in monolayer technology

High tech polymers could be the next big thing in curbing evaporation from on-farm storages, potentially improving water use efficiency and productivity.

Evaporation from on-farm storages is a problem for irrigators right across all sectors of agriculture in Australia, resulting in the (potentially avoidable) loss of more than 1320 gigalitres of water annually. Cotton industry research also shows that evaporation losses from farm water storages are the major loss of water on cotton farms, estimated at between 20 to 40 percent.

In 2013, CRDC provided support for a series of large scale field trials on-farm, using new monolayer systems. The trials were undertaken by a team from the University of Melbourne and Griffith University, with the aim to provide information needed to inform a decision on whether to commercialise the technology. These trials built on previous work by the Cooperative Research Centre (CRC) for Polymers which had developed breakthrough monolayer technology, where laboratory and small-scale field trials of this technology showed a 40 to 60 percent reduction in evaporation.

Ultra-thin monolayers work by spreading out across the water forming a thin, one-molecule-thick layer. They have little to no capital costs, can be used only when needed, and can be used on storages of all shapes and sizes, as well as irrigation channels. They are therefore a potentially cost-effective method of reducing this

evaporative loss. However, the CRDC research found that current commercial products have low performance, are readily disrupted by wind and need to be frequently reapplied.

The learnings from this project have contributed significant knowledge to the development of monolayer technology, and built a strong base for future developmental work.

"Wind was identified as the main contributing factor to diminished evaporation savings, and the factor which needs to be addressed if monolayer technology is to be commercially viable," researcher Dr Emma Prime said.

"It was identified that there is a critical wind speed threshold for monolayer performance: below this threshold the monolayer could achieve evaporation savings of up to 20 percent.

"Above this wind speed the monolayer film was compressed to the downwind end of the storage and was unlikely to recover if wind speed dropped – the film was generally either lost into the water body due to turbulent mixing, or pushed up on to the bank."

CRDC R&D Manager Jane Trindall says these findings can be used to further refine the technology.

"Further work is required on developing

a technology with more wind resistance for this technology to provide a solution to evaporation on storages on cotton farms.

"After a tremendous 25 years and great contribution to polymer science in Australia, the CRC Polymers is coming to a close this year.


"CRDC's future focus will be working with the University of Melbourne and their partners to evaluate the future direction of the research.

"In a nation scarce of water, this is an issue of national importance, as the potential is enormous."

Using the Namoi Valley as an example, if a 15 hectare storage (around 900ML) with average daily evaporation of eight millilitres, then 1.22ML of water is lost daily to evaporation. This technology could save 20 to 40 percent of that lost water, or 0.24-0.49ML/day. If used from the start of August to end November (when there was water in the storage) or 120 days, this equates to 28-59ML water saved. With 250 cotton storages in the valley, this is 7000 to 14,700ML saved. If we assume 10ML is applied to one hectare to produce 10 bales per hectare at \$500 per bale this is over \$7 million in additional value for cotton growers in the Namoi.

## For more

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Examples of clamping methods for the ZIM probes onto the leaf using a) pot plant trellis b) magnets and the leaf after removal showing minimal disruption.

# New tool to monitor leaf hydration

A CRDC Summer Scholarship project undertaken by Anna Holcombe and supervised by Dr Helen Bramley of the University of Sydney has been investigating new technology to measure water stress.

Plant based measurements are arguably the most accurate method of measuring water status for irrigation, as they are a direct measurement of the plant condition, and the cumulative response to external and internal factors. However, all current methods of measurement on cotton are indirect or destructive and labour intensive.

To overcome these issues, CRDC has invested in the Summer Scholarship research to test the potential application of ZIM-probes in irrigated cotton. ZIM-probes are a novel, non-destructive technology used for continual remote measurement of leaf hydration by clamping pressure sensors onto the leaves of the plant. The probes work by using miniature pressure sensors clamped to leaves by magnets to detect the change in leaf turgor as the plant dehydrates and rehydrates in response to water availability and transpiration. The pressure output can be used as an indication of the changing water status of the plant.

Preliminary findings have demonstrated that the probes are potentially more sensitive in detecting signs of water stress than traditional techniques. Features of the probe output patterns have been identified that indicate calibration parameters could be developed to optimise the timing of irrigation.

"Signs of crop stress were able to be observed earlier using ZIM probe data than through traditional water status measurements, despite measurements taking place every second day," Anna said.

"Probes can also remain on leaves for long periods without requiring re-clamping.

"If this were possible for a whole season, the system would have very low labour requirements once initially installed however additional testing is needed to determine whether re-clamping is necessary as the plant grows.

"The advantages of the ZIM-technology include direct continuous measurements that can be remotely accessed via the internet and once set up, have relatively low labour requirement.

"However, the technology may not be applicable to all irrigation formats (furrow/flood irrigation) and measurements can be confounded by leaf injury during initial clamping of the probes to leaves or after long-term attachment."

## For more:

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# Funding for irrigators

Northern NSW irrigators have until June 30 to apply for funding to upgrade on-farm infrastructure from two programs. All irrigators with eligible entitlements from the Lower Namoi and Border Rivers catchments can apply for funding via the Sustaining the Basin: Irrigated Farm Modernisation (STBIFM) program. All irrigators with eligible entitlements in the NSW Border Rivers, Gwydir, Namoi/Peel, Macquarie/Cudgegong and Barwon/Darling water management districts can apply for funding via the Irrigated Farm Water Use Efficiency Assessment (IFWUEA) program.

The NSW STBIFM program is funded by the Australian Government through the Sustainable Rural Water Use and Infrastructure Program.

Since September 2013, the Australian Government has spent around \$1.5 billion on infrastructure modernisation and efficiency improvements nationally, and is providing a further \$2.5 billion under the National Water Infrastructure Development Fund and National Water Infrastructure Loan Facility.

## For more:

w [www.dpi.nsw.gov.au/land-and-water/water/sustaining-the-basin](http://www.dpi.nsw.gov.au/land-and-water/water/sustaining-the-basin)



# Revealing native fauna on cotton farms

A four-day fauna survey on the farm of Cotton RiverCare Champion Mark Palfreyman yielded more than 130 different species of native animals – a promising result, according to Mark.

“It’s encouraging to see such a great diversity of species on our farm, especially considering this was only a short snapshot in time,” Mark said.

“We know that there are other species here that were not spotted during the survey – some of the smaller mammals, for instance, like the narrow nosed planigale.”

The survey, part of the CRDC-supported and CottonInfo-led Cotton RiverCare project, was conducted by ecologist Phil Spark on the Palfreyman’s ‘Taraba’ in October 2016. The native species recorded during the survey included: seven fish, 13 frog, 24 reptile, 11 mammal and 76 bird species.

CottonInfo technical specialist Stacey Vogel said it was a pleasing result for a cotton landscape.

“According to the Living Atlas database, a number of species spotted during the survey, like the vulnerable silver perch and the silver catfish or moonfish, had not been recorded this far east before,” Stacey said.



A Gould's wattled bat (*Chalinolobus gouldii*) caught during the survey.



Ecologist Phil Spark revealing what lies beneath.

“That’s a really interesting discovery, and it shows the diversity of native species that can be found on – and near – cotton farms.”

However, the abundance of each species recorded during the survey was quite low – a worrying trend not only on ‘Taraba’, but right across Australia, says Stacey.

“This is thought to be linked to habitat loss and fragmentation,” she says.

“Take for example microbats – seven of which were found in the survey.

“We know from research – in cotton and elsewhere – that microbats play a significant role in natural pest control in cotton landscapes.

“However, if we want to keep these important natural pest controllers, we need to maintain and even improve their remnant habitats.”

Phil Spark said that to maintain and enhance the native fauna diversity and abundance found on ‘Taraba’, a range of management actions could be put in place – including controlling weeds and feral animals, excluding grazing from riverine areas and vegetation, and allowing

the remnants to mature and expand over time to increase the area of habitat and abundance of hollow trees and logs.

“We recognise the importance of our native vegetation in encouraging native animals to thrive, and we’re introducing a range of measures to help this,” Mark said.

“We hope – for example – that our recent decision to stop grazing here on ‘Taraba’ will reduce the loss of habitats such as logs (via trampling), allow more regeneration and improve native groundcover and litter helping to suppress weed establishment.”

For more information on how you can maintain and enhance natural habitats on your farm, please visit the myBMP sustainable landscapes (natural assets) module at [www.mybmp.com.au](http://www.mybmp.com.au)

## For more

**w** [www.cottoninfo.com.au/natural-resource-management](http://www.cottoninfo.com.au/natural-resource-management)

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# Cotton knows how to compensate

There were clear messages around pest management at a series of field days late last year.

The CottonInfo Integrated Pest Management (IPM) field days were held throughout five growing valleys in November and December and featured the industry's leading scientists and researchers in the field. Attendees also heard from local growers and agronomists, with the events covering major benefits of IPM, how to achieve it while still growing high yielding crops. As such, the presentations from entomologist Dr Lewis Wilson, cotton physiologist Dr Mike Bange and NSW DPI's Dr Robert Mensah, were insightful, with many questions from attendees around economic thresholds and compensation.

Lewis says based on discussions at the field days, that there is still a misconception that high retention early must be preserved at all costs.

"There is a belief that we need high retention early to get high yields, but there is not a linear correlation as the plant can compensate, and, as every consultant has experienced, even very high yielding crops can have poor early retention," he says.

"Chasing high early retention by applying insecticides is a waste of time if pests are not the cause of loss or are below threshold and really only incurs a cost, reduces beneficial populations and increases the risk from mites and whitefly – which then cause problems.

"We've done many experiments exploring the relationship between early leaf loss, early tip damage, early fruit loss and the crops yield and maturity.

"Results from these experiments were used to develop the current thresholds that have both a pest abundance component and a plant damage component, so both are taken into account.

"The economic thresholds and the guidelines around IPM are a good basis to make decisions thinking of the whole season, not just reacting to a situation.

"When pests do need control, a more selective option is desirable to try to conserve beneficials for the long haul."



Dr Lewis Wilson takes a closer look at the IPM field days.

Lewis also commented that there has been a generational change in agronomists/consultants many of whom have not had experience with the levels of tip damage and early fruit loss that occurred this season making it hard for them to have confidence in compensation.

"Perhaps some damage experiments in our new higher yielding varieties, in collaboration with growers and consultants, would give more confidence in understanding and using compensation," he said.

Mike Bange says the IPM workshops were a great opportunity to reiterate the role of physiology and how crops grow, influencing decisions by growers and consultants relating to IPM and other aspects of management.

"One of the key messages of IPM relates to the health and development of the crop, so it was great chance to talk about how early growth and compensation relates to final crop outcomes," he said.

"IPM is as much about responding to the plant as it is to pest population; and most industry pest thresholds are developed with this in mind."

During the course of the IPM workshops there was much discussion on the effect of very early fruit loss from insect or due to physiological reasons (eg cold weather).

"In most cases some small amount of early fruit loss does not cause yield losses or delays in maturity, because the resources that would have been available to grow that fruit are immediately available to grow new fruit."

Mike's message was that "sustained fruit loss and fruit loss in the mid to later stages affects yield and maturity more".

Another point of discussion was the effect of the early plant size affected by cool and colder temperatures.

Mike said this may have impacts later in the season when plants start to lay down significant amount of fruit.

"Keeping crops from having rapidly declining nodes above white flower and reaching cut-out too early may be a challenge," he said.

The developer of plant-based control product Sero X, NSW DPI's Dr Robert Mensah was also at several of the field days, and had some sound advice to give around IPM principles.

He reiterated that the presence of a pest does not necessarily mean control, and growers and consultants need to bug check their crops for pest and beneficial insect numbers, damage and fruit retention.

"Growers and consultants also need to determine the predator to pest ratio threshold as a guide in making pest control decisions," he said.

"If there is the need to spray, growers and consultants should use biological control measures and IPM options which include petroleum spray oils (PSOs), Sero-X, reduced rates of pesticides mixed with PSOs and other soft options.

"Broad spectrum (hard chemistry) synthetic insecticides should be used on as-needed basis when everything else fails."

## For more


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Graham Clapham and his son Nicholas at home on the Darling Downs.



# Looking below the surface:

## What does it mean to you, our growers?

Over the recent editions of *Spotlight* we've been looking at some of the soil biology research CRDC supports and how it relates to cotton production systems and farming landscapes. In this final instalment UNE's Oliver Knox and *Spotlight*'s Melanie Jenson have been talking to growers to determine what soil biology means to them and their attitudes to how it influences their farming practices. To kick things off we called Graham Clapham on Queensland's Darling Downs...



Graham Clapham has been a huge supporter of soil biology research, as a champion in the fight against the soil-borne pathogen *Fusarium* since its discovery on the Downs. But, as this experienced cotton farmer is keen to point out, “with *Fusarium* you can never say that we’ve passed the danger or the threat of *Fusarium* to our cotton crops.

“We are in a vastly different world than we were 10 or 12 years ago, when even our most tolerant varieties could still easily succumb to it and we’d lose whole fields.

“These days though, with the amount of tolerance that we have in the available varieties we’re back growing cotton in even our most infected fields.”

This success story is not just limited to the industry’s varieties. The research Graham has assisted with has provided further insights into *Fusarium* management.

“Whilst good soil nutrition and soil health won’t prevent *Fusarium*, poor soil nutrition and poor soil health is one of the stress factors that help to trigger *Fusarium*. Because of this, we’ve concentrated on those aspects of our soils.

“This has been achieved by the extensive use of thousands, if not tens of thousands, of tonnes of biosolids.”

These biosolids are mainly sewage products, but as Graham will tell you the requirement for dry soil profiles, due to the weights involved in spreading and incorporating, can be quite limiting with these products. However, the nutritional and biological benefits of these products are not in doubt to him.

“On some fields we had used up nutrients such as nitrogen, phosphorus, potassium, copper and zinc,” he said.

“Even where we’ve applied these elements in a chemical form we can still see a difference in the fields where there is a history of biosolids, so there is something else there.”

This of course leads to the obvious question as to what this “something else” is. To which Graham says “Well I am not a soil scientist and we’ve never looked closely as to what that something else is, but I’d guess the organic matter in it is important in retaining our soil health”.

As well as a belief in biosolids, Graham also keeps a very close eye on his fields’ nutritional status, with the assistance of his agronomist,

*“Once upon a time having the right amount of nutrient available was a major issue, but these days it just seems to happen.”*

Mathew Holding. Together, they’ve been using a ‘nutrient bank’ for over a decade on each field.

“This is just like your bank statement, in that everything that goes in and everything that goes out is documented,” Graham says.

“With our nutrient application we use this tool and seldom use soil tests anymore, although they were used as checks in the beginning.

“The more data that goes into the nutrient bank the more accurate it becomes.

“Once upon a time having the right amount of nutrient available was a major issue, but these days it just seems to happen. We look at the nutrient bank and we can tell exactly what we need to apply and it works.”

So if the fertiliser requirements are right then is there a benefit from the soil biology as well? According to Mathew, “biosolids are gold” and Graham would encourage growers to look at alternative fertiliser sources.

“To this end, we’re blessed in this part of the world with very large nearby feedlots, which means there’s a lot of animal manure applied to fields in the Downs. We’ve used it in the past and will into the future, largely due to the constraints on availability and use of biosolids.

“Using feedlot manures in some fields has definitely helped the biology of the soil.”

### **Creatively composting at Yenda**

In other areas, where biosolids or manures might be more limiting, alternative organic amendments, such as compost, are proving popular. Compost and alternate fertiliser amendments have been behind changes that Paul Moon has instigated on his property near Yenda in the Riverina.

A combination of personal circumstances, droughts and rising fertiliser prices had Paul realising that we are reliant a lot on fertilisers and chemicals.

“I just thought, we’ve got to make a start and make a change, so we started making our own composts – however, compost is not the be all and end all, you’ve got to have a balance of both,” Paul said.

“What we’ve been working toward, especially in our dry land, is liquid injection using a balance of fertilisers in combination with the Allgrow product.

“We’re winding back our synthetic fertilisers, we’re still spending the same dollars per hectare, but I know myself that, even this year in the wet conditions, we’ve seen a fantastic result.”

So where does this change come from, is it improvement in the soil structure?

“If you’ve got good soil structure then you are going to grow good roots,” Paul said.

“If you can grow good roots then that’s the fuel tank to drive the plant, and we’ve got big fuel tanks.

"What we've been doing in the irrigation is spreading five tonnes per hectare of compost over stubble, which we then plough in.

"Our summers are a bit too dry here to make things break down really quick, but we irrigate after we've ploughed everything in you could see the breakdown occurring really quick and worm casts... the amount of worms in the ground is unbelievable."

Do you need to know what these worms and biology are though?

"I am happy to know the biology has improved, but the biggest thing is being able to quantify what we have done," Paul says, "knowing where we started and where we are is hard to actually test."

So how do you measure this?

"The health of the crop," is the short answer.

"A visual on a plant will tell you if it's healthy and if it's not, then there is something lacking in the soil. If it is growing like a house on fire, then everything there is right.

"What we've also noted is that the water holding capacity in our soils is improving."

Paul is again quick to remind us that these changes don't take place overnight.

"I think we saw improvements in the biology and the worms in about two years, but we were using a lot of fertiliser and still do, but we are using it in different forms.

"You can't just go cold turkey, you've got to wean the system off it."

Paul also offers up some cautionary notes.

"I am happy doing what I am doing and I know I am building my soils and that's what I am trying to do, but what I do on my farm may not work on someone else's – everyone has a different outlook and goal.

"A lot of guys are starting something, whether that's a straight manure or compost program, but we're about five or six years in front."

Many would consider that getting ahead is important and as Graham Clapham pointed out, one of the strengths of the cotton industry is that we talk to each other and share our successes. If someone has a good idea then it becomes an industry-wide option.

### Going to ground at Goondiwindi

So what other options are out there for supporting or improving our soil biology?

For an alternate tack, we spoke to Goondiwindi



IVA QUARISA, IREC

farmer Nigel Corish, who used his recent CRDC and Cotton Australia-supported Nuffield Scholarship to delve deeper into the soil and has taken his learnings back to the farm.

Nigel sees soil biology as very important.

"From what I've learnt from my experiences in recent years I think it is an area where there are improvements to be made in how we are growing our plants and crops to produce yield," he says.

"Currently many growers would skip over this, in favour of mineral fertilisers, but they are missing a trick."

So the biology is important and could give us additional production options?

"Absolutely, what I am finding is that we often don't treat soil the way we should and we can improve it," he explains.

"If we're getting the nutrient cycling going and having a healthy soil then production is going to increase and we can reduce inputs."

But how long does it take to improve our soils when we start to farm with a consideration of the soil biology?

Nigel says realistically it's going to take a good five years, and that's with incorporating rotational crops and different management to achieve that.

"That said, I am in my second year of making changes and have seen benefits within 12 months from rotations, cover crops and minimum tillage," he adds.

"One of the biggest has been moisture retention with cover crops, they have really helped with retaining water and letting us use less irrigation water in crop.

"We've got some zero-till cover crops under some overhead irrigation and that's been shown to really improve infiltration and water use.

"We've got capacitance data that indicates cotton roots are extracting water down to 80 centimetres, whereas where we've just gone in

In his mixed cropping enterprise at Yenda, Paul Moon also hosts research such as National Variety Trials.



with a standard practice the cotton is only pulling water from the top 40 centimetres. That's a big difference."

So what you are measuring is things that are important to the crop, but not necessarily the soil biology itself?

"Yes that's exactly right," Nigel says.

"Something else that we've done is reduce our synthetic fertilisers in favour of more liquid/biological fertilisers. These are things like molasses and kelp based products and we're maintaining or seeing the same results with these.

"For me that's encouragement enough to say that what we're doing is helping the soil out."

### Carbon is key at Trangie

The theme of needing to help the soil out is also what's behind the changes that Mick Wettenhall is making on his property in the Macquarie, but for him the imperative is driven by climate change.

"We're going headlong into an unmitigated disaster with climate change," said Mick.

"The reality is we have to remove 1800 gigatonnes of carbon dioxide (Co2) to avoid dangerous climate change.

"We broke through the 400ppm (parts per million) Co2 barrier early last year which means the

blanket of Co2 that now envelops the earth is 25 percent thicker than it's been for nearly a million years.

"The last time we had a below average temperature was December 1984.

"Agriculture is going to be most affected by climate change but this also creates a real opportunity for us and we need to embrace it.

"Our industry needs to evolve and we need to do it sooner rather than later, but I am inspired by what our industry has the potential to do, we've just got to develop the means by which to do it."

These means have obviously been on Mick's mind a lot and he's got some clear ideas on how we might approach it as an industry.

"We've got to rebuild carbon and the question is how? People don't want to pay to mitigate climate change, we've seen that with the carbon tax, so change has to be market driven and agriculture has the capacity to do that.

"It's privately funded and there are millions of hectares that farmers drive over at least once a year, so there is a real opportunity.

"We're not just going to stop doing industrial agriculture, so we've just to look for ways we can harness what we can do now and there's some really exciting stuff being done."

Nigel Corish has taken a serious approach to improving soil quality through soil biology and rotation crops.



MELANIE JENSON

*"We've got some zero-till cover crops under some overhead irrigation and that's been shown to really improve infiltration and water use."*

So what does Mick class as these exciting opportunities?

"There's cover crop work and Gabe Brown's work from the US. His farming system is all about regenerative agriculture and he talks about having living roots going all the time with cover cropping in amongst his cash cropping and he's had incredible results in building soil C.

To this end, Mick's been cover cropping in place of a chemical fallow in summer. He's had mulch species cover crops to increase diversity and he grazes that as well. He takes it out at the end of the summer and puts in a green manure crop prior to planting cotton in October. Although this approach has seen some good results, he says so much more needs to be done.

So what else has gotten Mick excited?

"Sydney Uni's Peter McGee and his melanised endophytes. This is only small bit of work, but it has really exciting potential," he says.

"Preliminary farm trials with this carbon endophyte showed that we can get a carbon response in the soils that we're working with now.

"This backed up Peter's findings in the lab, that we should be able to see a 10 percent carbon gain per year, which is really exciting and shows immense potential."

So if the science is working then why aren't we all doing it?

"It's early days and I feel that what we do in agriculture has to be adoptable and reliable. It has to be something that everyone can use and not just a select few."

Mick then reminded us that this is achievable.

"Rhizobium was stumbled across in the 1950s and it's now a reliable system for legumes, but it wasn't at the time.

"There's hardly a farmer in the world, who 60 years later, would not consider adding the right rhizobium to their legumes and that's what any new system has to be. It has to work all the time and in a way that is as reliable as urea or MAP.

"That's where we are trying to get to with this carbon endophyte."

To this end, Mick is a part of a research group called Soil C Quest which has the sole purpose of developing farming systems capable of building soil carbon.



"We need to find a reliable carbon fixing endophyte that works all the time – so we're trying to partner a specific plant to a specific endophyte," Mick says.

"We can test whether we've got infection and then we can measure the carbon gain.

"Other stuff we've done in the past has been good, but it has been a bit of a shotgun approach.

"Sometimes it works and sometimes it doesn't and it is very hard to measure. We have to have a system that is point and shoot."

So together there is real potential to make change?

"What we are doing by applying big amounts of green manures or synthetic nitrogen is just spinning the wheels quicker.

"Until we can protect the carbon we aren't getting any traction. While we get good agronomic outcomes with these measures we are losing as much as we are putting in."

And so "we need to create improved relationships with the soil biology in our systems. We need to drive diversity below the ground by looking at cropping systems that preserve and support microbes.

"Soil biology underpins every function in soil and soil carbon is the holy grail of being able to measure how we are going on this front."

### Common themes

There were common themes that ran through the conversations we had with the various growers. Most highlighted that you don't have to measure the soil biology as long as the changes made and the impact on the crop and system are recorded in some manner.

"That's spot on," said Nigel. "I can't make any true measurements of how the soil is improving,



**ABOVE:** Mick Wettenhall says we need to create improved relationships with the soil biology in our systems.

**TOP:** The Wettenhall's cover crop trials, including mulch species to increase diversity, and are also used for grazing.



but visually I can see outcomes and changes that I would not have seen from continuing with the same practices I was using five years ago.

"I've gone down this track looking for alternate ways to do things and the soil biology is central to most of these."

Of course not all the soil biology is beneficial and Graham reminded us that "we can't take our eye off the ball with *Fusarium*, or *Verticillium* for that matter.

"The screening of new plant material is vital if we are not to slip back to where we were a decade ago."

Of course these aren't the only two soil-borne issues affecting cotton production and the soil can also throw up the odd surprise.

"On the Downs this year we had nematode issues in wheat, which we had heard about, but never had been a problem before so there is always something."

Perhaps if the soil biology was in better health these issues would have been reduced and for these growers the best way to achieve this is to try and build carbon into the system. Everyone that we spoke to had approached the issue of improving their soil biology through a reduction, but not abandonment of mineral fertilisers, in favour of some form of increase in organic returns, whether

through sewage, manure, alternate fertilisers, rotational diversity, cover crops or endophytes. This highlighted that at present there is not a single option and, as all our growers said, there is no quick fix, but with volatility in fertiliser prices and future supply sometimes on our minds, alternatives need to be considered.

Hopefully in the course of these articles we've highlighted some of the biology in our fields and on our farms and some of the methods available to you as growers that can help foster and improve your soil biology. As Graham said, "it's often the case in farming that as we solve one problem, the method we use to solve that problem eventually creates another one".

"That said, one of the great things about Australian agriculture and the research that supports it is that we're great at solving these problems." ... Oliver could not agree more.

#### For more

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Cover crops are becoming more popular with growers looking to improve and maintain soil structure.



MELANIE JENSON

# Soil organic nitrogen: vital to healthy function

CSIRO's Dr Ben Macdonald and Dr Mark Farrell join *Spotlight* this edition to discuss research into the often-overlooked valuable resource of soil organic nitrogen.

A farm's soil is arguably its most important asset, yet it is both vulnerable to degradation and effectively a non-renewable source on relevant timescales.

Ben says in recent years, there has been an increasing focus on the organic matter component of soil, both from a potential carbon sequestration perspective, and from the recognition of the importance of organic matter in underpinning soil health and fertility.

Though often misinterpreted as being 'just' carbon, organic matter contains a range of nutrients, and in particular is the soil's largest pool of nitrogen.

Organic matter has been shown by Jon Sanderman from CSIRO to be in decline in many agricultural systems as soil processes adjust to a new equilibrium because of imposed management changes. Cotton systems are no different in this regard, and given the intrinsic link between soil organic matter and soil nitrogen, if organic matter is declining then soil nitrogen is declining too.

During his CSIRO career, the late Dr Ian 'Rocky' Rochester has demonstrated that the soil nitrogen pool will supply between 40 and 70 percent of the nitrogen taken up by cotton. Ben's own work has shown

similar uptake in transgenic cotton (about 60 to 70 percent uptake). The researchers say previous work by (former NSW DPI and CRDC researcher) Nilantha Hulugalle reporting the decline of carbon in cotton trials at ACRI would represent a change of storage and the release of approximately 70 kg of nitrogen per hectare per year from organic matter breakdown. More recently, researchers have observed a loss of 40 kg of nitrogen per hectare per year from the soil for the 2014-15 season, which is middle range for the nitrogen loss calculated in other studies.

These are small losses compared to the total soil inorganic and organic nitrogen pool, the current school of thought is that the lost nitrogen has gone from the plant available portion of the total soil nitrogen pool. If this is, the case then soil nitrogen decline has serious implications for sustained food and fibre production because the mainstay of crop nitrogen nutrition is the soil.

Dr Mark Farrell's work has shown that the soil nitrogen cycle is intricate, with many different forms of nitrogen present in the soil and complex factors governing interactions and the ultimate release of plant-available nitrogen. In recent years, it



Dr Mark Farrell's work shows that is challenging some long held paradigms about nitrogen.

has become apparent that the long-held paradigm that nitrogen is only available when in the mineral (ammonium or nitrate) form is incomplete.

Evidence from ecosystems as disparate as Arctic tundra and subtropical sugar production strongly suggests that some forms of dissolved organic nitrogen such as peptides and free amino acids are directly accessible to plants and in some cases may consist a major portion of their nitrogen supply (Figure 1).

Although positively charged nitrogen compounds such as ammonium may bind strongly in some soils, most dissolved organic nitrogen compounds are actually highly soluble, particularly in calcareous soils such as those which typify some areas of Australian cotton production. Some of our recent work has identified that over 50 percent of nitrogen losses through deep drainage in cotton can be in the form of dissolved organic nitrogen.

Currently much of the management of nitrogen in agriculture is focused on nitrate as the main form of mobile and plant-accessible nitrogen. It is important that this is revisited for three main reasons:

- Nitrogen and soil organic matter are intrinsically linked. In systems where

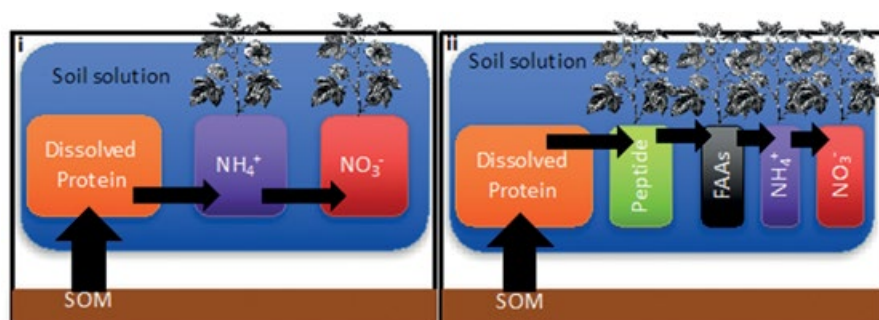


Figure 1: i) Traditional view of nitrogen release, which assumed that plants could only access mineral N (NH<sub>4</sub><sup>+</sup> and NO<sub>3</sub><sup>-</sup>), and mineralisation from macromolecular proteins regulated its availability; ii) current understanding that once protein is broken down to short chain peptides and free amino acids it is plant available. SOM is soil organic matter and FAA is free amino acids.



organic matter levels are being degraded, it is likely that the overall fertility and health of the soil is being reduced, and nitrogen is being lost.

- Organic nitrogen is soluble and can make up more than 50 percent of total leaching losses. This represents an economic penalty where fertiliser nitrogen inputs form a major component of the production budget. As dissolved organic nitrogen also contains carbon, this represents a loss pathway for soil organic matter too.
- The evidence that plants from many ecosystems can access some forms of dissolved organic nitrogen directly highlights the need for organic nitrogen to be considered a potentially available form of nitrogen. While further research is required to understand the size of this resource over a growing season, it is important to understand that assessments of nitrogen availability that focus on the nitrate pool will underestimate the size of the available soil nitrogen resource.

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## Management options

Ian Rochester's nutrition and long-term crop rotation work at the Australian Cotton Research Institute showed that it is possible to grow high yielding cotton without accelerating soil organic matter and nitrogen decline. Rocky found that by incorporating legumes within the rotation, residue incorporation and maintaining cover during the fallow was a successful way to manage the system. He would regularly achieve 14 bales with 220 kg nitrogen applied up front as urea.

In other Australian cotton growing regions, such as Emerald, the exact cropping sequences and nitrogen use efficiency may be different due to inherent soil properties and regional climatic conditions. Nonetheless, in agricultural systems around the world, this type of legume / residue incorporation / covered fallow system has helped maintain or improve soil health.

The take home message is that the soil organic nitrogen pool is one critical environmental component to achieve high yielding cotton. It is the soil nitrogen bank where synthetic and organic fertiliser nitrogen is deposited, cycled and released to the plant. Its maintenance improves the value and longer term sustainability of the soil resource base.

# More profit from nitrogen

CRDC is a major partner in significant research projects as a part of the national partnership *More Profit from Nitrogen: enhancing the nutrient use efficiency of intensive cropping and pasture systems*.

With support from the Australian Government Department of Agriculture and Water Resources as part of its Rural R&D for Profit Programme, CRDC is supporting two specific cotton projects under the More Profit from Nitrogen partnership, one of which is with the University of Southern Queensland (USQ). This project aims to improve profitable use of nitrogen by producers through an increased understanding of how to optimise plant available nitrogen when it is needed most, and minimise loss to the environment when uptake is reduced in the cotton, sugar dairy and horticulture sectors.

An important component of the research is the role of nitrogen mineralisation in the soil and the impacts of this on availability to the cotton crop. The research will evaluate production outcomes, nitrogen availability to the plant and potential loss to the environment throughout dry-wet cycles that occur during an irrigated cotton season. The research will also test the relative effects of enhanced efficiency fertilisers (EEFs) compared with urea. The USQ project is being undertaken over two years on two commercial farms on the Darling Downs.

Farmers, service providers and extension advisors will be kept up to date with the progress and final outcomes of the project. The CottonInfo team will provide updates, while growers and consultants are encouraged to keep an eye out for field days and farm walks showcasing the research over the next two years.

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# Taking on the Gwydir

One of the cotton industry's best known research and extension faces, Janelle Montgomery, has taken on the role of CottonInfo Regional Extension Officer (REO) for the Gwydir Valley.

Janelle was already a highly valued member of the CottonInfo team as the NSW water use efficiency technical specialist, on top of her role with NSW DPI as an irrigation research and development officer, based in Moree.

In her Gwydir Valley REO role, Janelle will provide growers, consultants and the wider cotton industry there with the latest outcomes and findings across all areas of industry R&D.

"I'm looking forward to working with cotton growers and consultants rights across our great Gwydir Valley, from Mungindi to Gravesend," Janelle said.

"It's exciting to be working on all aspects of cotton production, where previously I have concentrated on irrigation and water management.

"I'm keen to get back on-farm and help deliver a range of research outcomes to many familiar faces, along with those new to the industry."

Janelle has just over 20 years of cotton industry experience, during which time she's made a major contribution nationally as both a researcher and extension officer. With an extensive regional knowledge, she is the longest serving regionally based cotton extension officer (in Moree) where, since 2006, she has championed water use efficiency and productivity gains across the entire industry. CRDC supported this position through a number of projects including: *Advancing Water*



MELANIE JENSON

CottonInfo's newest recruit, Janelle Montgomery is no stranger to the cotton industry, or CottonInfo.

*Management, NSW; Water Smart Cotton and Grains; Promoting Water Smart Infrastructure Investment and more recently Benchmarking Water Use Efficiency and Crop Productivity in the Australian Cotton Industry.*

Janelle has worked in projects around consultant training, Irrisat technology, on-farm energy, storage evaporation mitigation, deep drainage, surface irrigation optimisation, irrigation systems evaluations and industry publications such as WATERpak.

A major contribution was establishing irrigation benchmarks for the Australian cotton industry, providing vital industry data. Early in her cotton career Janelle also led a unique project that studied water quality, soil salinity and birdlife on farms in the Gwydir Valley. She was named the Australian cotton industry Researcher of the Year in 2013.

"Janelle will naturally bring her passion for research, knowledge of the cotton industry and extensive existing networks to her new role within the CottonInfo team," said CSD Manager of Extension and Development, James Quinn.

"We also thank former Gwydir REO Alice Devlin for her work in this role since 2012."

CottonInfo is a joint venture of CRDC, CSD and Cotton Australia tasked with communicating research outcomes, encouraging grower adoption and improving industry practices. CottonInfo has a team of REOs across the cotton growing valleys, along with researchers who are Technical Specialists and myBMP support staff.

## For more:

**Janelle Montgomery**

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*Janelle has just over 20 years of cotton industry experience, during which time she's made a major contribution nationally as both a researcher and extension officer.*





# Never stop learning

Regional Australians have long been innovators and early adopters of technology say Crop Consultants Australia, who is encouraging cotton industry consultants to make the most of the resources available to improve knowledge and capacity.

Limited by our isolation and lack of resources, we have often looked for new ways of doing things to save time, manpower and ultimately, money. This type of innovation led to revolutionary developments in agriculture including the stump jump plough and the Ridley stripper, which changed the face of farming forever.

In recent times however, when we refer to technology in agriculture, we all too often think only of the internet and the data sharing capabilities it presents to us. With more than 60 percent of regional dwellers now owning smartphones, and 80 percent connected at home via broadband, we are entering an age where information is literally at our fingertips. With this, comes a rate of technological development and innovation that we have never seen before.

These are exciting times but whether you are a grower, a researcher, a reseller or a consultant, there has never been a more important time to invest heavily in professional development. If we don't – we are left behind.

Most of us remember leaving our formal education and feeling like we knew it all. We were bursting with enthusiasm and knowledge that we needed to share with our chosen industry. If only we knew then what we know now – that the process of learning never stops.



MELANIE JENSON

The pace of technological advancements and research means consultants are continually learning new skills and ways of doing business.

While the science behind agronomy will remain true (and needs to be constantly reinforced), much of what you learned at university might well be out of date by the time you get your boots in the paddock.

So how do we ensure that we keep up to date? The answer of course lies partly in the myriad extension and information resources now available online. On any given day, we can attend webinars on everything from business development to soil nutrition – and much of it comes at little or no cost. The challenge for us as industry members is to sort the wheat from the chaff as to what is useful, and credible information to us.

Over recent years CCA has developed feedback systems with our members and seminar attendees to ensure the professional development activities that we specialise in delivering to industry are specifically tailored to current needs. CCA's charter is to 'facilitate the transfer of knowledge to members and act as a means of communication'. With this in mind, we are continuing to explore new ways in which we can better transfer meaningful, timely industry information to our members including the increased use of social media, and possible live

streaming of future seminars.

While 'remote' learning will continue to have a place in our professional development program, CCA has long recognised the benefits of personal networking and mentoring. The twice yearly CCA Cropping Solutions Seminars have become a valuable professional (and social) event for many industry members and planning is well underway for the 2017 series. In response to overwhelming requests by members, the first seminar will have a special focus on technology and its application in industry.

The CCA seminars will be held on May 18 and 19 at the Dubbo Western Plains Zoo and in Moree on July 18 and 19. The seminars are open not only to members, but to all people with an interest in agronomy. So for those of you who are time poor, and wish to invest in relevant, timely professional development, we look forward to welcoming you in Dubbo on May 19 and 20.

## For more

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

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

## MEET THE RESEARCHER

# Grower, teacher, researcher

As a former owner and manager of the extensive agricultural operation "Darling Farms" at Bourke, Steve Buster is no stranger to the Australian cotton industry.

Steve managed Darling Farms from 1996 to its sale in 2015 and says since then he's had some time to think about a new challenge. This came with the newly created cotton research position at the Yanco Agricultural Institute in South-West NSW. NSW DPI and CRDC have funded the position as part of a commitment to meet the needs of both current and emerging southern cotton growers in Hillston, Condobolin, Griffith, Coleambally and Berrigan districts.

The experience Steve brings to this position however is not just confined to the field.

While studying for his Masters of Rural Science (physiology of Pima cotton) from the University of New England in 1994, he was contracted by the newly formed Cotton Co-operative Research Centre to design the first Cotton Course, which is still running through UNE with support from CRDC. It was after this period Steve returned to run the family farms, which totalled about 16,000 hectares, growing between 2000 and 4000 hectares of cotton annually, depending on the season and year. Darling Farms itself was growing around 3000 hectares at peak production. The Busters also dabbled in horticulture, with grapes, citrus and rockmelon, but it is



Steve Buster brings a lifetime of cotton experience to a new role.

in cotton that Steve's real interest lies. He has received both the Cotton Grower and High Achiever of the Year awards.

This can-do attitude also extends to cotton ginning, as the Busters (mainly brother Sam) built the first grower-owned cotton gin at Bourke in 1995. Steve was managing the gin in the last years before their property sale in 2015. The gin was unique in that it was designed to accommodate both Pima and upland cotton. Steve's brother Sam was also involved in building the grower-owned Rivcott Gin at Whitton, which was similar to the Bourke project.

In his new role Steve will apply his knowledge of cotton farming and physiology to address, in particular, issues of germination and emergence specific to southern growing systems under the *Optimising seedling emergence* project.

"We are attempting to grow a tropical crop in a temperate environment and cotton is largely temperature driven," Steve says.

"So the issue in the south is short seasons, which pushes the planting window as early as possible, which can mean temperature issues (cool starts)

for the young crop both pre and post emergence."

Steve will bring a farmer's attitude to research.

"I enjoy the research but for me it is not driven from a pure science background – it heavily incorporates practical management considerations – how the research will work for the grower in the field.

"You have got to look at the whole production package together – which is what I guess I am trying to bring – the practical aspect to research, answering the question 'what will work on farm?'"

Steve is excited about the potential of the southern region.

"They are growing around 40,000 hectares here, which I believe is equal to area in established valleys such as the Gwydir and Namoi," Steve said.

"The potential for improving current practices and expansion are certainly here.

"Cotton does not share the market risk of horticulture and uses two-thirds the water rice does, and there is good water security here.

"There is a lot of potential for success – we firstly need to separate the averages from the pub talk to actuals, but there is a lot of interest in growing cotton.

"A lot of people are looking over the fence, and there have been suggestions that it wouldn't take much to get to 70,000 hectares.

"I've been around long enough to remember a young industry in the 90s when cotton really took off, and that is what it feels like down here now.

"I'm keen to look at the particular management aspects here, what they do and importantly, why they do it.

"We don't have to reinvent the wheel and while conditions are different from up north, the principles are still the same, but need to be modified to make it work optimally.

"Research will reinforce or challenge the way we do things and we need to then transfer that knowledge to the growers."

## For more:

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*"You have got to look at the whole production package together..."*



# Avoiding spray drift: temperature inversion research starts



The low-down with  
**Jon Welsh**

The 2016-17 Australian cotton crop has seen a marked increase in planted area, with more than 240 new or returning growers choosing cotton as a summer crop. However herbicide spray drift has the ability to severely curtail growers' success.

The season began with healthy water storage levels, full soil moisture profiles and a cotton bale price above \$500. The spring of 2016 also saw the start of a joint initiative between the CRDC and GRDC on understanding thermal temperature inversions in Northern NSW and Southern Queensland.

In early 2016, CRDC's General Manager R&D Investment Ian Taylor convened a meeting with the cotton and grains industry including GRDC's Ken Young, where the need to collaborate on reducing drift damage was highlighted. The need for action was later affirmed at the CRDC Strategic Forum in May 2016, with the temperature inversion project being fast-tracked to begin before year's end.

In September 2016, a three-year research project aimed at developing a spray drift hazard prediction system was commissioned. A Melbourne-based research team (MicroMeteorology Research and Education Services) led by former aviation consultant Graeme Tepper then set out to install a wireless sensor network across Northern NSW and Southern Queensland cotton growing areas.

## **Off-target herbicide damage – not just a cotton problem**

Herbicides are considered a significant component of modern farming, playing a major role in maintaining high agricultural productivity. However, unintended herbicide damage is an issue affecting a number of broad-acre and intensive agricultural industries.

In the 2015-16 season alone, off-target phenoxy drift cost the Australian cotton industry an estimated \$20 million in foregone yield. Horticultural industries such as vegetables and viticulture are also very

sensitive to selective herbicide spray drift.

Some herbicide products contain active ingredients which can potentially convert into a gas or vaporize when temperatures are high and humidity is low. Herbicides containing 2,4-D are particularly at risk for volatility and different formulations of 2,4-D respond differently to temperature. For example, 2,4D LV ester formulations are more likely to volatilise at lower temperatures than a 2,4-D amine formulated tank mix. When spray droplets are captured and transported in thermal temperature inversions, these compounds can affect other agricultural pursuits in other areas, severely damaging or killing sensitive vegetation.

Research in the United States found herbicide concentrations as high as one-tenth of the applied herbicide rate deposited by thermal inversions onto nearby broccoli and capsicum vegetable crops, consequently reducing yields by 50 percent. In these instances, challenges then arise with marketing, acceptable levels of chemical residues and food safety standards.

Advances in plant breeding technology of broad-acre grain crops in the US has increased the adoption of 2,4-D and dicamba herbicide use and concurrently, the incidence of unwanted spray drift. Vineyards are highly sensitive to off-target phenoxy herbicide injury from applications on other crops in the vicinity. Young vines are more likely to be killed than older vines if exposed to phenoxy drift, especially early in the growing season.

A range of herbicides can create issues to neighbouring production systems. There have been herbicide drift events with products other than glyphosate which affected sorghum crops in Northern NSW this summer. In 2014, a Tenterfield tomato farmer sustained damage to a \$1 million crop as a result of herbicide spray drift from a neighbouring farm.

Aerial and ground application of glyphosate in forestry establishment has strict spraying guidelines to avoid the



DAVE BOYLE

A storm rolls in over a recently installed temperature inversion research tower at “Waiwera” north of Wee Waa, NSW.

thermal inversion conditions potentially affecting neighbouring cereal crops in southern Australia. Other industries affected by unintended spray drift include lucerne pasture which is highly susceptible to phenoxy drift and bee colonies, where pesticide from neighbouring crops may travel in a temperature inversion and affect populations.

### Researching inversions

Numerous factors can affect the occurrence and the extent of pesticide drift: application method; spraying equipment used; the canopy type and height; physiochemical properties of the tank mix and the weather conditions; especially the micro conditions in the zone of release.

The recently launched CRDC/GRDC temperature inversion research aims to minimise the damage to crops caused by chemical drift. The project is ultimately looking to provide notification of a surface temperature inversion that might result in long distance drift out to 36 hours ahead as well as real-time updates for spray applicators.

Monitoring towers have already been erected in the Lower Namoi Valley, Gwydir Valley, Border Rivers and Darling Downs regions. The high-quality equipment

very accurately monitors small and rapid variations (every second) in wind and temperature up to 10 metres (Figure 1 and 2) to determine the potential for drifting pesticides to be held at high concentrations near the surface. Ultimately, the information will be converted to parameters for timely advice and warning of hazardous spray conditions.

The parameters will be tested for consistency and repeatability across different agroecological regions by correlating to historical data through CSIRO's The Air Pollution Model (TAPM). TAPM is a proven and validated model that can detail micro-meteorological and air dispersion variations in the local atmosphere and assess conditions hazardous to spraying.

The initial stages of the project involve collating and gathering detailed site observations which include measurement of vertical air currents, horizontal winds and temperature difference with height to find relationships between atmospheric stability and inversions that will lead to hazardous spraying conditions. The data will be analysed to determine hazard variability (it is known that not all inversions are hazardous) and associated

factors including local wind flows that correlate to hazardous conditions.

Once model outputs are validated and the model can usefully discriminate hazard variability during an inversion event, a communication strategy will alert users of unfavourable spraying conditions. When equipment quality assurance and website security measure are complete, local temperature, delta T (or relative humidity) and wind observations from the installed towers will be made available on the Oz-Forecast network.

CRDC and GRDC have also compiled an inversion fact sheet, which is available at [www.grdc.com.au/GRDC-FS-sprayinversions](http://www.grdc.com.au/GRDC-FS-sprayinversions)

### For more

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