Spotlight

ON COTTON R&D

SPRING 2023

$10M disease project announced

ED Dr Ian Taylor moves on

Sustainability Update released

CRDC

In the Spotlight

This is my last *Spotlight* editorial as CRDC's Executive Director; by the time you read this, I'll have started my new role at Cotton Seed Distributors. As such, I'd like to take the opportunity to thank all those who have supported and encouraged me during my time here.

Dr Ian Taylor

It is also fitting that in this edition we focus on our team for the future, sustainability and some major investments including in people – our greatest asset.

It's been a fantastic time at the helm of CRDC, and one of the most satisfying outcomes has been around sustainability. The industry has recently released its 2022 Sustainability Update and I urge our readers to take a look at our articles around this. While we've made significant gains in areas such as water use efficiency, greenhouse gas (GHG) emissions are up. As a result, we've included some articles on CRDC investments into R&D to help growers and post-farm gate sectors to reduce emissions.

"Sustainability isn't just a buzz word, it is a fact of life and the future of not just cotton but all agricultural industries"

Sustainability isn't just a buzz word, it is a fact of life and the future of not just cotton but all agricultural industries. All our futures depend on how well we manage it. The new CRDC 2023-28 Strategic RD&E Plan, Clever Cotton, is structured around the themes of Paddock, People and Planet – in line with the Australian Cotton Industry Sustainability Framework – underlining our commitment to those principles.

CRDC's investments under these pillars is overseen by an incredibly capable group of Innovation Brokers, who I'd like to introduce (or re-introduce!) to you in this edition. I leave CRDC knowing that RD&E is in good hands with this team, along with our innovation administrators, our business and finance and our communications and extension teams.

And they are going to be busy! Clever Cotton outlines CRDC's ambition and new approach featuring larger programs of research investment, rather than individual projects. It kicked off with the new $10 million Australian Cotton Disease Collaboration (ACDC), which we announced in July. CRDC has listened to growers and crop managers who have been calling for more help to manage disease and we have received an overwhelming response to our call for potential partners.

In this edition, we also take a look at some of our most impactful investments under our last strategic plan. A benefit-cost analysis has found that some of our major collaborative projects have delivered the greatest return to growers. The analysis found that WAND, the Weather and Networked Data (WAND) partnership with GRDC and Goanna Ag, will deliver a benefit-cost of $12.54 to $1 – that is, a $12.54 return to growers for every dollar invested over the period 2023-2030. I started my career in cotton looking at herbicide resistance and spray drift, so it has been an enormous pleasure to see that project come to fruition and deliver real, tangible impact to our industry.

Finally, in this edition, we also outline some of our investments to ensure cotton has a sustainable workforce, both in the field and in the lab. Several initiatives are underway to attract and retain people across the sector. We are all aware that the quality of cotton's people has led the industry to where it is today: we stand on the shoulders of giants.

With that, I would like to thank all of our readers, our growers, and the wider industry: all the people I've worked with and for during my time at CRDC. I will no doubt see you around as I move into a new era, and I leave you, and CRDC, in good hands.

Dr Ian Taylor
CRDC Executive Director

CRDC acknowledges Australia's Indigenous people as the traditional custodians of our country, and recognises their continuing connection to lands, waters and culture. We pay our respect to Elders past, present and emerging, and extend that respect to all Indigenous people. Throughout this publication, we reference traditional country names, drawn from the Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS) map as a sign of respect.

Spring 2023

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CRDC
COTTON RESEARCH AND DEVELOPMENT CORPORATION

Cotton Research and Development Corporation
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Our vision: A globally competitive and responsible cotton industry.
Our mission: To invest in RD&E for the world-leading Australian cotton industry.

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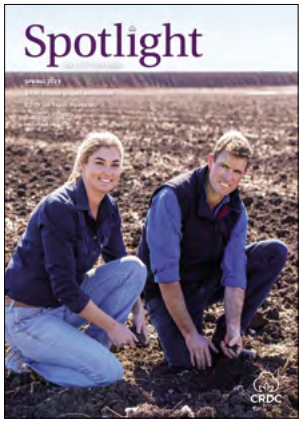

MELANIE JENSON

ON THE COVER:
CRDC Innovation Broker Elsie Hudson and cotton grower Mick Humphries caught up on-farm at Moree (Kamilaroi country) to discuss disease and how CRDC's new $10 million investment aims to tackle the issue.

Want to see more of Spotlight?

This edition can be viewed online at: www.crdc.com.au

COTTON NEWS

FEATURES

ON THE COVER

New guide a must-read for key changes

THE 2023-24 Cotton Pest Management Guide has some important updates and changes around pest management, thresholds and pesticide use.

The Guide is published by CRDC and CottonInfo. It provides a comprehensive summary of crop protection issues and updated each year to incorporate the latest research findings.

There are some notable changes and inclusions this year, such as a new set of industry recommendations for managing fruit retention (see story page 26) based on Dr Paul Grundy's work over three seasons to investigate early season compensation capabilities of Bollgard 3.

With resistance levels rising in cotton aphids, two-spotted mites and silverleaf whitefly, crop managers need to know what the new recommendations are and undertake careful stewardship to keep the industry safe.

We've enclosed the Guide for *Spotlight* subscribers, or you can download it from the CottonInfo website.

For more

www.cottoninfo.com.au/publications/cotton-pest-management-guide

MELANIE JENSON

CRDC-supported PhD and postdoctoral students enjoy a range of support initiatives beyond financial support. Networking, mentoring and cotton industry experiences like this visit to a cotton gin near Narrabri (Kamilaroi country) are also a part of the program.

Open call for postgraduate scholars

IF you're considering undertaking postgraduate study, don't miss the opportunity to secure support and become a part of the cotton research community via a CRDC scholarship. There are two types of scholarships on offer, PhD top-up scholarships or full postgraduate scholarships with applications closing November 30, 2023.

The PhD top-up scholarship offers up to $10,000 per annum and can be applied for by cotton-relevant scholars who are already receiving a Research Training Program (RTP, or equivalent) scholarship.

The postgraduate scholarship offers up to $40,000 per annum and can be applied for by masters or PhD students to assist with the completion of a cotton industry-specific project related to CRDC's Strategic RD&E Plan, Clever Cotton. These scholarships include a student stipend of $34,000 and an operating budget of $6,000 per annum.

To be eligible for either CRDC scholarship, candidates must undertake postgraduate study at a recognised institution, and be interested in working in the Australian cotton industry.

"Under the new Strategic Plan, CRDC has committed to collaborating with current and new partners to achieve Clever Cotton's aspirational strategic goals," CRDC Innovation Broker Rachel Holloway said.

"There are three pillars of investment – paddock, people, planet – drawn from the Australian cotton industry's Sustainability Framework. Each pillar contains three themes, creating nine key investment areas.

"Postgraduate scholars may align with any of these nine areas and their associated research disciplines. We're looking for novel approaches: new solutions to the industry's old problems, or fresh approaches to emerging challenges.

"If you are considering applying but are a little unsure, we encourage you to contact CRDC to be connected to the relevant CRDC Innovation Broker."

Applications close November 30. For details, visit the CRDC website: www.crdc.com.au/researchers/scholarships-travel

For more

Rachel Holloway

rachel.holloway@crdc.com.au

Creating a culture of empowerment for industry success

CRDC's outgoing Executive Director Dr Ian Taylor says the greatest challenges offer the greatest opportunities for change, innovation, and decisive leadership.

Ian finished up after 11 years with CRDC in late August, and has moved to a new role as CEO of Cotton Seed Distributors (CSD).

He's had an interesting and serendipitous 23-year journey through the Australian cotton industry he came to as a young research scientist. Ian became an integral member of CRDC in 2012 as manager of the extension program undertaken by the Development and Delivery (D&D) team. He played a key role in establishing the D&D team's successor CottonInfo. Two years later he became the General Manager, Research & Development, a role he held for five years before becoming Executive Director in 2019.

Interestingly, Ian leaves CRDC on the same note he entered the cotton industry. Ian has overseen the completion of the largest single investment in CRDC's 33-year history – the development of the Weather and Networked Data (WAND) spray hazard warning system. WAND was developed to mitigate spray drift by creating more information – which is what Ian was working on when he first entered the cotton industry.

"I was undertaking drift trials for the Centre of Pesticide Application and Safety in the holidays before I started my PhD – and these trials were at Auscott Warren (Wongaibon country) and Narrabri (Kamilaroi country)," Ian said.

"That is why I became interested in cotton. My PhD was through grains but I was invited to talk about the introduction of herbicide tolerant technology and the potential for the development of herbicide resistance by one of the cotton industry's key weeds researchers, Graham Charles. He was the first cotton researcher I met and ultimately this led to my participation in cotton.

"I was amazed at this industry and am still amazed by it today."

Spotlight caught up with Ian to reflect on his time with CRDC via this Q&A.

"Our cotton industry is successful because it has been built on quality science and research with an incredible team of researchers."

MELANIE JENSON

Dr Ian Taylor's leadership will be missed at CRDC. He has created a culture of empowerment, which he cites as one of the most important aspects of leadership.

After 23 years: what's been the biggest takeaway from your current role as CRDC Executive Director?

The biggest takeaway for me is the importance of the culture of an organisation – that's what allows it to push boundaries, to push limits. Culture can be the biggest advantage or the biggest impediment. Empowering people to do their job and letting them do it: that is a part of the culture I aim for. If we don't empower people, we have to question why we chose them initially.

I dislike micromanagement and aspire to enabling people to do their jobs well and accept mistakes because we all make them, but also hold people accountable at the same time. That's how we learn and grow. No individual has all the answers. It's great teams that have great outcomes. Growers and government entrust us with money to invest on their behalf and with that comes great responsibility and accountability. There are many different views we have to take into account and we must have engagement with and be transparent to our stakeholders. It's a case of constantly assessing and continuous improvement, assessing and asking what we need to do better. We have to be a learning organisation and as an industry we need to be the same.

What has being at the helm of CRDC galvanised for you about what it takes to sustain and improve an industry like cotton? Where do our challenges lay?

It's about always trying to be in front of the curve. If CRDC's RD&E isn't positioning us for 15 to 20 years into the future then we are missing opportunities. It's not what next week is going to bring, it's 'what is it going to take to get there?'.

CRDC is not a large capital organisation compared to the other research and development corporations (RDCs). What's great about the cotton industry is it's not about the quantum of funds but how we work collaboratively as an industry to shape the future. Working together is absolutely paramount to that success. CRDC, Cotton Australia, and CSD are great examples, each has a different role and together, we're shaping the future. We are who the industry turns to with the tough questions – how we use water, our emissions, cotton's social responsibility. How do we continue to work together to solve the challenges? We are in new, more complex and challenging times than ever, so how we approach and deal with them must be new.

Climate change and public perception of water use remain as significant challenges for irrigated agriculture, and our research investment must address these hurdles. We also ensure that we are good custodians and stewards of the lands in much the same way Indigenous people have been. Resilience and sustainability revolve around issues such as biodiversity on our farms, and given the challenges of climate and factors like increasing rainfall variability, how do we build resilience?

These are some of the issues we need to address together. Cotton's Sustainability Framework should be at the front of everything we do. Market access also demands that we prove our sustainability credentials.

The foresight of industry researchers in the establishing stewardship frameworks for Bt and herbicide tolerant cotton decades ago has enabled and led to us being recognised global leaders in resistance management and RD&E. Our cotton industry is successful because it has been built on quality science and research with a team of incredible researchers.

Some things change and some stay the same. The two strategic plans you've overseen are quite different – is that an indicator?

The role of RD&E and innovation has changed. If we go back 30 years, the focus was on-farm and industry establishment: insect pests, then disease, and breeding varieties suitable for Australian conditions.

While some of these issues remain we're now looking bigger picture: circularity, green energy, low carbon farming. The breadth of our work has increased enormously. The digital revolution and the opportunities for data to create impacts on cotton farming are endless. Technology such as gene editing and synthetic biology also hold so much opportunity – which is also part of the challenge because for all we have achieved, we still face major challenges.

We have to navigate the impact of climate change, community views on water, trade and geo-political tensions, all of which impact RD&E. At the same time, our principles don't change: we're always looking over the horizon, and we recognise the fundamental importance of collaboration and cross-sectoral partnerships. One of our great achievements is in working with the Grains Research and Development Corporation (GRDC) and other RDCs to achieve outcomes for growers.

Our strategic plans offer opportunity and demand change. Today there is an expectation of innovation and timeliness. People are pushing the envelope harder but we can't afford to substitute speed for rigour. We need to understand innovations and science well enough so they deliver. It's the quality of science that has kept the industry at the forefront and CRDC's new strategic plan doesn't waiver from that.

Some highlights?

The strength of the team at CRDC has been a highlight – what an amazing group of people I've had the privilege to lead. We have worked very well together and operated in a highly effective way.

Working with people growing cotton – to be able to understand and address their needs, making sure they are more productive and profitable than they were 10 years ago – has also been a privilege. Then, ensuring that profitability is shared by the community: ensuring prosperity in motion for the communities that support our growers is important.

I'm proud to have been a part of the formation of CottonInfo, so cotton had an extension network to deliver R&D and innovation as quickly as practicable. The formation of the Australian Cotton Industry Sustainability Framework, the Rural R&D for Profit program collaborations and getting WAND up and running are stand outs for me. Being based in Narrabri means CRDC is a part of the community and that's been very important for me, this organisation, our team, our culture and our values.

On moving on...

I've loved every second at CRDC but it is also healthy to do something different. I'm looking forward to working at CSD: it is an organisation created by cotton's pioneers. I'm keen to keep that passion going in order to service the industry. Australian cotton varieties are the world's best and every seed a grower plants comes through CSD. When you look at the complexity of the world and the environment we operate in, there are challenges ahead for cotton, and CRDC and CSD have a role to play in what that future looks like. I look forward to continuing to work closely with the CRDC team and cotton growers in my new role at CSD.

MELANIE JENSON

CRDC RD&E delivering return on investment for growers

CRDC investments in projects to alleviate damaging spray drift, improve irrigation productivity and manage pests have provided the greatest economic impact to the Australian cotton industry over the past five years.

That is the finding of economic impact assessments of major RD&E projects, commissioned by CRDC and undertaken by agricultural economists at AgEcon.

The Weather and Networked Data (WAND) spray hazard tower network represents CRDC's largest single project investment in CRDC's 33-year history. It's a collaboration with GRDC and Goanna Ag with a total investment of $5.5 million over five years. The AgEcon analysis estimated a benefit-cost ratio of $12.54 for every dollar invested over the period 2023-2030.

Canopy temperature sensors developed to aid irrigation scheduling had an estimated benefit of $7.40 for every dollar invested. Closely following was the development of the automated management tool for silverleaf whitefly, the Pest Detect app, with a ratio of $6.61–$1. The analysis found that these three projects had both the highest net present value and the highest benefit cost ratio. Collectively they accounted for more than 85 per cent of the estimated value and benefited from having a commercial partner on board to drive the desired outcome.

WAND shows benefit in dealing with drift

The assessment report comes on the back of one of the worst seasons for spray drift damage the cotton industry has experienced. Spray drift damage totalling millions in lost income was reported in every growing valley, with an estimated $100 million damage on the Darling Downs (Barrunggam country) alone. Mitigating spray drift and the damage caused by herbicides in particular to cotton crops has been a difficult issue to rectify from an RD&E perspective.

The WAND spray hazard tower network saw the development of software and hardware to support 100 towers erected across Queensland and NSW cotton and grain growing regions. It came on-line in late 2022 with the full network of towers live by March 2023, and is free for use by producers from the cotton and grains sector to predict and warn of hazardous spray conditions in real time, taking any guesswork out of whether conditions are suitable for spraying or not.

While past investments into initiatives such as spray application training and certification, educational campaigns, pesticide volatility and

The Weather and Networked Data (WAND) investment by CRDC has been identified as returning the most favourable benefit-cost ratio to growers: $12.54 in benefit for every $1 invested by growers.

propensity for damage to cotton have created tools to understand the nature of spray drift and give spray operators the best chance to mitigate it, the issue has persisted. WAND was developed as a result.

Independently assessed: $5.98 returned to growers

CRDC commissioned the independent impact assessment of RD&E projects completed under the 2018-23 Strategic RD&E Plan. Assessments were completed of 10 project clusters, comprising 24 individual RD&E projects, with a combined CRDC investment of $10.7 million – equalling 38 per cent of CRDC's investment from 2018 to June 2022.

Along with the three most impactful investments, the project clusters included: smart sensing and automation for irrigation, integrated pest management, community resilience, Bt resistance, integrated weed management, sustainability, the silverleaf whitefly decision support tool, and nitrogen management.

"The total net present value for all 10 clusters assessed was $165 million, and the collective benefit-cost ratio was found to be $5.98 to $1 – or $5.98 in benefit returned to cotton growers and the wider industry for every $1 invested through CRDC into RD&E," CRDC's Acting Executive Director Allan Williams said.

"In light of the increasing importance of addressing sustainability from a market requirement perspective and the need for greater data to fully assess the impact of our investments in this area, we'll be exploring potential methodologies to collect future data," Allan said.

"We have made data collection, reporting and analysis a central part of our new 2023-28 Strategic RD&E Plan, Clever Cotton, in response to this need, through the Data-driven decisions theme.

"This will support reporting against the outcomes of many of the different themes in Clever Cotton, as well as against the industry sustainability metrics and goals."

Early iterations of the canopy temperature sensors under development at the Australian Cotton Research Institute in 2014.

Commercial partnerships define best performers

The top three performers in the impact analysis – WAND, canopy temperature sensors and Pest Detect – all involved commercial partners, which has a greater focus under the new strategic plan.

"A major aspect of Clever Cotton is working with commercial partners to develop and bring R&D more quickly into the field and into the hands of growers, to create greater impact and value from our investments – like the new algorithm commercialised by UniSQ, CRDC and Goanna Ag to deliver greater value to growers via canopy temperature sensors (see story page 24)," Allan said.

"Our recently announced Australian Cotton Disease Collaboration (ACDC) is another example of this focus under Clever Cotton, which will see us bringing partners in at the project development stage for co-design.

"Like ACDC, WAND and canopy sensors, longer-term (five to eight year) investments will be the aim.

"This will be guided by clearly defined opportunities for co-investment, co-design and implementation.

"This will ensure that CRDC investment, research effort and industry knowledge is developed, delivering economically relevant on-farm impacts and building critical industry capacity."

For more
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Innovation Brokers are key to delivering new strategic plan

Clever Cotton, CRDC's Strategic Research, Development and Extension (RD&E) Plan for 2023-28, sets out a vision for a sophisticated, prosperous and sustainable Australian cotton industry that is strongly connected to its value chain and end users.

The strategic plan is the roadmap by which all of CRDC's investments occur. These investments are overseen by CRDC's Innovation Brokers. Formerly known as R&D Managers, the title change is to reflect CRDC's new approach to investment under the Clever Cotton plan – a move away from smaller projects towards larger programs of investment, requiring the brokering of research and innovation.

The Innovation Brokers are led by Allan Williams as CRDC's General Manager, Innovation. Allan is currently Acting Executive Director while recruitment for Dr Ian Taylor's replacement is underway. To assist Allan and the team, Innovation Broker Dr Meredith Conaty is Acting General Manager, Innovation during this period. Fellow Innovation Brokers are Susan Maas, Elsie Hudson, Nicola Cottee, Rachel Holloway and Stacey Vogel, with support from Innovation Administrators Megan Baker, Lynda George and Callie Hudson, Innovation Advisor Warwick Waters, Sustainability Advisor Chris Cosgrove and CRDC's General Manager, Communications and Extension, Ruth Redfern.

Clever Cotton has three pillars of investment – Paddock, People, Planet. Each pillar subsequently has three themes, which creates the nine key investment areas. Each of CRDC's investments over the next five years will fit under one of these nine investment areas and be the responsibility of one of the Innovation Brokers.

Paddock

Our future fields

- Data-driven decisions
  Merry Conaty
- Adaptive systems
  - Solving farming system constraints
    - Water & Agronomy **Elsie Hudson**
    - Climate change **Allan Williams**
  - Disease **Elsie Hudson**
  - Biosecurity **Susan Maas**
  - Northern Australia **Susan Maas**
- Connected market intelligence
  Allan Williams

People

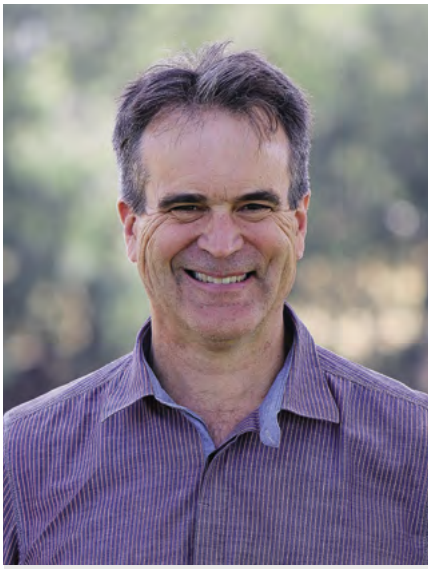
Central to our success

- Design and innovation
  Warwick Waters
- Leadership and capacity
  Rachel Holloway and Ruth Redfern
- Adoption and impact
  CottonInfo Program Manager (currently recruiting)

Planet

Our shared future

- Natural capital
  - Biodiversity **Stacey Vogel**
  - Soils **Merry Conaty**
  - Water **Elsie Hudson**
  - Pesticides **Nicola Cottee**
  - Nitrogen **Merry Conaty**
- Carbon
  Merry Conaty
- Circular economy
  Merry Conaty



Allan Williams

Along with his current role as Acting Executive Director, and overseeing the Innovation team as CRDC's General Manager, Innovation, Allan Williams is also responsible for Connected market intelligence and Climate change.

Allan needs no introduction to those who have been involved in the cotton industry for any length of time. He has an extensive knowledge of cotton science and sustainability across many of CRDC's portfolios, and has held many industry positions – senior agronomic advisor for the global Better Cotton Initiative, executive officer for the then Australian Cotton Growers Research Association (now merged with Cotton Australia), and executive officer for the then Cotton Consultants Australia (now Crop Consultants Australia). Allan was responsible for developing cotton's first BMP program and has long been an industry advocate for sustainability and transparency in the Australian industry. Allan is co-Chair of the industry's Sustainability Working Group, and moved to the CRDC General Manager role in 2019, after overseeing several investment areas as an R&D Manager including soil, carbon, fibre quality, nitrogen and climate. Allan is based in Narrabri (Kamilaroi country).

Dr Meredith Conaty

Merry is responsible for Data-driven Decisions, Soils, Nitrogen, Carbon, and Circular economy.

Merry is no stranger to the cotton industry or science, having lived, studied and worked in Narrabri since she was a PhD student studying cotton nutrition and physiology at the Australian Cotton Research Institute (ACRI). She now holds both a Bachelor of Science in Agriculture and a Doctor of Philosophy from the University of Sydney. Post PhD, Merry worked for Bayer Crop Science at its Narrabri research facility. She joined the CRDC team in 2019.

Projects in Merry's remit include the development and implementation of a digital strategy for the cotton industry, and the build and launch of the industry-owned data platform. The platform will aggregate, analyse and report data from across the industry supply chain for the first time, making cotton industry leaders in data and digital solutions. Merry is currently the Acting General Manager, Innovation, while Allan Williams is CRDC's Acting Executive Director. Merry is based in Narrabri (Kamilaroi country).

Susan Maas

Susan is responsible for Biosecurity and Northern Australia.

Susan is one of CRDC's longest serving innovation team members. Coming from Qld DAF to work with CRDC in 2012, Susan has extensive experience across many investment portfolios and a long history with industry leadership as an early participant in the Future Cotton Leaders Program. Susan's focus on northern Australia is reflective of the secondment she undertook with the Cooperative Research Centre for Developing Northern Australia in 2022, helping to develop the four-year, $27 million collaborative project, Cotton Grain Cattle. Susan has also been a driving force in the area of spray drift, having overseen the collaborative Weather and Networked Data (WAND) project on behalf of CRDC, plus the Business Research and Innovation Initiative with the Australian Government's Department of Industry, Science and Resources.

As a Senior Innovation Broker, Susan is helping to develop CRDC's new approach to program design: co-designing projects with the leaders and experts in their respective fields in the room. Susan is based in Emerald (Gayiri country).

Stacey Vogel

Stacey is responsible for Natural capital and Biodiversity.

Stacey is an environmental consultant, who has led CottonInfo's Natural Resource Management (NRM) area as Technical Lead since 2014. Since 2019, Stacey has also been CRDC's lead for the NRM R&D portfolio. Stacey has been working in NRM for more than 25 years, the majority of which has been with the cotton industry. She has also worked in the areas of population dynamics, soil landscape surveying, salinity and riparian/riverine management.

Stacey was a finalist in the Australian Cotton Industry CSD Researcher of the Year Awards in 2022 and 2023 for her work on the Cotton Landcare Tech Innovations 2021 project, along with the project team. Passionate about improving the sustainability of cotton farms from an NRM perspective, Stacey has also worked on many publications and resources for growers, including the *Native Revegetation Guide for Cotton Growers*, and the CottonInfo Biodiversity Management Tool. Stacey is based in Wee Waa (Kamilaroi country).

Working closely with the CRDC Innovation team to deliver Clever Cotton are CRDC's remaining team members and advisors:

Megan Baker, Lynda George and **Callie Hudson** are CRDC's Innovation Administrations. They are the crucial point of contact between CRDC and all partners involved in research contracts.

Ruth Redfern is CRDC's General Manager, Communications and Extension. Ruth oversees all CRDC communications, monitoring and evaluation, and CottonInfo. Ruth is the editor of *Spotlight*, sits on the Sustainability Working Group, and manages CRDC's leadership investments under the People pillar, supporting Rachel Holloway.

Megan Woodward is the Communications Lead for CottonInfo: the industry's joint extension program. Recruitment is currently underway for a new CottonInfo Program Manager, who

Elsie Hudson

Elsie is responsible for Water, Agronomy and Disease.

Projects under Elsie's folio include the newly announced Australian Cotton Disease Collaboration (ACDC), a five-year, $10 million investment in disease RD&E (see story page 12); and the CSD Richard Williams Initiative projects focused on disease and the water dashboard. Elsie also manages all the water and weeds projects.

Elsie joined CRDC in 2021 having moved from her role as a CottonInfo Regional Extension Officer in the Namoi Valley. Elsie is a cotton consultant who has worked across cotton farms in the Narrabri, Moree, Walgett (Kamilaroi country) and Bourke (Wongaibon country) regions. She is already very familiar with CRDC's RD&E portfolio through her previous role with CottonInfo. Elsie holds a Bachelor of Applied Science in plant science and regional and rural business from the University of Queensland. She is based in Goondiwindi (Bigambul country) and was named as the Young Achiever of the Year at the Macquarie Valley Industry Awards in August.

Rachel Holloway

Rachel is responsible for Leadership and capacity.

Rachel has been involved in cotton most of her life, as in her early career she worked as an agronomist/environmental officer for cotton grower and former CRDC Chair Mike Logan. In the agronomy role, Rachel was mentored by the late Chris Lehmann and as the environmental officer she was responsible for helping Mike achieve ISO14001 certification: becoming the first farm in the world to achieve this standard.

With this background, Rachel first joined CRDC in 2001 to coordinate environmental management projects including the audit program with BMP's pilot growers, the cotton industry's environmental assessment in 2003, and the industry's managing farm safety program.

Rachel worked in a similar role for Cotton Incorporated while living in Lubbock, Texas a few years ago with her family, before returning to Australia and CRDC as an Innovation Broker. Rachel is based on the South Coast of NSW (Tharawal country).

Dr Nicola Cottee

Nicola is responsible for Pesticides.

Former cotton scientist Dr Nicola Cottee has returned to her research roots, joining CRDC as an Innovation Broker in June 2023. She completed PhD into the heat tolerance of cotton at ACRI in Narrabri in 2009.

Since then, Nicola has worked as a postdoctoral fellow with CSIRO, as a research direction and stewardship policy officer with Cotton Australia, and most recently, as a senior technical advisor with the NSW Environment Protection Authority. This background has given Nicola environmental and community experience, and an in-depth understanding of the interactions between cotton, the environment and decision making.

As such, Nicola will also be working on the Australian Cotton Industry's Sustainability Framework PLANET. PEOPLE. PADDOCK. and with two of the TIMS (Transgenic Insecticide Management Strategy) Committee Technical Panels: Bt and insecticides. Nicola is based in Sydney (Eora country).

will lead the Adoption and impact theme under the People pillar.

Warwick Waters is CRDC's Innovation Advisor, leading the Design and innovation theme under the People pillar.

Chris Cosgrove is the cotton industry's Sustainability Advisor, supporting the Sustainability Working Group and the interaction of the Sustainability Framework with Clever Cotton.

Evan Wilcox is CRDC's Commercialisation Advisor, supporting the Innovation team to commercialise research.

Graeme Tolson, Emily Luff, Paula Ryan and **Jeevi Arjunan** are CRDC's Business and Finance team, who manage all of CRDC's financial interactions. **Delece Harnett** is CRDC's Executive Assistant, providing support to CRDC's Executive Director, Board and Executive.

Disease review outlines path forward

The Australian cotton industry has invested in cotton disease research over a number of decades, building a strong knowledge base and making significant gains in disease management along the way.

MELANIE JENSON

The disease review recommended economic assessments of disease and control options to extend the current knowledge of disease incidence to understand progression to severity and yield loss.

However, despite these ongoing efforts, disease is still one of the leading limitations in the cotton production system. CRDC is acutely aware of this and as a result, commissioned a study to review and reflect on the past investments and outputs, identify shortfalls or research gaps and critically review the strategic direction for future CRDC pathology investments to deliver impact at the field level. The result of this review has been the formation of the Australian Cotton Disease Collaboration (ACDC).

The review undertaken by Professor Mark Gibberd of Curtin University says that the nature of cotton farming, as with other cropping systems, has created the ideal environment and selection pressure for more virulent pathogen strains. Growers are dealing with the emergence and dominance of fungal pathogens, and the discovery of reoccurring wilt (eutypella) in fields highlights the evolving and growing disease issue.

The review identified a high level of concern among stakeholders and acknowledged that the risk of pathogens to cotton production is both currently substantial and likely to increase with time. It found that while the cotton industry is strongly supported by a high-quality group of people dedicated to RD&E, it has a limited toolkit for disease control and disease research should remain a high priority for CRDC.

Unlike many other broadacre production systems, the review found that there are few effective fungicides for cotton diseases and, although new fungicides may be a possibility, there is limited incentive for registration.

It also found that there is a track record of genetic gain by breeding for biotic stress resistance for cotton and new sources of resistance exist within germplasm collections. Breeding for new host resistance is important and ongoing, however, there is a long pathway to the delivery of disease-resistant germplasm.

As a result, the review recommended that CRDC adopts a strategic approach to bring together current and future industry knowledge and research for in-field disease management based on systems-based disease control packages. It suggested the development of a robust theoretical framework for each disease of interest, clearly identified critical control points and the deployment of near-to-field analysis of disease pressure, soil health and agronomic solutions based on empirical data sets (derived from in-field trials), including economic impact assessments.

It also recommended research focuses on:

- Understanding pathogen behaviour (both the phenotype – i.e the virulence and epidemiology of the pathogens causing disease, and the genotype – genetics of the pathogens and pathogen populations).
- Economic assessments of disease and control options to extend the current knowledge of disease incidence to understand progression to severity and yield loss.
- Increasing adoption of spatial data analytics and advanced modelling capability.
- A longer-term (five to eight year) investment framework with clearly defined opportunities for co-investment and co-design and the implementation of an enabled national leadership role.

As a result, CRDC has developed the Australian Cotton Disease Collaboration (see next story).

For more

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MELANIE JENSON

CRDC directs $10m towards solving the disease challenge

CRDC is committing $10 million to disease RD&E over the next five years via the Australian Cotton Disease Collaboration (ACDC).

The goal is to reduce the economic impact of current and emerging diseases of cotton to less than five per cent of the cost of production by 2028, through RD&E and practice change. ACDC is a collaborative national disease program which will enhance foundational pathology capacity and capability and deliver tactical management and innovative technical solutions for cotton growers.

The formation of ACDC is in response to grower concerns and the results of a major disease review commissioned by CRDC and undertaken by Professor Mark Gibberd of Curtin University (see previous story). This review highlighted the need for long-term investments with strong linkages to ongoing economic impact assessment at the field level.

ACDC is being overseen by CRDC Innovation Broker Elsie Hudson. She said disease is resulting in significant yield losses, and in some cases undermining the long-term confidence of growers in growing cotton.

"In extreme cases, some growers have opted out of growing cotton in response to severe and escalating disease pressure," Elsie said.

"We are seeing that in some regions in particular, for example in the south with black root rot, however all growers are being impacted in some way.

"While some have managed to alleviate and mitigate the effects, emerging pathogens and severity are an issue, despite CRDC's investment in cotton disease research over several decades.

"Disease is still one of the leading limitations in the cotton production system and as such has required a total rethink of how we approach it."

ACDC represents an entirely new approach to RD&E for CRDC and is the first initiative announced under CRDC's new five-year Strategic RD&E Plan Plan, Clever Cotton.

It will involve long-term strategic partners

CRDC Innovation Broker Elsie Hudson and Moree (Kamilaroi country) cotton grower Mick Humphries.

selected based on their strategic alignment to CRDC and ACDC's mission, incluing a willingness to co-invest, and a commitment to co-design and capacity building.

"Through ACDC, CRDC aims to help maintain and build capacity in partner organisations and bring together complementary skills to tackle the disease challenge," Elsie said.

"This is in line with Clever Cotton, which has a focus on collaboration and a shift away from smaller projects to bigger investments with bigger outcomes and bigger impact.

"We recently ran an expression of interest period for parties interested in partnering in ACDC, with lots of interest shown."

CRDC will be forming strategic partnerships with research, government, and commercial partners with expertise in developing systems-based disease control packages, understanding pathogen behaviour, increasing adoption of spatial data analytics and advanced modelling capabilities for disease prediction and management, and supporting the testing and introduction of new actives for disease control.

Major diseases impacting the cotton industry and the biggest threats to the viability of cotton are Verticillium wilt, Fusarium wilt, reoccuring wilt (eutypella) and black root rot, particularly in Southern NSW.

Moree (Kamilaroi country) cotton grower Mick Humphries has been dealing with both Fusarium and Verticillium wilt on his farm and has been involved in CRDC's disease research for the last five years. He is hopeful the change in approach can unlock new solutions to old problems and avoid emerging ones.

"Disease is such a hard area to get meaningful R&D breakthroughs," he said.

"We'll get a head of steam on a promising solution and then, almost out of the blue, it's back to the drawing board.

"We saw this with Fusarium, and it felt like when we had a handle on that, Verticillium came into our fields which required the development of a totally different management style. Meanwhile we have to deal with the economic losses while that research is underway.

"ACDC is about bringing people together to attack the problem in a strategic, coordinated way – rather than the piecemeal 'one project here, one project there' approach the industry has relied on for the last 30 years."

Growers like Mick are embracing the ACDC's mission of reducing the economic impact of disease to less than five per cent of the cost of production by 2028.

"Our farms grew cotton year in year out through the 1980s and '90s, and that frequency of cropping allowed the disease inoculum to build up to the point where it has become a real production issue for us now."

This can result in growing less cotton area and a reduction in yield.

"All up, I'd estimate disease costs our business 20 per cent of our gross income per annum.

"I want to claw that 20 per cent back, so I'm excited to see what ACDC can bring."

For more

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Ongoing issues a focus of ACDC

Professor Gibberd's disease review said that the nature of cotton farming, as with other cropping systems, has created the ideal environment and selection pressure for more virulent pathogen strains.

The review highlighted the tightening of crop rotations, the adoption of agronomic practices to maximise yield, and the ongoing evolution of pathogens as three factors creating this selection pressure. This has been witnessed by growers and consultants in the southern regions who were seeing incidence increase markedly after just a few seasons when *Spotlight* reported on the impact of disease in the Lachlan and Macquarie Valleys in 2018.

Then as now, black root rot was the biggest threat to the sustainability of cotton production in the Hillston area in the Lachlan Valley (Wiradjuri country) and consequently growers' number one issue.

In the Lachlan, it was not confined to back-to-back cotton – it was in any field that had a high frequency of cotton, even those managed with regular fallow and rotation crops. While it had taken several years to become severe around Hillston, in the Murrumbidgee it was taking its toll within five seasons.

Short seasons and traditionally wet winters meant growers couldn't take the risk of trying to grow the crop out or plant late to mitigate impacts of disease such as black root rot, unlike in northern regions.

In 2018 in the Lachlan, black root rot was appearing in approximately 70 per cent of fields and of that, 50 per cent had a severity level of eight to 10 out of 10. This was translating to losses of around three bales per hectare, but some growers were reporting as high as five due to the inability for the plant to compensate and/or loss of plant stands. Black root rot was also acting as a catalyst to and in conjunction with pythium and rhizoctonia.

Recent incursions highlight importance of correct ID and biosecurity vigilance

The recent discovery of the exotic Papaya mealybug in Australia and its likeness to endemic species reinforces the importance of correct identification – the key to the success of a management response and potential eradication strategies.

CRDC has supported training to ensure key people have the skills for correct identification that they can share with the broader industry. Like the papaya mealybug, the exotic brown marmorated stink bug (BMSB) shares similar physical characteristics to other bugs in the stink/shield bug *Hemiptera* family. In order to recognise unknown and invasive species of *Hemiptera* family members, a two-day training workshop in identification was held in June with Dr Michael Elias, the *Hemiptera* Taxonomist at the Australian National Insect Collection in Canberra. It was attended by CSIRO and Qld DAF staff along with crop consultants and facilitated by CSIRO's Simone Heimoana.

CRDC Senior Innovation Broker Susan Maas said BMSB has previously been detected in Australia, and while not on the current list of High Priority Pests for the cotton industry, it was basically a matter of time before it became a permanent pest. She said the extent of its potential impact in cotton is unclear.

"Biosecurity preparedness remains a core part of our work – ensuring the cotton industry has the capacity to identify an exotic pest in order to manage it," Susan said.

"We have prioritised BMSB identification for industry experts because we know the chances of an incursion are high.

"There are many species of shield bug in Australia, so if an incursion happens we want to make sure we have people in the industry who know what they are looking for and what they are looking at.

CRDC has supported industry training to distinguish the exotic brown marmorated stink bugs from endemic stink bug species.

"In cotton, BMSB feed on bolls which can reduce lint quality and yield. Observations from the US are that BMSB prefer larger bolls than other cotton stinkbugs, such as green vegetable bugs, therefore impact in cotton would be expected at a similar time or later in the season in comparison to endemic stinkbugs.

"We do know integrated pest management (IPM) may be disrupted while we learn how to manage them."

Another recent incursion is the Guava root-knot nematode (*Meloidogyne enterolobii*), detected in Queensland and the Northern Territory. Early detection and reporting are key elements in controlling this highly pathogenic and invasive species. Despite its name, it has a broad host range including cotton. Typical symptoms include severe root galling (knotty root growths stimulated by nematode infection), stunting, wilting and leaf yellowing. All nematodes can be easily transmitted with soil and plant material. Susan says this incursion along with the papaya mealybug discovery re-emphasises the cotton industry's biosecurity messages.

"The crucial message is that the threats will keep coming," she said.

"Even though we are relatively isolated geographically, the best thing you can do for your individual farm is to have good biosecurity processes and Come Clean. Go Clean. is the first. The second is to be on the lookout for anything unusual, reporting any unknown pests or plant symptoms.

"It's all about managing risk, so limiting visitors or keeping vehicles and foot traffic to certain areas, along with tracking all traffic coming on farm can provide traceability in the event of an incursion.

"This applies to all equipment or material coming on-farm for other crops like grain and fodder deliveries as well.

"We strongly recommend growers have a biosecurity plan and stick to it – even though at times it may seem inconvenient or add a layer of time or paperwork."

CottonInfo Biosecurity Technical Lead Sharna Holman said sometimes it won't be the pest that is first detected, but unusual symptoms in a plant.

"If you detect damage or symptoms you haven't seen before, report it," Sharna said.

"For example with nematode species, they are microscopic and the first detection will be through anomalies in the plant that may look like water or heat stress.

"For accurate identification of suspect pests or symptoms, a trained expert needs to be consulted through the Exotic Plant Pest Hotline."

CottonInfo has developed guides to help identify key features of these exotic pests, available at www.cottoninfo.com.au/insect-and-mite-management

For more

Exotic Plant Pest Hotline
1800 084 881
Sharna Holman
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Proactively managing industry success through sustainability

The Australian cotton industry's 2022 Sustainability Update provides a clear and balanced summary of what the industry is doing well, and just as importantly it shows where more can be done to better manage risks and opportunities.

Providing regular and accurate sustainability updates shows growers and the industry how the industry is progressing and if emerging risks and opportunities need to be better managed, says cotton's sustainability advisor Chris Cosgrove.

"Making sure we are balanced and transparent in these updates is essential to build customer, community and other stakeholder trust in Australian cotton."

Why is this so important?

"Sustainability is not a list of nice things to do: it's a process to proactively manage the topics that contribute to the industry's success, now and in the future," Chris said.

"It manages industry risk and opportunity, supports productivity, and enhances market access."

Every single topic in the PLANET. PEOPLE. PADDOCK Sustainability Framework is critical for the industry to manage well because they directly impact:

- market access and customer purchase decisions
- community, customer, government and other stakeholder trust in the industry, and
- grower productivity, profitability and resilience.

What does this mean for growers?

The Sustainability Update provides a snapshot of industry-scale performance. Most of the data shows the average for cotton growers across the industry.

Every farm business is different, so some growers may be well above average on sustainability measures and others may be below. Data in the Sustainability Update could help individual growers assess if there is more they could be doing in specific parts of their farm businesses.

For the industry as a whole though, the data is telling us some clear messages, which Chris has summarised in the accompanying table.

For more

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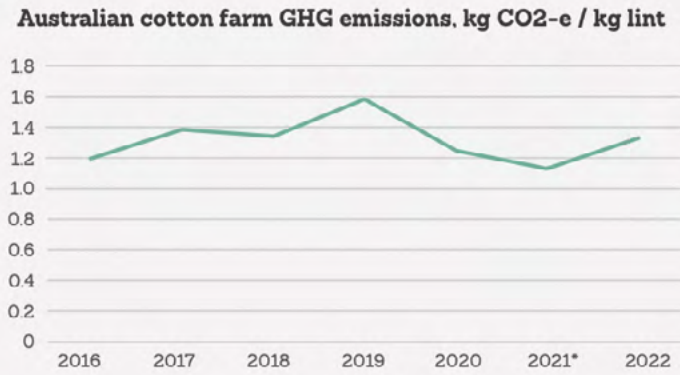


Yield down but emissions are up – why is this?

While cotton production accounts for just 0.2 per cent of Australia's total greenhouse gas emissions (GHGs), the urgency with which society needs to avoid the worst effects of climate change means every sector will be under increased pressure to reduce its emissions.

Per bale GHGs for fully irrigated cotton increased by an estimated 15 per cent in 2022 compared to 2021. This is because emissions per bale are driven largely by yield and the amount of nitrogen (N) applied per hectare; in 2021-22 a two per cent decrease in yield and a six per cent increase in N per hectare led to an increase in emissions per bale.

Improving N use efficiency will reduce per bale GHGs. This is a major challenge for the industry: the propensity for some to manage the risk of yield losses through under-fertilisation by applying more N than is needed. This is a complex behavioural task we are continuing to work on.

To reduce total GHG emissions there are a number of pathways that need to be taken:

- reduce emissions from N fertiliser, via green ammonia (manufactured using renewable energy instead of fossil fuel energy), and/or enhanced efficiency fertilisers, and/or reducing synthetic N via cover crops or other practices;
- reduce fossil fuel use on farm and in purchased electricity; and
- increase the amount of carbon sequestered in woody vegetation on cotton farms.

Topic	2022 takeout	Suggestions for growers
Water	**Good story, but pressure remains.** From 1997 to 2021, 52 per cent less water was used to grow a bale of cotton – but most of those gains came in the first 10 years.	Climate change impacts, societal pressures and water costs mean growers need to continue to improve water use efficiency. Evaporation losses are a priority.
Greenhouse gas emissions	**Small contribution, big impact.** Greenhouse gases (GHGs) per bale rose 15 per cent from 2021 to 2022. Cotton growing accounts for about 0.2 per cent of Australia's total emissions.	N fertiliser makes up about 70 per cent of cotton production emissions, so reducing N fertiliser and/or improving nitrogen use efficiency are critical to maintain community trust.
Native vegetation	**Coordinated action coming.** About 21 per cent of the area of an average cotton farm has remnant native vegetation. Most of this is grasses on grazing land.	Growers are being consulted on a major new project to set targets in line with identified regional priorities, to improve grower certainty, reputation, and environmental outcomes.
Pesticides	**Be alert to pesticide use.** Insecticide and herbicide toxicity per hectare has reduced a lot since 2002, but herbicide toxicity increased in the last five years with rain and more residuals.	Community pressure on pesticide use will increase. As well as research into alternative controls, growers need to consider toxicity of active ingredients when making pesticide decisions.
Soil Health	**Give your soils food and shelter.** The cotton industry released its soil health framework, based on two principles for supporting a living system: provide food and shelter.	Until national soil health indicators are agreed: give soil shelter (maximise soil cover, minimise disturbance) and feed soil organisms (maximise living roots, maximise diversity).
Workplace & working conditions	**Human rights is an opportunity.** Census data from 2021 show an increased proportion of women and First Nations peoples working in the cotton industry.	The cotton industry is looking at how to show human rights are upheld on Australian cotton farms. This is primarily to meet customer demand for evidence of human rights.
Wellbeing	**Important, but hard to impact.** Regional wellbeing survey showed some drivers of cotton grower wellbeing increased, and others decreased from 2020 to 2021.	The cotton industry has little impact on most wellbeing drivers (physical, social, financial and other factors) We are advocating for a coordinated government-agriculture-community approach.
Productivity	**Second year of good yields.** Average irrigated yield in 2022 decreased slightly to 11.2 bales/ha, and dryland yield increased significantly to 4.3 bales/ha.	By balancing productivity with social and environmental sustainability, the Australian cotton industry is providing a blueprint for 'sustainable intensification' or doing more with our existing resources (expect to hear this phrase a lot more).
Profitability	**Cotton supports farm resilience.** Research of farms with irrigation, dryland and livestock showed irrigated cotton makes the most contribution to whole farm profitability.	Growers and industry have little or no influence on seasonal conditions, cotton prices, or exchange rates. The focus will continue to be what we can influence: input costs and yield.

A reminder: PLANET. PEOPLE. PADDOCK.

PLANET. PEOPLE. PADDOCK. is the Australian cotton industry's sustainability framework. It guides work to:

- identify the environmental, social and economic topics assessed as being most important to industry and its stakeholders;
- coordinate a whole-of-industry strategy to manage these topics; and
- engage with stakeholders on actions and progress.

PLANET. PEOPLE. PADDOCK. is not a compulsory standard or a brand. It provides a path for the entire industry to benefit from improving sustainability performance. A Sustainability Working Group comprised of industry representatives from CRDC Cotton Australia, CottonInfo, myBMP and the Australian Cotton Shippers Association oversees PLANET. PEOPLE. PADDOCK, and reports to the Boards of Cotton Australia and CRDC.

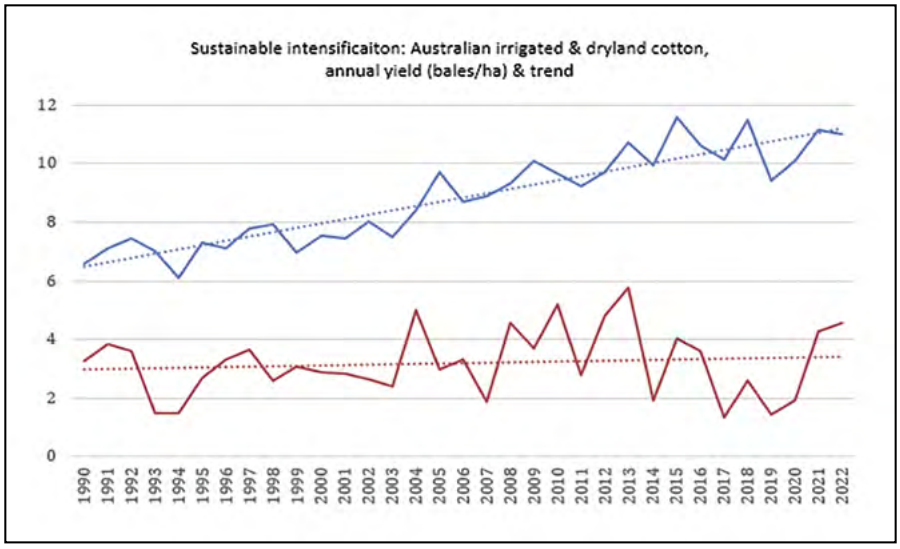
For more

Australian Cotton Industry Sustainability Framework

www.crdc.com.au/growers/sustainability

Keeping the industry updated on sustainability credentials

The Australian cotton industry's 2022 Sustainability Update released in early July reveals the complexity of sustainability in farming systems, and the extent of the industry's investment in collaborative initiatives to accelerate positive impacts.



The Update is an initiative of CRDC, Cotton Australia and the industry's Sustainability Working Group.

A 52 per cent improvement in water use efficiency since 1997, reductions of 91 per cent and 66 per cent respectively in the hazard of pesticides to bees and algae since 2004, and an increase in the proportion of female and Indigenous workers since 2016 are some of the mainly positive trends reported, while annual data shows a decrease in yield and increase in greenhouse gas emissions from 2021 to 2022.

Cotton Australia CEO Adam Kay said the 2022 Sustainability Update provides evidence of an industry seeking to give its stakeholders a transparent and balanced review.

"Since becoming the first Australian agricultural industry to independently assess its environmental impacts in 1991, the Australian cotton industry is proud of long positive trends in many areas but also knows it needs to keep looking at ways to improve," Adam said.

"Our latest update clearly shows what we're doing well, but just as importantly it shows what challenges we have and what we're doing to address areas where we can better manage risks and opportunities.

"...the five-year average yield of irrigated Australian cotton increased by 55 per cent from 1994 to 2002"

"The data shows we have more to do in reducing greenhouse gas emissions, and while we have witnessed a significant decline in the negative impact of herbicide use since 2004, there has been an increase in herbicide hazard over the past two years. As an industry our goal is to minimise the environmental impact of herbicide use."

The 2022 Sustainability Update also reveals the five-year average irrigated yield of Australian cotton increased by 55 per cent from 1994 to 2002, compared to an eight per cent dryland yield increase in the same period.

This highlights how efficient use of irrigation water, within sustainable river and groundwater system limits, can meet a growing global call for 'sustainable intensification' of agriculture: to produce more food and fibre while reducing negative impacts and increasing positive impacts on people and nature.

CRDC's Acting Executive Director Allan Williams said collaboration and coordination were key parts of the cotton industry's work to deliver sustainable intensification.

"The PLANET. PEOPLE. PADDOCK. Sustainability Framework is the Australian cotton industry's tool to deliver sustainable intensification by improving the resilience and productivity of farming systems while maintaining nature's contributions to people," Allan said.

"Collaborating with others inside and outside the industry to get the environmental, social and economic balance right is absolutely essential, and we are investing time and money to make this happen.

"Working with Natural Resource Management Regions Australia to develop regionally appropriate native vegetation targets, supporting the work of the National Soil Strategy to improve soil health, and advocating for a whole of agriculture approach to promoting human rights on Australian farms are examples of the collaborative approach the industry is taking."

For more
Australian Cotton Sustainability Update 2022
www.crdc.com.au/publications/australian-cotton-sustainability-update-2022

Irrigation channel sediments could be hot spots for N_2O emissions during irrigation cycles. Research is testing this in the field and specifically during urea-run irrigation, as there are a lot of unknowns on how much dissolved urea makes it to the crop during channel transport.

JACKIE WEBB

Looking to water for emissions reductions

Researchers are looking at optimising irrigation performance in bankless channel cotton layouts to improve water management, optimise nitrogen use efficiency and measure greenhouse gas emissions from water delivery systems.

Irrigation performance influences the efficiency of fertiliser uptake by plants by affecting the uniformity of water both across the field and at depth; and consequently the scheduling of fertiliser to the crop.

Researchers from the Centre for Regional and Rural Futures at Deakin University, Dr Wendy Quayle and Dr Jackie Webb, say that since on average about a third of applied nitrogen (N) is lost in conventional growing systems (costing the industry approximately $32 million each year), there is opportunity to reduce these losses and improve N recovery through linking fertiliser application and watering schedules.

By developing datasets, the researchers hope to assist the development of integrated irrigation and N technology in different designs of bankless surface irrigation layouts.

"Reducing up-front costs, increasing flexibility, and technology advances are encouraging growers to install bankless systems for labour, water and energy efficiency," Wendy said.

"Despite bankless channel irrigation systems becoming more widely adopted, there's currently no specific information available for growers that discusses the overall efficiency of N applied using these new layouts.

"Our research plans to change this."

The project, which began in 2022, will use existing commercial bankless systems on farms in the Murrumbidgee region (Wiradjuri country) and in Northern NSW (Kamilaroi country) for the study.

Nitrogen fertiliser use efficiency (NUE) will be a primary focus through understanding the effect of layout and irrigation water dynamics. The project will consider linking farm decisions of water-run urea and ground application to automated irrigation scheduling

driven by soil moisture sensing. New, controlled-release fertiliser N products will be tested at irrigation bay scale, and N measurements in tailwater will be measured to compare runoff nitrogen losses in different layouts.

Jackie says they also aim to measure greenhouse gas (GHG) emissions from on-farm irrigation channels, tail water and the bankless channel area during a field trial as part of this project.

"These are essentially the uncropped areas on the farm that don't get accounted for in farm GHG budgets, so we are looking to fill a gap here," Jackie said.

"The International Panel on Climate Change (IPCC) provides emission factors to help calculate nitrous oxide and methane emissions from these on-farm irrigation areas but they are based on global averages which are not representative of our semi-arid temperate climates of irrigation farms in Australia.

"Cotton industry researcher Dr Graeme Schwenke of NSW DPI conducted a laboratory study on cotton channel sediments and found they could be hotspots for N_2O emissions during irrigation cycles.

"We essentially want to test this in the field and specifically during urea-run irrigation, as there are a lot of unknowns on how much dissolved urea makes it to the crop during channel transport."

The project is still in its infancy and more measurements will be undertaken this coming field season.

"Jackie undertook some preliminary pilot investigations last season and we are considering options around methodologies specifically for on-farm channels and bankless channels and what we might be able to do in coming seasons," Wendy said.

"This research is exciting as it will provide better definition of water-nitrogen options in new bankless layouts including the on-farm fate of N surface run off and GHG emissions."

For more
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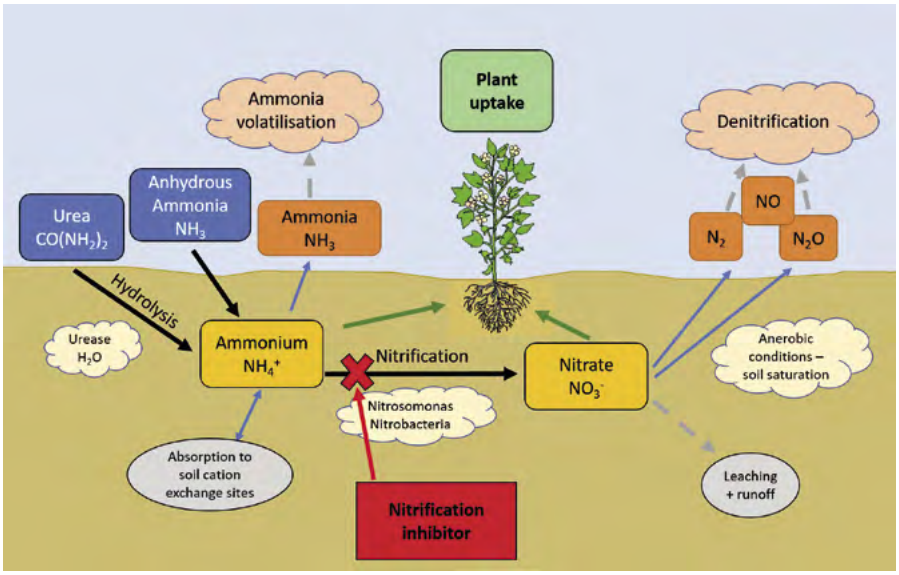

This diagram illustrates where nitrification inhibitors block the nitrogen cycle.

Enhanced fertilisers for reduced emissions

CottonInfo and NSW DPI are investigating the use of enhanced fertilisers in cotton systems on a number of commercial farms to reduce greenhouse gas emissions.

The experiments are based from St George (Kooma country) in south-west Queensland down to Pilliga (Kamilaroi country) in north-west NSW, where new fertiliser technologies will be compared to current grower practices.

CottonInfo Nutrition Tech Lead Jon Baird said enhanced fertiliser provides a technology that can reduce greenhouse gases in irrigated systems.

"Previous research has shown that our main losses for nitrogen (N) fertiliser occur early season when plant uptake is low, coinciding with the application of irrigation water," Jon said.

"Enhanced fertilisers contain a barrier (either physical or chemical) that protects the fertiliser, maintaining it in a stable form for longer.

"For cotton systems, our goal is to protect the fertiliser from early season losses and as the barriers break down, the N becomes available for crop use during the important flowering and fruit set growth stages.

Coated urea (42 per cent nitrogen) recovered eight months after application. Timing the release of the fertiliser N to the plant use is crucial to maximising fertiliser use efficiency.

"Research has shown that the potential reduction in losses from utilising enhanced N fertiliser can equal the emissions from unfertilised crops."

Growers seeking more information on these technologies and using them in cotton systems are encouraged to contact your local CottonInfo Regional Extension Officer or Nutrition Technical Lead Jon Baird.

For more
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jon.baird@dpi.nsw.gov.au

Accelerating development of sustainable options for cotton

CRDC-supported Australian agri-food technology accelerator SparkLabs Cultiv8 has supported 50 companies to promote innovation in Australian agriculture.

SparkLabs Cultiv8 is also supported by NSW DPI, Agricultural Innovation Australia and CRDC's fellow Research and Development Corporations Meat & Livestock Australia, the Grains Research and Development Corporation, the Fisheries Research and Development Corporation, and Hort Innovation.

It was launched in 2017 at NSW DPI's 'The Gate' facility in Orange, with CRDC coming on board in 2023. The objective of the partnership is to enhance collaboration across the innovation and investment ecosystem. The most recent focus is addressing climate change through innovation, with 10 start-ups in the cleantech sector chosen for funding.

"Our partnership with SparkLabs Cultiv8 aims to commercialise and accelerate the adoption of innovative technologies and tools," CRDC's Acting Executive Director Allan Williams said.

"We believe that through joint efforts with the SparkLabs partners, we can attain greater impact."

This year's participants work in areas such as biodiversity, resource efficiency, and renewable energy.

Among the start-ups is NanoSoils, founded by this year's CRDC-supported ABARES Science and Innovation Award winner, Dr Cong Vu, who is bringing technology from medicine to cotton.

NanoSoils is developing nanoparticles, originally created to treat cancer in humans, to protect cotton crops – delivering pesticides and fertilisers into a precise location in the plants, thereby reducing pesticide residues in the environment. This offers enhanced efficiency of these products over an extended duration and protects crops for longer. The discovery may now also be used to help cotton plants tolerate drought stress, while also acting as a nutrient.

Dr Cong Vu could revolutionise the use of pesticides and add drought resilience to cotton plants with the use of nanoparticles.

Cong says the technology could be used as a seed coating, foliar spray, and soil application.

"The nanoparticles can carry fertiliser and pesticide providing a more effective delivery system, reducing agrochemcial residues and minimising environmental impacts," Cong said.

"While still at the early testing stage, results are promising and I am enjoying working in agriculture for the first time as a part of a start-up.

"I think the market and opportunities in agriculture are a lot bigger than in medicine."

Cong says being a part of the NSW DPI's The Gate incubator and SparkLabs Cultiv8 accelerator has provided the opportunity to translate NanoSoils' medical research to agriculture, get connected with experts and scientists, and expand the technology globally.

"In the third year of my PhD in nano-medicine, I pitched the idea to SparkLabs Cultiv8, and one week later, the Cultiv8 team visited our nano-medicine lab at the University of NSW," Cong said.

"Their support really motivated me and my PhD supervisor Professor Justin Gooding to think deeper about the opportunity of translating the cancer drug delivery technology to agrochemical delivery – which we then committed to doing.

"I came from Vietnam to study nano-medicine, so this has opened up a new world for me. I thought I would be medical researcher, not an agricultural innovator, which has been facilitated by being a part of the accelerator program."

The 50 start-up companies supported by the accelerator have collectively raised more than A$500 million (US$326 million). They boast a combined value of more than A$1.6 billion and have created over 750 new jobs.

Among the climate-focused start-ups are Carbonaught, which delivers organic fertiliser from enhanced rock weathering to permanently remove carbon dioxide from the atmosphere, and ExoFlare, with a platform to evaluate and manage biosecurity hazards in real-time.

"The SparkLabs Cultiv8 partnership facilitates the discovery, validation and commercialisation of technologies that have the potential to result in real industry impact and adoption" Allan said.

"This focus fits well with our new 2023-28 Strategic RD&E Plan, Clever Cotton, in the areas of innovation, commercialisation and sustainability.

"It also aligns with our commitment to involve new partners – commercial entities, start-ups, innovators – to solve industry challenges and create new opportunities."

For more
SparkLabs Cultiv8
www.sparklabscultiv8.com

New project to assess cotton's natural and social capital

Natural capital accounting is something we are starting to hear a lot more about, as businesses and supply chains around the world work to better understand the true value of natural assets (soil, water, air and biodiversity) to their business, and the impacts their operations have on these assets on which they depend. A more recent but related concept is valuing human and social capital.

In an Australian first, the cotton industry (with support from CRDC) is exploring if an industry-scale assessment of natural and social capital value is feasible and beneficial. This project is being undertaken by cotton's sustainability adviser Chris Cosgrove and is designed as a proof of concept for other agriculture industry sustainability frameworks.

"If we can value natural and social capital for the cotton industry in a robust and cost-effective way, the same method can be adopted by livestock, grains and other industries, if they wish," Chris says.

"A major aim is to allow other industries to observe and learn from the cotton industry's work, to prevent future duplication and inconsistency across sectors.

"We also want to create a consistent standard for individual farms and supply chain businesses that are planning to value their natural and social capital as well."

You can't manage what you don't measure

This work is part of a broader project to revamp the industry's sustainability data and reporting framework to deliver data in new and better ways, to allow for more informed decisions by all cotton industry stakeholders.

Natural and social capital assessments aren't a silver bullet for good decisions, but when considered along with other data and contextual information they should provide a clearer picture of cotton industry impacts, risks and opportunities. This should help the cotton industry better allocate research and extension resources to where they are most needed and give customers more confidence to buy Australian cotton.

Chris Cosgrove will present a 30-minute webinar on the project, as well as offer an overview of natural and social capital assessments, on Thursday 21 September 2023 at 12.30pm (AEST).
Register here: https://bit.ly/3QKyac7

For cotton growers, some of the ways this new information could be applied to their farm business may be to estimate:

- the increase or decrease in input costs associated with soil management practices.
- the lost opportunity from reduced water infiltration or water holding capacity of soils.
- the value of native vegetation for beneficials habitat, carbon sequestration and industry reputation.
- the cost of injuries to a farm business, and to rural health services, and
- the value of skills and experience on farm business productivity, culture, corporate knowledge and climate resilience.

"These are just examples as this is brand new work, and like anything new, the opportunities and applications will become more apparent as we learn more," Chris said.

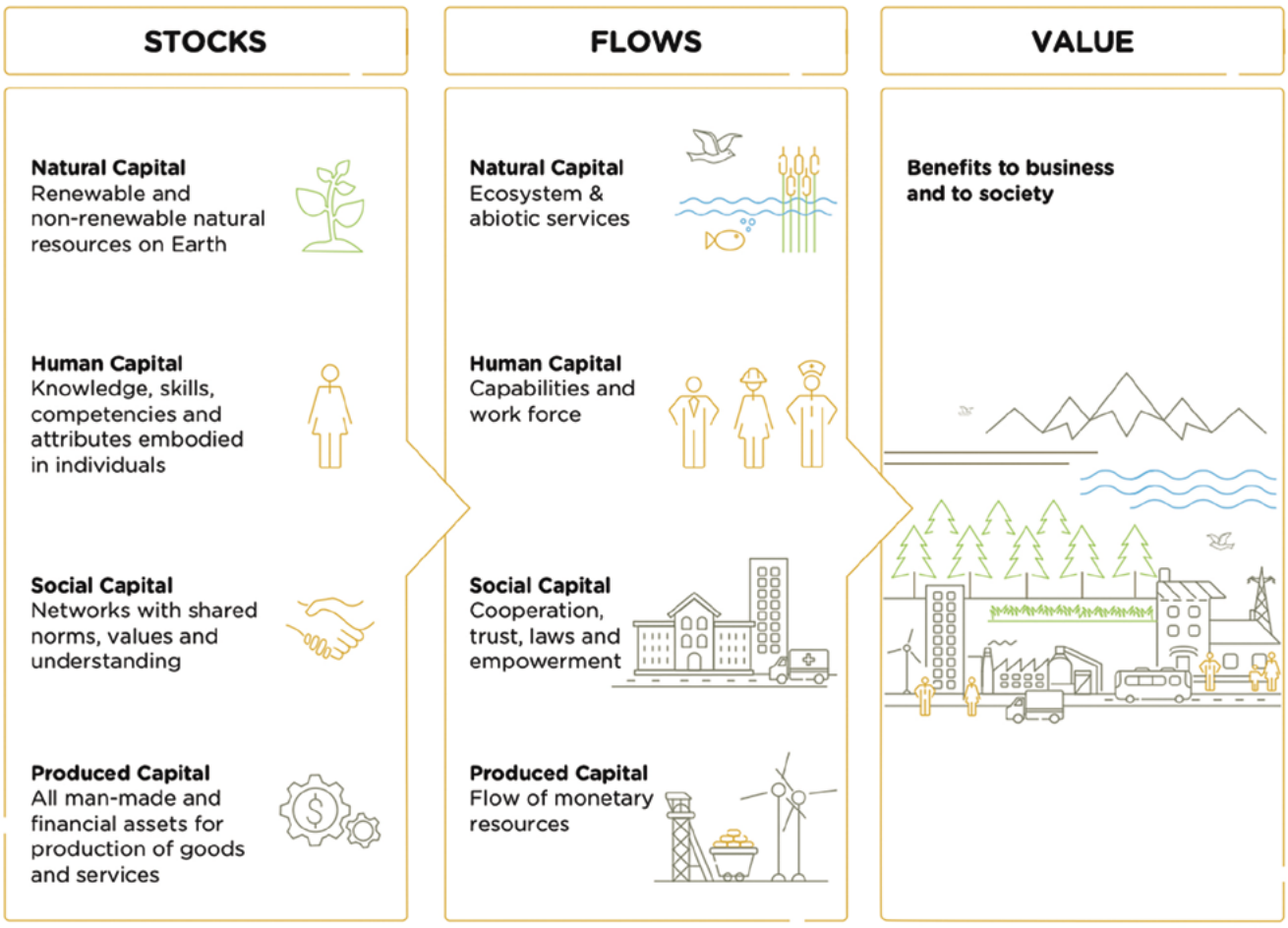
"Many big businesses around the world are looking for ways to make natural and social capital assessments work for them; the cotton industry is leading the way to see how we can make these assessments work for cotton growers and more broadly for Australian agriculture."

Because this is a new field, regular knowledge-sharing will be undertaken with other agriculture sustainability frameworks and stakeholders to upskill people across agriculture and reduce duplication and inconsistency.

"If a grower is keen to apply natural and social capital to their own business, we expect they will be able to use the same methods and data sources we use at industry scale, to estimate natural and social capital value on their farm," Chris said.

"It won't be completely accurate, but it will be cheap and quick and let them see if these concepts help them – that is they don't need to embark on a complicated process and spend a lot of time and money on data inputs to get started.

"But if they want to have a very accurate picture – if they want to use accurate impacts on natural and social capital to help decide big land use change investment decisions, or if they want to claim increases in natural capital to support a premium for their product – they can use the same methods but will likely need much more accurate (and probably expensive) data.



Natural and social capital basics

A capital is the stock of an asset that combines to yield a flow of benefits or services to people and nature.
When invested in and managed responsibly, the asset creates value. If we 'draw down' on the capital stock itself we limit its ability to provide. If we degrade it too much, it can stop providing value all together. The Capitals Coalition uses four stocks of capital: natural, human, social, produced. The Capitals Coalition is a global collaboration of organisations providing standardised guidance for integrating natural and social capital into decision-making.
Businesses rely heavily on all these stocks of capital. For that reason, they are referred to as dependencies.
All businesses also have an impact (positive or negative) on natural, human, and social capital with every action they take. These are referred to as impacts. Capitals can also be affected by social, environmental and economic changes outside the control of the business.
A capitals assessment seeks to value a businesses' dependencies (benefits received) and impacts on capitals through its operations. Valuing the relationship to nature and society helps make better informed decisions and create future-proof businesses.

"The cost of that data will be offset by the benefit they get from it, so data needs to be fit for purpose, but the approach is the same regardless of data quality.

"We will share progress directly with cotton growers too, so they can increase their own knowledge of natural and human capital assessments and provide input to the process so we can better understand how to apply this work in ways that benefit them."

The industry is using the globally recognised Capitals Coalition methodology to assess natural and human capital. The natural and social capital assessments are being supported by Qld DAF, endorsed by the National Farmers' Federation, and funded in part by a grant from the Australian Federal Government's National Agriculture Traceability Grants Program.

For more
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Sensor upgrade builds on success for early season management

Canopy temperature sensors have already revolutionised irrigation scheduling, and are now equipped to optimise watering from the first crucial irrigation, with the ability to distinguish between canopy and bare soil temperatures.

CRDC has successfully facilitated the commercialisation of ground-breaking research by the University of Southern Queensland's (UniSQ) Centre for Agricultural Engineering, with a new algorithm licenced to Goanna Ag. The new algorithm, pioneered by UniSQ's Dr Alison McCarthy with support from the Smarter Irrigation for Profit program, builds upon the existing canopy temperature sensors, developed by CSIRO in conjunction with CRDC and commercialised by Goanna Ag.

The result is a vital tool to support growers in their irrigation decision-making process.

The introduction of the new algorithm marks a significant advancement. Leveraging multiarray sensors, this state-of-the-art solution distinguishes between canopy and bare soil temperatures. This advancement allows for early-season canopy temperature measurements, particularly pertinent for the crucial first irrigation, and also eliminating the necessity to adjust the height of sensors throughout the crop's growth cycle.

This innovative solution builds upon the remarkable achievements of long-term research and development conducted by CSIRO in conjunction with CRDC in engineering the canopy temperature sensors. Continuous sensing offers more accurate irrigation scheduling, as decisions are based on the crop's response to immediate soil water status rather than relying on a fixed soil-water deficit.

Canopy temperature is a plant-based tool and is a strong indicator of crop's access to soil water. It allows the plant's water status to be continuously monitored which enables growers to apply an irrigation before the stress has occurred, thus avoiding yield loss from water stress.

University of Southern Queensland's Dr Alison McCarthy has developed a new algorithm for canopy temperature sensors to schedule the first irrigation.

The initial study involved developing stress-time thresholds for cotton irrigation timing, primarily relying on canopy temperature measurements. This algorithm, created by the CSIRO team at the Australian Cotton Research Institute with support from CRDC was subsequently made available through Goanna Ag in 2019.

New capability

The initial irrigation decision, especially during the early growth stages, has historically posed challenges for growers due to limited technological support. Traditional methods, such as visual inspections and soil probes, proved unreliable.

"The cutting-edge innovation presented by Alison's algorithm fills this gap by providing decision support for the critical first irrigation stage," Goanna Ag CEO Alicia Garden said.

The commercialisation of this research through Goanna Ag not only enriches grower decision-making capabilities but also improves water use efficiency within the cotton industry. Goanna Ag will incorporate this technique into its flagship GoField service, offering cotton growers a comprehensive and effective solution to optimise irrigation events.

MELANIE JENSON

CSIRO's Rose Roche was integral in developing the original canopy temperature sensors in a project which began in 2014 at ACRI.

"It is exciting for my research with CRDC to be commercialised and available to growers in the coming cotton season," Alison said.

"The collaboration across institutions and geographic locations in the Smarter Irrigation for Profit program enabled us to develop and test the algorithm under a range of conditions.

"The algorithm linked to Goanna Ag's GoField service will even further broaden the applications for canopy sensing technology, as well as save labour and improve precision in sensing for irrigation management."

CRDC's Senior Innovation Broker Susan Maas says the technology will have immediate impact for cotton, and potentially also other crops.

"It is anticipated that the new technique may find application in other crops, such as legumes, further expanding its reach and benefits to agricultural communities," she said.

"CRDC's recent benefit-cost analysis put canopy temperature sensors in CRDC's top three investments under our last Strategic Plan, with a return to growers of an estimated $7.40 for every dollar invested (see story page 7).

"This has been a major collaborative piece of work across multiple research partners – UniSQ, CSIRO, Goanna Ag, CRDC and Smarter Irrigation for Profit. It's a great demonstration of how we can work with many partners to deliver tools to growers to improve crop management and resource use efficiency, which offer multiple benefits to growers.

"By supporting the commercialisation of this crucial research, this collaboration is continuing to drive innovation, sustainability, and precision agriculture within the cotton industry, positively influencing the future of global agriculture."

For more
Goanna Ag GoField service
www.goannaag.com.au

Real-time water accounting on the cards

When it comes to irrigation, knowing how much water is available is key to making informed decisions around water management and water use efficiency. Real-time water accounting for cotton growers is the aim of a new on-line program called the Water Dashboard.

The Water Dashboard is being designed to help keep track of water resources, for simplified management and reporting. It will give a snapshot of total water available at any point in time to assist in planning, estimating future water availability and water use efficiency.

The dashboard will use data from on-farm sensors monitoring storage; bore and channel water levels and soil-water measurements, matching them with water allocations. It is being developed via a partnership between Goanna Ag, CRDC and Cotton Seed Distributors (CSD) as part of CSD's Richard Williams Commercial Research Initiative, which honours the late Richard Williams, father of CRDC's Allan Williams.

Goanna Ag is leading the project and is working closely with the growers trialling the technology. Goanna Ag Chief Development Officer John Pattinson is excited about how it will equip growers in the future.

"It will be an easy-to-understand tool that shows how full the system is, much like a fuel gauge or accessing your bank balance on-line," John said.

"Working with growers we have also identified additional potential uses of the dashboard, like the concept of 'origin of water'.

"Put simply, we can track where water has come from on the farm and understand where it moves across the farm before it is used to irrigate a crop."

CSD Commercial Research Manager Dr Michael Bange said until now, it's been hard for growers to gain an accurate picture of water availability without relying on estimated or sometimes inaccurate figures, adding difficulty to precise management decisions.

"This will be a game changer when it comes to implementing best management and efficient practices," Mike said.

The Water Dashboard is still under development and is expected to be available for broad release in the 2024-25 season. It will initially be trialled this coming season using Goanna Ag sensor technology, but the final product will be able to use data from any sensor brand.

CRDC's Acting Executive Director, Allan Williams, says that the Water Dashboard closely aligns with one of the aims of CRDC's new Strategic RD&E Plan, Clever Cotton: to improve productivity, profitability, and sustainability by accurately monitoring and measuring every field on every cotton farm.

"The Water Dashboard is a great example of the benefit of this: turning raw data into real, tangible, beneficial decision-making information for growers," Allan said.

"It also supports our aim to work collaboratively with commercial entities to bring benefits to growers sooner."

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Not all branches are created equal

Integrated pest management (IPM) involves a lot of information and tactics, yet one of the simplest ways to improve IPM on-farm is to avoid any unnecessary insecticide use. One of the greatest challenges a crop manager will face is the decision not to spray.

This branch is vegetative as there is no square or abscission scar opposite the subtending leaf.

This branch is clearly a fruiting branch with a square opposite the subtending leaf.

This branch is also a fruiting branch denoted by the scar (following the loss of a square) opposite the subtending leaf.

Careful examination of the branch structure is needed to distinguish between vegetative and fruiting branches during the squaring growth stage.

CottonInfo IPM Technical Lead Paul Grundy of Qld DAF has worked with a broad team of people from CottonInfo and NSW DPI to investigate the early season compensation capabilities of high-yielding Bollgard 3 crops, creating a new set of industry recommendations for managing fruit retention.

This work and its resulting recommendations are included in the 2023-24 Cotton Pest Management Guide, which is enclosed with this edition of *Spotlight* for Guide subscribers. Conducted over three seasons and spanning growing regions from Emerald (Gayiri country) in Central Queensland to Griffith (Wiradjuri country) in the south, this work demonstrated that moderate square loss during squaring prior to first flower in Bollgard 3 did not impact crop maturity, yield or lint quality.

"Since the introduction of glyphosate-tolerant cotton, a common 'shortcut' has been to add an insecticide with an over-the-top glyphosate application during early squaring to improve retention," Paul said.

"While this is seen to be operationally efficient, we found it provides little benefit in terms of securing yield potential, earliness or lint quality.

"Square loss during early squaring prior to first flower in Bollgard 3 does not impact crop maturity, yield or lint quality."

"With little to be gained, insecticide use at this time instead disrupts the establishment of natural enemies that are important for the control of a range of sucking pests later in the season.

"We saw a practical example of this last season where early season dimethoate usage for thrips and mirids precipitated outbreaks of cotton aphids that were resistant to this compound as well as the IPM-friendly insecticide – pirimicarb – which shares the same mode of action."

The research over the last three seasons examined the impact of early square loss on yield potential and found that square loss during early squaring (nine to 13 nodes) prior to first flower did not impact crop maturity, yield or lint quality. This is because cotton has a remarkable ability to rapidly compensate at this early stage under good growing conditions.

The ability to compensate begins to decline during early flowering as developing bolls compete for resources, slowing canopy expansion and the plant's ability to produce replacement fruiting sites. Consequently, mid-season fruit loss is much more likely to impact a crop's yield and maturity.

Measuring early season retention

"Growers should aim to manage square retention from the initiation of the fifth fruiting branch onwards," Paul said.

"The most important first step is to accurately distinguish branch types on young plants."

Because the node at which fruiting branch initiation commences will vary across varieties, regions and seasons, it is critical to differentiate between fruiting and vegetative branch types on young cotton. This will ensure that vegetative branches (which lack squares during early development) are not counted when assessing retention on pre-flowering crops. For example, a crop at 10 to 11 nodes may only have one to three fruiting branches present, so what might appear to be low retention is just a lack of squares developing in the first place.

The images (above), from the Cotton Pest Management Guide, show very clearly what to look for in distinguishing between vegetative and fruiting branches when examining crops during the squaring growth stage.

Paul says this requires careful examination of the branch structure. Fruiting branches during squaring will always have either a square or a scar (from where a square has been lost) directly opposite a subtending leaf on the developing branch (see Images 1,2 and 3). Checking five to 10 plants in several locations will provide a reasonable idea of the crop's development status.

Low retention isn't always pest related

Crop managers must keep in mind that square loss is not always related to mirid or thrip damage. Temperature extremes (below 12°C and above 35°C) or cloudy

weather for only a few days can cause significant square loss on young plants.

"No amount of insecticide will stick fruit if the shedding is due to environmental causes," Paul said.

"A tell-tale sign of environmentally-induced shedding is patterned square loss (such as squares of a certain size or at a particular branch node).

"If crop development or environmental conditions do not explain the low retention, check carefully for pest insects, as mirids or thrips can impact retention at squaring."

Paul said it is worth noting that:

- Very high retention (greater than 80 per cent) on the first five fruiting branches can reduce mid-season canopy expansion and yield potential.
- Premature cut-out is likely to limit the crop's yield potential.
- The fruit setting period (late squaring – peak flower) is dynamic. Square production accelerates after first flower as the canopy expands to row closure. Retention management should consider crop stage, existing boll set and factors that might reduce boll set (insects, weather etc).

Refer to the decision support table in the Cotton Pest Management Guide for more information.

What about a cooler than average season or in rainfed crops?

The research on which these recommendations are based was conducted in high yielding irrigated fields throughout the industry spanning Griffith to Emerald over three seasons that could be described as hot, average and then cool.

Where early squares were physically removed, the mean yield across 34 sites was 12.1bales/ha, compared to 12 bales/ha for undamaged plots. The plant growth and development data collected at these sites can be used to inform retention management where the season might be constrained by cool conditions or inadequate soil moisture.

Crops within the trial program averaged a total of 15 to 16 fruiting branches and compensation was largely achieved within the first 10 to 12 fruiting branches from the base of the plant.

"If a crop has sufficient season length or soil moisture to set at least 10 or more viable fruiting branches, the early season retention targets in the table in the guide should be adequate to maintain yield potential – keeping in mind that these recommendations are more conservative than the research undertaken where all early squares were removed from the first five fruiting branches and yield recovery was complete," Paul said.

"If a crop is likely to be constrained in such a way that less than 10 fruiting branches were produced (so crop cutout prior to 18 to 19 total nodes) then a more stringent approach to early management may be warranted."

A clue to look for with physiological shedding is a pattern. All of these squares are the same size with no other squares in this crop affected. Insect damage is typically much more random. The new guideline for monitoring and managing square retention based on insect damage (not environmental-related shedding) is contained in the Cotton Pest Management Guide.

For more

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Cotton Pest Management Guide
www.cottoninfo.com.au/publications/cotton-pest-management-guide
A short clip is available at
https://bit.ly/3PhRwnT

When managing for early season retention

1. Only count fruiting branches when assessing retention during squaring

Vegetative branches are not sufficiently advanced during early crop development to have squares. Accurately differentiate branch types during squaring (see photos).

2. Early fruit loss does not automatically mean yield loss

Square loss from crops that have only produced four to five fruiting branches will have no discernible impact on crop maturity, lint yield and quality.

3. Focus on total retention (not just first positions) across all fruiting branches prior to flowering

A combined retention of 40 per cent or more of all fruiting sites by first flower is adequate to maintain high yield, earliness and lint quality. First position boll retention is not the only driver for yield potential in current varieties.

4. Avoid applying insecticides before four fruiting branches are produced where possible.

While early season thrip management in southern regions may be warranted, early insecticide applications can negatively impact the build-up of natural enemy populations. Be mindful of insecticide resistance management advice regarding early season spraying. Secondary pests such as aphids and mites are carrying resistance alleles to various products and repeated selection can result in mid to late season field failures.

5. Actively manage for retention from latter squaring stages (four to five fruiting branches onwards)

Check for pest activity prior to spraying and consider the possibility that environmental factors can also cause square loss. Squares lost early season will be quickly compensated during late squaring and early flowering with no impact on earliness, lint yield and quality.

6. Be aware of physiological shedding

Sub-optimal temperatures, cloudiness or moisture stress can induce physiological shedding. This natural response allows continued growth and rapid recovery once conditions improve. Maintaining a large early-season fruit load during periods of short-term environmental stress can limit future canopy expansion, fruiting site production, lead to premature cut-out, and be counter-productive for yield potential.

Emerging resistance threats in several key pests of cotton have resulted in changes to the Insecticide Resistance Management Strategy (IRMS). The IRMS is found in the annual Cotton Pest Management Guide (CPMG), released by CottonInfo and CRDC each September.

Counter resistance threats by following the IRMS

Resistance testing by Qld DAF and NSW DPI is conducted with support from CRDC and has reflected what was seen in fields last season. Outbreaks of resistance to pirimicarb and dimethoate in cotton aphids were first confirmed on the Darling Downs in Queensland by NSW DPI's Lisa Bird and subsequently also found to be widespread in other growing regions from the Border Rivers to the Macquarie Valley. Testing has shown that resistance in cotton aphids has increased from one per cent in 2021-22 to around 30 per cent in 2022-23, with spray failures of pirimicarb reported in many regions.

"Resistance to pirimicarb (Group 1A) has not been a major issue in cotton aphids for several years, but use of Group 1B insecticides (dimethoate and phorate) to control early season cotton pests may have selected for cross-resistance to pirimicarb," Lisa said.

"Our testing has also shown cotton aphid populations from northern NSW have multi-resistance to chlorpyrifos and it is likely that all Group 1 insecticides will continue to cause field failures in the coming season.

"Further testing will be done to determine how widespread this dual form of resistance is in the industry."

Lisa has also highlighted emerging resistance in two-spotted mites, which is concerning because control options are already limited. Resistance to diafenthiuron was detected in populations from the Namoi and Gwydir valleys which were found to respond quickly to selection pressure in the laboratory, indicating a high risk of resistance developing in the field.

"Given widespread resistance to Group 6 (abamectin), the emergence of diafenthiuron resistance further restricts control options for mites in cotton," Lisa said.

"To minimise selection pressure on remaining cotton miticides, avoid consecutive sprays of diafenthiuron and consider using alternative mode of action groups such as 10B and 12C."

Qld DAF's Jamie Hopkinson has detected resistance to pyriproxyfen and spirotetramat in silverleaf whitefly (SLW) in some regions, reinforcing the need for adherence to the IRMS for all SLW products.

Jamie said resistance to pyriproxyfen in SLW is low and stable, with far fewer detections than the previous season, but given the seasonal outlook of a hotter and drier summer which may favour whitefly outbreaks, the regional 30-day pyriproxyfen window and restrictions on pyriproxyfen use in open cotton have been retained. Up-to-date windows will be published on the CottonInfo and Cotton Australia websites before the start of the 2023-24 season.

"There are concerns around widespread low levels of resistance to spirotetramat in most regions, as resistance has the potential to develop rapidly, especially if there is an over-reliance on this product," Jamie says.

"A moderate level of resistance was detected this year in whitefly from the Lockyer Valley: a clear demonstration of the potential for resistance to evolve to field failure levels and once entrenched reversal of this resistance is unlikely."

Control options for SLW that are both highly efficacious and have minimal impact on natural enemies are limited, so key products including pyriproxyfen, spirotetramat and buprofezin are limited to one application per season.

CRDC Innovation Broker Nicola Cottee is working with the TIMS Committee and on recommendations for the IRMS.

Nicola said the field failures for pirimicarb in a high-pressure aphid season (2022-23) was a salient warning to adhere to the IRMS and closely read the new CPMG.

"We saw high resistance to Group 1 insecticides with 90 per cent of populations from southern Queensland and northern/central NSW positive for pirimicarb and dimethoate resistance," Nicola said.

"With pirimicarb resistance now widespread, selection pressure is likely to increase for other aphid control options and crop managers must follow the IRMS when selecting aphicides.

"We saw a four-fold increase in resistance to diafenthiuron in two-spotted mites in northern NSW last season, with signs this has the potential to increase in frequency if not managed well.

"Crop managers should consider that these resistance risks are increasing, and ensure they know how to use the IRMS to select appropriate pesticides.

"If crop managers see suspected field failures of insecticides, they are urged to contact the CottonInfo team who can provide support to send samples to the correct location."

Key messages

- Do not follow an at-planting phorate treatment with pirimicarb or dimethoate as first foliar spray.
- Do not use pirimicarb and dimethoate in the same field.
- Avoid dimethoate usage until late season. If an end of season clean-up spray is required in fields that have had prior dimethoate, pirimicarb or neonicotinoid usage, use another mode of action group as an alternative option.
- Avoid overuse of neonicotinoids as resistance has been detected in the past and overreliance on this group will reselect for resistance in aphids.

For more

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Growers called to co-design workforce development tools

Using a social media profile to entice potential staff to a farm or company, and focusing on creating open communication structures and pathways to retain staff and ensure wellbeing, are just two of the methods cotton growers are using to solve workforce challenges in an increasingly competitive workplace climate.

A grower-only virtual meetup – the SHIFT Workforce Solutions 'unconference' in June – attracted 35 participants to share, discuss and brainstorm their workforce development practices and solutions as part of a CRDC-supported project, Delivering best practice for management of future skills, headed by Dr Nicole McDonald of CQUniversity (CQU). The unconference was designed specially with growers in mind.

"The grower-only format meant they could be really candid, and they were, sharing successful strategies but also stories of when things hadn't worked so well – it normalised how challenging people management and this 'workforce stuff' can be for everyone," Nicole said.

Nicole has been working with growers to develop SHIFT, which will culminate in producing a variety of resources and tools for growers aimed at giving them the skills they need to become 'employers of choice' while also managing their staff and personal wellbeing.

"We wanted to avoid developing solutions to problems that may not actually be the priority issue for growers, and by working with directly with growers on their specific workforce challenges, we are finding the transferable strategies that may help other cotton growing enterprises," Nicole said.

"We needed to develop these from the ground-up, test our evidence-based ideas through a co-design process with growers, and alongside this, explore how best to deliver extension activities that support growers to focus on workforce development."

The SHIFT project team includes leadership consultant Jo Eady (well known for running the Cotton Australia and CRDC Future Cotton Leaders Program), CRDC-supported PhD candidate and cotton grower Chantal Corish, and Dr Amy Cosby of CQU who is also leading two other CRDC-supported projects on workforce development (see next story).

MELANIE JENSON

The on-farm workforce attraction and retention issue is ongoing, however growers are working with industry to pin down methods to build a resilient workforce.

"While strategies to attract and retain staff are ongoing, there are also growers who are continuing to reflect, think innovatively and strategically tackle workforce challenges and we wanted to be able to allow them to share their ideas with others through the unconference catch up," Nicole said.

"Australian cotton growers are known as being great sharers of information about things like crop management, yet how they manage their workforce and what they struggle with is not as broadly discussed.

"A salient grower comment during the conference was that 'the issues are the same for most people, so it's the solutions that others have come up with that are important to now share.'

"We felt it was important to highlight strategies for growers to take control where they can in order to improve the attraction and retention of the workforce, and to focus on how they can recharge and manage the risk of burnout for themselves, while providing a safe and supportive workplace for others."

Feedback from the event showed about half of the respondents reported feeling more confident in their workforce development or people management practices after attending the sessions, and about 90 per cent of growers said they would try something different in their work with people based on what they had learned or listened to at the unconference.

In the next phase of the SHIFT project, the team are set to launch a series of resources to support

the ongoing development of cotton farm workforces to be engaged and productive at work. These have come from practical skills and strategies identified in the project team's work with cotton growers.

From younger staff who may only recently have been introduced to a work environment to managing the aspirations of older people, three main challenges the project team looked at with cotton growers through SHIFT were:

- Attracting good team members, including navigating the shortage at the farm manager level.
- New entrants that were 'greener' than ever and needing to learn both technical and non-technical skills, and
- Making sure team members are speaking up, managing burnout, and staying engaged at work.

Some of the solutions offered to these challenges included:

- Communicating your employee value proposition, and recruitment strategies for on-farm workforce including the use of social media.
- Developing farm managers – the skills needed to lead and manage teams with resources to complement on-the-job training.
- Supporting new entrants with very minimal experience or knowledge of the cotton farm workplace, helping them to know what they need to do to set themselves up for success, and trialling the use of training videos to support inductions.
- Developing good work cultures that minimise psycho-social safety hazards and support team effectiveness, including planning an annual 'workforce development' calendar alongside an annual production calendar, and guides for effective and clear communication and conversations.

This has led the SHIFT team to developing a number of workbooks on different topics to help growers to keep developing the skills and mindsets needed to address attraction, retention and development of the workforce. These resources have been designed to complement on-the-job learning and will be available from early October. Further extension activities are also being planned over the coming months.

For more

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Who knows who works in the cotton industry?

The cotton industry is seeking a greater understanding of the state of its workforce to better manage and grow it. An essential first step is to improve the collection, quantity and quality of data around the industry's workforce.

CRDC and its fellow Research and Development Corporations (RDCs) have identified workforce data as a challenge across their industries, and a top priority focus area. The RDCs are now working together through the Emerging National Rural Issues (ENRI) program, facilitated by AgriFutures Australia.

A newly formed AgriFutures' workforce team has initiated the project Mapping the workforce of Australian Agriculture – current and future requirements. The team includes representatives from all RDCs, including CRDC's Innovation Broker Rachel Holloway, the Department of Agriculture, Fisheries and Forestry, the National Farmers' Federation and ABARES.

The team is focused on solving the challenge of collecting comprehensive data on the current agricultural workforce, and emerging and changing labour needs. Currently, the source of data is the Australian Bureau of Statistics (ABS) Census. It poses challenges as it is only conducted once every five years, so doesn't remain current; the timing is in the off-season for many crops, so doesn't accurately capture the on-farm workforce; and categories can be broad, meaning it is hard to classify people per industry. It doesn't provide a comprehensive picture of Australia's agricultural workforce or future labour requirements, which is why CRDC is working together with other rural RDCs to coordinate a solution.

The end result, the final research findings, will inform how the cotton industry and rural industries can collect workforce data in a consistent manner that complements existing data sets.

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For more

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Working out what young people think is key to get them into cotton research

Researchers are targeting secondary school and university students and teachers in regional and metropolitan areas across NSW and Queensland to understand their perception of the cotton industry, and support them to explore employment opportunities in the sector.

CRDC supports the Cotton Production Course at the University of New England, with students recently visiting a property at Delungra (Kamilaroi country) with course convenor Oliver Knox. Students come from a variety of backgrounds and disciplines.

Attracting and retaining the next generation workforce for the Australian cotton industry is key to the industry's success and sustainability, and the viability of our rural and regional communities.

The recent nationwide agricultural study by CRDC's fellow Research and Development Corporation (RDC) AgriFutures Australia, Community perceptions and worker experiences, reinforced that rural industries need to focus on closing the gap on perceptions, and how youth access career information on cotton and cropping industries.

By engaging a diverse cohort of young people, the CRDC-supported How to attract and retain young people to the cotton industry project is another way the cotton industry is working to create a sustainable workforce. The focus of the research is to understand what attracts and motivates young people to consider a career in the cotton industry: particularly professional service and research scientist roles.

In the first phase of the project, the research team – led by Associate Professor Amy Cosby at CQUniversity – are speaking with current higher education students studying agriculture and related degrees (e.g. science, environmental science, business) to explore why students chose to study at university, what factors they consider when deciding to apply for a job in agriculture and the cotton industry in particular, and their opinions on a range of tools and platforms commonly used to advertise roles.

These insights are vital to ensure cotton industry employers attract high performing, passionate and skilled graduates.

CRDC Innovation Broker Rachel Holloway said strengthening capacity was a priority under CRDC's 2023-28 Strategic RD&E Plan, Clever Cotton.

"There has been a loss of cotton research capacity in key research areas as long-standing industry researchers retire, and historical research funding fluctuated with seasonal conditions," Rachel said.

"There's a recognition of this decline, not just within cotton, but also across other agricultural industries: we're hearing it across our fellow RDCs, universities, and state and federal departments.

"This project is a step towards addressing this, to ensure we understand the perceptions of university graduates towards careers in cotton industry RD&E and will pilot targeted strategies to highlight the value and rewards of such a career to students, graduates and other potential entrants."

"Enhancing cotton's research capacity has the potential to contribute to increased profitability on-farm, to improved sustainability and value chain competitiveness and to greater adaptive capacity for cotton businesses," Amy said.

The next stage of the project will work with secondary school students and teachers to trial a range of interventions, including lessons aligned to the curriculum, and excursions to improve their awareness and perception of the cotton industry as an employer of choice.

"We know that it is important to engage with young people about careers pathways early and often, and this project will give the cotton industry the edge over other agricultural commodities and sectors to attract the next generation workforce," Amy said.

This project is running concurrently with another led by Amy with support from CRDC and the Grains Research and Development Corporation, into opportunities for a cotton and grains apprenticeship to establish clearer pathways for a career on-farm (see the Winter 2023 edition of *Spotlight*).

For more
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Pictured are trainee agronomist Tiffany Tarrant and agronomist Alice Jorgensen, who recently hosted the CRDC/UNE Cotton Production Course participants for an on-farm visit.

MELANIE JENSON

Lending support to early career professionals

Early career crop consultants and young professionals in agriculture-related industries are set to receive greater personal and professional development opportunities through Crop Consultants Australia (CCA) in an initiative supported by CRDC and the Grains Research and Development Corporation (GRDC).

CCA will use its existing network and expertise of its leadership and members to provide targeted learning and networking opportunities for early career agronomists along with interested researchers and rurally based early career professionals.

The new collaboration is a particular win for young agronomists, employers and their clients, which flows to the broader cotton and grains industries' ability to attract and retain people. Students studying agriculture and agronomy will also be involved to ensure them a smooth transition into work which often entails moving to a new location.

Alex Trinder is CCA's Young Member Director and believes this initiative fills a discernible gap that has surfaced in recent times. As an independent consultant with HMAg in Moree and vice president of the Moree Young Aggies group, she is excited about the significance of this project.

"The project gives our young professionals the chance to enhance their skills and address gaps in their existing knowledge," Alex said.

"Information transfer is the key to all that we do, and you can't learn everything at uni. Our roles require us to find a balance between the science and the interpersonal skills to share it, and developing a network that lends support when you just aren't sure.

"We really want to help in the establishment of those vital professional networks early on in careers across all aspects of the industry – consultants, researchers, and other industry professionals at all stages of their careers."

The new initiative will run for three years and kicked off with a one-day Early Career Workshop in July at the CCA seminar in Narrabri. It involved CRDC's CottonInfo Communications Lead Megan Woodward working with an enthusiastic group of young aggies on strategies for delivering an impactful 'elevator pitch' and approaching difficult

professional conversations with confidence. The group also spent a part of the day with experienced industry members who shared stories of their own professional journeys.

"The level of engagement at the first workshop was incredibly high, which I think is a great reflection on both the need for this type of early career support as well as the high calibre of young professionals keen to make the most of the opportunities they're given to build their careers," Megan said.

GRDC Grower Relations Manager – North, Vicki Green, helped to lead discussions at the workshop and said it was fantastic to see the support the participants offered each other in a new environment.

"Even though many initially felt nervous when charged with the task of public speaking, there was obvious support in the room for each other," Vicki said.

"It is not unusual to feel overwhelmed when new to industry and we wanted to create an event where participants were surrounded by peers with similar levels of experience.

"It was wonderful to witness networks being established at this first event and friendships building throughout the duration of the conference."

CCA's Events and Communications Manager Leisl Coggan was integral in setting up the workshop and said feedback has been overwhelmingly positive from both participants and their employers. She said more events are planned to be held in different regions, along with developing an industry mentoring program. Support will also be available for eligible applicants to attend major industry conferences.

"While the current job market appears promising for these graduates, a shared concern for CCA, and the cotton and grains industries is that without adequate support, these promising early career agriculturalists might succumb to burn-out and be lost to the industry before their careers have taken off," Leisl said.

"There are also concerns about the number of experienced consultants who are in a position to have a graduate work with them.

"Agriculture offers so many opportunities for graduates, yet we need to be mindful it can be daunting at first to give advice around the health of millions of dollars' worth of produce, so it can be a stressful environment if our newcomers feel they lack the support, experience and/or knowledge to make informed decisions, or even be a part in making them."

The value of people and access to skilled professionals is front of mind for CCA in the development and roll out of this initiative, particularly with the transition away from in-person to online learning, which naturally affects the way people connect and access information. This has resulted in lost opportunities for university graduates to create and foster vital support networks and gain 'on the job' experience.

"If we were asked to consider the reasons why you choose to work in the agricultural sector, a significant proportion of the answers would invariably revolve around 'the people'."

Employers have also reported concerns about what they describe as a lack of confidence in the areas critical to agricultural professionals such as interpersonal skills, communication and extension of knowledge.

An increasing number of graduates now hail from metropolitan areas, which means they may need another layer of support to navigate and enjoy a totally different living environment and new groups of people in regional areas.

"If we were asked to consider the reasons why you choose to work in the agricultural sector, a significant proportion of the answers would invariably revolve around 'the people'," CCA Executive Officer Doug McCollum said.

"Within agriculture, many of us have found like-minded peers with whom we share values, interests and a love of the lifestyle: it's this network that bolsters us in the hard times and celebrates our wins in the better times.

"For those who have spent some time in the sector, we know that while career paths may shift, we seldom stray far from our network or agriculture in general.

"While CCA will be delivering the events and programs for the initiative, CCA membership is not a requirement to participate. The program is open to university students and early career agronomists, researchers and rurally based early career professionals.

"To get involved, simply reach out to Leisl at CCA."

For more
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Emma Bond (right) at Glenn Rogan's property near St George (Kooma country), with three generations of the Rogan family: Julieanne, Annabelle and Robyn, dressed in her designs.

JEM HAWKER

Designing a future with Australian cotton

The annual Cotton Industry Awards were held at the 2023 Cotton Collective in Toowoomba (Barunggam country) in August, marking the first year CRDC has directly supported an award: the CRDC Chris Lehmann Young Cotton Achiever of the Year.

This year, the awardee was Gold Coast (Yugambeh country) fashion designer and industry advocate Emma Bond, originally from a family farm at Nevertire (Wiradjuri country).

This award recognises and celebrates the industry's future – those aged 35 and under making a positive contribution to Australian cotton. Emma was one of three finalists which included agronomists Jacob Thuijs of St George (Kooma country) and Kate Lumber of Moree (Kamilaroi country).

"CRDC is proud to support the Chris Lehmann Award for the first time, after many years supporting behind the scenes as part of the judging panel," said CRDC's General Manager Communications and Extension, Ruth Redfern, who is CRDC's representative on the panel.

"Our congratulations to Emma, Jacob and Kate on being finalists for 2023. Despite their relatively short careers in cotton so far, they have already made large contributions, making this extremely difficult to judge."

Emma promotes cotton and creates cotton designs through her label Madi and Pip and is passionate about sustainability and circularity. She was part of the 2022 cohort of the CRDC and Cotton Australia Future Cotton Leaders program, attended the Global Fashion Summit in Copenhagen in June alongside Cotton Australia's Brooke Summers, and showcased her designs at the fashion parade at Brisbane's EKKA in August.

"From the beginning, when I launched Madi & Pip in 2020 I chose to lead with Australian cotton fabrics," Emma said.

"It has always been my first choice for design, given its quality, the sustainability credentials of Australian cotton, and its local provenance, which I promote at shows and conferences.

"With lived experience from life on the land, I felt I was in a unique position to celebrate Australian cotton and re-humanise the story of how our clothes are made – which starts with the fibre."

Emma says the supportive nature of the cotton industry and its people are also key influences on her choice of fibre.

"I love that our growers are family farmers,

people that love their land and are active in their communities.

"Being invited to showcase at regional events, like the Spring Ridge Fibre to Fashion luncheon has allowed me to personally meet so many incredible people: you are all such great people!

"And when I see someone who works and lives in cotton wearing their own local cotton – one of my designs – it gives me a tremendous sense of pride.

"I am inspired by you to make premium quality designs that will last a lifetime – showcasing our fibre to the world."

Industry advocacy is a big part of Emma's ethos and her educational work *Wrapped in Cotton* engages youth, challenging students to design with Australian cotton. Emma also works with students and secondary school teachers to promote fashion circularity and Australian cotton's natural fit within this – connecting teachers to the learning resources she's developed in collaboration with Cotton Australia.

"It is important that we recognise customers are citizens, people that make choices," Emma said.

"Education can be used to rehumanise our industry so that people value the resources and skills utilised to make their clothes.

"What we buy says what we value, and ultimately creates the market: we can all use our purchasing power to speak our values.

"This award is a tremendous honour and I am very thankful, it is so great to be included in and celebrated as part of the cotton industry.

"Growing up, I loved living on the land, but working the land was never my calling.

"I'll be great company for you up the paddock – but I'm still rubbish at starting siphons! I really love that we are a diverse industry and I have found my place where I can let my passion soar, constantly challenge myself and help create genuine change to the fashion system."

As part of CRDC's support for the Chris Lehmann Young Achiever Award, Emma will be attending the Australian Rural Leadership Foundation's TRAIL program for emerging leaders in Canberra (Ngunawal country) in early 2024.

Among other awardees on the night were Johannes and Scarlett Roellgen from Tyunga Farms, Brookstead (Barunggam country) as the 2023 Bayer Cotton Growers of the Year. They have been growing cotton continuously on their farm for 29 years. Despite the challenges of drought and floods they have consistently improved their yields.

The Roellgens are passionate about reducing chemical use through the application of feedlot manure and insect pest management. They have also increased their water efficiency through laser levelling fields to improve flood irrigation, while investing in lateral move irrigators to further enhance efficiency. They highlighted *my*BMP as being extremely helpful in honing many practices, encouraging others to get on board.

CRDC's Allan Williams and Emma at the awards dinner.

Fellow Darling Downs grower Daniel Skerman of Skerman Farms at Dalby (Barunggam country) was the AgriRisk High Achiever Awardee. With an agronomy background, Daniel has a deep commitment to recording and tracking data to monitor the overall cost of production and maximise the use of every drop of water.

The Cotton Seed Distributors Researcher of the Year Award went to Dr Jamie Hopkinson from Qld DAF in Toowoomba. Jamie has made a significant contribution to the Australian cotton industry through his research into entomological issues, managing the industry's silverleaf whitefly resistance testing program with support from CRDC. Other finalists in the researcher category were also CRDC-supported: Guna Nachimuthu of NSW DPI, nominated for his important work in benchmarking soil carbon and soil properties, and Stacey Vogel of CRDC and CottonInfo, nominated as part of the team who led the Landcare Tech Innovations project to improve biodiversity on cotton farms.

"These awards have again displayed our industry's depth of talent and knowledge, and the potential to be even better than what we are today in growing Australian cotton," Cotton Australia CEO Adam Kay said.

"The award recipients and all nominees give me extra confidence that our cotton will continue to be considered among the best in the world while leading in sustainability outcomes."

Each year a Service to the Cotton Industry Award is announced, supported by Incitec Pivot Fertilisers. This year, that honour went to Peter Birch from Moree (Kamilaroi country) who has demonstrated a passion for agriculture and for supporting young people into agricultural careers since he first started as an agronomist in the 1980s.

For more
www.cottonaustralia.com.au/awards-recipients

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