

Spotlight

ON COTTON R&D

AUTUMN 2023

Taking a stand on human rights

WAND shines light on science of drift

The value of native vegetation





Dr Ian Taylor

In the Spotlight

Welcome to 2023 and the Autumn edition of *Spotlight on Cotton R&D*.

We're nearing the pointy-end of the season in most regions, in what has certainly been an interesting one. Growers battled floods in NSW and a cool, wet start across many parts of Queensland to get crops into the ground and make up for lost time.

Growers did well to turn a tricky start into a promising season, only to discover there had been widespread drift events prior to Christmas, which continued into the New Year across most growing regions. CRDC will continue to work to end spray drift through research and development. The roll out of WAND represents our commitment to invest in technology to give crop managers in cotton and grains another powerful tool in the arsenal of best practice. If you're a grower who is using WAND, we'd really appreciate you spreading the word with others, as with all innovation, uptake will determine success. WAND gives users another level of due diligence and a commitment to best practice spray application.

Due diligence doesn't just apply to spray drift, nor is it just confined to on farm – it's something we need to consider throughout our entire supply chain, and across issues like human rights abuses. CRDC's taken a lead role through research to explore how we can help curb human rights abuses in value chains that handle our fibre. It's a new way of thinking about where the Australian cotton industry's responsibilities start and end, by looking downstream all the way from our farms to the consumer. Already, our consumers, brands and retailers are looking for products free from human rights abuses. Australia has the opportunity to show leadership in the cotton industry globally with this initiative, which will be realised through the Australian Cotton Strategic Roadmap.

CRDC's also ensuring the safety and sustainability of our domestic cotton industry workforce by working one-on-one with growers to give them superior skills to attract and train people. A part of this is creating workplaces of choice, run by employers of choice, where staff feel valued and 'psychologically safe'. While this may seem like a new concept, it's an old problem. It means workplaces where people feel valued, cared for and free of any bias or vilification. Make sure to sign up for the 'Unconference' in June.

Also on the home front, consultation is about to start with growers around a model for native vegetation management. It is part of the process to create targets for the Australian cotton industry's Sustainability Framework PLANET. PEOPLE. Paddock.

PLANET. PEOPLE. Paddock also helps underpin the new CRDC Strategic RD&E Plan for 2023-28, which is currently being developed. It's an exciting time for CRDC and cotton research, with a bold, ambitious new plan built around the theme of 'clever cotton'. We've included a snapshot of the proposed plan in this edition.

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.



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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:
The Australian cotton industry is looking closely at who makes our clothes, by supporting targeted research to help curb human rights abuses in our value chains.

Want to see more of Spotlight?

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

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Cotton weed ID in your pocket

THE Weeds of Australian Cotton app builds on key industry publications including WEEDpak in identifying 50 key weeds found in cotton farming systems.

To help tackle weeds early, the app includes cotyledon shapes as an important diagnostic characteristic. As crop managers know, weed identification in early growth stages is critical, as similar-looking species often have different control requirements. Waiting for diagnostic features like flowers and fruit to appear means the optimal window for control has long passed.

The app was developed through the CRDC project Staying ahead of weed evolution in changing cotton systems and is based on WEEDpak and other research supported by CRDC.

It's suitable for all smartphones and available for free from the Apple App and Google Play stores.

For more

www.cottoninfo.com.au/weeds-australian-cotton-app

Taking a proactive approach to native vegetation

THE *Native Revegetation Guide for Australian Cotton Growers* is a new resource, now available to download from the CottonInfo website.

The guide is the first cotton catchment-specific guide based on research for revegetation and will help growers plan, prepare, plant, grow and monitor revegetation sites.

Based on research by Dr Rhiannon Smith from the University of New England, it also identifies other relevant research and extension products and tools that can help inform revegetation projects on cotton farms and, as an interactive online resource, has a 'click through' function to take users to them.

The guide comes as more and more cotton growers look into revegetation to boost their on-farm biodiversity.

"Protecting and enhancing biodiversity is essential because biodiversity delivers ecosystem services that growers and communities enjoy and depend on," CRDC R&D Manager for Natural Resource Management Stacey Vogel said.

"Revegetation supports habitats for natural pest control agents, soil stabilisation and carbon sequestration and provides shade and shelter for stock and windbreaks.

"It also strengthens ecosystem functions that sustain healthy environments, such as nutrient cycling, microclimate regulation and waste improvement.

"More landholders are looking to attract economic benefits, such as agroforestry, natural capital and carbon accounting."

Stacey also said that revegetation plays an important role in meeting sustainability goals and demonstrating good environmental stewardship.

"Australian cotton recognises sustainability is integral to the industry's future and is setting targets to improve farm and cotton landscape biodiversity conditions.

"This new guide will help growers and the industry meet those important targets."

This guide is an outcome of the Cotton Landcare Tech Innovations 2021



project, funded by CRDC with support from the Australian Government's National Landcare Program Smart Farming Partnership Initiative Round 1.

CRDC has invested in several projects to support land managers to understand, measure and protect biodiversity.

Available on the CottonInfo website, *Managing Biodiversity in Cotton Landscapes* is one such resource, providing biodiversity information for every Local Government Area (LGA) in Australian cotton growing regions. In total, 490 vegetation types were mapped across cotton landscapes, 348 of which occur on cotton properties. The mapping showed approximately 26 per cent of the cotton landscape and 21 per cent of the combined extent of all cotton properties retains a cover of remnant native vegetation.

How native vegetation is managed and its impact on future access to world markets is explored in the 'Leaving a legacy to be proud of through native vegetation' article on page 18.

For more

Native Revegetation Guide:

www.cottoninfo.com.au/publications/native-revegetation-guide

Managing Biodiversity tool:

www.cottoninfo.com.au/managing-biodiversity-cotton-landscapes

First of its kind guide for cotton farm revegetation

Creating a revegetation guide for cotton farms has required collating measurements and undertaking trials across NSW to provide the first research and publication of its kind specifically for cotton growing environments in Australia.

“Some of the most fertile soils in Australia can be found in cotton growing regions, but that doesn’t mean it’s easy to grow trees here as these plains can be hostile towards woody plants” is how Dr Rhiannon Smith describes the challenges of revegetation in heavy clay soils. It’s also why the new *Native Revegetation Guide for Australian Cotton Growers* guide will be so useful for landholders. Working with nature and knowing the soil in this unique landscape is key.

Rhiannon has been involved with cotton industry research for nearly two decades, covering biodiversity, ecosystem services, vegetation management, and most recently, exploring methods of revegetation in these intriguing soils found in cotton growing regions. Her CRDC-supported work provides the basis for the new guide, published by CottonInfo. It’s ground-breaking in every sense of the word, as Rhiannon has provided the first scientifically based information for re-vegetating semi-arid cotton growing floodplain landscapes.

“This floodplain environment breaks all the rules, it is the exception to the rule,” Rhiannon says.

“I learned this while I was completing my PhD – the methods you would usually use in a lab to assess carbon content or cation exchange couldn’t be used, I had to use methods specifically created for these heavy clay, high pH soils.

“Understanding the idiosyncrasies of the soil and how they relate to native vegetation has been a major component of my research.

“Flood frequency, duration and extent drive soil moisture, which, in turn, drives vegetation communities, the plant species that are present and the height and density of the vegetation.

“In the floodplain environments where cotton is grown, the influence of soil moisture availability is pronounced, it is definitely the limiting factor in these highly fertile soils.

“But the soil itself is thirsty too. For example,



we found that heavy cracking clay soils can have 15 percent soil moisture, but the plants can’t access it. And when the soil cracks, the woody roots of trees are torn apart.

“Cotton growers know this and how it drives cropping, so thinking about their revegetation in the same way makes sense, and this guide gives reliable scientifically-backed guidance.

“Revegetation is basically another crop, it requires planning, ground preparation, pest control, watering and weed control.”

The significance of this guide is that it is specific to these environments, alerts landholders to all the things that could go wrong and helps them plan to avoid the pitfalls.

“The guide draws on research which allows landholders to work with nature to put species back in the landscape where they occur, in the environments they are adapted to,” Rhiannon says.

The cost of revegetation may be seen as a barrier to starting any program. Though costs will vary through time, the guide offers different scenarios and options.

“There are different price points depending on the goals of the landholder and the methods used – it depends on what you want to do and want to achieve.”

Extensive research and trial work has been undertaken to understand how to both manage and improve native vegetation on cotton farms. Trials like this at Maules Creek near Narrabri (Kamilaroi country) run by Dr Rhiannon Smith provide data and information which feeds into the new guide.

For more

Dr Rhiannon Smith

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Tracking carbon sequestration and biodiversity

THIS March, Dr Rhiannon Smith of the University of New England is recommencing the first large-scale carbon sequestration and biodiversity survey in native vegetation in the cotton industry, with survey sites stretching from Emerald (Gayiri country) to the Murrumbidgee (Wiradjuri country).

This exciting project builds on Rhiannon's survey work from 2012–2015 measuring carbon storage and biodiversity conservation in native vegetation on cotton farms which, like this project, was supported by CRDC. She will now resurvey those sites to check carbon flux between March and May and return in September through to November to track biodiversity (birds) in native vegetation.

"This is really interesting as we are going from carbon storage to sequestration data, which allows us to start thinking about carbon neutrality, creating opportunities for new methods

under the Emissions Reduction Fund (ERF) for carbon credit generation," Rhiannon said.

"We will also collect data relating to biodiversity conservation value, which is also now attracting payment through the Federal Government's environmental stewardship programs.

"These schemes will grow into the future and generate alternate income streams for those landholders that have large areas of native vegetation on farm.

"Providing landholders with the information they need to understand the value of native vegetation on farm will provide some confidence when negotiating payments for these ecosystem services."

For more:

Dr Rhiannon Smith

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MELANIE JENSON

Rhiannon at work during the 2013 survey of carbon levels in riparian zones.

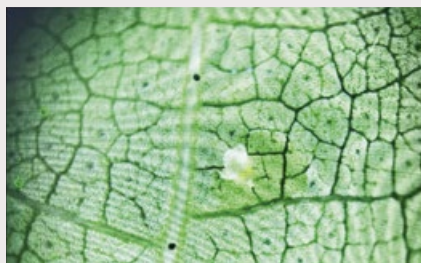
Download the newest tool in pest detection

AFTER initial trials across cotton growing regions last season, the Cotton PestDetect App is now available for use by crop managers as part of its testing phase. It's the newest tool to manage silverleaf whitefly (*Bemisia tabaci*), a notoriously hard pest to sample because adults are so small and mobile.

The Cotton PestDetect App has countered this by sampling whitefly nymphs, detected using a mobile phone camera. During the initial trial phase, consultants said the ability to detect parasitism was seen as critical and this is now also a function of the app.

The software is based on research and development by Drs Derek Long and Alison McCarthy from the University of Southern Queensland's Centre for Agricultural Engineering, with support from CRDC and in partnership with QLD DAF and CottonInfo Integrated Pest Management (IPM) Technical Lead Dr Paul Grundy. PestDetect is used in conjunction with the SLW decision support tool (DST), developed by cotton's leading whitefly researcher, QLD DAF's Dr Richard Sequeira.

The app counts SLW nymphs



and integrates this information with crop development and pest density thresholds to assist users to make better-informed management decisions. Using geotagged image analysis, the app allows users to create maps of where pests may be building more rapidly on individual farms or fields. It can also enable timely, impartial measurement of the efficacy of insecticides.

"The app will calculate the same risk zone for each sample at a management unit as if a trained professional was manually inspecting the photos," Paul said.

"It also has the ability to detect if nymphs are viable using an add-on microscope lens, providing a count of parasitised and viable nymphs, automatically calculating the percentage

of viable whitefly.

"The parasitism checking should be done if SLW numbers start getting a bit higher, and traditionally sampled parasitism can be substituted into the DST."

The app is not configured for other pest sampling however can give an indication of cotton aphids which are found on a similar area of cotton plants to SLW. The exact counting of aphids and output in relation to recommended thresholds is still a work in progress and will be displayed as aphid 'V' if detected.

"The ability to sample SLW with your phone and take the guess work out of parasitism assessment should save users a lot of time," Derek said.

"The automatic calculation of action thresholds via the DST within the app will be welcomed by crop managers."

Crop managers who wish to use the app are encouraged to contact Derek or their local CottonInfo Regional Extension Officer.

For more

Dr Derek Long

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Seeing things from a new angle: Justin completes ARLP

Justin McMillan of Australian Food and Fibre (AFF) recently graduated from course 28 of the Australian Rural Leadership Program (ARLP).

As he was about to embark on his 18-month experiential ARLP journey in 2021, Justin said he felt ready to experience a higher level of professional development.

Now he has completed the course, he says it was an eye-opener.

“You hear this a lot – ARLP took me way out of my comfort zone,” said Justin.

“At first, I wondered what I had gotten myself into. How was I going to interact with this group of highly intelligent and accomplished people?

“However, it didn’t take long for those feelings to disappear as I realised that everybody was feeling the same way.”

The course usually begins with the infamous ‘Kimberley experience’, but due to COVID-19 it was last on the agenda, with the first group catch ups via Zoom.

“Initially this made it difficult to interact and I did struggle with that a bit, but once we got together face-to-face in Gippsland (Gunaikurnai country) for 10 days, I was able to immerse myself more in the experience.

“The Kimberley (Gooniyandi country) session was awesome. We knew each other by then which may have changed the experience from most other cohorts, but it really made it for me.

“Learning by doing and being off grid for 12 days with zero distractions was great, and I was finally really grasping some aspects of what we were learning.

“Habits that I had cultivated over many years of doing the same thing really showed up. While those habits had helped me get the job done over the years, the Kimberley session showed me that if you slow down and take the time to look at things from or at a different angle, the job will likely get done faster and more efficiently.



MurriMatters’ Scott Gorringer, Justin McMillan, AFF’s Bernie George and the Australian Rural Leadership Foundation’s Margaux Beauchamp at Justin’s graduation from ARLP.

“Looking back over the course, I have more confidence that I am a good leader, and have been incorporating a lot of the learnings into my daily life.

“I now know I need to be more curious about situations I don’t properly understand and ask the type of questions that give me the answers that satisfy that.

“To stop and think in the heat of the moment and look at things from as many angles as possible has been a big learning, along with the importance of self-reflection.”

From Nevertire (Wiradjuri country) in the Central West of NSW where his family farmed, Justin has worked in cotton for more than 25 years across various valleys. He’s now based at “Midkin” Moree (Kamilaroi country) as of Chief Operating Officer for AFF overseeing its farms in the Border Rivers, Gwydir, Namoi, Darling, Macquarie and Murrumbidgee valleys.

“I’ve been in cotton a while now and we get centred on what we are doing,” he said.

“I was nervous going into the course as being in the cotton industry and coming out of drought, water was a big issue, but everyone was interested and if someone wanted to know something they asked.

“It didn’t take long to realise that

different agricultural industries share similar problems which highlights the need to work across industries in such areas as, regulations and public perceptions.”

As a part of his current role Justin is responsible for close to 100 employees at certain times across the AFF farms.

“The feedback throughout the course gave me the confidence that where I was going is down the right path,” he said.

“In a management role, I’m aware that I have to manage my own expectations and the expectations of our employees.

“I would like to thank AFF, Cotton Australia and CRDC for giving me this opportunity. I hope that some of the skills learned will pay back 10-fold to the cotton industry and the AFF team.

“It is important that strong voices from rural and remote regions continue to be heard and that takes strong leadership.”

CRDC, Cotton Australia and AFF sponsor up to two ARLP participants each year. To register interest, email info@rural-leaders.org.au. Applications for the next round open later this year.

For more

www.rural-leaders.org.au

What's the future of cotton RD&E?

Once every five years, CRDC develops a new Strategic Plan. This plan is the roadmap that guides all of CRDC's research, development and extension (RD&E) investments for the following five years. CRDC's next plan – which will cover the 2023-28 period – is now being built.

In this *Spotlight* feature, CRDC's Executive Director Dr Ian Taylor outlines the proposed plan.

Clever cotton

Our new plan focuses on the concept of *Clever cotton* – CRDC's vision for a sophisticated, prosperous cotton industry, connected through its value chain, delivering sustainable cotton.

As the industry has come to expect, the plan is bold: defining what we aim to achieve over the next five years, and what we will do to get there. It recognises that our industry operates in uncertain times and needs 21st-century approaches to overcome 21st-century challenges.

The plan commits us to investing in RD&E to address and capitalise on challenges and opportunities for the benefit of levy payers, the cotton industry and the wider community.

Importantly, the strategy is founded on the Australian cotton industry's sustainability framework, which recognises that sustainability is integral to the industry's future and provides a path for the entire industry.

It charts an ambitious new course through three pillars of investment – PADDOCK, PEOPLE, PLANET – drawn from the sustainability framework. Each pillar contains three themes, creating nine key investment areas. By adopting this approach, our RD&E will focus on industry priorities and long-term challenges to leverage higher investment returns and deliver the greatest impact.

Our goal is that by 2028, our industry is thriving, thanks to increased productivity and profitability, by sustainably addressing the impacts of climate change, and by improving decision making using data and digital technologies.

Of course, we cannot achieve these aspirations alone. 100 per cent of CRDC's investments are delivered in partnership with a trusted research partner: this will continue with current and new partners from 2023 to 2028.

The building blocks

CRDC will invest across three pillars and nine

themes to achieve our vision and deliver the greatest impact. These pillars and themes are distinct yet interconnected. Each supports the other while directly targeting its own bold strategic priorities:

- ◆ Paddock: Data-driven decisions; Adaptive systems; Connected market intelligence
 - ◆ People: Design and innovation; Leadership and capacity; Adoption and impact
 - ◆ Planet: Natural capital; Carbon; Circular economy
- Let's take a closer look at the three pillars and nine themes.

PILLAR 1 – PADDOCK:

Our future fields

Paddock focuses on the on-farm cotton system. The themes of this pillar – Data-driven decisions; Adaptive systems; and Connected market intelligence – unite data and insights to support growers to produce a premium product.

We will measure our success in this pillar by the economic value the three themes add to the industry over the next 10 years. Our target for added value is \$1 billion. Did we mention this plan is ambitious?

– Data-driven decisions

Improved data collection and data-driven insights mean cotton growers are able to increase their productivity and profitability. A substantial amount of data is already collected and stored on farms and through the supply chain, but cotton needs more comprehensive, consistent, trustworthy, and reliable data that is centralised and linked to fully take advantage of these opportunities. The objective of this theme is to improve productivity, profitability and sustainability by accurately monitoring and measuring every field on every cotton farm. By 2028, CRDC aims to have built a transparent and trusted data platform that will help growers with decision-making

– Adaptive systems

The future is increasingly complex. Our industry faces escalating threats and pressures that will affect how, where, and how much cotton we produce – like adapting to a changing climate, growing more cotton with fewer inputs, remaining resilient to changing and new disease, pest and weed challenges, and responding to market and community expectations on sustainability. Our goal is to secure the long-term



Clever Cotton

A sophisticated, prosperous cotton industry, connected through its value chain delivering sustainable cotton.

profitability and resilience of our cotton farms, via developing adaptive farming systems and supporting faster adoption of new solutions, technologies, and practices. By 2028, our system will be resilient, biosecure, and able to thrive in an increasingly variable climate with limited water and reduced inputs.

– *Connected market intelligence*

Retailer, brand, community and investor expectations are evolving: demanding better transparency, more sustainable and ethical practices, and reductions in environmental impact. Some jurisdictions have already started to regulate aspects of the textile supply chain. And because we export 99.9 per cent of our cotton, Australia will be directly affected by these changing expectations. As such, the objective of this theme is to enhance the sustainability, market access and value of Australian cotton. Our goal by 2028 is that Australian cotton growers are considered preferred global suppliers of sustainable cotton.

PILLAR 2 – PEOPLE:

Central to our success

The people pillar recognises that people are central to cotton's success. The themes of the people pillar – Design and innovation; Leadership and capacity; and Adoption and impact – ensure that in developing our world-class research capability, we are providing practical RD&E solutions and increasing the reach and impact of adoption.

– *Design and innovation*

Innovation is driven by people. As cotton tackles

more complex and competing forces in coming years, our people will be called upon to problem-solve, innovate and respond to challenges at an accelerated pace. This theme puts collaboration at the heart of research: people working together to prioritise, design, develop and adopt research. By 2028, our goal is that you, our growers, are closer to the RD&E system, that you can see RD&E addressing your needs, and that this results in practical solutions that can be adapted and adopted into your farming system.

– *Leadership and capacity*

Delivering world-class RD&E for the benefit of Australian cotton is the core business of CRDC. To achieve this, we must effectively build and maintain a diverse, world-class RD&E workforce, plus build leadership capability. This theme aims to do that. It will help ensure the industry has access to the right skills and capacity to support research and development. And it will help support the industry to develop more diverse leaders with the skills and knowledge to lead change and drive sustainable prosperity.

– *Adoption and impact*

Moving innovations from concepts to widespread practice change is critical to delivering a prosperous and sustainable future. To meet the challenges ahead, cotton growers will benefit from effective extension, adoption and, where applicable, commercialisation of CRDC's RD&E investments. Cotton's extension program CottonInfo is already pivotal in building relationships between innovation stakeholders, including researchers, growers and commercial providers, and this theme builds on that success to increase research adoption rate, reach and effectiveness.

PILLAR 3 – PLANET:

Our shared future

Planet is the third pillar. It recognises the importance of environmental sustainability in ensuring a successful future for the cotton industry. The themes of the Planet pillar – Natural capital; Carbon; and Circular economy – ensure that the cotton industry contributes positively to the environment, meeting community, government and market expectations.

CRDC will measure its success in this pillar by the level of trust the industry has regarding how it manages and reports on its environmental and social impacts.

– *Natural capital*

Research shows that the community's trust in ag is driven primarily by its environmental impacts and responsiveness to community concerns. As the pressures of climate change and habitat loss intensify, we must provide evidence of cotton's environmental benefits to avoid the risk of declining community trust, and to capture the benefits of increasing community acceptance. At the same time, our cotton farming systems benefit from the ecosystem services provided by natural capital. Good soil health, strong biodiversity, and clean air and water deliver significant tangible and intangible value, including boosting farm yields and reducing farm inputs. This theme will help cotton farms benefit from enhanced natural capital conditions and demonstrate their greater contribution to the resilience of regional communities and ecosystems.

– *Carbon*

In the Australian Cotton Sustainability Framework, the cotton industry aspires to contribute to the Paris Agreement's aim for a

climate-neutral world. To achieve this, growers need to reduce cotton production emissions – especially those associated with nitrogen (N) – and sequester carbon on-farm in the soil and vegetation. Through the Carbon theme, our RD&E investments will play a major role in helping growers meet this challenge. The theme aims to help the cotton industry meet market, community and government expectations for carbon by helping to establish a sustainable low-carbon cotton production system.

– *Circular economy*

Cotton has a natural fit in a circular economy. It's a natural, biodegradable, renewable, and recyclable fibre that can be returned to the earth. It can also be recycled and reused through the deconstruction of waste textiles and re-spinning of the fibres. There is a need to explore how all cotton-based products can be reused and repurposed as many times as possible before they reach their product end-of-life and can be returned to the soil. To capitalise on circularity's social, economic, and environmental opportunities, the industry must accelerate action. This theme supports the cotton industry's participation in the circular economy, with an initial focus on providing lasting end-of-life solutions for cotton-rich textiles. The ultimate ambition is to work towards developing a circular economy for Australian cotton.

That's the overview of the Plan. On the snapshot (opposite page), you can see how the three pillars and nine themes stand individually, but also interdependently.

What happens next?

The CRDC team and board will continue to work on the Strategic Plan over the coming months. We're now coming to the end of our consultation period, where we've asked for feedback from growers, researchers, consultants, key industry bodies and the government.

There's still time to have your say: if you have thoughts on the plan, please send them to us via our website or by calling a member of our R&D team, headed up by Allan Williams.

Based on the feedback we've received, we will then finalise the plan and it will go to the Minister for Agriculture, Fisheries and Forestry for approval. The plan will come into effect on 1 July 2023.

From there, the real work begins, as we start to implement the plan and deliver against its bold ambition: achieving clever cotton.

For more

CRDC Strategic RD&E Plan

www.crdc.com.au/strategicplan



Clever Cotton

Snapshot: CRDC's Strategic RD&E Plan 2023-28

Paddock

Our future fields



Data-driven decisions

Objective
Improve productivity, profitability, and sustainability by accurately monitoring and measuring every field on every cotton farm.

Impact
In 2028, a transparent and trusted data platform will deliver increased profitability and productivity through better decision-making, facilitate innovative research, and build trusted engagement.



Adaptive systems

Objective
Grow the profitability and resilience of Australian cotton-farming systems through innovative solutions, technologies and practices.

Impact
In 2028, Australian cotton farming systems are resilient, biosecure, and able to thrive in an increasingly variable climate with limited water and reduced inputs.



Connected market intelligence

Objective
Enhance the sustainability, market access and value of Australian cotton.

Impact
In 2028, Australian cotton growers are preferred suppliers of sustainable cotton.

People

Central to our success



Design and innovation

Objective
As the foundational principle, collaboration drives prioritisation, design, development, and adoption.

Impact
In 2028, growers can see RD&E addressing their problems and creating practical solutions to be adapted and adopted into their production systems.



Leadership and capacity

Objective
Develop people and skills to support industry RD&E.

Impact
In 2028, the development of world-class research capability supports industry goals.




Adoption and impact

Objective
Adopt knowledge and technology through dedicated development and delivery pathways.

Impact
In 2028, adoption has increased its rate, reach and effectiveness.

Planet


Our shared future



Natural capital

Objective
Implement resilient natural capital practices that support productivity, help maintain biodiverse ecosystems, strengthen capacity for adaptation to climate change, and progressively improve land and soil quality.

Impact
In 2028, cotton farms have maintained and enhanced natural capital and are more resilient to shocks.



Carbon

Objective
Establish a sustainable low-carbon cotton production system for a changing future.

Impact
In 2028, the cotton industry meets market, community and government expectations for carbon.



Circular economy

Objective
Develop the circular economy for Australian cotton.

Impact
In 2028, the cotton industry can participate in the circular economy, providing lasting end-of-life solutions for cotton textiles.



Supporting workers' rights around the world: who handles our cotton fibre?

Australian cotton enjoys a reputation as a crop grown under decent working conditions. However, once our cotton is shipped offshore and enters the global value chain, visibility is lost in an opaque system.

Textile manufacturing is one of the industries where modern slavery occurs, with women and children disproportionately represented. Are workers in our value chain treated fairly? Or are they among an estimated 50 million people across the world working under modern slavery conditions, 24.9 million of whom are in a form of forced labour?

Labour concerns in the cotton value chain after it leaves Australian shores include poor health and safety, human rights abuses, lack of freedom of association, and forced and child labour.

Organisations acting alone have been unable to address these issues, leading to ongoing exploitation of workers. And while labour abuses may occur anywhere in the chain, labour-intensive manufacturing is an area of particular concern.

Labour abuses in global supply chains are notoriously hard to monitor, but this is starting to change. Human Rights Due Diligence (HRDD) legislation has been coming into force around

the world. The modern slavery acts of the UK and Australia plus numerous corporate due diligence acts are now requiring companies to take greater responsibility for the human rights issues that may be occurring in their supply chains.

Practices occurring 'downstream' from Australian cotton growers – that is, within the value chain once cotton leaves Australian shores – represent a risk to the industry and to our partners, such as brands and retailers. Positive action represents an opportunity to demonstrate Australian cotton's commitment to human rights and sustainability.

Ensuring what goes on downstream doesn't stay downstream

A commitment to positive action is why CRDC commissioned research in 2019 to better understand labour issues along the Australian cotton value chain and to recommend strategies for the industry to explore. The research was led by Dr Alice Payne of the Queensland University of Technology (QUT), with colleagues from QUT, University of Technology Sydney and University of Notre Dame Australia. The project aimed to highlight the connection between critical labour conditions in the textile and apparel industry and the cotton grown in Australia, creating an opportunity for Australian cotton to support improvements. The study particularly focused on

the manufacturing segment of the value chain, noting that labour abuses may occur anywhere in the chain, however garment manufacturing, as the most labour-intensive part of the supply chain and employing an estimated 60 million workers globally, is an area of particular concern.

“There is a really unique opportunity to involve Australian cotton growers, merchants and spinners in the global campaign for fair working conditions throughout the textile and garment supply chains,” said Alice.

“The Australian cotton industry could play a part in helping to stop slavery and human rights abuses once cotton leaves our shores.

“In doing so, Australian cotton would become one of the first agricultural industries in the world to show due diligence by approaching labour conditions in the value chain with a new perspective – by looking downstream.”

Generally, the scrutiny of the product is from retailers seeking to look ‘upstream’ all the way back through the supply chain to cotton growers. Alice’s proposal flips this around, and suggests instead scrutiny looking ‘downstream’ from growers to retailers.

“It’s an opportunity for our industry to contemplate what happens to Australian cotton fibre when it leaves our shores – and why this matters,” CRDC General Manager R&D Investment Allan Williams said.

“Whose hands does our cotton move through, and what conditions are they working under?”

“While slavery through the post farm gate value chain will not be solved by the Australian cotton industry alone, that’s no reason not to take measures to strengthen our industry and the sustainability credentials of our fibre.

“This research allows us to better understand the risks that labour issues post farm gate may represent to the Australian cotton industry and assess targeted strategies to address them.”

What happens post farm gate?

Increasingly brands and retailers want to, and are required to, undergo due diligence in looking back upstream to understand where their cotton has come from and the conditions under which it was made.

Participants in the research agreed that the approach looking ‘downstream’ at the chain was very unusual.

“It is very challenging for growers or traders in cotton to exert influence over how and where cotton can be sold as it passes through multiple steps in the chain. However it is not inconceivable,” Alice says.

“There are examples from other industries such as pharmaceuticals and electronics where there is both downstream as well as upstream due diligence.”

Further compounding these challenges along

the chain is at the point of spinning, as cotton from Australia is often blended with cotton from other regions, based on the spinners' requirements. This adds exponentially to the complexity of determining the origin of the fibre as well as the working conditions at each step in the chain.

"What we have is super-complexity: tangled supply chains that are almost unfathomable," Alice said.

"As some of our participants termed it, the middle of the supply chain is like a black box, it becomes so opaque."

To stay ahead of the regulatory curve, there is an opportunity for the Australian cotton industry to play a more active role in seeking to address these labour issues, and in so doing, help our supply chain partners who are seeking to do their due diligence from the other direction.

The research report *Solutions Approaches to address Downstream Labour Abuses in the Australian Cotton Value Chain* proposes seven pathways for the industry to consider.

"The big goal we propose for the industry is that no Australian cotton will enter supply chains with labour abuses," Alice said.

"The opportunity is to enhance the reputation of Australian cotton with a view to establishing an ethical brand."

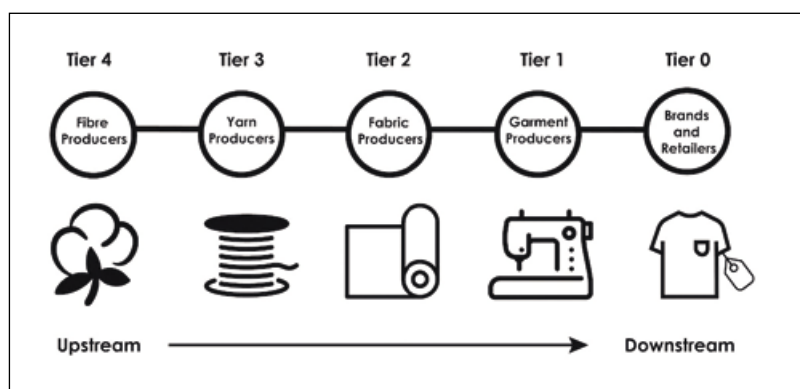
The seven approaches are:

1. Downstream due diligence

This could be promoted through a range of actions for cotton traders, from introducing new voluntary guidelines or reporting requirements, to even introducing mandatory due diligence obligations through contractual clauses with their buyers.

2. Australian cotton certification

Consideration of labour rights could be integrated with the Australian Cotton Mark certification through introducing an additional criterion on labour rights. This could be a unique opportunity for the industry to link its product to clean supply chains by adopting a holistic approach to social sustainability certification.



3. Transparency and supply chain visibility

Merchants trading cotton can take small steps to improve supply chain transparency to allow for the untangling of Australian cotton's complex supply chains. Partnering or connecting in with other global initiatives working from the other end of the supply chain could be beneficial.

4. Traceability

Traceability allows insight into the journey of a commodity throughout the supply chain, which supports the certification of sustainability credentials. It can also be used to verify the origin of the cotton used in a product. Importantly, when used holistically, it could also help verify that labour standards are being met throughout the chain.

5. Right-shoring

This involves identifying the 'ideal mix of offshoring, nearshoring and onshoring' based on the specific needs of a business and industry. Right-shoring is an opportunity to bring back some elements of manufacturing onshore if the energy and labour costs were right. The value-added element and the ability to control the branding further.

6. Strategic partnerships

Includes a shift from 'transactional or non-committal relationships' to 'medium- to longer-term volume commitments and strategic alignment with suppliers'. This would positively impact labour conditions through challenging the current fast fashion model. Increased collaboration between supply chain actors with shared values can increase supply chain resilience and visibility.

7. Collaborating with worker-driven initiatives

There is an opportunity for the Australian cotton industry to make real change on the ground through worker-driven social responsibility (WSR) centred around the voices of workers as agents of change. For example: collaborating with a worker-driven initiative project to support the implementation of training programs in spinning mills, fabric mills, or garment factories that process Australian cotton.

The Australian cotton industry is already supporting the improvement of working conditions through collaborating with other actors and existing initiatives, in particular through the Australian Cotton Industry Roadmap, which is addressing human rights.

For more

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Australian cotton industry will not look away from human rights abuse

The Australian cotton industry has a product the world wants: a high-quality fibre, grown with high sustainability standards, based on world-leading RD&E, and without human rights issues.

These credentials have served the industry well, but the landscape is changing as customers' expectations change both here and overseas. Brands and retailers are now looking to ensure there are no human rights abuses occurring in the value chain, not just on the farm.

Brands, shareholders and consumers, horrified by stories like collapsing garment factories in Bangladesh and forced labour camps in Western China, are calling for assurances that basic human rights are upheld right through the supply chain. Global frameworks and legislation are demanding it, and will make market access into places like the EU impossible without evidence to support sustainability and human rights claims.

"Human rights are a massive issue for the cotton industry globally, and there are many known issues in the textile value chain," says Cotton Australia's Cotton to Market supply chain consultant Brooke Summers.

"Our customers want products on their shelves that were grown and made with no human rights abuses.

"This presents both a risk and a huge opportunity for Australian cotton. A risk in that it's currently very difficult to trace and monitor our cotton beyond the spinning mill, and we obviously don't want our cotton processed by businesses doing the wrong thing.

"We also have an opportunity to add 'free from human rights abuses' to our credentials as we're currently known as a country with few risks, and we have programs in place to protect workers safety and rights.



"However, tracing Australian cotton from farm to beyond the spinner is very difficult at the moment, and these connected and transparent supply chains are what our customers are looking for so that certain assurances can be made.

Brooke Summers (right) has been working with brand partners and human rights advocates to increase understanding of the Australian cotton industry and its production standards.

The roadmap will answer questions like:

- ◆ Are we doing enough to protect the human rights of people on our farms and throughout our supply chains?
- ◆ How will new global legislation impact our ability to sell cotton into markets that need proof of no human rights abuses, right back to raw materials?
- ◆ Can we verify claims and take better advantage of our strong human rights record on farm?

"We will be taking a close look at whole of industry traceability, human rights and a number of other interlocking issues through the development of the *Australian Cotton Strategic Roadmap*."

The Roadmap will better align industry and customer needs to take full advantage of a changing global fashion and textiles industry, and changes to government regulations globally that will affect market access. It's a joint project between Cotton

Australia, Australian Cotton Shippers Association (ACSA) and CRDC. There are five areas of focus: traceability; sustainably-certified cotton/the *myBMP* program; human rights; industry data and Australian cotton marketing. The Roadmap is funded through an Australian Government Agricultural Trade and

Market Access Cooperation (ATMAC) grant.

“Our industry is at a critical time in its development – we have a choice to continue doing things the way we’ve always done them or find out if there is more value to be gained by doing things differently,” CRDC General Manager of R&D Investment Allan Williams said.

“We need to ensure we have the programs and systems in place to deliver the product and assurances our spinners, brand and retail customers want and need.

“We have to ask ourselves ‘what are the consequences if we do nothing?’ And, ‘are we keeping pace with our competitors?’”

In some of the key markets that Australian cotton can end up in now stipulate that companies show due diligence around human rights abuses in the making of their products.

“If you can’t prove it, you can’t import goods into certain countries – this is happening now in the US where products are being seized by customs at the border because the importer can’t provide clear traceability right back to farm level,” Brooke said.

“We don’t have human rights abuses on our farms, and we’re seeing an increase in enquiry from customers who want to source Australian cotton for that reason, creating a great opportunity for our farmers.”

Data collection and traceability will be key to ensuring future markets for Australian cotton, and to continuing to drive market access that is not just about quality, but also the many other attributes that brand and retail customers need, like traceability, sustainability and cotton grown free from human rights issues.

“We can potentially increase the premium for our cotton by adding the post farm gate credential to it, but it needs to be backed up with solid data, which is something CRDC is already working on,” Brooke said.

“We have a product the world wants and are advocating for our growers by responding to these global signals, frameworks and legislation that are placing further demands on brands and retailers.

“Currently around 30 per cent of the Australian crop is grown under *myBMP*, with the remainder considered by brands to be ‘conventional cotton’ which means it’s not being sold to the major brands that have 100 per cent sustainable cotton sourcing requirements.

“In the future, we won’t be able to sell into

What is the Strategic Roadmap?

The *Australian Cotton Strategic Roadmap* is being developed by Cotton Australia, ACSA and CRDC. It will provide clear direction for the industry to:

- ◆ position itself in a changing global environment
- ◆ remain competitive
- ◆ further capitalise on investments in research, innovation and sustainability
- ◆ create fair and equitable value for farmers and industry
- ◆ position the industry for the future
- ◆ better align industry needs with customer needs.
- ◆ clearly defines the target state (ie. where we want to be)
- ◆ set out practical and realistic strategies and actions for achieving the target state (ie. how we’ll get there)
- ◆ assign responsibilities for strategies and actions
- ◆ establish potential investment options, funding models and sources

certain markets like the EU unless our cotton is independently certified, through a recognised program like *myBMP*. This will be particularly important when brands want to make claims on products, as they’ll need to be backed up with traceability, data and certifications.

“The Roadmap will be integral to sorting through all of this, and an independent consultant has been engaged to work with the industry to agree where we should be, and how we plan to get there.”

The *Australian Cotton Strategic Roadmap* will develop over a series of phases and include broad stakeholder engagement and industry consultation. It is overseen by an industry steering committee made up of representatives from Cotton Australia, ACSA and CRDC and is being undertaken by independent consultants Aither.

For more

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How do you teach the skills we take for granted?

Growers often say that all the knowledge and experience in the world is only useful if coupled with the right attitude and a healthy dose of common sense.

Qualities like common sense, showing initiative, making good judgements, working well with people and managing time are known as 'soft skills' and cotton industry research has shown that this skill set is often lacking in new or prospective employees on cotton farms. The job of developing these skills is being increasingly left to the employer. But how do you develop qualities such as situational awareness, strategic thinking or time management in on-farm staff to create effective and safe workplaces?

This is the question on many grower's lips according to the 2022 CRDC Cotton Grower Survey. Growers were asked what skills their staff needed to improve to help unlock their workforce productivity and efficiency.

While technical skills, particularly around machinery operation, were shown by the survey to be most highly sought after, growers know that more than just these skills are needed.

About 50 per cent of growers selected at least one area of soft skills development for their team, such as personal communication skills, resilience, the ability to work well with others, and manage their own workloads and careers.

For cotton workforce researcher Dr Nicole McDonald these findings were no surprise: part of her work is in helping growers to build soft skills among employees.

"Through my research and working with growers on the industry's new SHIFT workforce program, we are trying to take some of the burden off individuals to teach these soft skills by offering practical solutions.

"We are currently working with



Farm work isn't all about tractors and technical skills. Growers say soft skills like common sense are on the wane. Goondiwindi (Bigambul country) cotton grower, psychologist and PhD candidate Chantal Corish is working on the SHIFT project to address these concerns.

growers one-on-one to identify and refine tailored solutions to their workforce challenges and find generalisable strategies that we can package and share with all of industry."

This work will culminate with an 'Unconference' on June 6 and 7. The grower-only remote hook up will be based on what Nicole learns from the one-on-one grower sessions and will cover training in non-technical skills and systems to support workforce development, attraction and retention.

"Time management is an interesting one, because our perception of time expands or contracts – as in 'I have time to do that, or I'm too busy to do that' – depending on our priorities," Nicole says.

"So, one way we can start to develop early career employees skills is to guide them through setting their weekly priorities for their work/career, their relationships and themselves."

The employee doesn't need to disclose this to anyone, however employers can help with their work/career priorities. Discussing the employee's relationship priorities (eg. I'm going to catch up with friends after footy training) and self-priority (eg. I'm going to get more sleep) might not seem the type of thing discussed at work but research shows that employers who care about their employees outside of work supercharge their at-work engagement.

"Being able to discuss these aspects of work/life priorities with your employees puts you in a mentoring role for that

younger worker needing to develop their soft skills.

"This strategy may not be for everyone – that's part of what we're trying to understand in our work with growers over the duration of the SHIFT project."

Nicole says employers also need to be aware of increasing legislation and codes of conduct that place the burden on employers to manage psychosocial hazards at work.

Psychosocial hazards can be anything in the workplace that impacts an individual's psychological health, and this includes how jobs are designed in terms of hours, workload, and working in isolation, or social factors including workplace relationships.

"Very simplistically it's about managing stress and wellbeing at work and realising that WHS now extends beyond physical hazard risk management," Nicole said.

"Managing these hazards could involve making sure employees get good recovery time outside of work or helping to build soft skills, like effective time management, to help manage the demands of the job and reduce the risk of work stress.

"Importantly, through the SHIFT project, we will be giving growers the knowledge, tools and skills to help you help your teams."

For more

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Leaving a legacy ‘to be proud of’ through native vegetation

Consultation is about to start with growers around a model for native vegetation management on cotton farms. It’s a part of the process to create targets for the Australian cotton industry’s Sustainability Framework PLANET. PEOPLE. Paddock. Cotton’s sustainability consultant Chris Cosgrove explains why.

When it comes to native vegetation on cotton farms, we know most growers want to do the right thing: 79 per cent of growers in a CRDC biodiversity survey said it’s important to do what they can to protect biodiversity. A similar number would enter into a partnership to improve biodiversity on their farm.

Growers also tell us they have a common barrier when it comes to managing native vegetation: it’s not seen as core business. While they are busy managing feral pests and weeds, many growers see managing native vegetation as a separate and lower

priority activity, rather than seeing native vegetation as having a complementary fit within a modern and productive farming system.

This is not new, but now there is an urgent need to address this thinking.

Many of the people all farmers around the world rely on – customers, banks, governments, local communities and others – are starting to treat farm native vegetation impacts as seriously as they do farm greenhouse gas impacts. Our monitoring of global sustainability frameworks shows us that the same pressure on supply chains to reduce greenhouse gas emissions will now be applied to supply chains to reduce their impact on native vegetation. So, just like customers expect us to report greenhouse gas emissions from cotton production, very soon customers will expect us to report native vegetation on cotton farms.

Positive news

The positive news is the opportunities these trends offer us.

We don’t want to wait to be told what to do by customers and governments. Instead, we see an opportunity to create a voluntary, industry-scale approach that makes sense for Australian cotton farms, still meets customer expectations, and gives us a chance to shape the narrative instead of being dictated to. Cotton industry researchers have been working for more than two years on this opportunity. They have developed a model that has the following.

1. Regionally appropriate cotton native vegetation targets, directly aligned to the priorities of local Natural Resource Management (NRM) organisations to make it very clear what practical, voluntary actions – if any – can be taken on a cotton farm.
2. Consistent native vegetation indicators and definitions, aligned with customer sustainability frameworks to measure progress, at no cost to growers, to show we’re getting it right as an industry.
3. All the grants, biodiversity payments, tools to measure impact, advice, materials and other support brought into one place to make it much easier for growers to take action if they want to.

Consulation begins

The Sustainability Working Group, led by CRDC

CRDC’s 2022 Grower Survey included a section on environmental management activities and awareness



- More than three quarters used weed and pest control and actively encouraged regeneration, with fencing to manage stock access and revegetation, in the previous 12 months.
- Management practices in native areas vary widely across regions. 78 per cent undertake pest control in the Macquarie, in the Macintyre/Balonne is it 58 per cent.
- 66 per cent of growers would participate in an industry partnership to restore biodiversity to their farm.
- Greater awareness is needed of tools being developed and offered by industry to improve biodiversity, such as CottonInfo’s web-based ‘Managing biodiversity in cotton landscapes’.

Time to tell our story



LOSIE VOLCK

Emerald (Gayiri country) cotton grower Graham Volck is clear the industry is facing both an opportunity and a threat.

“If the market judges us more on our environmental credentials, and we’re not perceived to be up to the expected standard, this is a threat to be taken seriously,” Graham said.

“It’s also an opportunity to tell the story of what we’re already doing, or to reflect on what small things we can do on our own farms to meet expectations.

“On our farms we have 16 per cent of the area as native vegetation. I’ve identified the least productive area and let it regenerate. As a result I have enjoyed higher profitability because I’m only spending time and money on the most productive parts of the farm.

“There are individual benefits for every farm having a little bit of native vegetation in place. It’s not going to send you broke, and it’s very satisfying to see the difference you can make to

the landscape.

“But we also need to remember we’re part of an industry that is trying to go forward and meet these requirements. This is bigger than the individual.

“If we can collectively agree to take a conscious decision to include and manage native vegetation on farms as best practice and gain all the benefits from that, wouldn’t that be a legacy to be proud of?”

and Cotton Australia, will be consulting with growers throughout March and April to explain this model in detail and to seek feedback. The model will be refined based on feedback from growers.

And, given most cotton growers are mixed farmers, the cotton industry is also talking to other industry’s sustainability frameworks, like beef, sheep and grains. The aim is for different governments and agriculture sectors to be working together to have consistent native vegetation definitions and metrics, to coordinate work avoid duplication, and to give clarity and coordination to all farmers.

This work puts the Australian cotton industry in a great position to respond proactively and take

advantage of emerging market opportunities.

It also makes it easier for more growers to gain value from having native vegetation on farms. Growers tell us the value they see includes big cost savings in insecticide sprays, preventing spray drift and wind-blown disease, the potential for carbon and biodiversity payments, the joy of seeing native species return to a farm, and improved reputation of the industry.


As industry participants we can’t tell growers what to do with their land. We do, however, want to clearly show the risks and opportunities growers and the industry face, so they can make an informed decision to support a model designed to fit in with Australian farming systems. This will, in turn, maintain access to premium cotton markets, and build trust in the Australian cotton industry.

For more

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“The same pressure on supply chains to reduce greenhouse gas emissions will now be applied to supply chains to reduce their impact on native vegetation.”



Preserving beneficials like spiders help when pest like silverleaf whitefly turn up later in the season.

Is Australia's world-leading IPM future-ready?

Australian cotton has long had an enviable reputation as a world leader in integrated pest management (IPM). Making sure the IPM strategies and knowledge are robust and future-ready is the focus of a recent CRDC-supported project.

As growers know, IPM is an integration of biological, cultural and pesticide control methods and forms the bedrock of cotton's pest management. To ensure ongoing efficacy, CRDC engaged Crop Consultants Australia (CCA) and Paul Horne from IPM Technologies to review, adapt and improve current pest management and monitoring techniques, and measure the impacts of these and future technologies on beneficial insects across all production regions.

This review is part of the broader *Novel Options and Strategies for Integrated Pest Management in Australian Cotton* project, supported by CRDC.

The review involved meeting with consultants to discuss IPM and their strategies. It found that right now, there are no immediate problems with pest management, for three main reasons:

- ◆ *Helicoverpa* and other caterpillars are now well controlled by Bt cotton.
- ◆ Mirids, the key pest nominated across all cotton regions, are able to be controlled with fipronil or sulfoxaflor.

- ◆ Other pests such as whitefly, mites, thrips, mealybugs and green vegetable bug are not regarded as major pests across the industry and are still able to be controlled.

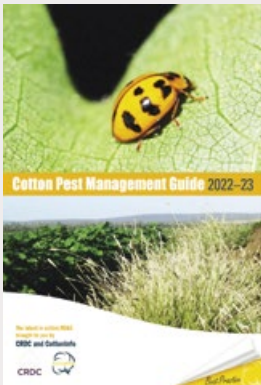
However, CCA's executive officer Doug McCollum said this state of pest management is not guaranteed to continue and is at risk from factors including potential resistance in *Helicoverpa* to Bt-cotton and loss of access to pesticides, particularly for mirid control.

"We know there's been Bt resistance in *Helicoverpa* in other countries and there is not a lot of cultural control for mirids so we rely on the available chemistry – there is no Plan B," Doug said.

"The continued availability (ie. registration) of pesticides for mirid control such as fipronil cannot be relied upon, and some of the current alternatives are facing regulatory pressures as well.

"The other main risk the review uncovered was that 'minor' pests are seen by some to be increasing and could be flared by either seasonal conditions or use of broad-spectrum insecticides, such as those used to control mirids."

Doug oversaw the review on behalf of CCA and said it was interesting to see the attitudes and practices of consultants across the regions. Although there is widespread awareness of IPM, there are differing levels of commitment across regions and between individuals to minimal use of insecticides using an IPM approach.



The impact of insecticides and miticides on predators, parasitoids and bees in cotton table (commonly referred to as the Beneficial Disruption table), is available in the *Cotton Pest Management*

Guide 2022-23.

This guide is updated annually and provides important information on the relative impact of pesticides (particularly insecticides and miticides) on the range of beneficial species found in Australian cotton. The information contained in the table is extensive and is considered a highly valuable resource by industry consultants and growers.

For more

Cotton Pest Management Guide

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

“One person’s IPM may not be someone else’s,” Doug said.

“When you get down to the finer details, some consultants may use higher or lower thresholds. For example there are some who have a low tolerance level for insects such as mirids, while others will push compensation boundaries.

“Those on each end of that spectrum might say they are practising IPM, but have a different approach to risk.”

The most notable difference was a generational one. Older consultants were more likely to take into account the past when looking at IPM solutions, due to what they’ve seen, and are more likely to take a softer option.

“We have found that the industry is broadly managing to run a reasonably effective IPM system now, but that this situation is viewed as somewhat fragile and relies on us retaining access to effective technology,” Doug says.

“There is also concern that the newer generation of crop managers haven’t lived through crises in pest management and are potentially not as motivated to be proactive with the implementation of IPM.

“A strong commitment is needed to reduce the risk of *Helicoverpa* developing resistance to Bt cotton and developing improved control of mirids without the use of broad-spectrum insecticides.



“Control of pests such as whitefly, mealybugs, mites and thrips can be achieved primarily by biological and cultural control methods, and this should be encouraged.”

The CCA believes that future research and extension in IPM should be supported through cross industry programs.

“Pest management systems need to be considered across all different crops being grown in each region.

“There is considerable scope for the cotton and grains industries to collaborate on pest management projects, and in some regions this could also involve horticultural industries.”

CRDC Senior R&D Manager Susan Maas said the findings of the project will help CRDC identify and close research gaps, evaluate extension and monitor IPM from a sustainability angle.

“As we set priorities for CRDC’s new Strategic RD&E Plan, this type of information helps us identify research, development and extension projects to support IPM’s ongoing robustness,” Susan said.

“We know that we are going to have to reduce the toxicity level of our pesticide use and have committed to that through the industry’s sustainability framework PLANET. PEOPLE. Paddock.”

“There are challenges around products we rely on because of their impact on bees, their levels of toxicity or the fact that they’re on global lists to phase out.

“The CCA review, and another being conducted by CSIRO, will inform where investment in IPM needs to be directed.”

Maintaining healthy trap crops, and populations of beneficial insects are a part of the industry’s successful IPM system.

For more

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Surveys show pests have greatest impact on profitability

With 200 cotton growers, 60 consultants and 38 research partners taking part in CRDC surveys in 2022, thoughts and data on everything from the cost of weed control to level of trust in CRDC have been gathered.

CRDC conducts three regular surveys – the annual cotton grower survey, the annual consultant survey with Crop Consultants Australia (CCA), and a survey of other key stakeholders, such as researchers, industry bodies, commercial partners and government partners, every three years. In 2022, all three surveys took place, collecting valuable insights to help CRDC identify research, development and extension (RD&E) priorities and investments, better understand what's happening on farm and in the field, determine impact and performance, and evaluate the strength and health of its partnerships.

In light of recent research by CRDC, reviews of integrated pest management systems by CCA and CSIRO, and concerns over growing resistance in key weed species to pesticides, the grower and consultant surveys offer further valuable insights.

Just shy of 100 per cent of growers said in the 2022 CRDC Grower Survey that they conserve beneficial insects whenever possible, while 97 per cent follow the Insecticide Resistance Management Strategy. The percentage using recommended sampling strategies, however, drops back to 78 per cent.

SataCrop is a website that allows growers/crop managers to map crop types across a farm. It can also be used by beekeepers to map hives. It's an industry initiative of Cotton Australia and PCT, developed to mitigate drift from any weeds or insect management by checking for

sensitivities when making spray decisions. Nearly 50 per cent of growers in the survey used the tool in 2021-22, while 28 per cent still aren't aware of it.

The grower survey also covered water use, crop and soil management, biodiversity and thoughts on CottonInfo. It shows that 90 per cent of growers are supportive of CRDC's research investments and activities, and nearly 95 per cent agree CRDC is a trusted information source.

The 60 consultants who completed the survey for the CCA Qualitative Report represent 413 cotton growers covering 285,000 hectares – 52 per cent of the Australian cotton production area for the 2021-22 season. The report provides valuable data for agronomists, which they can reference when planning workshops or extension. The survey covered thoughts on CRDC and CottonInfo, along with questions on planting, farming systems, crop protection, defoliation, nutrition management, water and yield impact.

According to the consultants, mirids have the greatest average impact on their clients' profitability through management costs and yield loss, with the cost in 60 per cent of cases ranging from \$11-\$50 per hectare. Green vegetable bug has been reported in growing numbers this current season, and last year represented a significant (\$51-\$100/ha) cost to control. Insects also rated highest in impact on grower profitability over weeds and diseases, at more than \$300/ha.

In terms of the impact of weeds and weed control, feathertop Rhodes grass, fleabane and sowthistle continue to top the charts. And, when it comes to confirmed herbicide resistance, 18 per cent of the consultants' clients have confirmed Group 9 (previously Group M)

and 12 per cent have Group 1 (Group A) resistance. This is reflected in the impact on profitability via management costs and yield loss, with fleabane representing anywhere between \$11 and \$300 per hectare in losses.

The percentage of total hectares with confirmed or suspected herbicide resistance was for Group 9: 50 per cent in irrigated and 70 per cent dryland; for Group 1: 11 per cent in irrigated and 10 per cent in dryland; and for Group 4 (previously Group I): one per cent in dryland area.

This is despite the survey showing that glyphosate (Group 9) was used as a single weed control tactic in only one per cent of total hectares. Glyphosate plus two other tactics were used across 43 per cent of total hectares

under dryland production, and 33 per cent in irrigation.

Consultants in general are happy with the level and quality of CRDC's R&D but would like to see more locally-specific trials and participatory on-farm research to ground-truth industry projects. CRDC is seen by consultants as a good collaborator driving continuous change in the industry.

"With the current CRDC Strategic Plan coming to an end and a new plan now being developed, there's no better time to understand the improvements we can make in working with growers and consultants," CRDC Executive Director Dr Ian Taylor said.

The results of the 2022 Grower Survey, the 2021-22 CCA Qualitative Report, and the 2022 CRDC Stakeholder Survey are now available on the CRDC website.



The Qualitative Report on the 2021-22 season is now available on the CRDC website, along with the 2022 Grower Survey and CRDC Stakeholder Survey.

For more

www.crdc.com.au/publications



Be selective in product choice to avoid insects doing the same

Several cotton aphid populations on the Darling Downs have recorded very high Group 1 (organophosphates/carbamates – dimethoate and pirimicarb) resistance.

Cotton aphids (*Aphis gossypii*) have limited options for control so this is a reminder to follow the Insecticide Resistance Management Strategy (IRMS), found in the CRDC/CottonInfo Cotton Pest Management Guide, and on the CottonInfo website.

CottonInfo Darling Downs Regional Extension Officer (REO) Annabel Twine said the resistant aphid samples were collected from fields in January,

where dimethoate had been used for mirid control and a later application of pirimicarb did not provide adequate control.

The two consecutive applications of Group 1 products may not have caused the initial selection event alone – it is likely that a strain of aphids with pre-existing resistance had by chance established in this field and that the two applications removed most of the susceptible individuals present.

“This is a classic example of how resistance can occur in below-threshold populations of aphids in the process of managing another pest – in this case mirids,” said NSW DPI’s Dr Lisa Bird, who monitors aphid resistance in cotton.

“The most recent testing shows the residual aphid population collected from these fields now has higher than 95 per cent resistance to pirimicarb.

Cotton aphids are highly susceptible to developing resistance to key products, which need to be used with strict adherence to the Insecticide Resistance Management Strategy found in the Cotton Pest Management Guide.

“We know that dimethoate use will select for catastrophic pirimicarb resistance in aphids: that is a fact that crop managers must understand, along with windows for use of these products as set out in the IRMS.

“The use of dimethoate to control pests other than aphids can cause selection in small populations of aphids if they are also present in treated fields and this practice poses a risk for ongoing efficacy of pirimicarb, which is a very useful, selective product for their control.

“Crop managers in regions with suspected outbreaks of resistance to Group 1 insecticides are urged to avoid use of pirimicarb and dimethoate. Instead, select alternative mode of action insecticides that will break the cycle of resistance by removing Group 1-resistant phenotypes from the aphid population.

“The good news is that there is no evidence of cross-resistance to any other aphicides registered in cotton, so effective control of cotton aphids can be achieved without the use of Group 1 products.”

Minimising the build-up of resistant populations in affected regions will also help to reduce the risk of resistance genes spreading to other regions. NSW DPI is currently monitoring resistance levels in aphid populations from across the cotton industry.

“While it is too early to know how widespread resistance might be in cotton aphids this season, this finding is a timely reminder about the importance of product selection, timing and potential impacts on different pest species,” Lisa said.

“We urge growers and advisors to submit samples for testing, particularly if they suspect that a field failure has occurred.”

Lessons from the north

Aphid outbreaks observed over the past three years in north Queensland and northern Western Australia (WA) are likely to be the results of dimethoate applications in cotton and other broadacre and horticulture crops. Field failures have occurred.

“Dimethoate and pirimicarb will not control aphids in parts of northern Australia and the use of dimethoate for the control of other pests is likely to induce significant aphid flaring,” Lisa warns.

Resistance testing results from Kununurra (Miriwoong country) in WA last season found more than 50 per cent resistance to dimethoate and over 80 per cent resistance to pirimicarb. High levels of resistance to these insecticides in north Queensland aphid populations were reported in the previous year with 65 per cent resistance to pirimicarb and 75 percent resistance to dimethoate.

“In contrast, aphids tested from northern Australia continue to be fully susceptible to

To collect aphids

Important things to note:

- ◆ At least 50 aphids are needed for testing (preferably more).
- ◆ CottonInfo REOs are ready to help crop managers to collect samples. Contact your local REO for assistance.
- ◆ Samples should be couriered not posted – contact your REO or see below for address.

Steps:

- ◆ GPS the location.
- ◆ Collect aphids on leaves or stems and put the plant material and some extra leaves into a paper (this is important) bag with the aphids.
- ◆ Keep cool while in field and put into the fridge until they are couriered to NSW DPI (details below). They can be left in the fridge for three to four days before sending.
- ◆ Write on the bag the date, time, GPS location, field and spray history, along with name and contact details.
- ◆ Courier samples to: Lisa Bird, NSW DPI, Tamworth Agricultural Institute, 4 Marsden Park Rd, Calala NSW 2340. Ph: 0438 623 906.

sulfoxaflor, diafenthiuron and neonicotinoid insecticides,” Lisa said.

“While there isn’t a northern Australia IRMS, the same resistance management principles should be applied to every spray decision.”

Effective aphid management is important not just for preserving yield and lint quality, but also because aphids are a vector for cotton bunchy top. Testing by QLD DAF has shown this viral disease is present in cotton plants taken from the fields on the Darling Downs in the region where resistant aphids were detected.

“We would like more aphid samples from all cotton growing valleys to test for resistance,” Lisa said.

“Please refer to the IRMS and the Cotton Pest Management Guide for the most up to date guidance on control and check CottonInfo updates and regional round ups for testing results.”

For more

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Cotton Pest Management Guide:

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

Bunchy top concerns heightened with aphid resistance on radar

There are two good reasons why cotton aphids need to be effectively and correctly controlled: their susceptibility to developing and spreading resistance to pesticides, and as the key insect responsible for the spread of cotton bunchy top disease (CBT).

CBT is a disease with no control methods available and carries the risk of severe yield loss.

Crop and rogue cotton destruction at the end of the season is critical to avoid giving aphids, and the virus that causes CBT, a perfect overwintering location. Elimination of plants affected by bunchy top at the end of the season will help to break the green bridge and greatly reduce the virus inoculum in the environment before the next season.

QLD DAF plant pathologist and cotton industry researcher Dr Murray Sharman says failure to do so could result in early aphid populations and increased incidence of CBT.

Murray tested plants taken from the western Darling Downs in late January, confirming CBT in all samples.

“While we know CBT is found across all valleys, these wet seasons and a build-up in aphid numbers could lead to worsening problems,” Murray said.

“If you have old ratoons on your farm, you are much more likely to find the virus in them, and any aphids left over from the season will keep feeding and vectoring the disease.”

“Therefore, crop destruction, along with ratoon and volunteer (rogue cotton) and weeds management will be critical to avoid a build of up inoculum in a green bridge heading into next season.”

While cotton aphid has a broad host range, Murray says cotton is the crop of choice for both aphids and the virus, so to control them and disease, crop destruction is critical.

“In particular, rogue cotton allows cotton aphid populations to persist over winter, increasing the likelihood of aphids re-establishing on CBT ratoons and moving into cotton early in the season,” Murray said.

“Our research shows that the earlier the infection the greater the potential loss, so crop managers do not want this in fields at all let alone at around crop emergence.

“There are no control methods for CBT and it has the ability to cause serious yield loss – so avoiding its spread and managing aphids according to the Insecticide Resistance Management Strategy (IRMS) is crucial.

“It is especially important to manage along field edges, head ditches, tail drains and channels, where we find higher incidences of infected cotton plants. These areas sometimes support old plants surviving across multiple seasons.

“A small number of affected rogue plants this season could be worse next season, especially in perennial plants in which CBT seems to build up.

“If you have ratoons one or two seasons old on your farm, you are much more likely to find the virus in them, and any aphids left over from the season will keep feeding and vectoring the disease.”

CRDC Senior R&D Manager Susan Maas says aphids have a propensity for resistance and the industry must protect the efficacy of soft control options such as pirimicarb.

“This breakout on the Downs has been a good reminder that the IRMS needs to be acknowledged and adhered to,” Susan said.

“It shows how there can be flow-on



MELANIE JENSON

Along with cotton aphid, rogue cotton also hosts mealybug and cotton bunchy top over winter.

effects from one or two decisions into other areas of crop management such as disease.

“In addition to rotating chemistry and adhering to spray windows, preserving beneficials through integrated pest management is important as they can mop up any survivors.

“Breaking the green bridge, especially through control of cotton volunteers and ratoons will not only help reduce carryover of aphids, but also other pests such as mealybug, along with reducing the risk of CBT.”

For more

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Cotton industry nurtures spray innovation

CRDC has been working to address spray drift in investments beyond WAND.

CRDC partnered with the Australian Government's Business Research and Innovation Initiative (BRII) in 2021. BRII supports early-stage development of solutions to major challenges – like the one submitted by CRDC: 'Is it possible to revolutionise agricultural spray application?'

BRII accepted the challenge, which unlocked funding of up to \$1 million for small to medium Australian businesses to develop a prototype or proof of concept – and as a result, two promising technologies about to come on line.

Two concepts were chosen for investment: one from LX, and one from SwarmFarm.

LX has designed the Maverick Spray Advisory, an in-cab spray management system, while SwarmFarm are a robotics company who will add safe spraying software to their already autonomous spray rigs.

LX's Maverick Spray Advisory is being trialled at sites in NSW and is due for commercial launch by mid-2023. It will be available as an advanced app within LX's current INCYT platform. The platform will

offer a level of basic functionality to producers at minimal cost.

Features of the full Maverick system include an in-cab view of the status of key environmental and machine variables that influence spray drift, with dynamic forecasts and alerts when variables exceed a limit which is preset by the user, such as wind speed and direction. Maverick will also offer readily accessible content such as short video clips to highlight best spray application practice. And, as the cotton industry considers an area-wide management approach to weed control and resistance management, Maverick will have a community networking functionality.

SwarmFarm aims to reduce drift by eliminating the possibility of off-label spray application: its robots will be enabled to autonomously carry out pesticide applications that are compliant with label conditions. To achieve this, SwarmFarm are adding software capability to access weather observations and forecasts from a variety of mobile and stationary weather sources, including the CRDC, GRDC and Goanna Weather and Networked Data (WAND) towers.

The robots will have the ability to stop/start spray operations dependent on weather conditions and the proximity of sensitive areas downwind of the spray application. A dock and refill system for autonomous refilling means the robots can keep working without human intervention, offering an efficiency to achieve the most of an available spraying window. Low power mode software will put robots into a deep sleep to save power and reduce emissions during times when spray conditions are not favourable.

To cope with variable conditions and weather changes (eg. wind direction) which may create unsuitable conditions and increased risk of pesticides moving off target, a replanning system is being developed to allow the robot to move to an alternative, safe location.

Both LX and SwarmFarm are working on automated data collection via record keeping and reporting.



For more

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Incorporating XtendFlex into the integrated weed management system

As the Australian cotton industry prepares for the commercial release of Bayer's XtendFlex™ with resistance traits for glyphosate, dicamba and glufosinate, CRDC has been supporting research to test the efficacy of these pesticides against key weeds.

The research comes at a time when the industry is grappling with an increase in resistance to several modes of action among already hard to manage weeds such as fleabane, sowthistle, awnless barnyard grass, feathertop Rhodes grass and windmill grass. Research led by Dr Jeff Werth at QLD DAF investigated options for effective use of glyphosate, dicamba and glufosinate in cotton systems. They also explored using glufosinate as an in-crop, double knock option.

Bayer has a range of herbicides proposed for registration in XtendFlex crops. These include XtendiMax 2® (dicamba), Roundup Xtend 2® (glyphosate + dicamba) and a registered glufosinate in addition to Roundup Ready® herbicide, and Roundup Ready PL® herbicide. These trials contained Roundup Ready herbicide, Clarity® (dicamba), Basta® (glufosinate), and clethodim for the grasses. Clarity is a dicamba formulation with a diglycolamine salt. The proposed XtendiMax 2 has an monoethanolamine salt, however weed efficacy is expected to be similar.

"We've done this work as more efficacy data is required to work out how to incorporate the new herbicide tolerance traits into the existing Herbicide Resistance Management Strategy (HRMS) and ensure best stewardship," CottonInfo Weed Management Technical Lead Eric Koetz said.

"A lot of data is from overseas studies, and we have different humidity and soil pH for example, so we want to understand how these products will act locally."

Jeff said the study was an opportunity to test glufosinate as an in-crop double-knock partner, as the new XtendFlex traits



Obvious effects of treatments on feathertop Rhodes grass showing (from left) the control, glyphosate+clethodim, glyphosate+clethodim followed by glufosinate 1, 3, 7 and 10 days later.

allow for this type of use.

"Double knocks with paraquat and the partner have proven successful in fallows for several years," Jeff said.

"Glufosinate, although a different mode of action, has similar parameters to paraquat, being a contact herbicide with relatively quick burn-down.

"Our study also allowed the comparison of efficacy of these tactics on glyphosate-resistant against glyphosate-susceptible populations."

Treatments included glyphosate alone, dicamba on fleabane and sowthistle, clethodim on grasses and glyphosate + dicamba, glyphosate + clethodim and glufosinate alone. The double knock treatments included the above combinations with glufosinate at one, three, seven and 10-day intervals.

Results showed that combinations of glyphosate, glufosinate and dicamba/clethodim were effective on both glyphosate resistant (GR) and glyphosate susceptible (GS) populations.

Of all the trials, windmill grass was the most challenging to control. Reasons for this are unclear, however Jeff says it could be a result of glufosinate reducing the translocation of glyphosate within the plant before it has time to take effect.

"This has been observed in other species internationally," he said.

"Timing of herbicides for windmill grass control is critical, and we found the most consistent results when glufosinate

application was seven to 10 days later than glyphosate."

The XtendFlex herbicides were found to be useful if used in addition to integrated weed management and Jeff says we must remember how important it is to maintain diversity in the cotton and farming system.

"Relying on one or a few herbicides will ultimately lead to resistance, as we have already seen with glyphosate," he said.

"Incorporating residual herbicides to reduce the numbers of weeds emerging will considerably reduce the pressure on post-emergent herbicides.

"Glufosinate has only one application allowed in-crop, so it's important that its use is effective: using it as a double knock partner is one way to do this."

The research showed the timings of the double knock applications were similar to that of paraquat, even though glufosinate is typically slower than paraquat to show symptoms. This should make it easier to plan for the follow-up applications.

"It's also important to remember that, like paraquat, glufosinate is a contact herbicide with limited translocation," Jeff said. "As a result, effective coverage is critical for control."

For more
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JEFF WERTH

Check the rate: beware of unintended consequences in fleabane management

Incorrectly using herbicides isn't just costly and ineffective, it has serious implications for the spread of key weeds and herbicide resistance by stimulating growth and reproduction in susceptible and already resistant populations.

For a CRDC project, NSW DPI scientist Dr Md Asaduzzaman (Asad) researched hard to control weeds flaxleaf fleabane (*Conyza bonariensis*) and awnless barnyard grass (*E. colona*). He found that low doses of herbicides can have unintended effects by stimulating more vigorous growth.

Called hormesis, this response can then indirectly contribute to resistance development. Hormesis describes the stimulatory effect of low doses of toxic substances on plant growth. A high herbicide dose can cause inhibition, while a low dose can stimulate plant growth.

Paraquat is a contact herbicide with limited translocation and as a result, effective coverage is critical for control of fleabane.

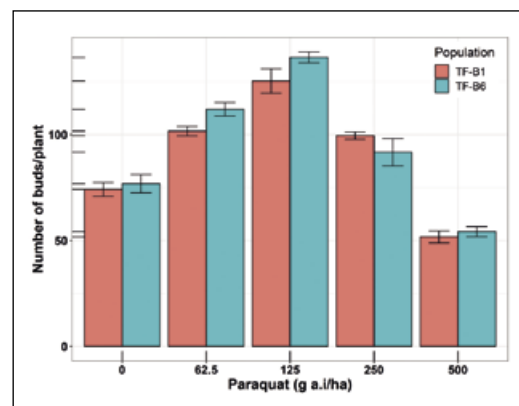


Figure 1. Paraquat hormesis in two resistant (TF-B1 and TF-B6) populations of tall fleabane. The application of low doses of paraquat act as sub-lethal doses and stimulated the vegetative and reproductive growth of resistant tall fleabane populations.

The study looked at additional factors involved in directly or indirectly influencing resistance development and the potential impact of herbicide hormesis on resistance development in awnless barnyard grass and tall fleabane.

The research shows a clear negative implication of low doses of glyphosate and paraquat in resistant populations of the flaxleaf fleabane and awnless barnyard grass. The study highlighted the importance of accurate herbicide application, according to label requirements to kill weeds but also to control resistance evolution. Regular herbicide resistance testing of problem species is also required.

Asad found low doses of paraquat can induce more biomass in resistant tall fleabane plants and consequently these plants can generate higher numbers of seed buds during the reproductive stage compared to plants treated with nil and high doses of paraquat. This has implications for weed control as this strategy is the mainstay of the double knock tactic employed by growers to combat poor efficacy with the first application of a herbicide. It shows the importance of always checking that there are no survivors.

Both the vegetative and reproductive growth of resistant populations were stimulated by low doses of paraquat applied at the four to six leaf stage. Hormetically-boosted resistant plants produced, on average, 30 to 60 per cent more buds/plant than untreated plants.

The adaptability of these two species led researchers to hypothesise that herbicide hormesis

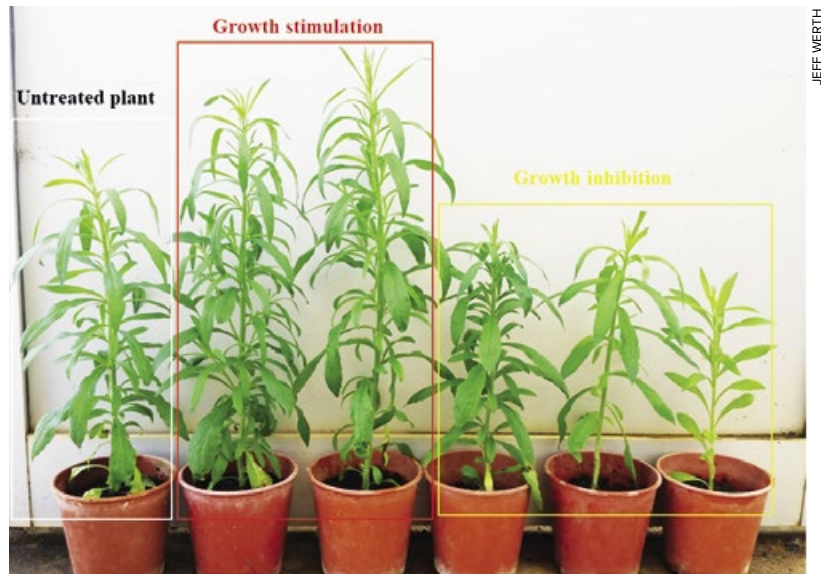
can occur particularly in resistant populations and might be adding an extra advantage in resistant phenotypes of heterogenous natural populations.

Plants from resistant phenotypes can shift the hormetic dose zone to higher doses and this can intensify the hormetic effect causing the stimulated weed to be more competitive with the associated crop.

NSW DPI's Eric Koetz, the CottonInfo Weed Management Technical Lead, says resistant populations that are stimulated by herbicide hormesis may achieve an overall fitness and over time develop a mechanism to hormetically adapt themselves to the high selection pressure environment. A good example is the more vigorous, healthy, and tall weed growth at non-cotton crop sites such as fence lines, laneways and channels.

While these plants are not competing with crops for resources, they may be exposed to spray drift which can act as hormesis doses, through management or environmental factors (eg. dust on their surface, high temperatures, shading from taller plants or stubble) that convert full herbicide doses into different sub-lethal doses.

"Eventually these enhanced plants have the



JEFF WERTH

potential to contribute resistant phenotypes to susceptible populations leading to resistance development in cropping fields," Eric said.

"The most recent results from QLD DAF's fleabane screening to glyphosate paints a worrying picture with 59 per cent of populations having confirmed resistance, and a further 25 per cent developing resistance."

Testing was also undertaken on another key weed, awnless barnyard grass.

Low doses of glyphosate generated more biomass in both susceptible and resistant phenotypes of awnless barnyard grass. The resistant phenotypes produced more biomass than susceptible phenotypes throughout their life cycle and they expressed their enhanced response mainly at the reproductive stage, at doses of glyphosate 100-540g active ingredient/ha. The resistant plants generated 20 to 40 per cent more spikes/plant than non-enhanced plants.

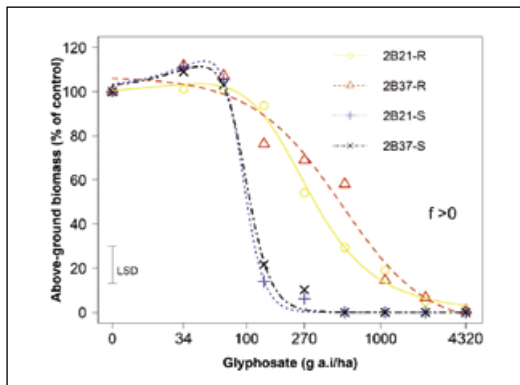


Figure 2. Above-ground biomass of glyphosate-susceptible (2B21-S and 2B37-S) and glyphosate-resistant (2B21-R and 2B37-R) phenotypes of awnless barnyard grass. Lines describe the predicted survival responses according to employed hormesis equation. The $f > 0$ indicates there is a stimulation at low doses of glyphosate in susceptible phenotypes.

For more
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Evolution of year-round germination

Further to developing resistance, weeds are adapting to new climatic conditions, creating a greater headache for crop managers.

QLD DAF's Dr Jeff Werth says the temperature range of germination for fleabane appears to have increased, compared to studies undertaken in 2007, where no germinations occurred at 5°C and 35°C. In his most recent work, he found an almost 30 per cent germination

rate at 35°C.

"This change supports anecdotal evidence that in the field, fleabane is emerging more in summer, as well as the main times of autumn and spring," he said.

"The ability of fleabane to produce a large number of seeds has more than likely facilitated this adaptation to warmer conditions."

In another key weed, Jeff found sowthistle germinations were consistently

high over all the temperatures tested, with the lowest germination of 64 per cent occurring at 38°C.

Sowthistle was previously considered a winter weed. However, as is indicated by results from the research, it is emerging in the field all year round. Older research also reported a wide range of temperatures at which sowthistle can germinate with above 80 per cent germination at both 5°C and 35°C.

The cost of spray drift goes beyond economic damage for those affected



When he received a call from a local agronomist on Boxing Day last year, Mick Humphries knew it wasn't to wish him a Merry Christmas...

Many phone calls later it was obvious there had been widespread drift events in the Gwydir Valley onto cotton crops, and as he was to realise a few days later, on to his too.

Mick was a point of contact for people in the valley as the chair of the Gwydir Cotton Growers Association (CGA). He said the call on Boxing Day wasn't the ideal present for people with affected crops, nor was what he saw later in his own fields. He said the drift was most likely caused by hazardous inversions. Farmers can usually tell the difference between directional drift and drift caused by an inversion when they see it, especially since

it's something that many growers have just had to deal with, year after year.

"When 100 per cent of your crop is affected, you know some ordinary stuff has been going on," Mick said.

"Since then, some people have copped drift onto their crops four times and some of those won't come back from that – it will be a total loss.

"It doesn't matter what you grow: to have your livelihood affected due to the actions of someone else in some way nearly every year gets tiring.

"You don't start off the season thinking, 'a third or more of my gross margin will be lost this season because of factors caused by other people'. But that's what we are dealing with every year: only the scale varies.

"Every year there is income lost to drift, but it is these big years where everyone galvanises."

To find out the extent and level of damage, the

Emma and Mick Humphries, along with cotton growers in the Gwydir Valley, have been dealing with the fallout of poor spraying practices and the effects of spray drift.

Gwydir CGA sent a survey out to members asking for details of the events and what direction they should take to advocate for change.

The responses showed that 90 per cent of the Gwydir Valley crop was damaged in some way, with up to 40 per cent moderate to severe. As of mid-February, around 60 per cent is growing out 'okay' but there are some small pockets that suffered up to four drift events that have been written off because the damage is too bad.

"The total written off might only be a small percentage of the valley's entire crop – but if that small percentage is your whole crop, it is very hard to swallow," Mick said.

Not only is spray drift costly in terms of lost yield; there's also the increased time, cost and emotional outlay of nursing the crop back, along with the environmental aspect. It takes its toll mentally and physically on farmers doing the right thing. And it could be prevented – all the knowledge, tools and information are readily available to avoid it.

"After drift damage, when you know your crop is half buggered and you still have to do the work, it is demoralising, especially as it's not due to any fault of your own. That really makes it really hard," Mick said.

"Given that this year's crop was already delayed by three to five weeks due to the flood and cool early season weather, this added time penalty could really hurt at the back end of the season.

"In the best case scenario, it lengthens the season. Worst case scenario: you give it extra time, fert and water to pull it back for what is going to be a lower yield anyway. It makes you question why you bother."

He says while ending spray drift will involve technology, like the leading-edge WAND towers now up and running, he says what's really needed is cultural change.

"It's poor attitudes to stewardship and an irresponsible attitude towards drift," he said.

"People need to change attitudes to spraying in general. What is driving some people to be spraying in adverse conditions? It doesn't matter what you're spraying – it all moves.

"We all have a responsibility for what is happening on our farms, regardless of who is sitting in the spray rig.

"You don't start off the season thinking, 'a third or more of my gross margin will be lost this season because of factors caused by other people'"



MELANIE JENSON

"This isn't a cotton versus grains issue, nor does it need to involve finger-pointing. It's a cultural issue, where corners have been cut in the past and that has now become accepted and common practice.

"I've seen clips of younger people on Instagram and Tik Tok spraying on sunset and you can actually see the inversions behind them.

"They are obviously not aware of correct spraying conditions so who trained them and why are they being allowed to keep spraying? Who is monitoring the conditions?"

Mick says beyond or along with inexperience or ignorance, people allow spray drift to happen because of time pressures.

"I understand the pressure to get things done before rain or for any reason, but the thinking that 'we can't afford to stop' – that is the attitude that needs to change," he said.

"Because I can't, the industry can't, and the environment can't afford for them not to.

"It's going to take a lot of work to change those attitudes.

"All farmers who do the right thing are hoping it won't take a litigation case or a loss of product until we do see that change.

"No-one wants to see more regulations put on all of us because of the actions of potentially just a few people, but that is potentially the path we're on.

"We really need to come together as a whole to get on top of this issue before change is forced upon us – change that could have implications for our future farming systems."

A study conducted by AgEcon found that WAND could help reduce the impact of spray drift onto sensitive crops, while also increasing chemical efficacy and improving labour and machinery productivity on farm. In cotton alone, the warning system could help the industry avoid \$40 million in losses and costs associated with spray drift over five years.

For more
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Increased understanding can open and close windows

The WAND system is now almost fully up and running, with the final few towers expected to be operating by the end of March.

The WAND (Weather and Networked Data) system is a new decision support tool that measures several weather parameters and includes novel technology that detects hazardous inversions in real-time, along with offering a two-hour predictive function.

The establishment of WAND was possible through six years of collaborative R&D by CRDC and the Grains Research and Development Corporation (GRDC) to develop and then test the technology. The RDCs have partnered with Goanna Ag to build and maintain the 100 WAND towers and the technology attached to them.

WAND is providing critical real-time data when planning and spraying, as well as valuable insights for users of this state-of-the-art technology, who have signed on from Emerald (Gayiri country) in Central Queensland to the NSW-Victorian border.

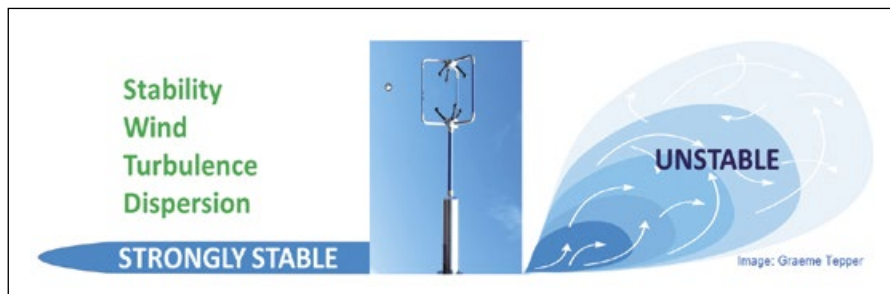
CRDC Senior R&D Manager Susan Maas has overseen the WAND project on behalf of the cotton industry and says it's been an eye opener to see the information coming through from the towers.

"Before WAND there was no way to distinguish a hazardous inversion from a non-hazardous inversion: we had to treat them all the same," Susan said.

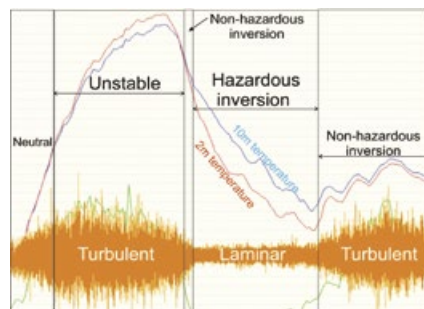
"WAND clearly tells us when not to spray, but importantly, it also provides clear information to tell us when it is safe to spray.

"Feedback from users is that while it (rightly) has the information to know when to delay or stop spraying, it also has information that is opening spray windows some thought were permanently closed.

"WAND shows you can't rely on some of the old visual cues such as fog or dust levels, as these can take time to develop or might not occur at all even when conditions are hazardous.



ABOVE: Figure 1. Strongly stable conditions (as represented by the image on the left) are hazardous due to there being insufficient turbulence to achieve droplet dispersion or deposition. Unstable or weakly stable conditions (as represented by the image on the right) do not support long-distance concentrated drift; they support droplet dispersion and deposition.



"Knowing when conditions are good is as valuable as knowing when they are unsuitable, and our studies have shown that stop/start spraying is a costly exercise.

"By eliminating uncertainty, we can make better decisions," Susan said.

Observing regional differences in the timing and duration of hazardous inversions has confirmed what early inversion research showed: because there is no accurate rule of thumb, this network of towers is needed to provide localised information. WAND has shown that hazardous inversions set in at different times across different regions, which can change daily.

WAND's historical data is being used to better understand local conditions which gives added insight when planning spray jobs. Along with another key feature of WAND – the nowcast, with a two-hour hazardous inversion prediction – it will take the guess work out of whether to start a job or refill tanks once a job has started.

Susan says that as insightful and helpful as WAND is, it doesn't negate the need for spray operators to remember

the basics: follow label directions; monitor weather at site of spraying; use appropriate nozzles; consider tank mix partners; and operate at appropriate speed and boom height.

"While WAND allows us to see other parameters such as wind speed and air temperature in light of inversions and how one affects the other, I really want to emphasise the need to continue to also measure local conditions at the site of spraying," Susan said.

"We are really pleased to hear from users that WAND is giving a better understanding of how, when and why hazardous inversions form.

"The better informed all spray users are, the better the chance we have of eliminating spray drift."

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For more

www.wand.com.au

What makes an inversion hazardous?

Pesticide applications during hazardous surface temperature inversions can lead to spray drift, causing severe damage up to many tens of kilometres away from the site of application. Current regulations prohibit spraying of agricultural chemicals when hazardous temperature inversions exist.

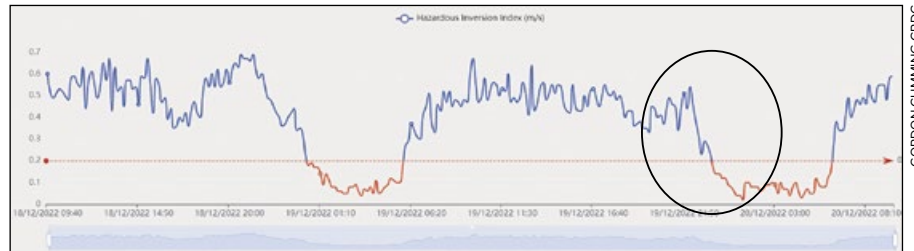
So, what's the difference between a surface temperature inversion and a hazardous surface temperature inversion?

A surface temperature inversion occurs when the air temperature increases with height from the ground surface, which is the opposite of what normally happens (i.e. the temperature profile is 'inverted'). This results in a layer of cool dense air being trapped below warmer air close to the surface.

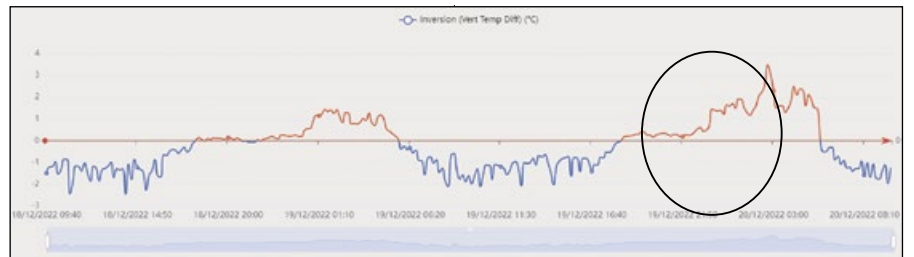
Hazardous surface temperature inversions occur when these droplets remain suspended in the inversion layer in concentrated form and are then transported by laminar winds. Laminar flows are smooth and streamlined across the landscape, as opposed to 'turbulent' conditions where air mixes at different levels, allowing droplets to stay in and on their intended target (see Figure 1).

Ultimately, it's the laminar winds that cause inversions to be hazardous and are known to be associated with long distance and widespread damaging drift. Laminar winds with weak turbulence are capable of transporting droplets in high concentrations for long distances across the surface. Understanding hazardous inversions requires a new focus on turbulence as opposed to the vertical temperature difference.

When a hazardous inversion has established, it acts like a barrier, isolating the inversion layer from the normal weather situation, especially the normal wind speed and direction. Sprays applied in these conditions can become trapped in this cool air layer where there is insufficient turbulence to either deposit or disperse the suspended spray droplets. This lack of turbulence results in the transport of drift over long distances in localised laminar air flows that are often in different directions to those indicated by the general synoptic (weather pattern) winds.



GORDON CUMMING GRDC



Example 1. The circled area showing that while there was a temperature inversion, there was not a hazardous inversion. An inversion occurs when temperature increases with height. It is measured as the Vertical Temperature Difference (degrees C) between 2m and 10m above the surface. A positive (+ve) number represents the presence of a surface temperature inversion. If a hazardous inversion is absent, however an inversion is present, represented by a positive (+ve) number, then conditions are suitable for spraying, but extra caution may be needed. Consider the direction of wind speed (2m) and max wind gust in relation to nearby sensitive areas and avoid spraying under still conditions.



Example 2. As opposed to Example 1, this is an interesting case where conditions have been hazardous, and yet the temperatures weren't inverted. In this instance at Warrawidgee on January 23, there had been very strong hazardous inversion conditions overnight and these conditions remained until 8am - yet the vertical temperature difference would have suggested it was okay to spray by 7am.

Network capability

It is important to recognise that tower measurements represent conditions at the location they are installed. WAND towers are installed between 40-70km apart depending on topography, and while CRDC, GRDC and Goanna Ag have attempted to provide as much coverage to the landscape as possible, it is extremely important to consider several factors when choosing which tower to use to assess weather conditions at your specific location.

These factors include:

- ◆ Proximity to the tower.
- ◆ Whether the tower is "up-wind" of your location.
- ◆ Whether there's a direct line of sight between you and the tower. There should not be any topographic features (i.e. hills) between your location and the tower that would significantly impact or vary air movements.



RONALD SMITH, AUBURN UNIVERSITY

Investment in diagnostics pays dividends

It goes without saying that an exotic pest or disease incursion could have a significant impact on production, trade and market access for Australian cotton.

When a pest or disease does arrive in Australia, the ability and success of containment and/or eradication initially depends on how rapidly it can be identified. Waiting until exotic pests arrive here to study and understand them is too late and leaves cotton growers and the broader industry unnecessarily exposed.

That's why Australia's biosecurity system includes a network of researchers working to support diagnostics and prevent the spread

of biosecurity threats. Working 'behind the scenes' they are integral to high-level biosecurity preparedness. And, since 2019, this network has been boosted further through the *Boosting Diagnostic Capacity for Plant Production Industries* project, supported by Australia's plant-based Research and Development Corporations (RDCs), including CRDC, and the Federal Government through the Rural R&D for Profit program.

Under this project, the cotton, grain, fruit and vegetable, wine and table grape, forestry and sugar RDCs have been working together to increase preparedness capacity by training more scientists and developing faster, more efficient methods of detecting and diagnosing exotic threats. The focus has been on diagnostics for high priority exotic pests and diseases such as those causing bacterial blight and equipping new scientists with diagnostic skills as they collaborate with growers on farms.

Exotic strains of cotton aphid may carry exotic pathogens like mosaic viruses or have different insecticide resistance traits.

Biosecurity threats

Exotic forms of cotton bacterial blight, nematodes, begomoviruses and poleroviruses are all potential threats to the cotton industry and a focus of research under this project.

“We know the better prepared we are, the more chance we have of managing an exotic incursion by understanding the biology of these pests and the potential impacts under Australian conditions,” CRDC Senior R&D Manager Susan Maas said.

“As plant industries we share some common pest threats and an interest in maintaining robust biosecurity measures.”

The project brings together QLD DAF, NSW DPI and CSIRO. QLD DAF scientists are optimising diagnostic and surveillance resources to maximise the chances of early detection. Working with NSW DPI they are developing cheaper in-field screening tests for exotic viruses, particularly cotton poleroviruses and begomoviruses.

NSW DPI’s Toni Chapman is developing new techniques for identification of exotic bacteria. Toni has been undertaking research to better describe Xanthomonads (the cause of bacterial blight in cotton) already found in Australia and is leading the development of new molecular diagnostic tools for *Xanthomonas citri subsp malvacearum*.

“This will assist in distinguishing exotic Xanthomonas and Pseudomonads from those already present in Australia,” Susan said.

“If we don’t know what our endemic or current pests look like and how they behave, we have no way of distinguishing between them and a new

PEGGY GREB, USDA



species, so it could potentially go unnoticed, which is very far from ideal.”

Meanwhile, CSIRO researchers are building expertise in nematode diagnostics in cotton. This involves training scientists while ensuring identification protocols are advanced. The research is delivering taxonomic knowledge of cyst nematodes like cereal cyst nematode and nematodes that impact soybean, barley and chickpeas to develop improved commercial diagnostic tests.

Paracoccus marginatus – Papaya mealybug is a sap-sucking insect that can feed on cotton leaves, buds or stems. The damage deprives cotton plants of nutrients and water and results in yellowing of plant tissue, stunted growth, early leaf and fruit drop, and leaf distortion. It is native to the Americas and is found throughout Asia and the Pacific Islands, with recent detections in Africa.

Download the high priority pest ID factsheets

Identification factsheets have been produced describing exotic, high-priority biosecurity threats to plant industries.

Many of the pests affect a number of industries but the cotton-specific fact sheets now available cover cotton aphid, European flower thrips and papaya mealybug. In particular, cotton aphid is a serious pest of cotton and exotic strains may carry exotic pathogens like mosaic viruses or different insecticide resistance.

“If aphid has been identified in the crop, watch for unusual cases of chemical tolerance or plant disease symptoms,” says CottonInfo Biosecurity Technical Lead Sharna Holman.

“Detection of exotic strains of cotton aphid is likely to be a result of

repeated chemical control failures of aphid populations, or of unusual disease symptoms, coupled with the presence of aphid populations.”

European flower thrips are also on the radar due to their similarity in appearance to western flower thrips.

“European flower thrips cause shedding and scarring of young bolls and leaves when large populations occur,” Sharna said.

“European flower thrips are present in many parts of the world including New Zealand.

“In Australia, another species, western flower thrips can damage cotton crops.

“The similar appearances of thrips species make it difficult to identify them in

the field, therefore, any unusual thrips and associated damage warrants investigation and reporting.

“Remember, if you see anything suspicious, call the Exotic Plant Pest Hotline 1800 084 881. And our CottonInfo team of Regional Extension Officers are always standing by to help you with your on-farm biosecurity.”

For more

High priority pest ID fact sheets:

www.cottoninfo.com.au/insect-and-mite-management



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

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