Spotlight.

ON COTTON R&D

Summer 2017-18

Growers on board for Rural R&D

Gross margins analysed

Annual Report in focus

Australian Government

Cotton Research and Development Corporation

Bruce Finney

In the Spotlight

Welcome to the Summer edition of *Spotlight* magazine in which we are pleased to report on achievements through research and innovation during the last year as well as taking a look at the future direction of cotton RD&E.

Measuring the impact of research is essential to reporting the benefits of funding research and informs CRDC's future investment decision making. We have included a summary of recent assessments undertaken to measure the economic impact of research into planting date in Central Queensland, nutrition and water use efficiency. It's great to hear reports of growers in Central Queensland already with fields of open cotton as they seek to reduce the likelihood of late season weather impacts. The results on nutrition and water use efficiency research are encouraging as there is still significant opportunity to improve nutrition and water use efficiency. CRDC greatly appreciates grower assistance with surveys, like the benchmarking of cotton water use efficiency, as this information is critical in communicating the performance of the industry.

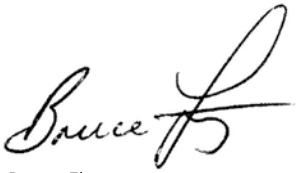
This season there are also more irrigated cotton growers investigating and using technology such as automation. Through the Australian Government's Rural R&D for Profit Programme, rural research and development corporations like CRDC have pooled resources to implement change on the ground. CRDC oversees three projects under this programme, and this cross-sectoral research has seen unprecedented information sharing between research bodies and sectors. Under the Smarter Irrigation for Profit project, technology and techniques developed with cotton industry support, such as VARIwise, has moved into the dairy and rice industries. Precision irrigation, using variable rate technology has benefits across many rural sectors, and CRDC is proud of its involvement in supporting this research from infancy, through USQ researcher Alison McCarthy.

The Accelerating Precision to Decision Agriculture project, also led by CRDC, has delivered important analysis and recommendations for actions to prepare primary producers to take advantage of the technology and big data boom. Poor connectivity in regional areas was highlighted in the report, however connectivity solutions do exist as shown by Sundown Pastoral at Moree. Their ability to harness precision and decision agriculture has seen the adoption of new implements to improve planting efficiency, automation in irrigation trials and a real-time, 24/7 link to machinery.

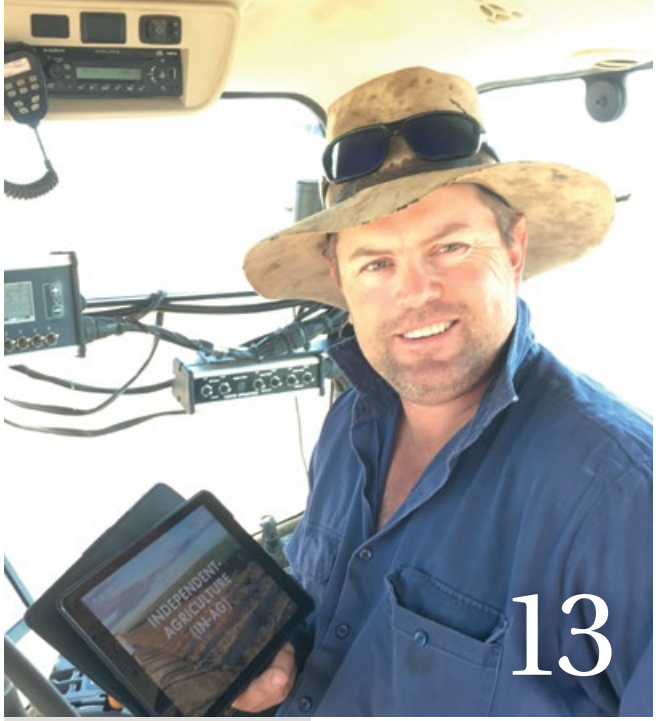
As the saying goes "from little things big things grow" and CRDC's support for innovators to attend start-up workshops is very much the case. We are impressed with the results of this investment, and see it as a new and complementary path for industry research and development. We have included an update on these initiatives and featured grower Andrew Gill's website idea which has been turned in to a reality.

The spirit of grower led R&D continues to be key to the industry's success and CRDC gives thanks for commitment of growers who generously given of their time and ideas. In November we engaged with growers, through Cotton Australia and the research advisory panels, to receive their advice on prospective R&D projects commencing in July 2018.

CRDC has received positive and valuable advice from stakeholders and partners on the future direction for RD&E within our draft 2018-23 strategic plan. Having considered future scenarios for the industry we have proposed ambitious goals for increased productivity, profitability and sustainability outcomes based on the adoption of transformative technologies and building new capacity to adapt and innovate. The future is almost here and we will be ready.



Bruce Finney
CRDC Executive Director



Summer 2017-18

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

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IMAGE MELANIE JENSON

ON THE COVER: Long-time supporter of cotton R&D Peter Glennie and farm manager Richard Ross have become involved in trials under the More Profit from Nitrogen project.

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

Included with this edition of *Spotlight* is the **2018 CottonInfo calendar**, which features a range of stunning insect photos from St George cotton grower Johnelle Rogan. Additional copies of the calendar are available on request by emailing spotlight@crdc.com.au

Cotton News

Features

Fast Facts

17:1

The benefit-cost ratio from a $1.8 million CRDC investment over three years in the *Strengthening the Central Highlands cotton production system* project with QLD DAF (page 7).

2

The number of years it took Wee Waa High School student Montana Jones to complete a school-based traineeship, a Certificate II in Agriculture and gain entry to university with help from CRDC (page 29).

70

researchers, including PhD, post doctorate, research and technician positions are working on the Rural R&D for Profit Programme's More Profit from Nitrogen projects, led by CRDC (page 20).

350

RD&E projects were invested in by CRDC across five key program areas in 2016-17, working collaboratively with 122 researcher partners and growers (page 31).

Pictured at the AgriFutures Rural Women's Award dinner are cotton's 2017 young farming champions Jess Lehmann and Nellie Evans, Federal Member for Maranoa David Littleproud MP, CRDC director Kathryn Adams, CRDC team members Di Purcell and Jane Trindall, 2017 ADAMA Chris Lehmann Trust young cotton achiever Fiona Norrie, 2017 ABARES Science and Innovation Award recipient Dr Priscilla Johnston, CottonInfo's regional extension officer for the Gwydir Janelle Montgomery, and cotton grower and Cotton Australia director Barb Grey.

Rural women inspiring country kids

IN support of women in agriculture, a cotton industry contingent attended the AgriFutures Australia Rural Women's Award at Parliament House in September.

CRDC has long been a supporter of projects and initiatives designed to support rural women, such as the Rural Women's Award. This year it was women who inspire the ambition of country kids who took out the top awards. Winner Tanya Dupagne was chosen for her work in supporting the wellbeing of young rural Australians through her role as director of Camp Kulin in WA's wheatbelt region. Runner-up was Simone Kain, recognised for her work in educating children about farming and encouraging them to consider a career in agricultural industries through her 'George the Farmer' and soon to launch 'Dr Ruby' characters.

"CRDC continues to support the award, as it recognises, inspires and connects women in our agricultural industries," CRDC Executive Director Bruce Finney said.

"Along with the many personal development programs we support, our new *Cotton Industry On-Farm Workforce Development Strategy* has further committed to supporting women through business skills planning courses, including business planning, business performance, risk management (including climate), human resources and WHS."

Applications for the 2018 AgriFutures Rural Women's Award opened in September.

For more
www.agrifutures.com.au

Survey to benchmark water use efficiency in cotton

COTTON growers are invited to participate in a water productivity benchmarking study.

The 2017-18 survey, delivered by NSW DPI with support from CRDC, follows on from similar surveys in 2006-07, 2008-09 and 2012-13, which found that the cotton industry has achieved a 40 per cent increase in water productivity since 2003.

"This is an important piece of research for the Australian cotton industry, providing metrics for the industry to understand its current performance, and continuously improve," said Ali Chaffey, NSW DPI's irrigation research and development officer for irrigation and CottonInfo's irrigation technical lead.

"There is no cost for growers to participate, but a wealth of information about your on-farm water productivity to gain."

Water productivity benchmarking compares the amount of harvested cotton produced per farm to the amount of water used, determining a bales per megalitre result. It involves calculating water use indicators from on-farm data, and evaluating these relevant to established performance indicators.

"Doing so provides participating growers with a snapshot of how their fields and farms are performing this season, across seasons, and against regional and industry averages," Ali said.

"It provides valley by valley data, to see how different regions have performed this season compared to other regions, and compared to previous surveys and provides the industry as a whole with a means to identify trends and determine what drives top water productivity outcomes for growers."

Growers who are interested in participating will work with NSW DPI researchers to collect water measurements throughout the season (including all irrigation, stored and soil moisture and in-crop rainfall) and the harvested yield for each field. To register your interest, contact Ali Chaffey.

For more
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ali.chaffey@dpi.nsw.gov.au
0439 326 601

Optimising irrigation and nitrogen: CottonInfo researchers tour

COTTONINFO will host its annual researchers tour in early 2018, with a focus on optimising irrigation and nitrogen (N).

CottonInfo will host eight irrigation and N researchers on-farm across six valleys in February 2018 to discuss the impact of irrigation management on N efficiency in the crop.

The tour will cover four key things: benchmarking to quantify irrigation losses on-farm; identifying where N losses occur and what can be done; understanding how irrigation management influences in-crop N losses; and maximising your irrigation system performance.

The CottonInfo regional extension officers (REOs) will also provide the initial findings from this season's in-field experiments, which are investigating the potential for N-loss during the first two irrigation events after its application.

The tour has already visited Emerald in November as part of the Central QLD irrigation big day out. The remaining valleys will be visited on the mornings of the dates opposite.

For more information, contact your local CottonInfo REO.

February 6 Point Farms, Darlington Point
February 7 'Strathern' Warren
February 8 'Keytah' Moree (GVIA field day)
February 9 'Waverley' Wee Waa
February 13 'Mundine' Boggabilla
February 14 'Melrose' Brookstead

Funding for natural resource innovation

APPLICATIONS are open for the Smart Farms Small Grants of between $5000 and $100,000, as part of the Australian Government's National Landcare Program.

Farmers, community and industry groups can apply for grants to assist them to protect and improve the condition of soil, vegetation and biodiversity and support agricultural systems to adapt to change.

Significant technological advances are taking place in land management and the Smart Farms Small Grants will provide grant funding to develop and extend new tools, methods and technology for farmers to continue to be at the forefront of land management. The grants will help farmers to come up with, or take advantage of the next great idea and support the adoption of on-the-ground innovative practices that improve the management and quality of our natural resources and increase on-farm productivity.

Applications close December 7, 2017.

For more
www.nrm.gov.au

What's on the five-year horizon for cotton RD&E?

WHAT do the next five, 10 and 20 years look like for the Australian cotton industry? That's the question CRDC has posed to the industry in developing its next Strategic Plan, which will guide the organisation's investments in RD&E from 2018-23.

"Our Strategic Plan is our key planning document – it sets the direction for our investments in cotton RD&E over the next five years," CRDC Executive Director Bruce Finney said.

"With our current Plan coming to an end in mid 2018, we've been working on our new Plan since April this year in collaboration with all our key stakeholders - including Cotton Australia and the research advisory panels, and you, our cotton growers.

"In developing the Plan, we've looked at not only the next five years, but also taken a longer-term view to help identify what's on the distant horizon for the cotton industry: so that we can be sure our goals and our investments over the next five years have us on the right track for a profitable, sustainable and competitive future for Australian cotton."

Through an extensive 'futures thinking' and consultation process with stakeholders, CRDC has identified three key goals and two enabling strategies as potential core components of the 2018-23 Strategic Plan – as outlined in the snapshot below.

Over the coming months, CRDC will be finalising the Strategic Plan and seeking final feedback from key stakeholders, including growers, Cotton Australia, Cotton Grower Associations, the Australian Government, Cotton Innovation Network, the Cotton Industry Forum, research partners and other industry organisations.

The Plan will come into effect in July 2018, following Ministerial approval.

CRDC 2018-23 Strategic Plan Snapshot	
Our Purpose	Investing in world leading RD&E to benefit Australia's dynamic cotton industry
Our Vision	Leading cotton research and innovation investment globally
Goals	**Key Focus Areas**
Increase productivity and profitability on cotton farms	• Optimised farming systems • Transformative technologies and myBMP • Protection from biotic threats
Build adaptive capacity of the cotton industry	• Science and innovation capability, and new knowledge • Futures thinking
Improve cotton value chain competitiveness and sustainability	• New high value uses for cotton, market access • Measurement and reporting throughout the value chain
Enabling functions	**Key Focus Areas**
Effective adoption of cotton R&D	• Partnerships and collaboration • Innovation and commercialisation
CRDC's organisational excellence	• Organisational effectiveness and efficiency

Responding to grower RD&E needs:
our 2018-19 investment round

CRDC's annual RD&E priority setting forum was held with the Cotton Australia research advisory panels back in May, to identify the key research and development needs for the industry in 2018-19.

The forum identified 25 priorities for future R&D investment, including research into ready-to-use soil tests to manage black root rot; an objective measure for improved water productivity in both full and partially irrigated cotton; and alternative energy technologies and policy solutions for the industry.

As a result, CRDC developed 25 open Expressions of Interest guidelines based on these identified needs, and invited researchers to respond with Full Research Proposals (FRPs). A total of 66 FRPs were received in response to these 25 EOI guidelines.

A review of all FRPs took place in October by the CRDC R&D team, before the Cotton Australia research advisory panels considered them in November. Recommendations considering this advice are then made to the CRDC Board in January, who will determine the successful applications in February.

Following Ministerial approval of CRDC's budget in May, successful projects will commence in July 2018. Details on all of CRDC's 2018-19 projects will be brought to you in the Winter 2018 edition of *Spotlight*. Stay tuned!

For more
www.crdc.com.au

Research returns gains to growers

Independent qualitative and quantitative impact assessments of CRDC investments have shown high returns to growers with benefit cost ratios as high as 17:1.

Growers in the Central Highlands have been able to grow better quality, higher yielding crops through a CRDC and QLD DAF project, which has returned a benefit-cost ration of 17.1 to 1.

CRDC has released reports on impact assessments in important areas of investment, including water use efficiency and nutrition, while QLD DAF has released an impact assessment of the project to improve crop management in Queensland's Central Highlands. Further impact assessments into Bt technology and sustainability are to come.

The purpose of the evaluations is to provide independent impact assessments of CRDC's investments against the current Strategic Plan's stated goals, and to inform future investments.

The first impact assessment was into nutrition and water use efficiency projects.

The results, released this year, found CRDC's investments delivered major economic benefits to growers. It found that CRDC's investment of $4.9 million on behalf of cotton growers and the Australian Government into six water use efficiency projects from 2010-2015 provided a return benefit of $40.62 million to growers, a benefit-cost ratio (BCR) of 8.29 to one.

In addition, CRDC's investment of $11.32 million funds into nine nutrition research projects from 2008-16 returned a benefit of $61.15 million to growers, or 5.4 to one.

Central Queensland growing strong

CRDC-funded research examining how to help Queensland's Central Highlands' cotton growers overcome climate challenges garnered support and praise from growers in the region, who are seeing real returns in yield and quality. In terms of impact, the value of total benefits was estimated at $20.24 million, from an investment of $1.18 million over three years. This result generated an estimated net present value (NPV) of $19.06 million, and a BCR of approximately 17.1 to 1.

The *Strengthening the Central Highlands cotton production system* project began in the 2013-14 season with trials led by QLD DAF's Dr Paul Grundy and CSIRO's Dr Stephen Yeates.

The researchers identified that a key tactic may be to plant considerably earlier (August) than the traditional mid-September to October window in an effort to pull the boll filling period forward into spring and early summer when weather conditions are at their most reliable. As outlined in the June 2017 edition of *Spotlight,* the early-sowing trials were replicated commercially for the first time in the 2016-17 season, with great success, and has been widely adopted for the 2017-18 season, with approximately 65 percent of the area planted by the beginning of September.

Central Highlands' grower Carlo Stangherlin was part of the trials over the four years and was very impressed with the outcome, and is seeing big improvements in quality and quantity.

"In 2016-17, our trial went all went base grade with no colour discounts – and yield was up four bales per hectare – from 10 to 14," Carlo said

"That equates to an added $2600 per hectare, so this research has been fantastic for us – it hasn't just allowed us to avoid wet weather at the end of the season, we can grow a better quality, higher yielding crop, which we've been struggling with."

Snapshot of benefit-cost ratio to growers

Water investments: 8.29 to 1
Nutrition investments: 5.4 to 1
Central Highlands project: 17.1 to 1

The evaluations can be downloaded at:
www.crdc.com.au
www.insidecotton.com

SciCott2017: Cotton science delivering impact

Cotton industry researchers looked to the future at the Australian Association of Cotton Scientists' (AACS) *'SciCott2017: Cotton Science Delivering Impact'* conference in September.

CRDC is proud to be a founding and continuing major sponsor of the biennial AACS cotton science conference, this year held at CSIRO's Discovery Centre in Canberra, with 150 leading cotton researchers converging for three days of scientific presentations. These covered digital agriculture, irrigation and water use productivity, weed control, nitrogen and nutrients, plant diseases, pests and pest management, farm systems and ecosystems, cotton fibre and post-harvest science, breeding and biotechnology. In line with the SciFi theme, guest speaker Dr Juan Landivar from the US spoke about R&D into the use of imagery and aerial base platforms for phenotyping in crop breeding and research programs. CRDC-supported researchers represented 51 of the 88 speakers.

Outstanding researchers were recognised with major awards at the conference dinner. Dr Lewis Wilson (CSIRO) was awarded the AACS Service to Cotton Science Award for his contributions to IPM research, and the Scientific Publication Award was given to Dr Grant Herron (NSW DPI) and Lewis for their recent publication on resistance management strategies for the recovery of insecticide susceptibility in the cotton aphid in Australian cotton.

Lifetime Members of the AASC were also announced in recognition of their distinguished careers in supporting cotton science in Australia. They were Dr Stephen Allen, Dr Geoff Baker, Dr Nilantha Hulugalle, Dr Jim Peacock and a posthumous award went to Dr Ian Rochester.

The new AACS executive will be headed by president Dr Paul Grundy, and include Dr Warwick Stiller, Dr Mary Whitehouse, Dr Linda Smith, Dr Michael Bange and CRDC Program Manager Allan Williams.

Since inauguration the association has held three conferences, grown its membership to just over 300 and has become a member of the International Cotton Research Association.

A full listing of session topics, speakers and abstracts can be found at: www.cottonresearch.org

JOHNELLE ROGAN

St George cotton grower Cleave Rogan (pictured) attended the conference in his (then) capacity as CRDC vice-chair and says the conference highlighted that we are in good stead with the research we are investing in and researchers are taking lead roles in their organisations to deliver to growers and industry.

"Having been involved in research for a long time, I was expecting it be a good conference, and it was a great conference," Cleave said.

"What really struck me were the young career scientists who are capturing opportunities in their research careers and are now taking a lead role in cotton research, they are outstanding."

CRDC-supported PhD students also presented their research, which was another highlight.

"I was at the last world cotton research conference in Brazil and saw our researchers there presenting, and some younger researchers doing PhDs presenting on the world stage, which was so fantastic, therefore a highlight this year was seeing those students again and how they have progressed with their research projects.

"There were such a wide variety of projects and the plenary sessions were exceptional, there was so much depth in their presentations which went across their research and also drew on decades of research collaboration.

"Seeing the breadth and support of research investment from all investors, also gave a holistic context to research across the industry."

Cleave said from both a board member and grower perspective, the networking opportunities were many, including at the dinner.

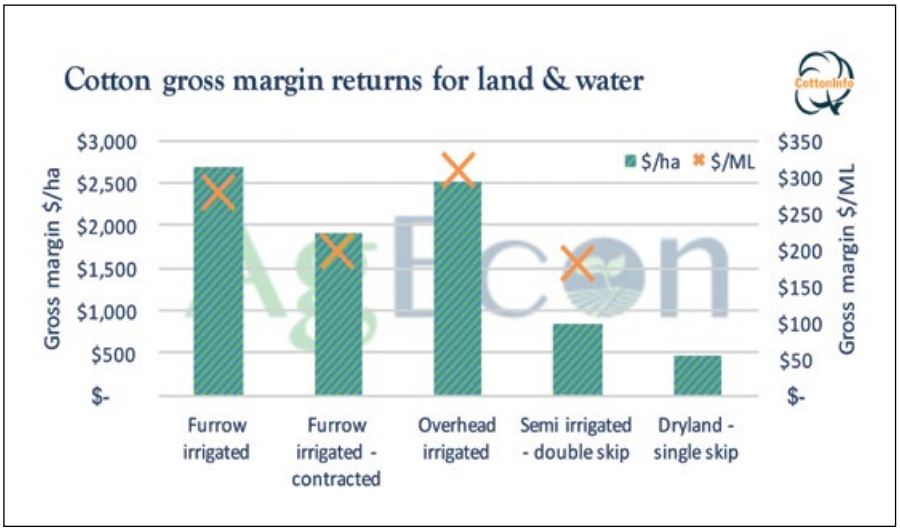
"I would definitely recommend this conference to those with a passion for research, innovation and science. With this and the Australian Cotton Conference, we have two exceptional opportunities to learn more and use the research to become better growers," Cleave said.

"This whole event was a credit to the committee, it was really well done."

The next conference will be held at UNE in Armidale in 2019.

Budget better with gross margin study

The *2017-18 CottonInfo Cotton Gross Margin Analysis* is a comprehensive document for new growers, financiers looking to manage risks or as a refresh for growers and consultants keeping abreast of practice change.



The gross analysis delivered good news, with continued per hectare and per megalitre profitability since a 2014-15 analysis by NSW DPI.

COMMISSIONED by CottonInfo and undertaken by economists Janine Powell and CottonInfo's Jon Welsh, the analysis involved in-depth surveying across all valleys was undertaken to examine changes in input costs, while also incorporating application of current research findings and best management practice. Margins were calculated for furrow irrigated, contract furrow irrigated, semi-irrigated, overhead irrigation and dryland cotton.

"With current costs and a comprehensive list of operations they are a good starting point for those wanting to create their own budgets," Janine said.

"Some growers use the budgeting process to make decisions on the best way to allocate resources (land and water).

"By comparing the likely return by resource, a grower can, for example, make an informed decision on how they may tweak the coming season's cropping rotation."

The study delivered good news, with continued per hectare and per megalitre profitability since a 2014-15 analysis by NSW DPI. As expected, irrigated cotton planted in a solid row configuration with full irrigation had a higher gross margin per hectare than crops using skip row and limited water scenarios (Figure 1).

Within the irrigated cotton gross margin, costs for most line items such as nutrition and irrigation have remained at similar levels to the previous study. In present value dollar terms, the urea price is lower now than at any time in the last 45 years, however crop protection and defoliation were more expensive due to an increase in the number of operations.

"Per megalitre gross margins are close to $300 which is consistent with the previous analysis, however the five-year average cotton lint and seed price has come off slightly, reducing revenue," Janine said.

"While the budget incomes reflect five-year average pricing, they don't take into account that many growers take advantage of forward selling when lint prices are favourable."

Cost of contracting

Timeliness and availability of contractors is always a key consideration when weighing up owning gear or outsourcing for farm operations. Per hectare returns are reduced in the gross margin when all farming operations are contracted. However, a gross margin considers variable costs only and contractor rates include provisions for overhead costs such as depreciation, interest and labour.

If all operations are contracted (see 'contractor' gross margins in Figure 1), the overhead portion in the farming operation is simply transferred from the farm balance sheet into variable growing costs. While the cotton crop gross margin appears reduced, whole farm profitability may be maintained or increased. The analysis for irrigated cotton using contractors found increases in picking and aerial spraying, with an 18 percent rise in round module wrap, but little change in other costs.

"Contracting rates have remained relatively static, suggesting that good competition exists in most areas," Jon said.

"Contract farmers are absorbing rising depreciation costs associated with 20 to 30 percent price increases on new machinery since the prior analysis, when the stronger Australian dollar offered a buffer from exchange rates."

This latest analysis has provided new market information when using contractors for siphon irrigation, measured on a per hectare basis. While terms vary between contract irrigators such as responsibilities for pump management and rotobucks.

Key inputs such as water and energy will be examined in more detail to better understand resilience, risk and impacts on cotton industry gross margins.

For the full analysis, visit:
www.cottoninfo.com.au/publications/australian-cotton-industry-gross-margin-budgets-2017-18

For more
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A weather station network near Emerald has improved the access and accuracy of information for growers Nigel and Ross Burnett.

IMAGE RENEE ANDERSON

Small grants, big returns

CRDC's small grants program is delivering big returns for participants and the broader cotton industry.

CRDC'S Grassroots Grants is a unique program where grants of up to $10,000 are available to Cotton Grower Associations (CGAs) to help fund projects solving specific regional issues and improving skills, knowledge-bases and networks. The grants have been used to install technology such as weather stations, conduct grower-led trials, skills development and for events such as nutrition workshops.

Since 2011, the Grassroots Grants program has supported 52 individual CGA projects. CRDC General Manager Research and Development Ian Taylor oversees the program, and is encouraging CGAs to discuss avenues or issues and talk with him about furthering them.

"We continue to invest in this program because we continuously see great outcomes which are delivering immediate, usable solutions for growers," Ian said.

"Take for example the weather towers/stations.

"Six inversion towers have been installed under the grants along with weather stations and station upgrades.

"These have helped fill in black spots and (with other investors) created networks which give growers greater weather coverage, which is so crucial for timing of operations and avoiding drift.

"We are seeing initial grants leading to successive projects, which is building real capacity, having a positive impact and offering increased value on investment from our perspective."

CottonInfo Lower Namoi Regional Extension Officer (REO) Geoff Hunter has been involved with several CGAs' Grassroots Grants projects, from on-farm trials, building prototype planting implement, and weather stations to irrigation scheduling.

"These grants are fantastic - they provide a real avenue for CGAs to get support to undertake a project, and there are some really good ideas coming from them," he said.

Some initiatives Geoff is involved with this season include irrigation scheduling trials in the Lower Namoi which are cross-referencing data from canopy sensors and C probes; dryland cotton establishment, cover crop trials and workshops for spreader calibration for greater accuracy and efficiency which have come off the back of grower demand.

In the Macquarie, with the aid of REO Amanda Thomas, trials are underway into seasonal benchmarking with canopy temperature sensors. Meanwhile the Southern Valley CGA is assessing the benefits to growers by transitioning to controlled traffic farming for compaction management.

"Some ideas may be incubated here, and broadened, such as the Walgett CGA proposal for a group to travel to the US to study herbicide resistance and the effect of bringing dicamba into the system (with the release of new Bollgard varieties)," Geoff says.

"This proposal was embraced by CRDC and attracted additional funding (primarily from CRDCand Monsanto) to allow weeds researchers, tech panel representatives, technology providers and Cotton Australia to be part of the tour, which offered a timely and serious reminder to the Australian contingent of the seriousness of resistance and drift, which is of broad-scale industry benefit.

"For growers groups the grants are a resource and opportunity to think outside the box, develop an idea, and then test whether the idea would work in practice.

"From an REO perspective, we hear a lot of good ideas from growers who just need help to get them out there and then bring them to life.

"When you have an idea, you don't know how relevant it is until you put it out there, and these grants offer an avenue to do that."

For more
Ian Taylor
ian.taylor@crdc.com.au

Savvy young leaders participate in Startup Catalyst

TWENTY young tech-savvy future leaders have just returned from a fully-funded 10-day mission to Silicon Valley with Startup Catalyst. Two participants – QLD engineer, mathematician and programmer Harry Roache-Wilson and ACT neuroscience PhD candidate Hayley Teasdale – participated in the program with support from CRDC.

Startup Catalyst's aim is to take high-achieving young leaders aged 18 to 29 on missions to international start-up hotspots to fundamentally reprogram the way they see the world, and the pace and scale at which they operate, inspiring the next generational of global tech business leaders.

"For CRDC, it is about identifying future leaders with entrepreneurial drive and the ability to deliver a benefit back to rural Australia," CRDC Executive Director Bruce Finney said.

"This partnership is one of a series of collaborations between CRDC and start-up companies aimed at encouraging futures thinking and entrepreneurism in the cotton industry."

In the past year, CRDC has partnered with start-up science company Pollenizer to run two rural.xo microhacks; incubator program x-lab to incubate core ideas that emerged from the microhacks; Startup Catalyst on the Silicon Valley youth mission; and, a newly announced partnership with QUT to support cotton participants in an MIT innovation bootcamp taking place in February 2018, for change-makers who wish to help solve real-world problems.

"As an industry, cotton has a reputation for being innovative, adaptive and quick to uptake technology and RD&E," said Bruce.

"Yet technology is changing at such a rapid pace, and 'disruption' has become the norm.

"So, to ensure that we as an industry can keep pace with these changes and are ready to capitalise on the opportunities ahead, we're helping identify and build the skills and capacity we'll need in the future."

CRDC-supported participant Harry Roache-Wilson with CRDC Director Greg Kauter.

Be connected and bee aware

CRDC and Cotton Australia are urging all farmers, no matter what crop they are growing, to access tools to protect their crops from spray drift and to apply pesticides responsibly to prevent damage to surrounding farms, and bees.

All property managers, consultants and farming contractors should be informed of, and connected with beekeepers in their area through **BeeConnected**.

Connecting is easy via smartphone by downloading the app and registering as a user and property location. If a beekeeper registers the location of their beehives within 10 kilometres of a farmer's property, then both parties will be notified and will be able to discuss their activities further using the secure messaging service.

Conversely, growers can register the time and specific location of crop protection activities they are planning, and if they're within a 10-kilometre radius of registered beehives, the beekeeper will be notified. The app is made available by CropLife Australia.

Furthering crop protection is **CottonMap**, a collaboration between CRDC, Cotton Australia, Nufarm Australia Limited, and GRDC. As with BeeConnected, growers, consultants, agronomists and contractors are encouraged to input planted cotton fields into CottonMap to help protect their crops against Group I herbicides, such as 2,4-D.

According to Cotton Australia, more than 250,000 hectares of cotton has been mapped on CottonMap so far this season. There are also a number of other resources available to improve spraying practice and efficacy.

For more:

www.BeeConnected.org.au

www.CottonMap.com.au

www.cottonaustralia.com.au

www.spraywisedecisions.com.au

Thinking up a storm: x-lab's Allen Haroutonian and Tim Parsons with CRDC Executive Director Bruce Finney (centre).

New approach bringing life to ideas

THERE are plenty of everyday people with great ideas which never see the light of day, as most people have no idea how to get them off the ground.

CRDC is taking a new approach to research through a series of 'start-up' workshops to identify and support ideas or innovations which could take the cotton industry into a blue-sky future.

CRDC supported innovators to attend initial science start-up workshops early this year called 'rural.xo microhacks' (See *Spotlight* June 2017). From these events, several participants were chose to take their idea or innovation to the next level - into the 'cotton x-lab' to further incubate and grow their projects. The proposals are as varied as those presenting them.

These innovators are Narromine farmer Andrew Gill's IN-AG website; PhD student Grace Scott's research into nitrogen fixing bacteria; PhD student Anastasia Volkova and Malcolm Ramsey with ag-analysis tool Flurosat and St George cotton grower Glenn Rogan's eco-friendly 'winter cotton'.

"We know there are potential innovators out there, many already in the industry in differing roles, who are unsure of how to bring their idea to life," CRDC Executive Director Bruce Finney said.

"There is some really impressive blue sky thinking that exists outside of the established science research community, which is evident in the projects we have seen go forward.

"To harness this thinking means we have to step outside the traditional boundaries of how we approach research and development.

"And now, through these workshops for start-ups we are helping the disruptors, the innovators, the entrepreneurs – those people who want to challenge the status quo – to take their big ideas and turn them into reality.

"We are really looking forward to where this approach to innovation takes us, as based on the first crop of participants, there is an untapped resource of ideas out there we can really support.

"The cotton industry already has a reputation for innovation, future thinking and the high calibre R&D we produce, by supporting start-ups we are further cementing that reputation."

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Helping grow

Between planting cotton and harvesting winter crops, Andrew Gill has been developing a website to help farmers navigate the rapidly expanding world of technology and practice change.

AS with many great ideas, it was Andrew's personal experience as a farmer trying to bring his family farm into the 21st century that led this Narromine cotton grower to develop a website to help answer the questions many farmers are asking.

It began when Andrew began investigating installing a diesel solar hybrid bore on his farm.

"About two years ago, we installed the first of its kind, state of the art, diesel solar hybrid irrigation bore on our farm," he said.

"I became quite frustrated while investigating different systems and trying to get a sense of how they would work on my farm, and realised what I really wanted was to talk to another farmer who had experience with this technology, but I couldn't find one.

"The thing is when it comes to new technology for farmers, often there are very few with experience to draw on, and little knowledge of where to find this information.

"If other growers do have knowledge or experience, often it's locked up in their head, so I wanted to find a way we could share this knowledge and experience in a technological world many of us are unfamiliar with."

After installing the solar hybrid system, the response from other farmers cemented Andrew's conclusion that a platform to share ideas and experiences was overdue.

"When people found out what we had done, the number of people calling me for information was unprecedented, meaning there were many more people out there than just me who were looking for

wers brave a new tech world

Andrew Gill's experience navigating the world of new agricultural technology led him to creating a website built for growers to share knowledge and experience.

information based on experience," he said.

"This led me to think of developing an online ag discussion platform where farmers can help farmers, through a self-moderated live forum – except I'm a farmer not an IT expert so I needed some help."

This is where the series of start-up workshops came into play and as a result Andrew's Independent Agriculture (IN-AG) website is now live at www.in-ag.com.au.

"These workshops really helped us navigate the digital and IT world, a place I don't spend a lot of time in," Andrew said.

With the help of the x-lab team IN-AG will provide better search engine optimisation (SEO) and a plethora of other opportunities for growers to find and share information.

"My aim was to give growers independent advice based on experience," Andrew said.

"I wish I had a website like this when I was looking to install new technology, it would have made the process a lot easier and quicker.

"Most cotton growers/farmers are not necessarily as tech savvy as the under-30 age group for example, so it can be daunting to get your head around what technology is available, how it could benefit you, how you install it, what it costs and what the returns are.

"There is no doubt we are farming in a rapidly changing landscape, with innovations using solar, satellite, automation and robotics, which give us the ability to become more efficient and profitable, so they are things we need to become more savvy with.

"While still developing currently, the end goal is that the IN-AG website will provide access to information about those things so we can get on with what we do best – farming.

"Farmers and ag tech users can really get behind this idea and benefit our whole industry with the knowledge they have. On our own we may be daunted by the innovation, but by collectively using our experience we can be very powerful.

"I'd like to thank CRDC for the opportunity to attend the start-up workshops, as they are innovative in themselves and we are seeing some really interesting ideas moving to reality."

My aim with this website is to give growers independent advice based on experience.

For more:
www.in-ag.com.au

Insight into life below the surface

The cotton industry is leading novel research into groundwater health, with new tools being developed to monitor and manage this precious resource.

In conjunction with CRDC, Dr Kathryn Korbel is working with growers to study the health of groundwater-dependent ecosystems in aquifers in the Namoi and Gwydir valleys. The data will be used to inform the participating growers and industry about biodiversity within the catchment and demonstrate and monitor the groundwater health of the regions.

Kathryn is interested in the roles of two broad groups of organisms: groundwater microbes, and stygofauna (highly specialised invertebrate that live in aquifers). Together, they effectively maintain water quality through biogeochemical interactions and potentially maintain flow in aquifers, so that it remains suitable for drinking and agricultural purposes.

Amazingly, some of the stygofauna and microorganisms found in this study belong to species, or even genera, that are entirely new to science.

Involvement with Kathryn's groundwater research on "Warrangee" at Wee Waa, has given Steve and Anna Madden a close up look at this previously unknown life 'below the surface'.

Learning about these tiny organisms which are critical for water health at their property has been a real learning experience.

"Seeing the ecology in the water – it's a new area of knowledge," Steve said.

"We became a part of the study to assess the water quality at the bores, as we want to maintain the quality of this resource right in to the future.

"Now just knowing what is actually living in the water and the impact these animals have on water quality puts a new slant on it.

"We want to make sure we are not impacting on water quality and biology to maintain the ecosystem and health of the aquifer."

The Maddens said they will work on advice from Kathryn and CottonInfo NRM Technical Specialist Stacey Vogel to continue groundwater monitoring.

A further exciting development is interest from the European Union in a groundwater monitoring tool Kathryn devised as part of the project. Kathryn and the team at Macquarie University's Department of Biological Sciences developed the Groundwater Health Index (GHI) for the cotton industry in 2011 with support from CRDC. This framework for assessing groundwater ecosystem health is a tool that can be applied across the industry, and perhaps worldwide.

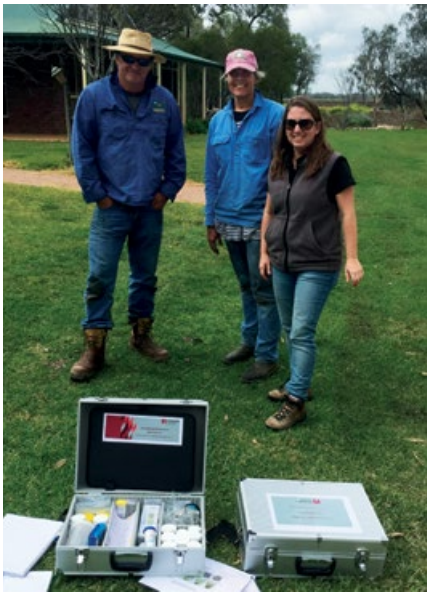
"Being able to explain the GHI to the EU Groundwater Working Group in Malta this year was particularly encouraging," Kathryn said.

"European groundwater scientists are taking particular interest in this methodology and how it can be applied to agricultural industries."

CRDC will use information from this study to directly report against sustainability requirements for the industry and demonstrate the responsible environmental management and stewardship of this resource. Research focused on the biological components of groundwater is a relatively recent endeavour in eastern Australia.

"The project will not only help farmers manage and monitor the health of groundwater resources, but will help establish the cotton industry as a proactive, world leader in managing groundwater resources through implementing the first world-wide groundwater health monitoring and reporting program," CRDC R&D Manager Jane Trindall said.

"For cotton farms and farmers, this research is highlighting the links between biology in the groundwater and water quality, which in turn has implications for the wider environment that includes our cotton production systems."



Steve and Anna Madden with researcher Kathryn Korbel have been involved in testing groundwater quality and discovering new organisms in the process.

What are stygofauna?

"Stygofauna are predominantly small crustaceans similar to invertebrates that we find in our rivers, but due to the lack of light in the groundwater environment, they are transparent and sightless," Kathryn says, "in fact, some of them are known to move between ground and surface water when conditions are favourable."

By looking at these animals we can gauge groundwater quality.

"Our work has also focused on the bacteria in groundwater, which are believed to be important in influencing water quality, ensuring groundwater remains suitable for drinking and agricultural use.

"It appears bacteria are important in the nitrogen, carbon and iron cycles within groundwater, with microbes possessing the ability to degrade nitrates being located in our focus catchments.

"Although more work on this is needed, results potentially indicate microbes may have a role in remediation of contaminated groundwater."

For More

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Taking care of business

The Australian Government's Rural R&D for Profit Programme has opened up new avenues for R&D organisations to develop and deliver research to those who need it most.

In 2014 the Australian Government launched the *Rural Research and Development (R&D) for Profit Programme* to increase funding to rural research and development corporations (RDCs) for nationally coordinated, strategic research that delivers real outcomes for Australian producers.

The programme is administered by the Department of Agriculture and Water Resources, with total funding of $180.5 million over eight years, ending in June 2022. The programme funds research which focuses on delivering cutting edge technologies and making research accessible for primary producers, while better leveraging coordination and cooperation between stakeholders.

Rural R&D for Profit is a competitive grants programme which initially began as a four year programme

ending in 2017-18, however as part of the *Agricultural Competitiveness White Paper* the Government committed to increase funding and extend the programme to eight years. This is a co-investment programme where the applicant and/or partner organisation(s) must provide cash co-investment contributions to each project, with in-kind contributions also accepted.

CRDC oversees three major projects under the programme. There are a number of research sub-projects under each project.

Smarter Irrigation for Profit

This major project will lead to improved irrigation practices on cotton, rice, sugar and dairy farms. It will help approximately 3000 farmers to optimise their water-use decisions, leading to yield increases and reduced input costs and water use.

More profit from nitrogen: enhancing the nutrient use efficiency of intensive cropping and pasture systems

The project will improve the nitrogen use efficiency for the cotton, dairy, sugar and horticulture industries. Farmers will gain a better understanding of the various influences on nitrogen use efficiency, and improved confidence to adopt fertiliser management practices tailored to specific crop requirements allowing greater farm productivity and profitability.

Accelerating Precision Agriculture to Decision Agriculture

This is the first project to involve all 15 RDCs. It will design a solution for the use of big data in agriculture in order to increase the profitability of producers and improve farming strategies. The project will help producers understand data ownership and access rights and will increase the adoption of new technologies to improve farm profits.

CRDC also has invested in and manages individual research projects in a number of Rural R&D for Profit projects being led by fellow RDCs.

- Stimulating private sector extension in Australian agriculture to increase returns from R&D.
- Improved use of seasonal forecasting to increase farmer profitability.
- A profitable future for Australian agriculture: Biorefineries for higher-value animal feeds, chemicals, and fuels.
- Digital technologies for more dynamic management of disease, stress and yield.
- Forewarned is forearmed: equipping farmers and agricultural value chains to proactively manage the impacts of extreme climate events.
- Improving plant pest management through cross industry deployment of smart sensor, diagnostics and forecasting.
- Increasing farm gate profits, the role of natural capital accounts.

Improving efficiencies is integral to the future of all primary production and by working together under the Rural R&D for Profit Programme, the capacity to produce more using less has been heightened.

Opening exciting avenues

CRDC General Manager R&D Ian Taylor said the Rural R&D for Profit Programme had opened new, exciting avenues to further research and put it in the hands of producers.

"CRDC is very pleased with the calibre and outcome of the projects both under our control, or undertaken by other bodies, in particular the scope of the research and its cross-sector relevance, as well as the rapid impact, with research and technology being taken up by industries involved and used in the field.

"The information and research exchange between industries and research organisations has been a highlight, and although we often collaborate with other RDCs on research project, the Rural R&D for Profit Programme has brought new meaning to the word 'collaboration'.

"It's been a game changer in the way we undertake and deliver research.

"Every industry has something (knowledge, research, experience, technology) to bring to the table that could be of use to producers in other primary industries sectors, it's a case of identifying what that is and how it can be adapted, if need be.

"The ability to pool the resources of government, RDCs and researchers has been very successful, and we look forward to seeing what else can be achieved by 2022."

In this edition of *Spotlight*, we have highlighted the projects CRDC is leading to give our growers and industry stakeholders an overview of the range and extent of the fantastic research going on.

Get smart: irrigation technology in the field

The Smarter Irrigation for Profit project has seen impressive uptake and trialing of technology and knowledge between agricultural sectors and is improving the way sugar, rice, dairy and cotton growers operate.

The Smarter Irrigation for Profit project aims to improve the profit of 3000 cotton, dairy, rice and sugar irrigators by $20,000 – $40,000 per annum, with the support of 16 research and development partners and 19 farm irrigation technology learning sites.
The project works through three avenues:

- Practical, reliable irrigation scheduling technologies
- Precise, low cost automated control systems for a range of irrigation systems
- A network of farmer managed learning sites located in major regions referred to as "optimised irrigation" farms.

Smarter Irrigation for Profit is a partnership between the major irrigation industries of cotton, dairy, rice and sugar, led by CRDC in conjunction with Dairy Australia, AgriFutures Australia, Sugar Research Australia and research partners and other industry organisations.

There are four key projects relevant to the cotton industry, which are delivering tangible results for growers in terms of efficiency and sustainability. The research is being undertaken from Queensland to Victoria across the four industries, who "share more commonality than difference in terms of uptake and needs" according to CRDC's Jane Trindall.

The four projects are: *Smart Automated Irrigation*; *Grower Led Irrigation System Research in the Gwydir Valley*; *Irrigation Cotton Agronomy for Tailored and Responsive Management with Limited Water* and *Maximising Irrigation Profitability*. These projects are outlined in detail in coming pages.

Jane said a major outcome for this project has been bringing researchers and research staff together for a national research effort.

"We've seen the development and installation of new automated, precision irrigation systems and established grower-led trial sites across the three industries in three states," Jane said.

"We've been able to rapidly accelerate the grower adoption of new technology, which is a really good outcome, as often taking research into the field commercially takes a lot longer than two years.

"To see the uptake of variable rate irrigation technology such as VARIwise, developed in the cotton industry, now being trialed on dairy farms is really pleasing, and shows what can be achieved with true collaboration."

Guy Roth manages the project on behalf of CRDC. He says among the major achievement so far have been the cross-sectoral involvement and information and capacity sharing.

"We've been really pleased with the way the industries are working together, sharing information and working together to promote adoption of methods or technology to become more efficient and sustainable," Guy said.

"Much of this learning and subsequent adoption has come as a result of bringing the growers from cotton, sugar, rice and dairy together, to compare and contrast their methodologies and technologies.

"We've had Northern Queensland sugarcane growers visit Northern NSW cotton growing operations, cotton growers visit rice farms and dairy farmers visit broadacre irrigated farmers and feedlotters around NSW.

"Not only is personal experience and knowledge shared at these events and field days, but we also have the change to showcase new technology such as irrigation sensors and automation.

"To give primary producers the opportunity to see technology being used commercially is a great advantage and is now a driver of adoption.

"It also helps us identify where further opportunity lies for cross-sectoral collaboration where we can collectively work to solve common issues by pooling our resources or sharing research."

Pictured are a group of sugar cane growers from Northern Queensland who visited on-farm irrigation trials at Moree, a completely new experience for them.

Automatically leading the way

The automated precision broad-acre irrigation project has worked continuously to bring forward a range of novel technologies to modernise traditional broad-acre furrow, lateral move and centre pivot irrigation systems, in cotton, sugarcane, and dairy pasture fields.

This project is being led by Dr Joseph Foley of the National Centre for Engineering Australia (NCEA) at the University of Southern Queensland, based in Toowoomba.

Research results on the performance of furrow irrigation in cotton and sugarcane from the NCEA have repeatedly highlighted the crucial role of good irrigation management in seasonal yield improvement.

"The irrigation management recommendations we've continuously delivered to growers for optimal furrow irrigation can often not be implemented, as these can require irrigation staff to work with siphons in the hottest part of long summer days, or in the dead of night," Joe said.

"Often, there can be other higher competing priorities for the small amount of manpower available."

This project has delivered automated irrigation solutions across a number of large commercial fields to remove the often mundane, repetitive tasks for growers and staff, so that improved irrigation management can be implemented. As a result of this project growers on co-operating farms can now remotely open valves and gates to automatically complete furrow irrigation at costs ranging from $600/ha to $2000/ha, depending on the size of irrigation sets.

To implement these automated furrow irrigation systems, a high density of cheap sensors are being installed to measure crop and irrigation parameters, and transfer data through modern communication systems to provide growers with control from smartphones and tablets, whereever they are located.

Andrew Greste and Steve Carolan of Waverley Agriculture at Wee Waa in Northern NSW have now taken forward the development of the small pipe through the bank systems and implemented this automatable system on 1700 hctares.

This system was first trialled by NCEA with CRDC support in 2014-15. With normal siphon irrigation manpower costs of between $200 and $250/ha, Waverley's fully automated system, with remote control capability, has a three to four year payback period. This system now allows the team to alter their irrigation flowrates and run time, to improve infiltrated water depths for each irrigation.

In the Burdekin River Irrigation Area, with the research activity of Dr Malcolm Gillies, sugarcane grower Russell Jordan now furrow irrigates sugarcane automatically under gravity from channel supplies through large buried pipelines and flexible fluming on over 82 hectares.

Russell has been using the system for 18 months to automatically schedule and monitor the irrigations from his home or smartphone, resulting in significant

Technology developed by the cotton industry to enable variable rate irrigation has made its way to the dairy industry.

David Robson, FarmConnect and Rubicon Water and Dr Joseph Foley, USQ have worked with Steve Carolan and Andrew Greste from Waverley Ag at Wee Waa to install an automated irrigation system.

labour savings. Sensors buried at pre-determined locations using Irrimate software, measures the advancing water front. SISCO optimisation enables the system to automatically stop the inflow or switch to the next set and almost eliminate tail water which could not be captured at this site. This system has also been demonstrated at two sugarcane farms with pumped supply and resulted in energy savings.

In each of these cases, growers also have cut down the number of times needed to travel to the fields, and monitor water supply outlets to control flowrates. These systems have reduced grower fatigue and vehicle wear and tear, through all hours during the summer irrigation season, and provided opportunity for broader improved irrigation management.

Dr Alison McCarthy has put in place VARIwise irrigation control across these systems, and on large centre pivots irrigating cotton, and dairy pastures in northern Tasmania.

On the large centre pivots with variable rate irrigation (VRI) sites in this project, prescription maps for individual sprinkler control can now be pushed automatically to irrigation control panels and operated for spatially optimised variable irrigations.

R&D Manager Jane Trindall oversees the Smarter Irrigation for Profit Programme on behalf of CRDC and says a significant gain from this research has been the team's 'reality checking' of real time automation.

"Joe has taken automation technology and Alison's blue sky VARIwise research out onto farms," she said.

"This aspect of the project has accelerated this technology to the adoptive stage, into the hands of the grower.

"Joe has spent a lot of time troubleshooting these systems on-farm with growers, it is incredible to see what has been achieved in a relatively short time.

"The researchers have developed a real-time precision irrigation system that has moved exclusively out of the cotton system and been trialled in sugar and dairy.

"The Victorian Department of Primary Industries is also trialling the technology, which may move on to the patent stage for use in cotton, dairy and sugar industries."

Jane says the advantage of projects such as this is the short-term focus to realise long-term gains.

"We are looking at the same problems differently," she said.

"Between industries there is more commonality than difference in uptake and needs.

"The system of peer-to-peer research has brought together a group of experts for a national research effort and the cross-sectoral facet through Smarter Irrigation has been illuminating to growers from across the associated industries.

"Leading industries have the ability to provide confidence to others to investigate and take up new technology and this project has broadened their horizons as to what is possible."

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It's widely acknowledged that being smarter about the efficient use of nitrogen (N) opens doors to greater productivity, increased profit and reduced environmental impact. But what is the best way forward for particular farming systems?

Pooling nitrogen resources

CRDC already invests in many research projects and initiatives to improve nitrogen use efficiency (NUE) in the cotton industry however it is also a key focus of broader cross-sector collaboration and investment.

The national *More Profit from Nitrogen Program (MPfN)* is a four-year partnership between Australia's four major intensive users of nitrogenous fertilisers: dairy, cotton, sugar and horticulture, led by CRDC. Supported by an injection of $5.8 million from the Australian Government's Department of Agriculture and Water Resources Rural R&D for Profit Programme, MPfN is entering its second year of delivering the research findings of 10 industry based projects from a partnership of 23 organisations. Combined contributions have seen an unprecedented commitment of $15 million to NUE research.

"By bringing the four industries together, the result is definitely increased cross-sector collaboration to reduce duplication of effort and development of more progressive and expedited outcomes for the investment than research undertaken in isolation," said Marguerite White, Science Coordinator for the program.

"With 70 PhD, post doctorate, research and technician positions contributing time on this from some of Australia's leading research organisations, plus incredible contributions from all the industry farm extension programs, MPfN will deliver highly advanced outcomes that will be game changers rather than incremental steps for NUE."

MPfN is working towards making a marked difference to farm profitability while reducing environmental impacts, by reducing the amount of N required to produce a unit of product for each industry sector. Producers know there are many contributing factors when deciding on how, when and where to use N. Too little may reduce yield potential, while too much can greatly impact on profitability and increase emissions.

Ensuring it delivers outcomes from research and practical solutions, MPfN has been designed to engage with growers from the beginning. The project involves 33 study sites from Darwin to Hobart, also used to demonstrate and host local field days to encourage local input. These sites are further supported by laboratory analysis, experiments,

It takes a team to make a collaboration: the many faces of the More Profit from Nitrogen team members.

simulation and modelling.

Program research is being undertaken under three focus areas for improving productivity and profitability through improved NUE. These are:

- Greater knowledge and understanding of the interplay of soil, weather, climatic and farm management factors to optimise N formulation, rate and timing in relation to irrigation practices;
- Greater knowledge and understanding of the contribution (quantifying rate and timing) of N mineralisation to a crop or pasture's nitrogen budget; and
- Greater knowledge and understanding of how enhanced efficiency fertiliser (EEF) formulations can better match a crop or pasture's specific N requirements by developing new ones and optimising existing ones.

Research findings of MPfN research projects will be integrated into the relevant industry programs as resources, guidelines and tools for producers and advisors.

"With research and demonstration underway across the country, farmers are encouraged to become involved in local project trials.

"Ensuring MPfN has practical relevance to farm management and accurately assesses profitability gains for the farm business is paramount to its ongoing legacy," Marguerite said.

CRDC is supporting two cotton projects under the MPfN Program, one with the University of Southern Queensland, *Optimising nitrogen and water interactions in cotton*, and the other with the NSW DPI, *Enhancing nitrogen use efficiency in cotton.*

"Both these projects build on previous research supported by CRDC, and include a focus on improving our understanding of the impacts of different water and nitrogen application strategies on NUE – and especially the interactions between the two," said Allan Williams, CRDC's R&D Manager for the program.

"As well as looking at looking at how irrigation management affects NUE, the DPI project is also investigating whether there has been any long term stratification of phosphorous (P), and the effect of N and irrigation management on P responsiveness."

For more
www.crdc.com.au/more-profit-nitrogen

Peter Glennie "Norwood" Moree with farm manager Richard Ross. Peter has been involved with on-farm trials for more than 40 years and his team has recently come on board to work with researchers measuring the effect of in-season water-run urea application on ammonia volatilisation.

More profit from nitrogen

Enhancing the nitrogen use efficiency of intensive cropping and pasture systems involves two major projects relating to cotton.

More Profit from Nitrogen: *enhancing nutrient use in cotton*, is being led by NSW DPI's Dr Graeme Schwenke. He is working with fellow NSW DPI researchers Jon Baird and Guna Nachimuthu, CSIRO's Dr Ben Macdonald, and also links with the universities of Queensland, Melbourne, and New England.

The project began in 2016 with a core trial at the Australian Cotton Research Institute (ACRI) comparing irrigation deficits, N products, N rates and a variety of N application strategies (including fertiliser placement and N timing). Phosphorus (P) nutrition is another focus of the project, with initial work focused on analysis of historical soil samples from five long-term research trials to investigate P decline over time. In 2017, the project has expanded to include two new on-farm research sites for N research and new soil sampling from the long-term trials for the P work.

The N research in this project developed from

several previous cotton research projects undertaken by the current research team. The new projects aims to address two major research questions: does the interaction of irrigation management and N fertiliser timing affect N use efficiency in cotton, and does the method of in-crop N fertiliser application affect N use efficiency?

Some of the major findings from the first season included:

- Irrigation deficit affected cotton growth and yield. At a 50 mm deficit, plant height, biomass and N content was greater than at a 70 mm deficit, but plants had more bolls lower on the plant under 70 mm deficit, which led to greater lint yield.
- The total N rate used across most of the ACRI trial last season was based on average current farmer N rates at 260 kg N/ha. At this rate, the N supplied was in excess to crop requirements and varying N application strategy did not affect cotton yields. Yields were no better at a higher N rate (360 kg N/ha), but were lower in 0 kg N/ha plots.
- Early N application led to taller plants, but later N-applied plants tended to have greater fruit retention, so N timing did not affect final yields in this high N situation.
- The extra high N rate (360 kg N/ha) and 50 mm deficit both reduced fertiliser N use efficiency (NUEf)
- N lost in irrigation runoff constituted less than 7.5 percent of the total N applied across most treatments, except in water-run treatments where greater than 23 percent of the N applied was lost.
- Pre-plant urea applied with a nitrification inhibitor reduced N in runoff from the first irrigation.
- In-crop sidedressed urea led to greater boll production than broadcast urea and water-run treatments, but did not affect final lint yield.

Graeme says the project is expanding in year two, with a larger trial in two new paddocks at ACRI, plus two growers involved in on-farm trials.

"The new ACRI trial repeats all of last year's treatments, but at a lower N application rate to better differentiate between N application strategies," Graeme said.

"It also incorporates a new polymer-coated urea product and additional Nitrogen x Phosphorus x Irrigation interaction treatments in conjunction with the treatments investigated during the 2016-17 season.

"The on-farm trials aim to investigate a few selected aspects from our core research site in a commercial situation.

"We brought a range of potential trial options to the table in discussions with the growers, and they both chose to investigate using a nitrification inhibitor in conjunction with their pre-plant N application."

Previous research by Graeme with nitrification inhibitors focused on reducing nitrous oxide emissions during cotton production - which was successful in on-farm trials at Gunnedah and Emerald last year.

"However, farmer adoption of inhibitors will require either the benefit of a cost saving (reduced N fertiliser needed) or lint yield increase," he said.

"This year's on-farm trials aim to see whether the nitrification inhibitor can improve the fertiliser-N response curve in furrow irrigated cotton."

Graeme is also pleased the research has sparked interest from growers, which has led to new trials on two farms, hence expanding research from the core site at ACRI.

"We had a field day at ACRI last February with growers and advisors at our trial, and also gave key results from the previous projects that had led into the treatments at the new trial," Graeme said.

"Peter Glennie from Moree had his first interaction with the MPfN project at our field day and through subsequent feedback and communication we are now basing a trial on Peter's farm "Norwood". Norwood will also be used for a case study to measure the effect of in-season water-run urea application on ammonia volatilisation, conducted in collaboration with the University of Melbourne."

"The other on-farm trial is at Noel Donnelly's "Sunningdale Park" near Gunnedah.

GROWER – PETER GLENNIE

Peter is a second generation cotton farmer in the Gwydir Valley, who has been producing cotton since the 1980's. Peter has a long history of working with industry researchers and believes in the importance of collaboration and co-investment of the cotton industry with research. Peter has recently incorporated chickpeas into his cropping rotation and is interested to see if chickpeas allow him to lower his nitrogen application rates without compromising his cotton yields.

GROWER – NOEL DONNELLY

Noel Donnelly based at Gunnedah on the Liverpool plains has joined the project this season as a collaborator for the More Profit from Nitrogen project. Noel has been following the progress and findings of past nitrogen research conducted in the local Upper Namoi area, and has an interest in reducing nitrogen loss from his cotton system by using nitrification inhibitors.

Don't drop out: Keeping growers connected

Across agriculture, cotton growers are the biggest users of on-farm telecommunications to link and analyse data.

It comes as no surprise then, that as the biggest adopters of digital agriculture technologies to improve productivity, cotton growers are also the least satisfied with options for connecting and analysing digital information. Poor connectivity across farms is a key barrier to adoption.

These findings are part of a survey, released in July, undertaken as part of the Australian Government's Rural R&D for Profit Programme's Accelerating Precision Agriculture to Decision Agriculture Project (P2D). P2D is a national project being supported by all 15 RDCs and led by CRDC. It involves research support from three universities, CSIRO Data 61, the Australian Farm Institute and the Data to Decisions CRC.

The survey of 1000 producers from 17 industry sectors found there is limited use of farm analytical software platforms in Australia - while 89 percent of survey participants collect at least one type of farm data, few are using specialist farm software to manage it.

As such, Australian farmers are missing out on profit gains available from digital agricultural technologies.

The survey of 1000 producers across 17 industries undertaken by CSIRO found that three quarters of digital agricultural technology users reported ongoing problems with the reliability of mobile telecommunications.

Project Management Committee Chair Mick Keogh said the survey results were concerning, given the potential for significant profit gain through the widespread application of digital agricultural practices.

"We're still pulling together the results of our research overseas about the potential benefits available from digital agricultural technologies, but I think the current forecast of 10 to 15 percent productivity gains for some Australian industries could be conservative," he said.

"The clear message emerging from this project is that we need to work together - and quickly - to make adoption easier for producers."

Constraints

A subsequent report into on-farm telecommunications by University of New England senior researcher Professor David Lamb under P2D found that producers are constrained by low levels of awareness of technology options, service provider options and mobile technology access.

He says education is needed so producers have the information and the confidence to make the most of technology to enable digital agriculture and, in particular, they need market solutions to mobile technology access.

David's report contains 13 recommendations, including an industry-wide 'fair use' policy that keeps mobile access costs down during periods of critical and data-hungry operations like harvesting. He's also calling for greater emphasis on data speeds as part of codes that govern service provision.

Aims of P2D

- Identify cases where the use of digital agricultural applications and use of data is likely to have high-impact profitability and productivity benefits
- Conduct a detailed analysis of the current and future economic benefits of digital agriculture in Australia, examining the projected use and benefits to farm business decision making, risk management and profitability
- Evaluate the options, merits and risks of business models to take advantage of digital technologies in the Australian agricultural sector

For more
www.farminstitute.org.au/P2Dproject

Go your own way:
Sundown signals change

Sundown Pastoral Company at Moree has solved their connectivity issues by installing their own network, beamed from town 50 kilometres away.

This has given them a guaranteed data speed and reliable connection 24 hours a day on their farming operation west of Moree in North West NSW.

Manager Nick Gillingham said their need for a solution was so great they engaged a telco to set up a system to create a high speed internet connection, which comes from Moree and bounced from complexes in between to the farm.

"This system has given us the speeds and connectivity we need to operate effectively," Nick said.

"This has come at a cost – but the alternative was we didn't have one.

"We use it to monitor all our machinery, telemetry and automated irrigation system.

"We manage quite a large area out here, and being able to manage our farms more remotely means there are less people to manage.

"I can pick up efficiencies by looking at data from machinery and be immediately alerted if there is a problem.

"Cotton is a precision crop to grow – so how can we gain efficiencies and reduce human error, and get things more precise to grow better crops?

"For smaller farms, I think the main gain through reliable connectivity would be easier implementation of precision agriculture."

Internet access is also a pre-requisite when attracting staff.

"Good connectivity is a consideration for staff – people expect to have good access to the internet when they are living here," Nick said.

"We are now in the process of bouncing our signal to other buildings and complexes around the farm to improve this."

Sundown has an interesting example of the benefit of connectivity away from the daily running of a farm.

"We had a Ritchie Bros auction here earlier this year, and having access to a high speed internet was a pre-requisite to hold it, so the auction could be streamed live across the world.

"Having the capacity to hold this auction here helped us to realise good resale value for all our equipment.

"We have also fixed our previous issue where it was extremely frustrating to analyse data and then we couldn't transfer it.

"Data costs are huge on the 3Gnetwork and it is ridiculously slow."

Nick says what they need now is better technology in the form of analytical platforms.

"The trickiest part for growers today is 'what technology or platform to do you adopt to give you the best returns?'

"We are getting swamped with ag-tech which has become an industry in itself and it can be costly if you waste your time investigating and then implementing technology that doesn't work for you or fit into your system."

The team at Sundown Pastoral's "Keytah" look over the planting job of their new, specialised and well connected cotton planter.

Planting on point

Using a specialised, custom built planting unit, Sundown Pastoral's managers at "Keytah" can check in real time as to the seed output of each row – whether it's dropping single, double or no seed.

"We can pick up issues immediately and also know exactly where to check and/or replant," farm manager Darren Hart says.

"Regardless of where we are, we can now see what is happening with each individual tractor and planter and are alerted to any inconsistencies or issues.

"This has been made possible through improving our connectivity right across the farm so we can install and access technology in our tractors and on these planters to save time and improve precision, which we have achieved."

So is this a wish-list planter?

The planters can be towed at around 14 kilometres per hour – nearly double conventional speeds, without sacrificing precision, which means they've gone from four planters to three and planting takes less time. The days of loading bags of seed from a trailer in the paddock and individually opening and emptying them into planter boxes have gone. The seed is delivered to the planter via a semi-trailer with a rubber conveyer belt attached to the bin, to avoid seed damage. The single seed bin set up has saved drivers half an hour per refill. With four planters previously, filling four times a day, that was eight hours spent stationary, which is now spent planting.

The trash-whippers are mounted with hydraulics and can be adjusted from inside the cab – a job that usually involves manually winding them up or down, and takes around 15 minutes each time. As growers and operators know, this may be done many times in a shift, so is time consuming and less flexible than hydraulic adjustment.

The team at "Keytah" are known for innovation and uptake of technology, but as Darren explains, the cost-benefit must stack up. The move to specialised planters was not a cheap one, but the time saved, precision gained and need for one less machine stacks up for Sundown owner David Statham, who has been a leader in precision and digital agriculture since the nineties. This culture of innovation clearly runs through the whole farming operation, as the team works together to come up with ideas and solutions and are involved in taking it into the field.

Darren was also involved in developing a method of water/herbicide injected post-harvest plant removal (see full story next page) which is being tested through a CRDC project.

"I had seen high-pressure water used on planters to cut a furrow through stubble and trash and it's also used to inject nitrogen in sugarcane, so thought it also may be effective as an alternative to root cutting," Darren said.

"So I got in contact with Greg Butler from the South Australian No Till Farming Association for more information.

"We tested the water method on cotton stalks with NSW DPI at Lismore and found there was no problem cutting them, so we progressed to making a tool bar for the implement.

"Paul has now come on board with this and I think it's got legs.

"For me, traditional disc root cutters just aren't effective enough in damp, uneven ground and varying soil types.

"If we can refine this water injection method for dryland systems and irrigation it will be a game changer."

Managing marginal conditions

Dryland research trials are underway again this season, as researchers look for methods to help growers overcome challenges associated with climate and soil constraints.

CRDC is supporting QDAF's Dr Paul Grundy in research to improving crop emergence, as well as plant removal post-harvest. Last season Paul worked with dryland growers to identify issues and strengths in their farming systems as well as in dryland cotton research.

Key issues common to all regions were identified. These centred around effective crop establishment and end of season crop destruction; the lead out/transition to grain crops after dryland cotton; and weeds, with summer grasses of particular concern.

To improve planting success and promote better establishment, for a second season, on-farm trials are underway using water injection both with and without moisture attracting additives for use under marginal surface moisture conditions.

Paul says the concept behind these additives is to hold moisture around the seed for longer after sowing to aid the germination process.

"Water injection is not new technology, and has been used by some growers in the past, however for many, the practicalities of handling the large volumes of water required is a major impediment," he said.

"The addition of moisture attractants may enable similar benefits as conventional water injection but with greatly reduced water volumes making such a tactic a more realistic option for many growers to help with marginal moisture planting conditions."

A number of treatments are being tested in collaboration with Ian and Harry Carter at "Connamara" near Quirindi. This region has missed much of the October rainfall that has fallen in other areas with planting conditions remaining difficult. Ian and Harry have been using water injection with excellent success for a number of years but are certainly interested in tactics being tested that could reduce the volumes of water required, making the process more efficient.

Darren Hart says using water under high pressure with a herbicide to manage cotton stubble 'has got legs'.

Water power

Investigations have also continued into the efficacy of ultra-high water pressure (50,000psi) for root cutting post-harvest.

Preliminary trials have opened new avenues for the technology to be used in a number of ways. A second experiment was set up at the end of last season at Sundown Pastoral's 'Keytah' west of Moree to further investigate the potential to utilise ultra-high water injection with herbicide as an alternative crop destruction mechanism post mulching to prevent regrowth. These treatments have lain dormant over winter but treatment differences have begun to emerge with the rainfall and increased temperatures of October.

Early indications are that this technique as a proof of concept has the potential to provide a non-tillage method for controlling ratoon cotton. CRDC have supported this work in collaboration with Greg Butler from South Australian Farmers No-Till Association and Darren Hart from 'Keytah'.

For more

Paul Grundy
paul.grundy@daf.qld.gov.au

Is your urea tank supplying the nitrogen you think it is?

CRDC helps further the career of young scientists by supporting PhD studies in their chosen field of study. For PhD Scholar James Latimer, that field is fertiliser.

James is being supported by CRDC, the Australian National University (ANU) and CSIRO, studying his PhD: *Improving precision agriculture and environmental performance for the Australian cotton industry through fertiliser optimisation.*

As part of this study he is testing the efficacy of water-run urea, saying that while water-running urea can be an effective way to top up nitrogen levels in-season, are growers getting the full benefit? He says properly managing concentration, flow rate and length of discharge time are key.

Water-running urea involves adding concentrated urea solution to water in tanks which feed into supply channels during irrigations. It's a well-known and popular method of nitrogen application, with 46 percent of Australian irrigated cotton growers using this method in the 2016-17 season. However this method can result in very poor application uniformity, as shown in James' research.

"An obvious downside to water-run urea is that growers can't see how uniform or efficient the application is," James said.

"This is often cited as a reason growers don't water-run, and indeed, they have a right to feel unsure, as small application shortfalls can go unseen, yet lead to big discrepancies between what they think they have put on, and what's actually gone on."

James' trial in a bankless channel system showed over the course of a 35-hour irrigation, the rate of supply and uniformity varied dramatically; with rates of almost 200 kg urea/hour at the start of the irrigation decreasing to less than 50 kg urea/hour for much of the last three bays.

The result of this inconsistency is that the first bay received half of the total nitrogen run, while the third and fifth bays received just nine and six percent respectively. Compounded over a whole season, this variation can of course have significant effects on yield, efficiency, emissions and the bottom line.

James said professional urea tank management services are available, and are a good way to ensure certainty about how many units of nitrogen have been added to the crop. However, he says farmers generally see these services as unjustifiably costly, and instead add extra urea to the tank, hoping to cover any deficits.

"When the price of urea is 'low' this may seem like cheap insurance, however from an efficiency, profitability and emissions perspective it is not a long-term solution."

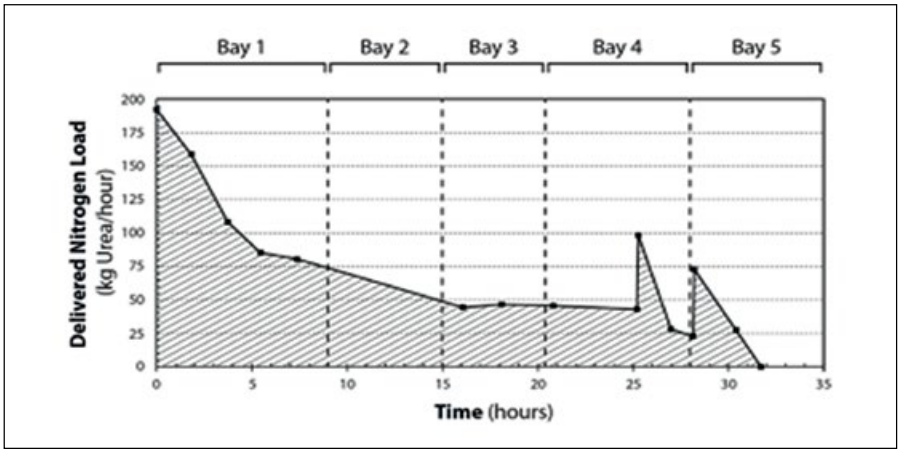


Figure 1. Nitrogen delivery from a single urea tank to five bays in a bankless channel layout.

Delivered Nitrogen from Urea Tank				
Bay	**Urea (kg Urea)**	**Nitrogen (Units of N)**	**Percentage of Total**	**Nitrogen Over/Under Application**
Bay 1	1023	120	49 %	+ 145 %
Bay 2	369	43	18 %	- 10 %
Bay 3	184	21	9 %	- 55 %
Bay 4	366	43	18 %	- 10 %
Bay 5	130	15	6 %	- 70 %
All Bays	**2072**	**242**	**100 %**	

Tank Concentration
Mix well. If the urea isn't dissolved properly before you start irrigating, much of it will be flushed out in the first few hours, over-supplying the first bays and undersupplying later ones.

Tank Outflow Rate
As the tank's water level drops, the driving head pressure falls, reducing flow. Use header tanks for a consistent flow to avoid dumping all the urea tank's contents in the first few hours. Even simple setups using a 44-gallon drum and a toilet float switch will mitigate this variability.

Tank Discharge Time
Think about how long the urea tank will be supplying each section of crop. If water runs into one bay (or over one section for syphon users) longer than another, it will also receive more nitrogen. Keeping tabs on how long each bay has been watered for will also track how much nitrogen they have received.

Table 1. Key numbers from Figure 1. Ideally the farmer would have applied 20 percent of the nitrogen to each of the five bays.

Stronger together

Both a cotton grower and a student have found being part of a school-based traineeship to be a highly rewarding experience.

Big rewards: Natalie Tighe of the Aboriginal Employment Strategy with Year 12 graduate Montana Jones, cotton grower Daniel Kahl and CRDC's Sally Knight.

Former Wee Waa High student Montana Jones has completed Year 12 and along with it a two-year school-based traineeship, a Certificate II in Agriculture and has applied to go to university – something she never dreamed of.

However it is a dream come true for this indigenous student, who has been a part of a CRDC and Aboriginal Employment Strategy (AES) school-based traineeship program. It's seen her realise her potential through working over the past two years with the Kahl family's Merced Farming at 'Glencoe' near Wee Waa in North West NSW. Her two main mentors are Daniel and Sam Kahl, third generation cotton farmers, who also have dryland farming and grazing.

After graduating Year 12 earlier this year, Montana is now working full time with Merced in her gap year. It's a great outcome for this young woman with her heart set on a career in agriculture. With the Kahls, Montana was able to fulfil her dreams of combining a career in farming and cattle.

Career inspiration came from school and particularly after being part of the highly successful Ag Show Team under the tuition and guidance of her agriculture teacher Verity Gett. Verity would be known to many in the industry through her previous role as a cotton research agronomist.

"I really enjoyed my traineeship, it has helped me prepare to become work place ready by giving me experience and tools like being part of a team, I know what it means to be part of the bigger picture," Montana said.

"It's also helped me learn independence and to take initiative.

"I've been paid as I go, so have been able to save a little, but I've also learned to manage my money.

"I'd really like to thank CRDC for offering the traineeship in an area where my passion lies.

"I've taken up a position with Daniel at Merced for my gap year also, which will be terrific for me to consolidate the skills I have learned operating different equipment on the farm.

"Daniel and Sam have also offered to help me get up north to experience a muster season, and I am thrilled about this.

"I can't thank the Kahls enough for agreeing to host me. I have felt so welcome and they have nurtured in me the opportunity to build not just my self-confidence, but arm myself with skills that will really help me with future employment opportunities.

"I really recommend these school-based traineeships, and it's even better if you are really passionate about the field, as it gives you a valuable piece of paper at the end - I now have a Certificate II in Agriculture.

"I have applied for early entry to the University of New England and if accepted, I will defer for a year as I've been selected to be a part of Cotton Australia's Gap Year scheme, and there may even be an opportunity in my gap year to start on a Diploma. I know Daniel is working on something!"

Montana's mentor Daniel Kahl (who is also a CRDC/Cotton Australia-supported Nuffield Scholar), said Merced Farming's involvement in supporting school based traineeships has been a really rewarding

one for their business.

"We believe there is a need for us to do what we can to support young people who want to get involved in agriculture, particularly on farm," Daniel said.

"As well as being a good fit for our business, the program ties in really well with my Nuffield Scholarship topic, 'Where are the next generation of farm managers coming from and how can we attract quality candidates on farm?'.

"It also allows farms and businesses to get involved in helping young people to develop their career path in ag, providing them with on the job experience and facilitating further training.

"Once the traineeship is completed, you have a young worker with a Cert II in Agriculture who has been trained on your farm, understands your operation and is already a valuable member of your staff if they were to take on a full time role."

Daniel says how individual businesses manage and retain their staff will be different for everyone, as it's not a one size fits all solution.

"To attract more people into agriculture and build a deeper, skilled talent pool for our industry to draw upon, it's really important to demonstrate to young people at a school age that there is a career path and opportunities to develop themselves in agriculture.

"These programs are an effective way of initiating that and attracting young people towards agriculture as their preferred choice of career.

"I'd encourage all growers who might be in a position to do so to consider participating in a traineeship program and would be happy to talk more about it with anyone who might be interested."

CRDC have long supported developing pathways for young Indigenous students with funding administered through the AES, and the current program is run by consultant Sally Knight, based at Wee Waa.

"It is really rewarding to see the outcome of this partnership," Sally said.

"It develops our cotton industry workforce, capacity building skills of local students and provides career pathways, so it is a win-win situation."

For more:
Sally Knight
sally.knight@crdc.com.au

Disease surveys underway

Kicking off in November, the cotton industry's annual early-season disease surveys are now underway.

There are two surveys – an early-season and late-season survey – to determine disease incidence and severity across Queensland and NSW. The surveys are designed to quantify endemic cotton diseases, and detect any exotic disease threats. The project is also looking to improve how information is collected and analysed in order to deliver improved advice to industry on disease management.

The project is led by Dr Linda Smith of QLD DAF, and involves the QLD DAF pathology team Linda Scheikowski and Tim Shuey, and the NSW DPI team Duy Ley and Aphrika Gregson. It is supported by CRDC and the Australian Government through the Rural R&D for Profit Programme.

The project also involves the CottonInfo regional extension officers (REOs) across each valley, to provide an on-the-ground understanding of each's valley's disease issues, and to deliver project results and best practice advice back to growers.

For more information, please contact your state pathology team (see contact details) or your local CottonInfo REO.

All NSW samples (except suspect fusarium samples) to be sent to:
ATTN: Duy Le/Aphrika Gregson
Australian Cotton Research Institute
21888 Kamilaroi Highway
Narrabri NSW 2390

Contact:
Duy Le: 0439 941 542 / 02 6799 1530
Aphrika Gregson: 0429 963 894 /
02 6799 1521

All Queensland samples (and NSW Fusarium samples) are to be sent to:
ATTN: Linda Smith/Tim Shuey
Ecosciences Precinct
Department of Agriculture and Fisheries
GPO Box 267
Brisbane Qld 4102

Courier address for large parcels:
Ecosciences Precinct
Basement 3 Loading Dock
Joe Baker Street
Dutton Park Qld 4102

For more:
Linda Smith
0457 547 617 / 07 3708 8456

SHANNA K WHAN

Delivering impact for growers through RD&E

In 2016-17, CRDC invested $24.1 million into cotton RD&E on behalf of Australia's cotton growers and the Australian Government – continuing our long-standing commitment to delivering real outcomes for growers and enhancing the industry's performance.

We invested into 350 RD&E projects across five key program areas (farmers, industry, customers, people and performance) during this year, working collaboratively with 122 researcher partners and growers.

In this special Spotlight feature, we take a look at some of the highlights of the 2016-17 year.

You can find more detail in our 2016-17 Annual Report and the Annual Report Grower Summary, both of which will soon be available via the publications section of our website: www.crdc.com.au/publications. You can also find a full list of our current research projects online at www.crdc.com.au/research-development.

RUTH REDFERN

YEAR IN REVIEW

CRDC RD&E achievements 2016-17

CRDC RD&E: delivering real impact for cotton growers

An impact assessment of CRDC's investment in the efficient use of water and optimising crop nutrition RD&E has found that these investments deliver major economic benefits to growers. The assessment found that CRDC's investment of $4.90 million on behalf of cotton growers and the Australian Government into six water-use efficiency projects from 2010-15 returned a benefit of $40.62 million to cotton growers, a benefit-cost ratio of **8.29 to 1**. In addition, CRDC's investment of $11.32 million of grower and Government funds into nine nutrition research projects from 2008-16 returned a benefit of $61.15 million to growers, or **5.4 to 1**. The assessment is part of a series of qualitative and quantitative impact assessments of CRDC's RD&E investments into important project clusters.

CRDC's early-planting research makes major impact in Central Queensland

CRDC-supported research examining how to help Queensland's Central Highlands cotton growers overcome climate challenges was put into practice commercially in 2016-17, with great success. The project identified that a key tactic may be to plant considerably earlier than the traditional planting window. As a result of the promising results from these commercial trials, it is anticipated that some 80 per cent of growers in the Central Highlands region will use the early-planting research outcomes to plant in August for the 2017-18 season. An impact analysis, commissioned by QDAF, found that the total investment into the project was $1.18 million, and the value of total economic benefits back to growers and the industry was $20.24 million – a benefit-cost ratio of approximately **17.1 to 1**.

CRDC drives research outcomes across three major collaborative projects

CRDC is leading three major projects under the Australian Government's Rural R&D for Profit programme: *Smarter irrigation for profit, More profit from nitrogen*, and *Accelerating precision agriculture to decision agriculture*. Together, these projects and their 29 sub-projects are making major gains across the research fields of irrigation, nutrition, and big data. The *Accelerating precision agriculture* project is also delivering the first fully cross-sectoral collaborative research project, with all 15 rural research and development corporations (RDCs) partnering in the program.

World's best science the basis of the Bollgard 3® Resistance Management Plan

The Australian cotton industry moved into the Bollgard 3® era in 2016-17, with the approval of the Bollgard 3® Resistance Management Plan (RMP) by

the Australian Pesticides and Veterinary Medicines Authority – a result of many years of collaborative research between CRDC, Cotton Australia and Monsanto. Industry contribution and consultation is a key part of the regulatory process in Australia for developing RMPs for products containing biotechnology. CRDC and industry play a critical role in providing and reviewing local and international research to assess resistance risks and mitigation strategies.

Helping growers to manage pest pressure while achieving high yields

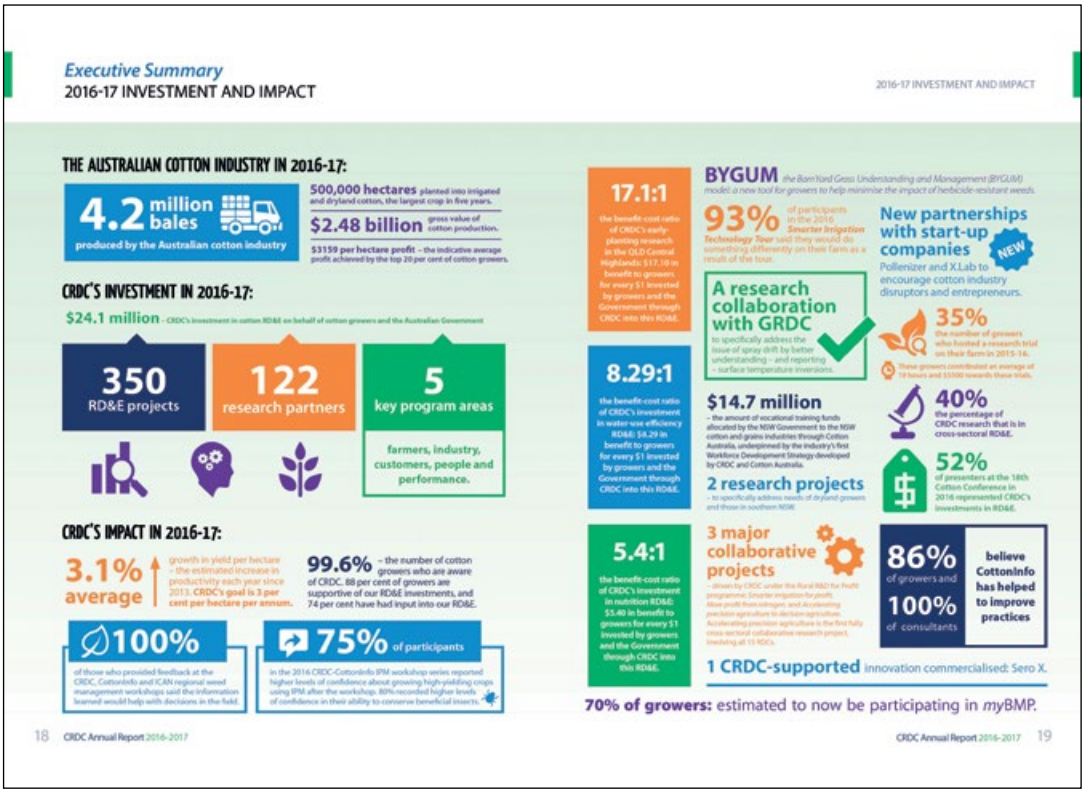
Seasonal conditions in the lead up to and during the 2016-17 season resulted in high pest pressure for cotton growers. This pressure, combined with industry concerns regarding increasing insect resistance, saw CRDC, CottonInfo and key CRDC-supported industry researchers join forces to deliver an Integrated Pest Management (IPM) workshop series. It took key IPM RD&E to 130 growers and consultants across five valleys. The workshops delivered two key messages to attendees: IPM plays an essential role in helping to avoid insecticide resistance, and high-yielding cotton can be achieved using IPM. The workshop series is being reinforced by an IPM short course during 2017-18.

Improving cotton's disease management capacity

CRDC's annual disease surveys project was completely reviewed in 2016-17 to improve impact and outcomes for growers. The core aim of the surveys remains the same – to determine the type and level of diseases present in cotton fields across NSW and QLD, as well as detect exotic diseases. A major change is that separate surveys previously undertaken by NSW DPI and QDAF pathology have now been combined within one project – ensuring greater collaboration and more strategic use of the resulting data. The new project also uses geospatial digital agricultural analysis and engages CottonInfo regional extension officers in the surveys to broaden monitoring capability.

Keeping cotton farms ahead of weed evolution

Minimising the impact of herbicide-resistant weeds remains a major focus for CRDC and cotton growers. In 2016-17, a CRDC-supported project has delivered a practical tool for growers, helping them to implement the recommended Herbicide Resistance Management Strategy (HRMS). This tool – the BarnYard Grass Understanding and Management (BYGUM) model – is delivered in partnership with CottonInfo, and is available to download from the CottonInfo website. In addition, a series of 16 workshops and masterclasses have delivered information about the impact of increasing levels of glyphosate resistance, and the strategies to delay or manage its onset, to 327 growers and consultants this year.



RUTH REDFERN

Predicting spray drift hazards through a hazard forecast system

A new three-year collaborative cotton and grains project, supported by CRDC and GRDC, is developing a spray hazard forecast system to minimise the damage caused by chemical spray drift. The project is a direct result of the extensive damage to cotton from phenoxy herbicides during the 2015-16 season. The project recognises that it is difficult for both growers and regulators to know when an inversion is present or is likely to form, and hence it is also difficult to know when the restriction of chemical use should apply. The project is particularly focused on understanding surface temperature inversions in cotton/grain landscapes, including a more detailed understanding of when they are present. Ultimately, the project aims to provide notification of a surface temperature inversion that might result in a long-distance drift, out to 36 hours ahead, as well as real-time updates for operators of spray application machinery.

YEAR IN REVIEW

CRDC organisational highlights 2016-17

Strong support for, and involvement in, CRDC RD&E by cotton growers

The 2015-16 Cotton Growing Practices Survey, published in July 2016, sought feedback from growers about their perceptions of CRDC and support for our RD&E investments. The survey found that 99.6 per cent of growers are aware of CRDC, 88 per cent of growers are supportive of CRDC's research and investments, and 74 per cent of growers have input into CRDC about research.

Stakeholder survey shows partner satisfaction

CRDC also commissioned a stakeholder survey in 2016-17, to gauge the strength of the partnership with key stakeholders, including government, industry and research bodies. The survey results showed a strong level of satisfaction, with 82 per cent of key stakeholders indicating overall satisfaction; 82 per cent indicating satisfaction with CRDC's engagement; and 87 per cent indicating CRDC is an organisation they can trust.

New Chair to lead CRDC's innovation in cotton RD&E

Richard Haire was appointed Chair of CRDC in August 2016, following the conclusion of Dr Mary Corbett's tenure in the role. Mr Haire has held many leadership positions within the cotton industry, including Managing Director and regional head of Olam International, and Chief Executive of Queensland Cotton Corporation Pty Ltd. Mr Haire had previously served as a Director on the CRDC Board from 2011 to 2014.

CRDC Directors visit growers in the Namoi, Central Highlands and Macquarie Valleys

Over the course of the 2016-17 year, the CRDC Board visited three cotton-growing valleys, with meetings held in Narrabri, Theodore and Warren. The Board meetings also incorporated on-farm tours to meet with local growers, view the implementation of CRDC-supported research, and discuss research priorities in response to local needs. The on-farm tours and in-valley meetings ensure that CRDC remains aware of and responsive to the RD&E needs of the cotton industry.

Third annual Research Priority Forum identifies cotton RD&E priorities

CRDC hosted its third annual Research Priority Forum in Brisbane in May 2017, bringing together cotton growers and industry supply chain members on Cotton Australia's research advisory panels to help determine the industry's future research priorities. The Forum is part of CRDC's procurement process, which was revised in 2015-16 to improve efficiency, streamline the RD&E investment process and provide greater clarity to researchers.

Development of CRDC's next five-year Strategic Plan begins

CRDC's current Strategic R&D Plan will conclude in June 2018, and as such, work has commenced during 2016-17 on the development of the new five-year Strategic Plan, which will guide CRDC's investments from 2018 to 2023. The Strategic Plan is CRDC's key planning document; it sets the direction for the organisation's operation and investments in cotton RD&E over the five years. The plan is developed in close consultation with key stakeholders, including cotton growers.

Collaboration: a key to cotton RD&E

CRDC works in partnership with other industry bodies and other rural research and development corporations (RDCs) to achieve strategic outcomes for the industry, and to leverage higher returns for our investments. This underpins our investment strategy, with CRDC partnering in over 80 per cent of RD&E projects conducted in the cotton sector. As of 2016-17, 40 per cent of CRDC investments are in cross-sectoral RD&E, up from 25 per cent in 2015-16.

Cotton Futures: investing in blue-sky, transformational cotton RD&E

Cotton Futures provides a clear framework for CRDC to invest in long-term, transformational innovations to ensure the industry remains profitable, sustainable and competitive in the future. In 2016-17, CRDC invested in 25 innovative blue-sky projects under the three Cotton Futures themes: Profitable futures (Farmers program); Sustainable futures (Industry program); and Competitive futures (Customers program). These projects include new or ongoing research into precision to decision agriculture, agri-intelligence, industry resilience, developing chemicals from cotton biomass, and creating nanofibrous coatings for cotton fabrics.

CottonInfo: continuation of program to connect growers with CRDC-led R&D

2016-17 marked four years of the industry's joint extension program, CottonInfo, supported by CRDC, Cotton Australia and CSD Ltd. It also marked the formal announcement of the continuation of the program to 2021. Studies conducted in 2016-17 have shown that 90 per cent of growers and 98 per cent of consultants are aware of CottonInfo; 86 per cent of growers and 87 per cent of consultants source information from CottonInfo; and 86 per cent of growers and 100 per cent of consultants believe CottonInfo has helped to improve practices.

For more information on all of these achievements and highlights, download your copy of our (soon-to-be-released) 2016-17 Annual Report or the Annual Report Grower Summary from www.crdc.com.au/publications.

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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Australian Government

Cotton Research and Development Corporation

MELANIE JENSON