Spotlight.

ON COTTON R&D

Spring 2015

Opening up to soil health:
Nuffield scholar takes new tact

The yield rise:
Growers getting it right

Comparatively speaking:
Putting profit in perspective

Australian Government
Cotton Research and Development Corporation

Bruce Finney

In the Spotlight

This edition of *Spotlight* really highlights the improved performance and excellence of our industry on many levels.

What stands out throughout is the strength of having innovative, capable and committed people driving our industry forward.

It is for this reason that CRDC invests in developing the capacity of people through a range of scholarships, many in partnership with Cotton Australia. In this edition we feature young Goondiwindi farmer Nigel Corish, who reports on the outcomes of his Nuffield Scholarship. Through his study, Nigel opened his own eyes about soil health and is now actively sharing what he has learned and how he is applying it to his own farm.
Nigel may change the way we all look at soil health and is to be commended for the way he represents the Australian cotton industry.

While the amount of cotton planted last season was considerably reduced, growers reached the highest yields yet recorded. We talk with growers on their practices in achieving record yields and to our world-class researchers to find out what the potential is for further yield increases.

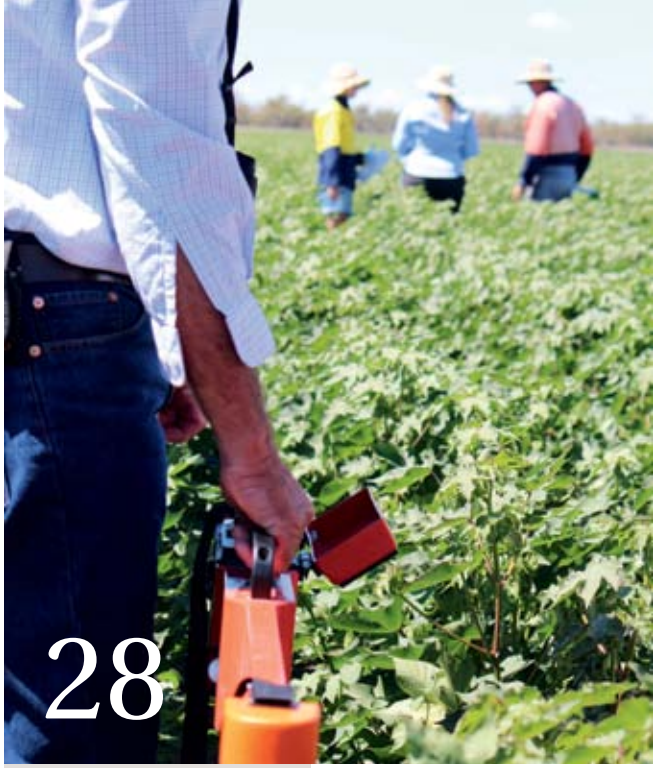
Turning from yield to profitability, CRDC with Boyce Accountants produces *The Australian Cotton Comparative Analysis* with the goal of providing sample financial performance information and benchmarks for cotton production that can help growers to understand the drivers for profitability and identify areas for further improvement. We provide a closer look at the 2013-14 season figures and a snapshot of the interim results for the 2014-15 season.

Improving water use efficiency and inputs involved in irrigation has been a strong priority for CRDC. As such we are pleased to report on CRDC's support for a Victorian innovator to bring a revolutionary irrigation gate for use by cotton growers and also on the excellent feedback we have received from growers regarding our investment with research partners in IrriSAT and EM38 technologies.

I was pleased to be able to present at the Crop Consultants Australia seminar in Moree recently. On the back of CRDC's investments in futures research and a recent visit to the USA I hope I was able to provoke thinking about the future for digital technology and its potential to transform our industry. The Consultants' willingness to work together and actively contribute to the industry and research is another key ingredient to shared success.

Finally, we include some words from the Australian Cotton Industry Award winners, with a foreward by CRDC Deputy Chair Cleave Rogan, who deservedly took home the Service to Industry award. The awards represent everything that is good about our industry, and no doubt will give us much food for thought.
On behalf of CRDC, our congratulations to all the Award winners and finalists.
Best wishes to all for another great cotton season in 2015-16.

Bruce Finney
CRDC Executive Director



Spring 2015

Spotlight is brought to you by Australia's cotton producers and the Australian Government through the publisher Cotton Research & Development Corporation (CRDC). CRDC is a research and development partnership between the Australian cotton industry and the Australian Government.

Cotton Research and Development Corporation
ABN: 71 054 238 316
Our vision: A globally competitive and responsible cotton industry.
Our mission: To invest in RD&E for the world-leading Australian cotton industry.

Postal:
PO Box 282, Narrabri NSW 2390
Offices: 2 Lloyd Street,
Narrabri NSW 2390
Tel: 02 6792 4088
Fax: 02 6792 4400
Email: spotlight@crdc.com.au
Web: www.crdc.com.au
Communications Manager:
Ruth Redfern
Editorial co-ordinator:
Melanie Jenson
Editorial Contributors:
Melanie Jenson, Ruth Redfern, Sally Ceeney, Meg Strang, Chrissy Brown.
Design: Deacon Design

Want to see more of Spotlight?

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

Cotton News

Features

Fast Facts

$1551

Average return per hectare for the 2014-15 season. *(Australian Cotton Comparative Analysis interim report)*

90

Percent of the direct energy used on an irrigated cotton farm is diesel fuel. *(Farm level benchmarking report of direct energy consumption in Australian irrigated cotton production)*

11.2

Gigajoules (GJ) per hectare, the median direct energy use per hectare from a total of 198 whole farm energy assessments undertaken by the cotton industry. *(Farm level benchmarking report of direct energy consumption in Australian irrigated cotton production)*

7.9

billion US dollars is the forecast global market for electromagnetic interference (EMI) shielding materials and technologies by 2020 *(Global Industry Analysts)*.

22

Bales per hectare is the 'theoretical yield' of Australian cotton. *(Bange and Constable)*

Seen this bustard?

IMAGE COURTESY CHRIS CAMERON

ABOVE: The bustard *(Ardeotis australis)* is a large ground bird of grassland, woodland and open agricultural country, and features in the new Birds on Cotton Farms mobile app.

THE launch of the new *Birds on Cotton Farms* mobile app will be a part of a family wildlife spotlight night and barbecue at Cecil Plains on Queensland's Darling Downs in October.

CottonInfo Natural Resource Management Technical Specialist Stacey Vogel said CottonInfo has partnered with the Focus on Feathers group and Millmerran Landcare to hold the event which will include spotlighting for birds and other wildlife. This includes getting close up with the one of nature's cotton pest predators – the tiny microbats. Greg Ford, author of *Birds on Cotton Farms*, will be on hand to explain how birds can contribute to the sustainability on farms and help participants identify the range of nocturnal animals which participants are sure to find.

Stacey said the new Birds on Cotton Farms mobile app, which will be launched at the event, will assist growers to identify birds on their farms and understand how to manage their habitats.

"The exciting feature of this new app is a monitoring tool which will allow growers to monitor the diversity and abundance of birds that can be found on their farm and in the surrounding landscapes," she said.

The event is free and will be held on Sunday October 4 at 4:30pm at "Bemarng" Cecil Plains.

For directions and to book contact Stacey Vogel.

The app will be available for download at www.cottoninfo.net.au after the launch in October.

For more
Stacey Vogel
t 0428 266 712
e staceyvogel.consulting@gmail.com

Benchmarking to improve energy efficiency

ENERGY is one of the fastest growing on-farm costs. In particular, electricity costs have increased by around 350 percent since 2000 and diesel is a major on-farm expense, especially for irrigators.

To help growers cut costs and improve on-farm energy efficiency, CRDC, the National Centre for Engineering in Agriculture (NCEA) and CottonInfo, with support from the Department of Industry and Science, have been delivering the *Improving energy efficiency on irrigated cotton farms* project over the past two years, including delivering on-farm energy audits to growers.

As part of the project, the *Farm level benchmarking report of direct energy consumption in Australian irrigated cotton production* publication was produced, which outlines the diesel and electricity used on cotton farms, based on the findings of 198 whole-farm energy assessments.

MELANIE JENSON

Significant tractor energy savings of up to 20 percent are possible with correct tractor and implement setup.

At a glance

- The median direct energy use per hectare from a total of 198 whole of farm energy assessments in the study is 11.2 GJ per hectare.
- The middle 50 percent of growers from the total dataset used between 7.4 and 16.4 GJ per hectare of direct energy in fully irrigated cotton production.
- With a median yield across 198 results of 10.7 bales per hectare, the median direct energy use is 1.1 GJ per bale.
- Generally, half of the direct energy consumed will be through irrigation, and about 25 percent will be used for high load tractor operations during the field prep and post-harvest phases of cotton production.
- A single pump make and model is used to pump up to 60 percent of the water volume in the industry, and uses up to 30 percent of the total direct energy of the industry.
- Significant tractor energy savings of up to 20 percent are possible with correction of tractor and implement setup.
- Diesel fuel provides at least 90 percent of the direct energy used on farm
- Expenditure on diesel fuel is at least 85 percent of the total direct energy expenditure.
- The median direct energy expenditure across 198 farm results is $298 per hectare across the two separate data sets, and represents 8.5 percent of 2013 average cotton production costs (reported in industry as $3627 per hectare).

The full summary of results is in the executive summary of the report – www.cottoninfo.com.au/energy-use-efficiency

Growers identify research priorities for 2016-17

THE inaugural CRDC R&D Strategy Forum in Sydney earlier this year brought together growers from Cotton Australia's grower advisory panels to help determine the industry's future research priorities.

The forum was the first step in CRDC's revised procurement process for the 2016-17 funding round, which aims to provide greater clarity to researchers about the specific R&D needs of the industry, so that they can tailor their research proposals accordingly.

The forum focused on four of CRDC's key strategic program areas: farmers, industry, customers and people, with growers and other participants from across the industry identifying research needs, gaps and opportunities.

Following the forum, CRDC's R&D team developed guidelines for researchers around the priorities identified, and, at the end of August, called for researchers to submit Full Research Proposals in response. The guidelines provide details for researchers around the specific issue to be addressed and the outcomes the industry wishes to achieve.

The Full Research Proposals are due in October, after which the Cotton Australia grower panels and the CRDC R&D team will review them and make their recommendations, with the CRDC Board making the final decision in February as to which proposals will receive investment.

The R&D Strategy Forum will become a permanent fixture at the beginning of each funding round, to help synthesise the key research needs of the industry.

For more
Ian Taylor
t 02 6792 4088
e ian.taylor@crdc.com.au

Your guide to best pest management

THE cotton industry's ready reference guide for pest control – the *Cotton Pest Management Guide 2015-16* – is out now.

The guide (which includes the new IRMS) should be consulted for every decision around insecticide and miticide use. Hot off the press and included with this edition for *Spotlight* subscribers, it's an important tool for all growers and consultants and provides updates on insect, weed and disease control; PGRs and defoliants; biosecurity; and spray application. The publication is brought to you by the industry's extension team, CottonInfo, of which CRDC is a partner. For additional copies, please contact CRDC on 02 6792 4400 or download at www.cottoninfo.com.au/publications

Cotton industry research on camera!

WANT to know how to use an EM38 for soil moisture monitoring? Or how to sample for silverleaf whitefly or spider mites? These are just three of the topics covered in a host of short videos produced by DAF QLD researchers Paul and Tonia Grundy for CRDC and CottonInfo, featuring many well known cotton industry researchers.

In one video, CSIRO's Lewis Wilson talks conserving beneficials in cotton, while in another, CSIRO's Rose Brodrick explains the latest research into irrigation management when dealing with limited water. And there's a whole series on practical on-farm tips and techniques, like irrigating with siphons, using a beat sheet and planting tips.

There are 48 videos – and counting – across the topics of growth and development, pest management, irrigation, agronomy and more. Take a look today at www.youtube.com/CottonInfoAust

Looking over the (electronic) fence

BOGGABRI cotton grower Andrew Watson has been putting integrated pest management (IPM) to the test to see if optimal growth rates, a healthy population of beneficial predators and plant monitoring are enough to grow Bollgard II with a significantly reduced reliance on insecticides.

So, how did his crop fare? That's the focus of one of a series of case studies produced by CottonInfo, featuring cotton growers from across the valleys. The case studies cover everything from insect, weed and disease management to nitrogen, energy and water use efficiency.

Walgett growers Toby and Susie Moore reveal how they've been making key on-farm decisions and managing climate risk via interpreting weather data; Brookstead grower Engelbert Krampl tells how he managed to get his herbicide resistant barnyard grass under control; and Mungindi grower Anthony Barlow talks about the range of benefits he's found on-farm from managing his riparian vegetation.

The full series of case studies are available to download at www.cottoninfo.com.au/publication-type/case-studies

Log in to POAMA

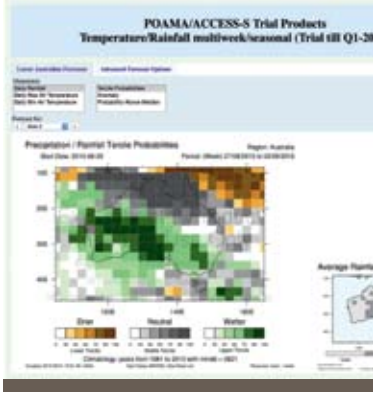
A MUST for all weather and climate enthusiasts is the website for the modelling arm of the Bureau of Meteorology called POAMA http://poama.bom.gov.au

This stands for Predictive Ocean Atmosphere Model for Australia. On this site you can track the behaviour of most indicators affecting our climate; Indian Ocean and Pacific Ocean sea surface temperatures, Southern Annular Mode and Atmospheric Blocking.

When a researcher develops a new predictive model, it appears on this site until the model becomes validated for performance and quality assurance. The new heat wave predictive model can be found here. We all know an intense heat cell can be a game changer on our farms, particularly with irrigation scheduling. This site also published a multi-week forecast for both temperature and rainfall. This tool is useful for monitoring changes occurring out to 28 days in one or two week intervals. The POAMA model is run twice weekly and outputs are refreshed on Thursday and Sunday mornings.

This site requires user and login details. These are – USER: research PASSWORD: cloud

Please contact CottonInfo Climate Technical Specialist Jon Welsh for any queries. jon.welsh@cottoninfo.com.au



Insight into future farming

CRDC partners with researchers at the National Centre for Engineering in Agriculture (NCEA) to develop adaptive and intelligent farming systems that use automation and robotics technologies, which are being designed to seamlessly interface with commercial on-farm operations to optimise use of resources and farm inputs.

This cutting edge research seeks to support farmers to choose the right management strategy in the right place, at the right time.

To showcase these developments, NCEA is holding a Future Farm Field Day on September 22, 2015, for attendees to experience first-hand the leading-edge agricultural research and technologies being developed at USQ including:

- Real-time interaction with on-farm data provided by mobile augmented reality
- Smart weed spot sprayers
- Adaptive irrigation machines
- Irrigation and farm management apps
- Unmanned Aerial Vehicles (UAVs)
- Semi-autonomous machinery
- Phenotyping (Centre for Crop Health)
- Farm energy systems
- Weather/seasonal forecasting models
- Alternate construction materials (composite fibres).

The event is being held at the USQ Agricultural Plot which is equipped with a bore, dam and irrigation system providing facilities for education and research of irrigation, mechatronic farming components and cropping. All welcome, for bookings go to www.payments.usq.edu.au/conferencingweb

For more

Steven Rees
t 07 4631 1397
e steven.rees@usq.edu.au

Gaining invaluable research support through Award

CRDC strongly believes in investing in the cotton industry's most important resource - people - to help it achieve its vision for a globally competitive and responsible cotton industry, delivered through RD&E.

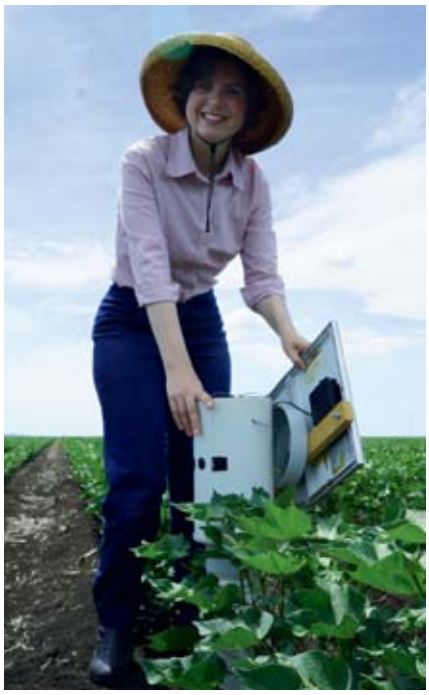
One such investment is through the Department of Agriculture's annual Science and Innovation Awards for Young People in Agriculture.

CRDC supports and rewards young scientists like 2014 awardee Dr Alison McCarthy, for their exploration of concepts and creation of new knowledge in the pursuit of scientific breakthroughs. Alison, who also received the additional Minister for Agriculture's Award, has developed an integrated image sensing system for soil-water and nitrogen levels in cotton crops.

Alison said her research for the 2014 Science and Innovation Award has led to collaboration with the USQ Computational Engineering and Science Research Centre and the development of an artificial intelligence and image analysis approach for estimating current and future soil-water, nitrogen and fruit load of cotton plants. The system uses cost-effective on-the-go sensors that are accessible to farmers, compared to conventional crop production models which require intensive calibration.

"The Award has complemented my current CRDC-funded research on irrigation automation by demonstrating proof-of-concept technologies to enhance conventional crop production models," Alison said.

"The artificial intelligence research is now being further developed by USQ and is expected to be evaluated at two commercial cotton sites in Queensland and NSW as part of the Rural R&D 'Smart Irrigation for Profit' project.



Dr Alison McCarthy says receiving the Science and Innovation Award for Young People in Agriculture expanded her professional network through collaborations such as undertaking nitrogen field trials with the CottonInfo team.

"The Award expanded my professional network enabling greater interaction with the CottonInfo team.

"As a result of my Award, I was also invited to speak at the Grain Growers' national Innovation Generation Conference and the Digital Rural Futures Conference."

Alison will present the final research findings at this year's Australian Cotton Research Conference at USQ in Toowoomba, QLD, from September 8-10.

2016 Science Awards: grants for big ideas

Grant applications for the 2016 Science and Innovation Awards for Young People in Agriculture, sponsored by CRDC, are now open. If you're 18 to 35, this is your chance to apply for up to $22,000 to fund your innovative research project that will benefit Australia's cotton industry, like 2014 winner Dr Alison McCarthy. Further information and application forms are available at www.agriculture.gov.au/scienceawards.

Applications close 5pm, Friday October 9.
Questions? Contact scienceawards@agriculture.gov.au

Bringing innovation to growers

The 2013 National Farm Invention of the Year was a flow-regulating valve designed by Peter Cocciardi, a farmer, draftsman and inventor formerly from Arawata in South Gippsland, Victoria.

MELANIE JENSON

CRDC s supporting farmer and inventor Peter Cocciardi to bring his revolutionary irrigation technology to growers.

WHEN presenting the award, NSW Farmers' President Fiona Simson described the invention as "capable of revolutionising the irrigation sector in Australia".

CRDC has since provided a development grant to assist this inventor to bring the 'Cocky Valve' to cotton growers. The invention is a novel flow-regulating valve that is float-actuated and automatically regulates water levels in channels, receiving pits and dams. It can manage a variety of head pressures and be adapted to suit almost any installation.

CRDC R&D Manager Jane Trindall oversees the project and says the valve has been used in southern irrigation schemes and is now being trialled in more northern growing valleys.

"This will test how the valves work in these situations and highlight any changes which might be necessary to tailor make this technology for Australian cotton farms.

"This project aims to tailor make and accelerate the valve's path to market, facilitating the automation of head heights of channels, saving many a trip around the farm, consequently saving irrigated cotton growers across the industry time, fuel and productivity."

On-farm tests in a variety of irrigation designs will be undertaken with valves from 300, 600 and 900 nominal bore (NB), mainly in the Cocky Flow N Stop configuration (300NB fits a 300mm diameter pipe).

Peter said the new valves will be tested for regulation of water inflows and on-farm regulation of water flows and levels throughout the irrigation networks to establish protocols for the adoption of the valves in a commercial irrigation system.

"These valves have the potential to dramatically reduce the amount of water used per irrigation while still delivering adequate water to each plant," he said.

"The valves should also reduce the man hours required to monitor channel flows and water levels and protect the channel infrastructure from damage by wash out or flooding."

The Cocky Flow regular was Peter's initial valve set-up for farmers receiving water from the channel irrigation network in the Griffith area.

"Many of these open concrete channels were being upgraded to pipe resulting in the water now being provided to the farmer being under pressure – some times as high as eight to twelve psi or an equivalent head pressure of five to eight meters," Peter said.

"The initial Cocky Flow regulator valve was developed to address this increase in flow and pressure.

"The Cocky Flow automatically regulates the flow back to the 1:1 flow rate for which the farmer's distribution systems are designed.

"A subsequent requirement was to supply a valve to combine a full shut off mechanism which has now been designed, built and marketed as the Cocky Flow N Stop and it is this version we will be basing most of our on-farm research around.

"We have had a professor in applied fluid dynamics describe our valves as "a breakthrough in design.

"We also have an international patent application in place and the initial report was very favourable, so we are confident we will secure this patent for these larger irrigation valves."

For more

Peter Cocciardi

e peterc@cockyvalve.com.au

Cottoning on to the brave new world of smart fabric

With developments in computer technology and interactive devices advancing at a breathtaking pace, CRDC is working to position cotton at the forefront of 'smart fabric' innovation.

INTERACTIVE electronic functionality is set to invade every aspect of our lives including our wardrobe. Indeed international research is already underway looking into shirt pockets that can charge your phone, and the integration of touch screen style controls in denim jeans.

Unfortunately the unwanted electromagnetic interference (EMI) emitted from electronic and digital devices, and from cables carrying high volume electric currents, is an ever increasing hazard of modern life.

Headaches, anxiety, and compromised immune function have all been reported as symptoms associated with the constant bombardment of the human body from electromagnetic signals.

There is now a growing market for 'functional' textiles and clothing capable of shielding against harmful electromagnetic radiation. Tapping into this demand, CRDC has launched the 'Smart Cotton' project to develop a cloth, incorporating cotton fibres, that can protect the wearer against electromagnetic emissions, while also being light weight and comfortable.

Electromagnetic emissions can also interfere with the function of sensitive electronic equipment, damaging system performance and degrading operational safety. These issues are of particular concern in military and medical applications, creating opportunities for the use of textiles capable of blocking electromagnetic interference.

Leading the Smart Cotton project is Dr Jin Zhang, a researcher at Deakin University in Geelong Victoria, with extensive experience in working with composites and natural fibres for use in automotive and aerospace industries.

Smart Cotton project leader, Dr Jin Zhang, in the lab working on the development of a new cotton-carbon fibre composite cloth

"There are already manufacturers making composite cloths with electromagnetic shielding properties, but they've tended to use heavy metal fibres," Jin said.

"We're working on a fabric that combines lightweight carbon fibres with high quality, long staple Australian cotton to create a far higher level of comfort for the wearer.

"The electrostatic discharge, electromagnetic protection and radio frequency interference protection qualities of carbon fibre, combined with the hypoallergenic, excellent moisture control and comfort characteristics of Australian cotton, will give rise to a new type of shielding fabric."

The 'Smart Cotton' project is targeting the development of a range of 'electronically functional' products such as internal pocket liners designed to protect the wearer against mobile phone radiation.

"We're also researching 'next to skin' clothing for the maternity market, such as an apron expectant mothers could wear under their clothing to shield their unborn child from the radiation emitted by electronic devices," Jin said.

"Light weight composite cotton shielding fabrics could be used in everything from anti-radiation pyjamas and bedding, to curtains, ground sheets and tents."

According to CRDC R&D Manager, Allan Williams, this research project will undoubtedly add value to Australian cotton, given the scope for innovation in the rapidly evolving 'smart fabric' field.

"A report by the Global Industry Analysts (GIA) forecasts the global market for EMI Shielding materials and technologies will reach US$7.9 billion by 2020 in a booming worldwide electronics industry," Allan said.

"While our main focus is the development of an EMI shielding fabric, this project will also investigate a range of composite yarns combining cotton and electronically conductive fibres that could lead to many new potential uses.

"Smart fabrics will transform consumer expectations of clothing apparel and textiles, and there are inevitably going to be intriguing functional fibre applications we haven't even considered yet.

"It's critical for our industry to be involved in the development of smart fabrics so that we can position cotton as an integral component of these emerging markets and maintain competitiveness against man-made fibres.

"If we can successfully combine the comfort of cotton with the functionality of electronically conductive fibres, cotton will be at the cutting edge of an interactive, smart fabric revolution," Allan said.

For more

Dr Jin Zhang
e jin.zhang@deakin.edu.au

Allan Williams
e allan.williams@crdc.com.au

Broadening industry's nitrogen knowledge

Nuffield Scholar Nigel Corish says his research into nitrogen optimisation has sparked a new passion for soil health.

Embarking on the Nuffield Scholarship in 2014 to investigate ways of improving nitrogen (N) use efficiency in irrigated cropping, Gondiwindi farmer Nigel Corish says he expected to find answers in technology. Instead, his research has steered him in a different direction looking into opportunities to capitalise on naturally occurring nitrogen through improved soil health.

Nigel is a third generation farmer and since 2007, has been managing one of the family's properties "Yambocully" near Goondiwindi in the Macintyre Valley. The predominantly cropping farm is around 7000 hectares with 900 hectares of irrigation area. Up until now, the business has produced irrigated cotton, dryland wheat and barley, chickpeas and sorghum.

In 2014, Nigel was awarded a Nuffield Scholarship through CRDC and Cotton Australia to research opportunities for *Improving Nitrogen Use in Irrigated Cotton*. The major component of his research involved travelling to England, the US and Japan as well as the Philippines, China, Canada, the Netherlands, France and Ireland to meet with researchers, consultants and farmers on their own turf.

Insight into global agriculture

"It was a great insight into global agriculture," Nigel says.

"Travelling overseas to visit different farmers and finding out what they do and learning from them so that you can bring new ideas home to implement and share with other growers has been invaluable.

"I think the biggest positive about the scholarship itself is being able to access information directly from successful farmers in their own environment.

"It's amazing how much farmers open up when you are there with them on their own farm, they seem to feel more comfortable about sharing their information.

"I probably found visits to the non-cotton growing farmers the most valuable as they challenged me quite a bit on some of the farming practices in our cotton industry.

"They were asking me in order to gain a better understanding for themselves,

MELANIE JENSON

but it was also really good for me to be presented with those sorts of questions – they would then give me ideas and examples of their own experiences, which although were obviously not related to growing cotton, were definitely very valuable.

"I had an expectation before starting the project that higher nitrogen use efficiency would be achieved on my farm through better application management and the use of technology. I did not expect my current farming practices to be challenged to achieve better nitrogen use efficiency.

"It has opened my eyes and I have been asking myself how I can do things better."

Travelling and networking with others passionate about agriculture is a major factor of the Nuffield Scholarship. Nigel met with UK Nuffield scholar Jake Freestone at Overbury Farms in Gloucestershire.

Key Findings

Key findings of Nigel's Nuffield research were related to tillage, rotations, nitrogen source, fertiliser application methods and timing, flood irrigation impacts, smaller management zones and precision agriculture.

"Probably the biggest thing I came to challenge as a result of questions from the other farmers was the amount of tillage the cotton industry does," Nigel said.

"I had to explain about pupae destruction and the licence agreement with Monsanto, as well as managing diseases and pests.

"However, the licence agreement only requires tillage down to 10cm whereas most of the time we are going down to 30 to 50cm trying to manage compaction in the fields due to flood irrigation and harvest operations."

Many of the farmers Nigel met suggested instead of deep ripping, shallow incorporation to 10cm would be a lot better for soil structure with controlled traffic and rotations then used to manage compaction.

"I am looking at the idea of using equipment that gets us on to three-metre spacings for controlled traffic," says Nigel.

"We are also looking at other crops following cotton to get away from deep tillage. This would also use up soil moisture left after cotton."

Cropping outside the square

There is also more consideration on rotations and alternate crops at "Yambocully" now.

Nigel says it obviously depends on infrastructure and markets as well as the capital investment required, so there are some big challenges for diversifying into other crops. However, with his much stronger focus on soil health in general, he says he's a lot more willing to put down manures, gypsum, and other soil amendments to improve the soil.

The long-term plan for rotations is to plant an alternate crop after cotton, preferably in winter if soil moisture allows, followed by a cover crop in November-December.

"Ideally I would like to achieve zero-till from the winter cereal phase until sowing the following cotton crop, with the only tillage in the rotation cycle carried out after cotton for pupae busting and disease management.

"Planned rotations would also help with cotton disease and pest management as well as increasing soil organic carbon levels.

"Many of the farmers and researchers I visited in both high and marginal rainfall areas around the world were huge on increasing carbon in the soil to improve not only fertiliser efficiency but overall crop efficiency."

This year Nigel has planted the whole farm to winter crops to take advantage of available soil moisture. However, he plans on green manuring some of the barley paddocks and ploughing them back in to increase soil carbon.

"Even in South Dakota (in the US) on 12-inch rainfall, a zero-till researcher I visited named Dwayne Beck has been cover cropping and green manuring for 30 years and it's amazing the amount of soil moisture and carbon he achieves," he says.

"It shows it can be done with time and effort."

Another key finding from Nigel's scholarship was that farmers in other countries, particularly in the US, are sampling fields on a far smaller scale (down to a one hectare grid) than Australian cotton growers, to determine variability across a field and create smaller management zones. Technology and computer programs are then used to determine fertiliser requirements in each zone and fertiliser is applied using variable rate technology.

Nigel believes there are benefits to developing smaller management zones across farms and has already started splitting some of his larger fields in half to enable improved monitoring and management.

"In terms of nitrogen use, probably the biggest thing I picked up was their use of variable rate technology (VRT)," he says.

"Growers are using a wide range of technology to gather data as well as process the information.

"The VERIS machine is very popular in the US which is used for mapping soil moisture, pH and organic matter.

"Satellite imagery, drones, NDVI (Normalised Difference Vegetation Index) imagery and yield mapping, are all used in various combinations to monitor the field and see how the crop is performing in season.

"Those farmers use VRT to apply N

and nearly all the farmers are then using anhydrous ammonia, UN32 or a liquid fertiliser as these are easier to use with VRT."

Identifying N loss

One of the objectives of Nigel's research was to consider N losses from his current system and investigate opportunities to reduce denitrification, leeching and volatilisation. He says that in the US, researchers at Cotton Incorporated questioned the quantity of N applied in our production system and the use of flood irrigation which causes losses through denitrification.

"Of particular concern is the N we put down pre-season.

"Their researchers questioned how much N would be lost through denitrification in the absence of any ground cover on the soil surface once the soils become water logged."

To manage this, Nigel plans to reduce the amount of pre-plant N and instead use a side dressing at planting and in crop and is working to reduce N lost through tail water after applying water run N when irrigating. A legume crop, at this stage faba beans, will become part of the rotation to increase nitrogen through N fixation and he hopes.

"I visited a grower in Blue Mounds Wisconsin who produces organic corn, soybeans, barley, and wheat.

"He made a point that has really stuck with me. He pointed out that the atmosphere is made up of 79 percent nitrogen, it is the only nutrient that is freely available, and the only nutrient growers can grow.

"I understand that to get the high (cotton) yields we are achieving now we need relatively large amounts of nitrogen available for the crop (300kg) so I will still need to apply at least 200 to 220 units of N but hopefully the crops can pick up the rest in mineralised N.

"Obviously I have only just finished my travels so once I start implementing all the new practices I may change my mind depending on the outcome but at this stage that is the plan."

Getting the balance right

"I really learned that to get the best out of any fertiliser, particularly nitrogen, all the soil components must be in balance, including structure, chemistry or biology," Nigel said.

"I have found a new passion for the benefits of improving the soil's health.

"Visiting all the people on my trip and going to places where farmers have been carrying out practices to improve soil health for 20 or 30 years and actually seeing them produce crops viably without applying any synthetic fertilisers at all and without any tillage, it just is just amazing."

Despite the changes he plans to experiment with at "Yambocully", Nigel says one of the great benefits from travelling to other agricultural regions in the world, is that he has gained confidence overall in what we are doing.

"I found in travelling to other countries and meeting other overseas farmers from various industries, you are really representing Australian agriculture.

"In the US, they could not believe the high yields we are getting with our cotton.

"This is really good for your confidence when are talking to others about what research goes on in Australia, how far we have come in a relatively short time, and how the whole industry pretty much works together to be so successful.

"The main thing I have learned is that nitrogen optimisation is complex and challenging and that the whole farming system needs to be in balance to achieve high nitrogen use efficiency.

"The Nuffield Scholarship experiences were very insightful and taught me to look outside the box and explore the world of soil health."

Nigel visited the International Rice Research Institute's (IRRI) trial sites in the Philippines as part of his Nuffield scholarship.

Key Changes

There are four key changes that Nigel is now implementing as part of an overall effort to improve not only nitrogen use efficiency but whole farm productivity:

- **Reduced tillage;**
- **Diversifying crops in the rotations, including cover crops;**
- **Nitrogen source, application and timing;**
- **Precision agriculture and smaller farm management zones.**

For more

Nigel Corish
e yambocully@bigpond.com
Nuffield Farming Scholarships
w www.nuffield.com.au

Carbon gains and losses during irrigation: A factor to account for in soil-carbon balances

New research is investigating the role irrigation water plays in carbon sequestration on Australian cotton farms.

CRDC is focused on developing a detailed understanding of the carbon flows on Australian cotton farms, and new research underway – *the Resilient cotton farming system: measuring soil quality, yield and nutrient losses in long term studies* project, led by NSW DPI researcher Dr Guna Nachimuthu – aims to fill a gap in this understanding.

It's the first time a study measuring carbon gains and losses during irrigation has been undertaken. Preliminary findings indicate carbon gains from irrigation water are greater than run-off losses, indicating that irrigation water may be enriching soil carbon in Australian cotton farms.

Measuring the carbon gains and losses during irrigation is important to accurately calculate carbon sequestration in cotton farming systems. To quantify the carbon gains and losses in cotton systems, Guna and his team are measuring the dissolved organic carbon (DOC) and total organic carbon (TOC) in irrigation water entering the field, leaving the field in tail end runoff, and leaving the root zone via leaching (deep drainage).

Carbon concentrations associated with irrigation water entering the paddock ranged from 4.6 to 11 mg/L over the season.

"We found considerable amounts of carbon in runoff, deep drainage and irrigation water, which explains well previously observed changes in soil organic carbon (SOC) stocks. These results could have substantial consequences for global carbon cycling and feedback to climate systems," Guna said.

"Any carbon farming methodologies that are currently being developed need to account for these carbon inputs and exports."

Dr Guna Nachimuthu

MELANIE JENSON

Measuring for credit

Guna's research will also enhance the existing knowledge on soil carbon benefits to cotton farming systems and provide managers and policymakers with information needed to determine whether cotton growers could potentially generate Australian Carbon Credit Units (ACCUs).

"One ACCU represents one-tonne equivalent abatement of carbon dioxide per year," says CottonInfo Carbon and Climate Technical Specialist Jon Welsh.

"If generating ACCUs are possible and fit within the guidelines of the Soil Carbon Method, then cotton growers may potentially register a project and surrender ACCUs via the Emissions Reduction Fund auction process.

"This is part of the Australian Government's Direct Action policy to help Australia meet its emissions targets and mitigate climate change.

"The cotton industry's jointly-funded (CottonInfo and Department of Agriculture) extension and outreach project is currently investigating likely feasibility of a range of methods applicable to broad-acre agriculture."

Carbon benefits of a corn – cotton rotation

Guna says theoretical estimates of soil carbon sequestration in Australian farming systems often do not coincide with measured values of soil carbon, possibly due to post-sequestration carbon losses.

In 2011, former NSW DPI researcher (now Australian National University) Dr Nilantha Hulugalle added corn crops into the ongoing long-term cotton rotation trials (begun in 1985) at the Australian Cotton Research Institute near Narrabri. The inclusion of corn was found to benefit soil health and productivity of the cotton farming system.

Nilantha's *Carbon in cotton farming system* project supported by CRDC found that corn rotations had the potential to increase soil organic carbon. However, there was a decline in SOC levels after the cotton crop in the next year. Though some of this decline could be attributed to the breakdown of soil organic matter, Guna suggests a portion of SOC decline may be associated with carbon lost in runoff, soil erosion and deep drainage. Future efforts should focus on how to prevent the loss of sequestered carbon.

Recent trials

During 2014-15 trials, an average 30 percent of water applied (over six irrigations) left the field as runoff. Runoff from the plots with and without corn during the previous season was 26 and 35 percent (respectively) of applied irrigation water.

"The lower runoff from the corn plots the previous season may be due to higher water use by the following cotton because cotton growth and yield after corn was greater than that in the control plots and/or due to greater water draw-down by corn," Guna said.

"These results are from only six irrigations in a season with limited irrigation water, however results will be collated over three years."

The trial found Total Organic Carbon (TOC) enrichment by irrigation water ranged from six to 13kg C/ha/irrigation with a cumulative total of 64 kg C/ha over six irrigation events. There was an increase in TOC throughout the season, with each irrigation event recording higher loads of TOC compared with the previous irrigation.

Cumulative TOC losses in irrigation induced runoff events ranged from 19 to 28kg C/ha over six irrigations during 2014-15 cotton seasons. The DOC was of the order of 86 to 93 percent of TOC (Figure 1). Carbon losses in runoff may be higher than carbon gains in a year with high rainfall.

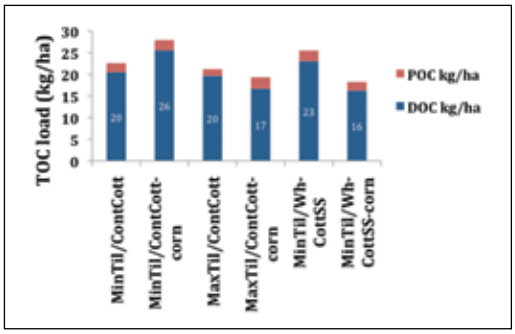


Figure 1. Total Organic Carbon (TOC) losses (kg/ha)in runoff water under different management practices in 2014-15 season (POC- particulate organic carbon, DOC- Dissolved organic carbon, Wh-CottSS- Cotton-wheat standing stubble)

Guna says besides measuring the gains and losses of carbon during irrigation, a better understanding of the mechanisms underlying the resultant total soil organic carbon levels needs to be gained to properly estimate the annual SOC dynamics. He is optimistic that a new CRDC-funded project led by UNE soil scientist Dr Oliver Knox will unravel some of the mechanisms underpinning the seasonal and annual changes in SOC down the whole soil profile.

"The knowledge of carbon loss through the terrestrial pathways and quantifying its rates will enable improvement of current models of soil carbon sequestration for irrigated cotton-farming systems," Guna said.

Increasing yield: The roles of research and management

Australian cotton yields per hectare lead the world and are three times the global average, yet growers continue to push the limits, with many breaking new ground with paddock averages of around 16 bales per hectare.

This inspired *Spotlight* to head into the paddock to find out what growers are doing in terms of management and talk with scientists to more fully understand the role varieties play in the yield ascent.

Recent analysis by the CSIRO breeding team has shown that variety contributes about 48 percent of the yield gain (160kg per hectare per year); management 28 per cent (95kg per hectare per year); and the interaction between variety and management contributes 24 per cent (80kg per hectare per year).

With a relatively small production area compared to other regions throughout the world, Australia has one of the highest cotton yields in the world. Lint yield has almost doubled since the adoption of locally bred varieties during the early 1980s. Long term records show that whole of industry yield during the 1960s was 869kg lint per hectare (3.7 bales/ha) and it more than doubled in the 2000s to 1890kg lint per hectare (8.39 bales/ha). There are now many examples of yields well in excess of 2800kg lint per hectare (12.35 bales/ha).

Theoretical Yield

CSIRO plant breeder Dr Warwick Stiller

says theoretical yield refers to a modelled maximum yield based on the physiology of current varieties. It is not a figure expected to be achieved in the field, as it uses perfect growing conditions where there is no stress from extreme temperatures, or water. The predictions use average temperatures and incident radiation with no cloud.

Theoretical yield helps us to understand what could be achieved if we are able to manage stress with improved varietal adaptation or management. Drs Greg Constable and Mike Bange have recently reassessed this figure in a soon to be published research in the special issue *Field Crops Research* journal.

"We calculated theoretical yield for irrigated cotton to be 5000kg of lint or 22 bales per hectare in a long-season growing environment," Mike said.

"To achieve this yield, a long season is definitely required, possibly with slower initial fruit set so canopy size is not restricted by high fruit load."

Yield potential differs from theoretical yield and is the yield that can be achieved in any one season. Comparing yields to the 'yield potential' can help to identify the 'yield gap' and can assist in identifying the production constraints in any cropping system.

The researchers say that under irrigated conditions, lint yield of 3500kg per hectare is now being obtained and they use this value for 'yield potential' under full season irrigated conditions. Thus yield potential is not a fixed value but it is increasing through time as crop management and genetics are improved – but it is also strongly affected by local conditions.

Worldwide, average cotton lint yield is about 800kg per hectare and is increasing at rates of 10 to 20kg/ha/year, especially where irrigation is available. Economics at the farm level dictate a continual need to increase yield and profit for most crops.

"Growers are already showing what is possible through last season's highest yields or 'yield potential'," Mike says.

"The potential is inherent in the plant, it's then best in-field practice management followed by correct ginning that is contributing to yield improvement."

Yield potential for rain-grown cotton systems depends on soil water storage and rainfall but is about 800kg of lint per hectare.

CSIRO plant breeder Warwick Stiller said that last season set a new benchmark of what can be achieved.

"We think with varieties like Sicot 74BRF – the most popular and highest yielding variety we have ever produced – there is still the potential for higher average yields.

"It's really pleasing to see the potential growers are extracting from our Australian-bred varieties and adapting management to achieve impressive yields in contrasting climates from Emerald in the north to Hay in the south," Warwick said.

MELANIE JENSON

Growing

The growers *Spotlight* spoke with are continuing to improve yields; how often and by how much is controlled by climate, weather and water availability.

Growers give credit to the varieties available to them and the weather, which last season in particular was kind to growers in all valleys.

However when we dig down, we find that attention to 'the little things', timeliness of operation and a belief that there is always room to do better is driving this trend.

Ken Stump from Rowena refers to the 'multiplier effect' of small gains in many areas adding up to what becomes a better than the average crop.

Perhaps most obvious is an inability to rest on their laurels, by continually striving to improve their farming operation by ironing out the lows, improving sustainability and being open to new information and research. Enjoy their stories…

David Ramsay and his son Alex grow cotton in the Macquarie Valley and averaged 15 bales per hectare across their farm last season.

Making it work in the Macquarie

It may have been an almost perfect season for cotton production in the Macquarie Valley but recent improvements in crop management, as well as adoption of latest varieties, have contributed significantly to achieving a record 15 bales per hectare in many of the area's 2014-15 crops.

According to owners David and Alexandra Ramsay, this season "Banchory" had its highest ever farm average cotton yields with the 400 hectares planted averaging around 15 bales per hectare. David added that the whole valley yielded well, and 15 bales per hectare was not uncommon.

Water available for irrigation was the most limiting factor in the Macquarie Valley for the season and David says they only grew about 35 percent of their potential area.

The perfect season

With limited water on offer, David dry planted a block of Sicot 71BRF, without water secured for irrigation as he had the seed on hand. Fortunately, 18mm of rain fell just after planting so water was then purchased to grow the crop in that block.

The remainder of the cotton crop was planted after that same rain with Sicot 74BRF between September 25 and October 3. After that, David says "It was pretty much the perfect season."

"We had good rain up until Christmas, which supplemented irrigation and had virtually no excessive waterlogging and there were no cold snaps either," he says.

"After Christmas, day temperatures were around 35 degrees, there was no wet weather and there were no heat waves.

"Without cloudy conditions we did not get excessive shedding in February, while January to March was pretty dry and not excessively hot which meant that irrigation was manageable and we ended up only using nine megalitres per hectare so our water use efficiency was pretty good too.

David has moved to using C-probes which he says has made a big difference for them with timing irrigations.

"Being able to monitor soil moisture use has made more timely irrigations with less water logging," he said.

"Now when there is a rain event coming, I can judge how much water is left in the soil and make more informed decisions."

More than just the weather

Even with all this good weather, there was more than just good luck involved with growing the record crop. Bollgard II and Round-up Ready Flex technology, improvements in nutrition management, regulation of plant growth, legumes in the crop rotations as well as careful irrigation timing are the key areas that David believes are helping him get marginal increases in yields each year.

"Four years ago we started making our own fertiliser for planting, which contains trace elements, and we inject it down the furrow straight on to the seed," he explains.

"The aim is to replace trace elements being removed with the crop at harvest and to improve seedling vigour and early plant growth."

David modified their existing equipment with a pipe going down to inject the liquid fertiliser on to the seed as it is being planted.

"I have also found that we get better results from less upfront nitrogen, only applying 100 to 120kg per hectare pre-plant, then trickle feeding another 200kg per hectare throughout the season in the irrigation water to top-up the plant each time we water," he says.

"This more consistent nitrogen availability throughout the season is paying dividends."

David had found the cotton crops were growing rank and the plants were becoming too tall, so fruit retention down the bottom of the plant was insufficient and impacting yield. This also caused the crops to finish progressively later as he would wait to fill the top bolls to get reasonable yields.

Managing plant growth

To combat this, Pix is now used strategically to manage plant growth.

"Holding the cotton up a bit around early flowering has worked well but it is seasonal and so you have to modify the Pix strategy according to the season.

"In the 2014-2015 season we applied 400ml per hectare of Pix before Christmas and again at the end of January and we've found we are getting really good results doing that."

Another important factor in optimising the farm's performance is the inclusion of chickpeas in the irrigation area's crop rotation, which David says improves the performance of the subsequent cotton crop.

"Cotton after chickpeas is definitely better than after wheat.

"It is not just the nitrogen, although that obviously helps, but it is the soil health benefits.

"I think chickpeas add more to the soil than we realise and there is not the excessive amounts of trash to contend with, which you have with wheat, when you come back to planting so it also helps with managing soil pests such as cutworms.

"I think nutrient availability and more targeted fertiliser applications are where there still needs to be more research to get closer to the 'yield ceiling' – I have done simple trials here myself and have seen some big yield increases.

"Research into optimal starter fertiliser types and rates could be beneficial too.

"Management has come a long way, and research is giving us answers we can work with."

The multiplier effect: small gains add up

Ken Stump has been growing consistently high yielding irrigated cotton crops at "Windella" near Rowena in North-West NSW, and *Spotlight* caught up with Ken recently to get some insight into his successful strategy.

Growing cotton now for 25 years, Ken has watched the industry evolve and with it average yields gradually increase. On his irrigated cotton operation, yields have been around 14 to 16 bales per hectare over the last few years with a field of Sicot 74BRF yielding 17.5 bales per hectare in 2012-13.

"I have never seen cotton like that," Ken says.

"The field had a split defoliation too, due to rain, so one end of the field did not look as good as the other. There were areas of that field going well above 18 bales per hectare on the yield monitor, but it averaged 17.5."

Starting out with 160 hectares of flood irrigated cotton in 1990, the property now has 800 hectares of irrigation area to allow for cereal and legume crops in the rotation as well as a fallow period prior to each cotton crop wherever possible.

Generally about half the area is planted to cotton, although only 150 hectares was grown last season due to limited water allocations as a result of dry conditions in previous years.

"Water is critical, I always try to plant cotton after a fallow on a full soil moisture profile and in most cases I will not plant a cotton crop unless I know I have enough water to finish off the season," Ken says.

Water use efficiency is a factor that has improved over time. Ken is using as much water now to grow nearly 15 bales per hectare (six bales per acre) as he did to grow just under 10 bales per hectare (four bales per acre) when he started growing.

"Taking into account that with better yielding varieties the plant is more efficient, it also uses more water, so we are pleased with our efficiency," he said.

"The flexibility we have in how we irrigate is a key factor in that."

Irrigation timing is a key factor in maximising yields and Ken says that having used various soil moisture monitoring devices, he does not rely on any one device and these days generally knows when the crop needs to be irrigated based on how the plants look, the weather and just knowing what the crop uses at each stage of development through experience. He will also change siphon sizes in-season to regulate the speed of irrigations.

He says timeliness of all operations is critical.

"Our cotton area is relatively small so when we need to do something we can actually do it quite quickly whether it is irrigating, planting, getting pickers into the field or whatever.

"In saying that: we also have a dryland cropping enterprise to manage which is the main part of our operation. But we give each field a fair bit of personal attention."

An important part of that personal attention is aiming to meet the crop's nutritional requirements to maximise yield. Although Ken says they are blessed with incredibly good soils in their area, soil fertility is carefully managed in an effort to ensure the crop gets what it needs, when it needs it.

"It's all flexible but basically we broadcast urea prior to planting and incorporate it," Ken said.

"Zinc is also sprayed on to the surface and worked in. Although we do not use variable rate technology (VRT) we apply extra zinc to some small areas where we have found zinc deficiency occurs which was affecting plant growth and productivity."

A further 50 to 100kg of nitrogen per hectare is water-run throughout the season using nitrogen buggies.

"One of the problems we were having with applying all the N pre-plant was that over time the crop at the top of the field was becoming N deficient towards the end of the season, which I

"I don't think growing a successful crop is down to any one thing we do: I think it is probably a multiplier effect."

suspect is from N leaching down the field as we try to move water quickly on and off the field to prevent waterlogging," Ken explained.

"Over the past five years we have gone to trickle feeding N to the crop throughout the season and we seem to be getting away from that problem.

"Although we do not use VRT here yet, I think it has huge application and we have had gypsum applied to various paddocks using VRT with very good results.

"Although not all of our soil needs gypsum, I believe in the saying 'it makes bad soils good and good soils better'.

"I think there are a few things about why we grow such good cotton: we are in an ideal location for growing cotton and have inherently good healthy soils; we get timing of operations pretty right; and if we think something might be an issue we jump on it quickly whether that be pests, nutrition, or whatever.

"Our agronomist Hugo Weissen (Narrabri) helps us look after the integrated pest management side of it, and he looks after it very well.

"It is not a low-cost operation, you only have to get a calculator out if you think something is affecting the crop and it will quickly tell you whether it is worth doing something about it or not.

"New varieties have also really helped all Australian growers along. I have been growing Sicot 74BRF since its release in 2011 and it has helped get yields up.

"I don't think it (growing a successful crop) is down to any one thing we do: I think it is probably a multiplier effect.

"If we get the timeliness of our operations right, and get the crop's nutrition pretty right, maybe we get a few other things right, you multiply them all up and maybe that gives us that bit of an advantage.

"Growing cotton you can't stop some things occurring, such as extreme temperatures or wet weather, but all the elements of production that can be controlled should be controlled to get the highest possible yields."

The challenge of consistency

Although this year was the biggest in terms of yield, for Central Queensland grower Cam Geddes, the challenge of growing cotton is to iron out the peaks and troughs, aiming for an increasing, yet consistent yield.

Cam and his wife, Tracey have been growing cotton on their property just north-west of Emerald for four of the five years they've been there, and lucky for the cotton industry, these growers aren't easily deterred when the elements go against them.

Although this past season the Geddes' grew their best crop of 10.4 bales to the hectare, which is around the district average, previous years weren't so kind. Their first two crops were dismal, with wet weather then hail putting pay to any reasonable yields. So much so they had a year off and grew corn before making the foray back into cotton, with a "not too bad crop" around 9.9 bales per hectare (four bales per acre).

While the weather was kind this past season, Cam says he thinks across the board "growers are applying the right management for the region, and the weather this year has allowed them to prove it."

But this grower has a pragmatic approach when it comes to yield.

"We saw a few wet years when we started, so it was good to have a brilliant year but I think it's better to have a lot of 'good' years," he says.

"Reading about southern yields can be intimidating, but in terms of what we have to deal with climate wise and other constraints we're happy with our progress and our district average is increasing all the time."

So how does Cam plan to add consistency and efficiency to his management program?

"I want the best possible conditions to put the seed into, which means the new season for me doesn't start at planting but when you put the pickers away.

"You've got to be well organised and manage to orchestrate all operations as precisely as possible, making best use of the weather.

"This year we finished harvest on February 20.

"We are already pushing the limits with planting early in September and the cool start means extra careful preparation of the seed bed, which last year included an early irrigation in August to help breakdown stubble and any uneven or rough soil.

"Later planting dates mean all the risk is loaded at the end of the season, so by planting earlier I am shifting some of that risk, but it also comes with other factors to consider such as a colder start.

"We have also modified our planter for more precision in seed spacing."

Reducing run times

Last season Cam changed his irrigation run times from 18 hours to 12, which dramatically improved irrigations in terms of uniformity and uptake.

"We do have a little bit of slope on our fields, so the shorter run times around eight hours, you hear about being used down south aren't an option for us.

"But bringing it back to 12 meant each irrigation was timed earlier than previous seasons, using a smaller deficit.

"We saw improvements with more volume in the furrows at the end of the field, better soakage into the side of the hill and less pooling at the top of the field."

The challenges of running his own farm are what make the job interesting for Cam.

"As a grower you've got to be all over research, policy, banking, agronomy, marketing and be able to specialise in every one so you can communicate with these professionals which form part of your business," he says.

"That's what I love about farming – the challenges this varied role throws up and the innovation and technology we have which leads to things like time saving and allowing us to be more dynamic in our management."

Cam maintains being part of on-farm trials and talking to researchers is vital to improvement. He was part of on-farm canopy sensor irrigation trials last season.

"Trials up here really showcase our differences," he says.

"As a grower you rely on research to guide decision-making, that's why we need this regionally-specific research that is relevant to us now.

"Our regional development officer Geoff Hunter has been great, I feel he's bought us into the cotton growing community more, through access to researchers and information.

"It's fantastic talking to our researchers to have the opportunity to tell them exactly what we are doing so they better understand our challenges.

"I definitely feel more connected to the industry now.

"Of course there's also a lot to be said for talking to and learning from other growers both inside and out of the industry.

"I really like cotton's 'open' growing community and the mateship and encouragement you see, especially among younger growers."

RENEE ANDERSON

According to the *2014 Australian Cotton Comparative Analysis*, growers should concentrate on growing higher yield within a realistic cost framework rather than searching for dramatic cost cutting measures if they wish to improve their performance significantly.

Greater efficiency in higher yields

The 2014 analysis is the tenth report to be produced by CRDC and Boyce Chartered Accountants and is regarded by the cotton industry as the benchmark for the economics of cotton growing in Australia.

The 2014 report reveals that for the average group, profit per hectare was $711 compared to $410 for the previous year and $871 over a four-year average. However it was a different season for growers in the top 20 percent group, with a profit of $1543 per hectare compared to the four-year average of around $1900. This result was a combination of decreased yield and increased expenses, although the price per bale had increased slightly.

Yet, while there was a decrease in the average yield for the 'top 20 percent' and the 'average group', the slightly upward trend for overall yield continues.

Report co-author Paul Fisher, a director of Boyce Moree, noted that yield is the most significant difference between the top producers and the average.

"The analysis shows us that basically, if costs are going up and price per bale remains relatively constant, the only way to stay in the game is to grow more bales per hectare," Paul said.

"Another term for growing more bales per hectare, is efficiency.

"The increased yield has two impacts; increased income and reduced cost per bale.

"In 2014, the cost of production for the top 20 percent of growers was $326 per bale, $56 lower than that achieved by the average growers."

Phil Alchin of Boyce Chartered Accountants presented the interim results of the 2014-15 Australian Cotton Comparative Analysis at the Cotton Collective recently.

Long term average figures for the top producers prove that it is possible to achieve a benchmark cost of production in the range of $290 to $350 per bale in a 'normal' year.

"One of the emerging issues in our view is the maturity of the industry in Australia as a whole, with different issues in 'younger' valleys versus 'more mature' valleys," Paul said.

"As an industry emerges, many of the efficiency gains (ie more bales per hectare) come for free as growers learn more and get more experienced at growing the crop.

"After a while, as the industry matures, these 'cheap' efficiency gains tend to taper off, and further efficiency gains tend to be those that providers to an industry generally charge growers for: so the key for any farm has to be the focus on the biggest efficiency gains for the cheapest price."

Paul said the 2015 interim figures (released at the Cotton Collective in August) are pleasing simply due to the increased yields and profits. The average net return per hectare was $1551. Across the industry, the yield average was 12.6 bales per hectare; 11.86 in southern regions and 13.01 in northern regions.

"These yields were in the majority due to a very kind season in terms of weather, however costs continue to climb and the growers who can control costs in the medium term while maximising yield will continue to be in the top 20 percent of the growers' 'pool'.

"Where water is erratic, success will come from a combination of reducing costs in low water years but not at the expense of being 'ready to go' and maximise yield when the water is available."

The *2014 Australian Cotton Comparative Analysis* can be downloaded from
www.crdc.com.au
www.boyceca.com/our-services/corporate-agriculture-services
The interim 2015 analysis
www.boyceca.com

The need for benchmarking

Financial analysis using comparative statistics helps farmers identify relative strengths and weaknesses. Accompanying budgets and long term business plans can then focus on ways to overcome weaknesses and build on strengths. This Comparative Analysis is a management tool to implement change and to identify where effort should be directed on a day-to-day basis – it benchmark or a standard to strive for. It is up to management to develop and implement specific action plans based on improved knowledge to set and achieve new goals, however the reliable, independent figures provide the starting point for farmers to develop "best practice".

Seminar strengthens networks

Looking at pest management, resistance and diseases at a landscape scale was a key theme the Crop Consultants Australia (CCA) two-day Cropping Solutions Seminar held at Moree.

MELANIE JENSON

Cotton Industry Young Achiever Award nominees Ben Dawson of Moree and Ryan Pratten of Narromine, NSW at the Crop Consultants Australia Seminar in late July.

The benefits of early detection and information sharing across growing areas were outlined by a number of speakers, including CSIRO Research Scientist Dr Nancy Schellhorn, Dr Jamie Hopkinson, Dr Paul Grundy and Dr Richard Sequeira (DAF), CSIRO Entomologist Dr Lewis Wilson, CottonInfo's Sandra Williams and Australian Cotton Shippers Association Chair Arthur Spellson.

CCA President Dallas King said a theme emerging from the presentations was the role consultants and growers play – as the eyes and ears of the industry – in working with researchers and other industry bodies to find solutions to everyday problems such as resistance and disease build-up.

"The concept of pulling together all levels of industry is not a new one for CCA, and its forums provide an ideal venue to put this into action," Dallas said.

"With some new faces on the Board this year including CottonInfo's Keiran O'Keeffe and Moree based B&W Rural Agronomist Ben Dawson, CCA remains committed to its charter of promoting and enhancing crop consultancy as a profession.

"It aims to do this by providing a conduit between its members and other industry groups, for the betterment of the industry as a whole."

The seminar was the second event held by CCA this year and attracted more than 120 delegates including growers, consultants, researchers and other industry professionals from as far afield as Central Queensland, Western Australia and Southern NSW.

Dallas said that CCA recognised some time ago that the value of its seminars was not just in the information provided 'on the day'.

"It is just as much about the connections you make, and the problems we solve through discussions with other like-minded professionals," he said.

"This is particularly evident when you walk around the room at a meal breaks, or at our networking dinner, or when you've drawn the short straw to try to get people to stop talking and return to their seats for a new session!

"As an organisation we have been really pleased with the increased attendance at our seminars over recent years.

"It is a testament to the fact that members and other industry players see the events as integral to their professional development as well as the promotion of their own businesses."

The seminars have become such an important part of CCA's core business that they have recently appointed Leisl Coggan, whose role is dedicated primarily towards planning and delivering the events.

In another move to enhance engagement across the industry, CCA has given special attention to ensuring that key researchers and industry professionals are on hand at seminars, to not only answer members' questions, but to assist in developing the direction of future research.

"We are very fortunate that we have a membership which is happy to share their opinions and knowledge on certain topics," Dallas said.

"It is their feedback that shapes the program for future seminars, and enables us to ensure that each event delivers content that is timely and relevant to delegates.

"When you are working on your own as a consultant, it's pretty easy to daunted by some of the things that we are facing as an industry including drought, and things like glyphosate resistance which a couple of our members outlined.

"The real benefit that I find in attending these seminars is that I always leave feeling part of a much bigger picture in an industry that has an extremely bright future – especially when we all work together."

The events are open to all industry members. To be kept informed of 2016 events, contact Leisl Coggan.

For more
Leisl Coggan
e events@cropconsultants.com.au

IRMS a must for decision making

The Insecticide Resistance Management Strategy (IRMS) should be consulted for every decision around insecticide and miticide use.

The strategy is a key management tool for growers and consultants as it includes all actives commercially available for use in cotton targeting all pests.

CottonInfo Bt and Insecticide Stewardship Technical Specialist Sally Ceeney says when used in conjunction with the Impact on Beneficials Table (found in the *2015 Cotton Pest Management Guide*) the IRMS enables the industry to follow a pre-emptive resistance management strategy that is effective on target pests, but without unnecessary disruption to the beneficial insect population.

The Transgenic and Insect Management Strategies (TIMS) Committee (part of Cotton Australia) develops the IRMS based on results from CRDC-funded annual insecticide and miticide resistance monitoring programs undertaken with researchers from NSW DPI and DAF (QLD). The results from this monitoring are used to inform the committee of any field-scale changes in resistance levels. Extensive communication and discussion with cotton growers and consultants is undertaken in all regions of the Australian cotton industry before TIMS finalises its recommendations, ensuring that the IRMS is practical and can be implemented.

Key IRMS changes for the 2015-16 cotton season

• *Inclusion of Flonicamid (Mainman) insecticide*

Flonicamid is a new insecticide with a novel mode of action (9C) registered for use on cotton aphids and green mirids.

• *Change to date recommendation for pupae busting*

This applies to the central and southern regions from March 9 to March 31. The date change is based on analysis showing March 31 is the first average date where the likelihood of diapause occurring is 50 percent. This change is also consistent with the pupae busting date for southern regions in the proposed Bollgard 3 Resistance Management Plan.

The date recommendation for northern regions remains the same (March 9) as although diapause is highly variable in northern regions, some diapause does still occur. Pupae busting in conventional cotton is still considered good practice and the earlier date reflects climatic differences and earlier maturing crops.

COURTESY PAUL GRUNDY

The Beneficials Table in the Guide helps growers to preserve predators such as green lacewing larvae, which place the bodies of dead prey on their backs for camouflage such as these mealybug carcases; however they also eat aphids, thrips, mites and many other insects.

For more

Sally Ceeney
m 0459 189 771
e sally@ceenag.com.au

Getting boots in the field early is vital for effective integrated pest management.

Early season sampling and ID vital

With healthy weed growth over winter and with many winter crops in the ground in many cotton growing regions, it can be guaranteed there will be a build-up of cotton insects over winter.

As the winter weeds and crops ripen, these pests and beneficials will move into greener, younger summer crops like cotton.

CottonInfo IPM Technical Specialist Sandra Williams said this means effective sampling will be vital early on, adding that correct identification is the next critical factor.

"This means getting boots in the field early to keep an eye out for sucking pests such as aphids, thrips, mites and an assortment of chewing pests like cutworm and army worm.

"For correct identification, the *Pests and Beneficials in Australian Cotton Landscapes* is the go-to resource.

"There are some tricky pests such as aphids, which can be easily misidentified as there are usually a number of species early in the season. It is equally important to know what beneficials have also come into the cotton early."

For a copy of *Pests and Beneficials in Australian Cotton Landscapes* go to www.cottoninfo.com.au/publications

Taking up technology

Irrigators and consultants found great value in the recent IrriSAT workshops in Griffith, Emerald, Moree and Narromine.

The workshops were rolled out as a result of interest sparked from the 2015 Irrigation Technology Tour earlier this year, with 90 percent of participants saying they would like to learn more about IrriSAT.

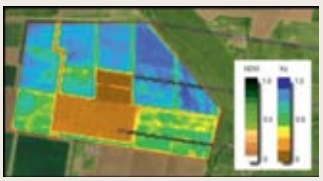
CottonInfo Water Use Efficiency Technical Specialist and IrriSAT project leader Janelle Montgomery, with support from CRDC, organised the events which included Dr John Hornbuckle of Deakin University who explained the technology and unveiled the new IrriSAT google app.

IrriSAT is weather-based irrigation management and benchmarking technology using remote sensing to provide site-specific crop water management information. It provides daily crop water use along with a seven-day forecast to assist in irrigation scheduling decisions. It complements existing scheduling tools, with the advantage of low cost and complete spatial coverage, according to Janelle Montgomery, who says it can also be used as a benchmarking tool to examine crop productivity between fields and farms.

"Identifying over-and under-performing fields holds the key to improving water productivity," Janelle said.

The project team aim to fully integrate IrriSAT into farms throughout Australia's cotton growing regions, and going off the workshops, this could be about to happen.

Reinder Prins of CGS in Emerald said the workshop showed the knowledge and technology currently available to growers for making irrigation decisions. Furthermore, he said he expects growers who attended the workshop will be using this technology to help their irrigation decisions this coming cotton season.



Crop co-efficients (Kc) calculated by the IrriSAT Google App.

Workshop participants were introduced to the IrriSAT mobile application.

"Individual crop coefficient for my crops, how good is that!" said Coleambally-based consultant Adrian Hayes of MIA Rural, who went along to the Griffith workshop.

"When looking at crop production performance, the capability to simply and quickly review the season's crop coefficients is incredible.

"The way the graphs are presented, showing the level of accuracy in the calculation, provides a great level of confidence in the data.

"The app does all the hard work very smoothly and surprisingly quickly.

"I recommend this tool to anyone interested in benchmarking their crop against others in the same season or to track against previous seasons. It will help make good water and crop management decisions."

The beta version of the app can be downloaded from www.irrisat-cloud.appspot.com with work underway to develop versions for all smart phones and tablets.

Emerald grower Tim Mackinlay says IrriSAT's ability to benchmark his fields' productivity in terms of yield to water use across his farms is definitely and exciting feature of the technology.

Also at the Emerald workshop was grower Tim Mackinlay from Cowal Agriculture who said the technology holds a lot of value in terms of benchmarking and he looks forward to using it.

"I found the IrriSAT app quite user-friendly and was impressed by the resolution in the maps which highlighted variation in crop performance throughout fields," Tim said.

"Providing a means of forecasting crop water use over a seven-day period could certainly prove a useful tool to assist decision making for timing of irrigations, although I'm not sure any technology will ever replace putting your boots in the field.

"The ability to easily benchmark our fields productivity in terms of yield to water use across our farms is definitely and exciting feature of the technology.

"Overall I found the IrriSAT workshop very interesting and look forward to using the technology in the future."

CottonInfo Carbon and Climate Technical Specialist Jon Welsh, whose weather-related research and knowledge is hitting the spot with growers and consultants, spoke about seasonal forecasting, demystifying the terms and tools involved.

Emerald-based consultant David Parlato found new, useful information in the presentations with which he can based decisions on.

"I didn't realise how strong the relationship was between evapotranspiration (ETo) and the Niño 4 indices during spring and how this relationship disappears through the monsoon from January onwards," David said.

"This is useful to know, as El Niño Southern Oscillation (ENSO) always features in commentary in the media and at least I know when it will affect growing conditions now and when it won't."

For more

w www.youtube.com/watch?v=ccvJizT4Iw0
e Janelle.montgomery@dpi.nsw.gov.au
e j.hornbuckle@deakin.edu.au
e jon.welsh@cottoninfo.net.au

Seeing inside the soil

"Cotton farmers place high importance on improving their use of water, yet essential elements are still lacking within the area of on-farm soil-water monitoring," says Soil Hydrology Scientist Jenny Foley who works with the QLD Department of Natural Resources and Mines.

"They have few ways of accurately linking their irrigation applications – when to irrigate and how much to apply – to known soil-water deficits throughout the growing season."

Jenny says this is largely because measuring soil water is difficult, particularly for the swelling clay soils found in the irrigated cotton growing areas of NSW and Queensland, adding that some technology used in the industry to monitor soil-water have known drawbacks in these soil types.

While there is plenty of capacity within the cotton industry to improve soil-water monitoring using newer approaches, bringing these technologies into common use can be challenging.

"Often fairly complex science underpins a simple field measurement method," Jenny says.

"I've found that training workshops can overcome some of the challenges by providing a mix of theory and hands-on training which greatly aids the uptake and adoption of these technologies."

CRDC along with the Department of Natural Resources and Mines supported a two-day event in Toowoomba recently which focused on providing accessible, hands-on training in how to use innovative electromagnetic induction (EMI) technologies to monitor soil-water to more than 70 consultants, agronomists, researchers and growers across a range of industries across NSW, Queensland and Victoria.

During the workshop a number of scientists and industry consultants spoke of their research and experiences in using EMI to monitor soil-water in a range of irrigated and dryland crop, pasture and dairy situations.

Jenny Foley demonstrated the EM38 at the 2015 Cotton Irrigation Technology Tour, which led to requests for the two-day workshop.

"The common consensus is that these instruments have a truly impressive ability to provide accurate estimates of soil water," Jenny said.

"EMI instruments such as the EM38 are one of a suite of instruments currently recommended for use in the industry after many years of successful use in research trials, either as a stand-alone method to monitor soil water or as part of an integrated combination of methods.

"They can provide accurate estimates of soil plant available water (PAW) so that informed management decisions can be made, for example, the application, timing and conservation of irrigation water and fertiliser.

"They are particularly good at estimating soil water in heavy clay soils, like those found extensively in the cotton growing regions from Emerald in the Dawson Valley to the Namoi Valley in Northern NSW.

"Because they have a sensing depth to 1.5 metres they are ideal for monitoring crop water use and PAW throughout a growing season."

Grants to improve water use efficiency

Funding for round six of the NSW DPI Sustaining the Basin Irrigated Farm Modernisation (STBIFM) program has now opened. The Program achieves water savings by recovering on-farm losses through water use efficiency assessments, infrastructure upgrades and training. The STBIFM program is funded by the Australian Government's Sustainable Rural Water Use and Infrastructure program. Interested irrigators are urged to contact the program team at IFM.info@dpi.nsw.gov.au
For more information on STBIFM go to www.dpi.nsw.gov.au/info/sustainingthebasin

Understanding overhead systems

The *Review of Centre Pivot and Lateral Move (CPLM) Installations in the Australian Cotton Industry* was released this year and shows the average water applied by centre pivot and lateral move systems in 2011-12 was 30 percent less than furrow irrigation while maintaining similar yields.

Released this year, this comprehensive review gives irrigators a close look at changes in design, operation and management of CPLM since the last analysis in 2001. It also gives a must-read list of recommendations for potential users.

The 2012 analysis was supported by CRDC and partners, covering 173 systems irrigating an area of 13,969 hectares. Of this area 42 percent was irrigated by centre pivots and 58 percent by lateral moves.

The leading factors driving the adoption of these systems were the same as in 2001: labour and water savings.

Co-author and CottonInfo Water Use Efficiency Technical Specialist for NSW, Janelle Montgomery says there were a number of recommendations from this report which should be considered by growers who use or are interested in investing in overhead systems.

"System capacity is critical – managed system capacity in particular needs to be high enough to satisfy peak crop demand and your irrigation management, while minimising capital and operating costs," Janelle says.

"It is important to ensure that operating pressure is minimised while still allowing optimum system performance, as energy costs are an increasing component of operating costs and may affect the financial viability of these systems.

"The performance of systems should be checked after installation and at regular intervals.

"Expect it will take several years before you get the best performance out of an overhead system. There will be a significant time investment in planning and setting up the system and learning to manage it.

"Learn as much as possible from growers and consultants operating these machines."

For a copy of the review www.cottoninfo.com.au/publications

Managing risk with row spacing

LOU GALL

Grower-led trials into row spacing offer insight into the effect on yield and water use.

In limited water situations, irrigators can choose to fully irrigate a reduced area; spread the water over a larger area of crop; and/or change row configuration. Research has shown that using wider row configurations can help reduce the risk of crop failure, buy time to gain rainfall or extra irrigations, spread the irrigation intervals, make better use of in-crop rainfall, and reduce variable costs.

To better understand the full potential of alternative spacing to the most commonly used solid one-metre (40-inch), trials undertaken by the Gwydir Valley Irrigators Association (GVIA) in Northern NSW investigated the yield potential of a number of different row spacings with optimal/full irrigation.

The trials were planted at Auscott "Watervale" and Sundown Pastoral Company's "Keytah" both near Moree. These experiments will add to the growing database of row spacing comparison already compiled that compare the yield and quality of these systems. Uniquely these experiments are comparing the water use of the systems and will help in the choice of row configurations when water is limited.

"What we wanted to know was what the absolute maximum yield you can get out of each of the row configurations," GVIA Project Officer Lou Gall said.

"We are aiming to give growers more information to be able to more confidently assess yield potential in limited water situations of a solid one-metre plant versus a two-metre (80-inch) row spacing should water become available during the growing season.

"The trial data indicates that the two-metre planting could be expected to yield about 35 percent less than the one-metre solid spacing with between 20 and 30 percent less irrigation water.

"The data on 30-inch row spacing is also encouraging from both a yield and an applied irrigation water perspective, and growers looking for improvements in water use efficiency will no doubt be looking closely at the findings from the 2015-2016 trial."

The trials were a part of the *Grower Led Research into Irrigation System Comparison in the Gwydir Valley* project funded by CRDC. The industry standard 40-inch (one metre) spacing was used as the comparison against the 30 inch (75cm), 60 inch (1.5 metres) and 80 inch (two metre) configurations.

The "Keytah" site was adjusted from the farm's standard 1.5m beds to include one-metre beds to plant the 40 and 80-inch configurations. The Auscott site was adjusted from one-metre beds to include 1.5m beds for the 30 and 60-inch trials.

Due to limited time available to reconfigure the beds at both sites, the new beds had not stabilised at planting creating difficulties when the trial was watered up. As such the Auscott 30-inch plot was replanted, using additional water and delaying maturity.

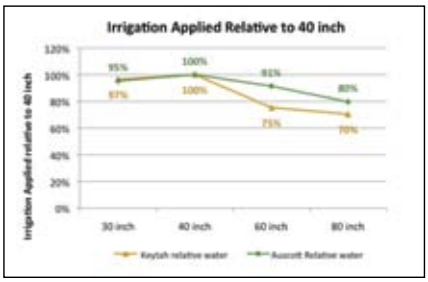
"Keytah" was planted in late October 2014, receiving 254mm of rain from October to April, while Auscott, planted early November, received 266mm from November to May.

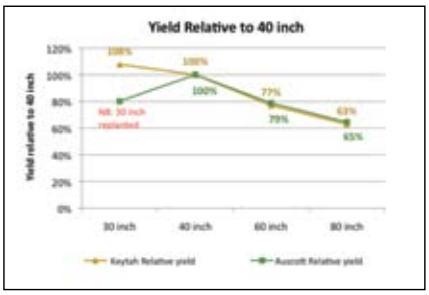
Lou says the results show that overall, the 30-inch configurations performed extremely well.

"At both sites it had less water applied than in the 40-inch, with the crop at "Keytah" yielding eight percent higher and using three percent less irrigation water," Lou said.

"At Auscott the 30-inch trial used five percent less water, however the yield did not reflect the potential of this configuration due to the replant."

Conversely, the 60-inch trial showed a yield reduction of 21 to 23 percent compared to the 40 inch. Water usage was also reduced, by nine percent at Auscott and 25 percent at "Keytah". The 80-inch configuration showed a more significant yield reduction of between 35 and 37 percent, but with a significant reduction in irrigation water applied of between 20 and 30 percent.





On-farm trials of 80-inch configuration showed a yield reduction of between 35 and 37 percent, compared to 40-inch, but with significant reduction in irrigation water applied of between 20 and 30 percent.

GVIA and the Gwydir Valley Cotton Growers Association will be working with Auscott in the coming season to collect more data on the relative performance of these different row configurations under optimal irrigation. The project has recently been enhanced with the support of a Grassroots Grant from CRDC.

For more

WATERpak Chapter 3.3

w www.cottoninfo.com.au/publications/waterpak

Mungindi cotton grower, Cotton Australia director and industry stalwart Barb Grey with CRDC board member Kathryn Adams.

COURTESY MYNARRABRI

Research on show

Discussing important issues facing the Australian cotton industry and hearing the latest research was on the agenda for this year's Cotton Collective industry forum.

Convened by Cotton Australia every two years, more than 250 growers, researchers and industry leaders came together for the collective in Narrabri in early August to discuss a wide range of topics, from 'big data' to positioning Australian cotton in the world fibre market, new crop varieties and access to water.

CRDC's Bruce Finney said many CRDC-funded researchers and research projects featured on the agenda, providing a great opportunity for growers to interact with the researchers and gain an understanding of their projects and results.

"Some of the key research highlights on the agenda included Dr John Bennett of USQ presenting on the impacts of the round bale picker (JD7760); UNE's Dr Oliver Knox speaking about the Cotton Hub; Dr Jeff Werth of DAF (QLD) talking herbicide resistance; Dr Sam Capon of Griffith University presenting on riparian vegetation; and Associate Professor Bryce Kelly of UNSW speaking about his work in assessing the hydraulic connection between fresh water aquifers and unconventional gas production," Bruce said.

"Delegates also heard from Boyce Chartered Accountants on the 2015 interim findings from our joint Cotton Comparative Analysis; and a special nutrition session featured both CottonInfo Regional Development Officer Alice Devlin and Nuffield Scholar Nigel Corish, all initiatives supported by CRDC.

"It was a full day of informative sessions across a diverse range of topics; a great opportunity to showcase some of our key research projects and for the researchers to discuss their practical application in the field directly with growers."

An impressive speaker line-up of experts in many fields included National Farmers' Federation (NFF) CEO Simon Talbot, Better Cotton Initiative (BCI) partnership manager Corin Wood-Jones, and Australian Farm Institute (AFI) executive director Mick Keogh, who spoke as part of his CRDC-funded project on the implications of 'big data' for Australian agriculture.

Cotton Australia CEO Adam Kay said feedback indicated big data is a topic of growing interest and importance for growers

"It has significant implications for efficiency on-farm, but there are also issues about who owns and controls the data produced by farm operations," Adam said.

"The other big issue covered was Cotton Australia's efforts to promote Australian cotton, both domestically and overseas.

"We were able to give growers the big picture on our Cotton To Market program, how it ties in to other initiatives such as the Better Cotton Initiative and the NFF's promotion program, and also how it will produce more value for growers through better access to markets and, potentially, a premium for our fibre."

Australian

The 2015 Awards evening was held on August 5 at Narrabri as part of the Cotton Collective.

Cleave Rogan is a cotton grower, CRDC board director and the 2015 Australian Cotton Industry Awards Incitec Pivot Fertilisers Service to Industry recipient. As such, *Spotlight* asked Cleave to introduce this year's other awardees.

"As part of the Australian cotton industry, I have been able to stand on many leaders' shoulders to look into the future and be associated with a vibrant industry, world-leading researchers, innovative farmers and our community-minded leaders to continue lifting the bar for growth in productivity and profitability. To receive this award amongst my peers of the industry was very humbling, and all made possible with the fantastic support of my wife Johnelle.

"The award's gathering reminds us that the 'industry' means people, who, like many of us in the industry, also share the support of family and the larger cotton community. The coming together to celebrate the industry reminds us that we are in good hands in terms of future security, sustainability and vibrancy. It reminds us that we should be thankful to have the opportunity to play a part, which brings us into contact with such amazing mentors and people. I believe every person has something positive to contribute, and the awardees provide a snapshot of the many faces not named, but who are all working for the betterment of our industry."

Cotton Industry Awards

Monsanto Cotton Growers of the Year – Robert & Jennie Reardon, Talwood, QLD

COURTESY MYNARRABRI

"If you haven't got good people to make it all happen you've got nothing.

"This is our employees' award – they've worked hard and deserve this and we accepted it on their behalf. The biggest thrill for us in being named Grower of the Year was to see our employees so excited about it and has created such good motivation for the team.

"We focus heavily on people in our team, you've got to create a place where people want to come to work."

Incitec Pivot Fertilisers Service to Industry Award – Cleave Rogan "Bookamerrie" St George QLD

"It all began with my passion for research and over time becoming the elected St George Cotton Growers Association representative on the Australian Cotton Growers Research Association. This merged into Cotton Australia advising CRDC on research in the industry and today representing the industry on the CRDC Board."

CSD Researchers of the year Colin Tann & Dr Geoff Baker – CSIRO Agriculture Flagship, Narrabri NSW

COURTESY MYNARRABRI

Colin – "We are quite delighted at winning this award. It is recognition from the industry and our peers, that the work we have done is helping to make a difference, and has significance to the future sustainability of Australia's cotton crop. Our research is largely focused on long-term ecological studies on *Helicoverpa spp.* and has evolved into a number of key research questions that form the platform of the Resistance Management Plan."

Geoff – "It's quite an honour and thus very pleasing to receive this. It's made all the more special by being joint with Colin – recognising the inputs of a couple of people, each with their different skills, working collectively to solve problems/ provide advice that has substantial relevance to an industry. When I became involved with cotton research about 15 years ago I was very impressed with the importance the industry placed on rigorous research and its application. It's great to see that attitude ongoing."

AgriRisk High Achievers – Peter and Caroline Tuohey, Carrathool, NSW

COURTESY MYNARRABRI

"Innovation plays a significant part in our operation in trying to find ways to maximise income and minimise expenses. For example, the new freight logistics system developed by Angelo Battaglino to cart stacked round modules more safely and efficiently. This has reduced our freight bill over the past four years by over 400 percent.

"Being involved in the cotton awards has been a truly exciting and humbling experience. It has allowed us to get to know a great group of like-minded industry people."

Chris Lehmann Trust – Bayer CropScience Young Achiever of the Year – Ross Burnett "Barkool" Emerald, QLD

"Cotton is a great industry to be involved in, Everyone wants the same outcomes so there is no 'competition' and people are supportive and willing to help. There's a multitude of ways and levels to be involved. It's both exciting and challenging to look toward continually improving, which we can do with an industry made up of young professionals who have an affection for agriculture and cotton in particular."

Removing the barriers

Developing a 'safety culture' pays off, and not just by reducing incidents on-farm and minimising working time lost. So why are there still barriers to adoption?

There are known solutions to improving on-farm safety. Utilities and quad bikes, for example, remain a major killer of people on farms, due largely to lack of basic safety.

CRDC is a partner in the Primary Industries Health and Safety Partnership (PIHSP) which recently released a report focused on barriers to Work Health and Safety (WH&S) adoption which found that almost half of all deaths on farms could be prevented simply by implementing solutions we already know about.

Exploring the barriers and facilitators to adoption of improved work practices for safety in the primary industries report author Richard Franklin of James Cook University says the rates of death and injury on farms and fishing vessels have improved, but are still unacceptable.

"We found a perfect example of how simple – and known – solutions can save lives," he says.

"From 2001 to 2014, there were 45 deaths involving farm utes – half of these were due to not wearing seatbelts or passengers being carried in the tray.

"When it comes to health, a willingness to make changes is at least partly dependent on people's perceptions of how likely something is to happen to them, and how serious they think the consequences could be.

"Farmers are also highly practical, and need evidence of how changing practices will improve their safety, production or income."

The report found the major barriers were universal and consistent across industries, and included attitudes, perceived cost, time and inconvenience to implement changes.

"Developing a culture where safe work practices are deeply embedded is critical to the future of the primary industries, particularly in relation to attracting and retaining workers," says Sally Knight, who works with CRDC and PIHSP.

"This report shows the creation of a culture of safety in the primary industries is possible, with strong leadership and positive attitudes from key people.

"Everyone is entitled to be at home each night with their family and loved ones – this is not just a cotton industry expectation, but the right of anyone employed in agriculture and the responsibility of every employee and farmer.

"CRDC's involvement in PIHSP this year will focus on delivering a clear message – that the barriers to adoption of systematic hazard management throughout agricultural Australia must be addressed.

"The term 'safety culture' is multi-layered and the adoption of a management system focused on embedding safety culture into the workplace is a major challenge.

"The greatest single barrier to success for smaller organisations is the belief that it is too difficult.

"Implementing change can difficult but in the long run, it is more dangerous not to.

"The saying is that 'A culture of safety is when safety is always in the back of your mind and at the front of your actions'."

CRDC, along with the meat processing and grains Research and Development Corporations, livestock industries and the Rural Industries Research and Development Corporation are partners in the Primary Industries Health and Safety Partnership (PIHSP). The partnership aims to drive sustainable improvements to work health and safety outcomes in agriculture, forestry and fishing through investment in RD&E. PIHSP is piloting a contemporary approach to improving organisational culture, and will look to other industries to identify what has worked in other sectors.
www.rirdc.gov.au/PIHSP

WH&S RESOURCES FOR GROWERS

- *my*BMP for templates for inductions, hazard reduction, employer responsibilities/legal requirements etc. www.mybmp.com.au
- Cotton Australia has a range of WH&S resources for growers in the CottonSafe section of its website www.cottonaustralia.com.au
- Tools including relevant checklists and all the required record keeping instruments are freely available at www.aghealth.org.au
- WorkCover NSW – 13 10 50 contact@workcover.nsw.gov.au
- Workplace Health and Safety Queensland – 1300 369 915

MEET THE RESEARCHER

Revealing riparian value

Burke and Wills may have met their end there, but cotton industry researcher Dr Sam Capon met her future on the Cooper Creek in South-Western Queensland's famed channel country.

COURTESY RUTH REDFERN

Australia's inland riverine and floodplain environments are among the "most variable, unpredictable and dynamic ecosystems on the planet!" Sam says.

"There are areas of amazing natural vegetation on cotton farms, especially in their riparian zones – we found more than 200 plant species in studies in the Central and Northern regions of the Murray-Darling Basin. This incredible biodiversity makes riparian zones the most important part of these landscapes."

As a Research Fellow at Griffith University's Australian Rivers Institute, Sam undertook the riparian regeneration research project with support from CRDC. The research seeks to inform best practice for managing riparian lands on farms in the Northern Murray-Darling Basin's cotton growing regions, and she says each region has specific characteristics and needs.

"I don't agree with the mantra that 'all ecosystems are supposed to be a certain way'," Sam says.

"I would say that through all my research that communities have to decide what changes are acceptable to us and how we manage that sustainably.

"Good management of riparian lands has important benefits for the health of vegetation, particularly tall eucalypt species like the river red gums, along the river banks on cotton farms in the Northern Murray-Darling Basin.

"Riparian vegetation also plays a really important role in terms of its ecological function in providing habitat for animals, its effect on nutrient cycling and water filtration, to name a few of its roles."

Sam's parents were teachers and most of her younger life was spent in Queensland's eastern seaboard, which could be considered one of the most desirable places in the country. However these days Sam has found what she describes as the most amazing ecosystems in these riparian zones and floodplains of arid and semi-arid Australia. Her admiration for these systems began in earnest while working along one of the most famous rivers in Australia, Coopers Creek – infamous as the site of the death of the explorers Burke and Wills in 1861.

At 1300 kilometres long, the Cooper is the second longest inland river system in Australia after the Murray-Darling system.

While studying for her Honours degree, Sam took her first trip west to Coopers Creek, and was surprised by how stunningly beautiful and welcoming the landscape was.

"I didn't see it as the harsh, barren place described so often in books and films and so on," Sam said.

"I remember the amazing colours especially the reds, greens and blues and the incredible hospitality of the farmers on whose properties we camped next to waterholes and were often welcomed into their homes for meals or taken on fabulous tours of their properties.

"I love seeing these landscapes dry and imagining how lush they will be when they've been flooded.

"The resilience of these floodplain landscapes and their ecology continues to fascinate me, how they can cope with long periods of drought then severe flooding; their ability to survive and regenerate.

"I think we can learn a lot from species and biological communities that can cope with such unpredictable and contrasting conditions – the strategies they use to cope with or escape from stress but still make the most of favourable times."

The resilience and toughness of floodplains and their riparian zones – identifying the vulnerable elements in these systems and how best to maintain them – formed the basis of Sam's PhD study.

"Having been involved in a lot of community engagement I've found landholders are very aware of what they have on their farms, they know what's there."

With this in mind and to harness this knowledge, Sam is undertaking a CRDC project to document local knowledge of riparian, floodplain and wetland vegetation change, and the major factors driving this change, among farmers of the northern Murray-Darling Basin.

"As part of this project, I would like to compile an oral history of vegetation dynamics and change across the northern Basin by recording stories of local land managers," Sam said.

"The information will be used to prepare an oral history document for use in local communities and to inform management agencies with an interest in the region."

For more

Sam Capon
t 0402 217 899

Understanding East Coast Lows: many unknowns remain

The low-down with
Jon Welsh

East Coast Lows are a valuable source of rainfall and run-off in cotton growing regions, and being able to understand the drivers of these systems would be a plus for growers. However as CottonInfo Carbon and Climate Technical Specialist Jon Welsh explains, they are a tricky beast.

A phenomenon particularly valuable to fresh water supplies along the eastern seaboard that continues to challenge scientists is the 'East Coast Low' or 'East Coast Cyclone'.

This year Australia has already experienced the force of two major East Coast Lows (ECLs), which led to massive rainfall totals and flooding in the Hunter Valley and Sydney, while also bringing welcome rain to many cotton growing catchments in NSW and Queensland.

With so much commentary in the media around El Niño-Southern Oscillation (ENSO), the identification of the origin of various synoptic systems, such as ECLs, and their contribution to rainfall is likely to be an important step in understanding the underlying processes connecting various large-scale drivers to regional rainfall.

These intense systems have proven to be independent of year-to-year variability of ENSO, contributing as much as 38 percent of annual rainfall in some coastal areas and delivering falls of up to 150mm in one single event through upper reaches of cotton irrigation catchments.

Understanding the ECL component of rain is therefore important in the context of rainfall and water supply variation along the eastern seaboard.

A closer look at current climate research reveals the difficulties in identifying the drivers of these systems and predicting their erratic behaviour.

What is an East Coast Low?

On the east coast of Australia, ECLs can cause heavy rain, hurricane-force winds and high seas resulting in major flooding, loss of life and interruptions to shipping. Researchers have identified that seven percent of all major natural disasters in Australia between 1967 and 1991 were as a consequence of ECLs, while an ECL in June 2007 caused close to $1.5 billion in damage, including the beaching of the bulk carrier *Pasha Bulker*. This event also produced significant in-flows into catchment dams in the Lachlan, Macquarie and Namoi following June totals of up to 250mm.

Subtropical storms such as ECLs can have characteristics of both tropical and extratropical cyclones and as such are thought to be hybrid storms. They have a large size range – from 50 to 1000 km and can last for a few hours to several days.

ECLs are responsible for more than 25mm of rain between three and five days each year along coastal and inland regions of southern Queensland, NSW and Victoria, as well as more than 50 percent of widespread heavy rain events during May through August. They can occur at any time of year, but are particularly important for cotton growers during the cool months May through October, when they produce 35 to 45 percent of total rain in the southern eastern seaboard.

Reliability

On average, ECLs contribute 23 percent of annual rainfall on the eastern seaboard.

The ECL component of total rainfall is also highly variable. Its annual contribution varies from a high of 38 percent of all rainfall in 1990 to just 13 percent (1973).

While the ECL-related rainfall is recognised as a major source of inter-annual variability in eastern seaboard rainfall, high rainfall from ECL in years such as 1990 and 1998 was able to mitigate otherwise drier than normal totals, while a lack of ECL rainfall in 1982 and 1994 enhanced rainfall declines.

A significant feature of the Australian ECL is the relatively small scale of the high-impact weather zones surrounding them, although these impacts can be very severe for these zones.

What do we know about ECL behaviour?

In order to understand and better predict ECL behaviour, we take a closer look at why these events form in this region, and why the Australian East Coast is especially favourable for the formation of these storms. The prime factors are as follows:

- The large dry continental region to the west
- The Great Dividing Range of mountains close to the east coast
- The character of the east Australian Coast. The mountains of east Australia have been shown to play a role in the formation of the trough associated with easterly dips.

The unique climate along the coast is linked to local topography, with proximity to the Tasman Sea and warm East Australia Current acting as a moisture source while the Great Dividing Range to the west provides orographic enhancement of rainfall and influences the passage of fronts and westerly systems.

This is particularly relevant during periods of anomalously easterly or westerly wind flow, with easterly wind anomalies enhancing rainfall along the coast, particularly during summer. ECLs are driven by the temperature gradient between the Tasman Sea air and cold air in the high levels of the atmosphere over the continent.

Predictability: barriers remain

Because of the diverse nature of low pressure systems impacting the east coast, there is considerable inconsistency in the identification of ECLs between studies linking climate drivers with ECL frequency. There is a relatively limited body of work on the climatology of Australian East Coast cyclones. Investigating the ECL connection with El Niño Southern Oscillation is the obvious first step in assisting predictability.

ENSO

The El Nino-Southern Oscillation (ENSO) phenomenon is a major source of year-to-year variability in rainfall across eastern Australia. The Southern Oscillation Index (SOI) is a common measure of ENSO behaviour and forms the basis of an operational seasonal forecasting scheme currently in use in Eastern Australia.

Research has proven ECLs have little relationship with broad scale climate features such as the ENSO phenomenon and the Indian Ocean Dipole during the cool months where such influences dominate South Eastern Australian rainfall.

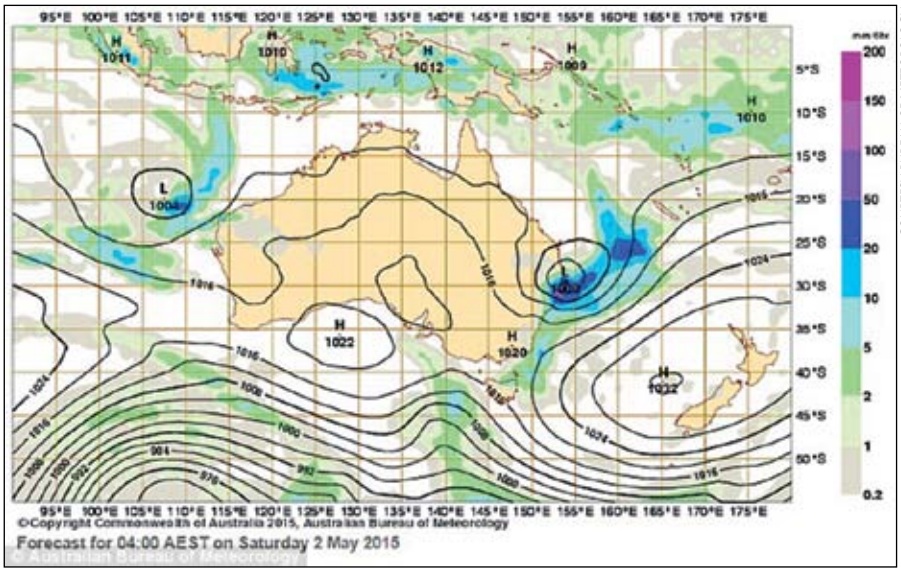
Correlations between ECL-related rainfall and Tasman/Coral Sea surface temperature anomalies along the eastern seaboard failed to reach any statistically significant level throughout any stage during the year, with weakly positive correlations in the cool season and weakly negative during the warm season. Local Seas Surface Temperatures (SST) indices used are a poor proxy to capture the possible ECL behaviour.

Atmospheric indices

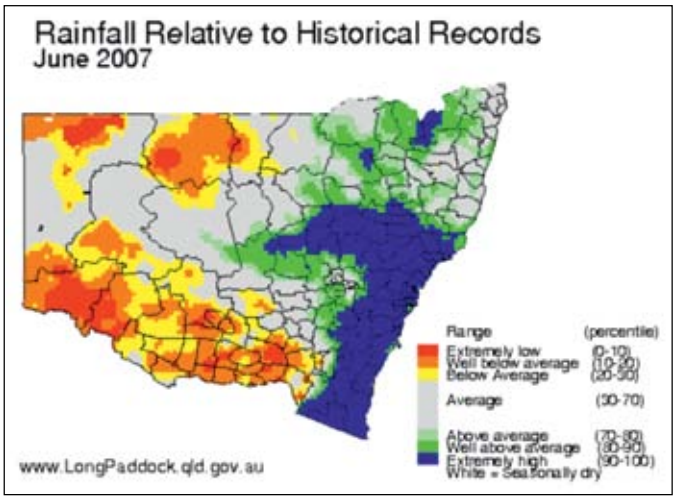
Atmospheric circulation indices have a stronger relationship with ECLs. The relationship between ECL-related rainfall and the Southern Annular Mode has been found to be statistically significant between July and December, with seasonal correlations of +0.36 in winter and +0.37 in spring.

While operational mesoscale nation weather predictability systems can now resolve the scales of these systems on shorter lead times, it is more problematic resolving such scales with the general circulation model (GCM) simulations of future climates on a seasonal basis, which are typically run with much wider grid spacing than short term weather models.

The improved use of short, medium and long term seasonal forecasting information can facilitate more informed decisions regarding the efficient use of farm inputs (including agronomy practices, fertiliser use, irrigation regimes and fuel and energy use) and agronomy practices to minimise greenhouse gas emissions and is supported by funding from the Australian Government.



COURTESY BUREAU OF METEOROLOGY.



ABOVE:
The East Coast Low moves in to devastate regions in Sydney and the Hunter Valley in May.

LEFT:
Figure 1 Rainfall anomaly for NSW in June, 2007 when a powerful East Coast Low made landfall.

This project is supported by funding from the Australian Government.

To sign up for the fortnightly e-newsletter (and other CottonInfo communications) visit www.cottoninfo.com.au/subscribe

@CottonInfoAust

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.

Subscribe to *Spotlight* today.

www.crdc.com.au

Australian Government

Cotton Research and Development Corporation

COVER IMAGE: MELANIE JENSON