

COTTON RESEARCH & DEVELOPMENT CORPORATION



Spotlight

AUTUMN 2015

on Cotton R&D

YOUR RESEARCH, YOUR FARM



Best Practice





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IN THE SPOTLIGHT



In this edition of *Spotlight*, change is the recurring theme. The Australian cotton industry is a very dynamic industry – with an ever evolving range of issues for the industry to overcome and opportunities to capitalise on. CRDC's investment in research is both driven by, and driving, change in our industry. Our R&D investment helps growers and the industry prepare for and make change to keep us at the forefront of global cotton production.

The role of R&D in helping growers adapt to and hurdle challenges was highly evident at the recent CRDC-supported industry events: the Irrigation Technology Tour and the Big Days Out. At these events, growers were keenly looking to the outcomes of research to help them make improvements to the way they manage natural resources, irrigation and energy. Some growers, like Ian Brimblecombe and Scott Morgan (who you'll meet in this edition) are early adopters of new technology on-farm, demonstrating that the value of growers and researchers doing Q&A on-farm remains immense.

Where and how cotton is being grown is also changing. In this Spotlight we report on research in the Central QLD growing region of Emerald investigating the viability of changing planting dates to accommodate the weather, while in southern NSW the number of growers and the amount of cotton grown continues to advance at a remarkable rate - in no small part due to the skill of the growers involved and the results of more than 30 years of grower-led industry research.

CRDC research is also driving change in the post-farm gate sector, with the invention of a new seed finger mechanism for cotton gins which has the capacity to significantly improve turnout. Similarly, Cottonspec software is demonstrating a capacity to help our customers predict fibre quality in a way that was not possible before.

Change also comes in the form of chal-

lenges and emerging issues, and a case in point this season is the prevalence of Verticillium wilt and the detection of a new strain. This has led to a call from all sectors of the industry for vigilance in the detection and confirmation of the type of wilt present in our fields. CRDC has a longstanding investment in research on Verticillium management, and is ensuring that growers and crop consultants are receiving the information they need to manage this disease.

CRDC is also supporting research of our changing landscape in terms of weeds and glyphosate resistance. As a new weed is added to the resistant register, we are reminded of how quickly plant biology can change in response to over-use of glyphosate or any single mode of action. Research into best practice weed management and resistance is ongoing and I urge growers and crop consultants to make use of WEEDPak and the Herbicide Resistance Management Strategy developed by CRDC.

Growers also know only too well that each season pest pressure changes in intensity. This edition we have a focus on silverleaf whitefly management and reiterate the importance of avoiding sticky cotton. It would be an understatement to say that other cotton producing countries are envious of our reputation for supplying clean, contaminant-free cotton. This has come around through sound research and good management, however we cannot rest on our laurels and the changing face of pest management and control must always be in forefront of our considerations.

Lastly, the CRDC is addressing industry change in an overarching way with the commissioning of a landmark study in agriculture. This study is assessing industry resilience to safeguard our industry's long-term prosperity. By identifying future trends and drivers of change, our industry will be better placed to prepare for uncertainties and to seize the opportunities that equally arise through change.

Bruce Finney

RUTH REDFERN



Irrigation researchers at the Quigley family's "The Wilgas" Nevertire.
Back row: Richie Quigley, Jenny Foley, Dr Malcolm Gillies, Dr Alison McCarthy, Dr Onoriode Coast, Tony Quigley, Dr Rose Broderick, George Quigley and CottonInfo RDO Amanda Thomas. Front row: Organiser Janelle Montgomery (CottonInfo WUE Technical Specialist NSW), Dr John Hornbuckle, Jasim Uddin and Tom Quigley.



FRONT COVER: CottonInfo Water Use Efficiency Technical Specialist Janelle Montgomery, grower Tom Quigley and CSIRO's Dr John Hornbuckle at the 2015 Irrigation Technology Tour's Nevertire event held at the Quigley's farm. Image Ruth Redfern



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

Our outcomes:
Farmers: Cotton is profitable and consistently farmers' crop of choice.
Industry: The Australian cotton industry is the global leader in sustainable agriculture.
Customers: The Australian cotton industry captures the full value of its products.
People: Capable and connected people driving the cotton industry.
Performance: Measured performance of the Australian cotton industry and its RD&E drives continuous improvement.
Corporate background: CRDC was established in 1990 under the Primary Industries Research and Development Act 1989 (PIRD Act.) which outlines its accountability to the Australian Government and to the cotton industry through the Cotton Australia. CRDC is responsible to the Australian Government through the Minister for Agriculture, Barnaby Joyce.

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Auscott Ltd Macquarie's Bill Tyrwhitt; Tom Quigley, Quigley Farms Trangie; CottonInfo Macquarie RDO Amanda Thomas; Brett Cumberland of AFF Narromine; and Dr Pat Hulme of Sustainable Soils Management, Warren, at the 2015 Irrigation Technology Tour's Nevertire event.

RUTH REDFERN

TAKING RESEARCH TO GROWERS

LEADING IRRIGATION RESEARCHERS TOURED COTTON REGIONS IN FEBRUARY TO SHOWCASE INNOVATIVE SCHEDULING AND AUTOMATION TECHNOLOGY TO COTTON GROWERS.

In the first initiative of its kind for the cotton industry, the 2015 Cotton Irrigation Technology Tour took seven CRDC-funded irrigation-specific researchers to Emerald, Moree and Nevertire in mid-February to showcase their research and technologies.

More than 200 growers and consultants attended field days across the three valleys, hosted at properties where irrigation research is taking place to meet the researchers and see the research and technologies in action.

New irrigation research is offering exciting options for growers to improve efficiency and yield through more precise scheduling and application technology. The researchers explained how their technology works and how it may be applied on individual grower's farms.

The tour showcased Dr Rose Brodrick's (CSIRO) scheduling with dynamic deficits; Dr Onoriode Coast's (CSIRO) canopy temperature sensor research; Dr John Hornbuckle's (CSIRO) IrrisAT weather based irrigation scheduling; Jenny Foley's (QLD DERM) EM38 soil moisture monitoring; Dr Alison McCarthy's (NCEA) VARIwise site-specific surface irrigation and fertigation using adaptive control; and smart automation in furrow irrigation with Dr Malcolm Gillies (NCEA), Dr Jasim Uddin (NCEA) and commercial providers David Robson and Peter Moller (Rubicon).

The tour was hosted by CottonInfo, with funding from CottonInfo partner CRDC, researchers and the research

organisations, and was designed to extend CRDC's irrigation research projects to growers. The Moree field day was co-hosted with the Gwydir Valley Irrigators Association (GVIA) and also looked at GVIA's optimised furrow row configuration research, CSIRO and CottonInfo's nitrogen loss pathways trials, and sap flow metres and stem psychrometers.

CRDC R&D Manager Jane Trindall said CRDC had gained valuable feedback on what growers think about current irrigation research and areas where they see gaps in scheduling and application information and technology.

"Taking researchers into the paddock to talk to the people who ultimately use their research is extremely valuable for both growers and researchers," Jane said.

"Growers get to interact directly with the researcher to understand more about the tools and technologies they're developing; and researchers get first hand feedback from the end users of their science. It's a win-win scenario.

"We've learned that 97 percent of attendees have an improved knowledge of the irrigation technologies and how they can be used on their farms as a result of the field days."

CottonInfo's Water Use Efficiency Technical Specialist for NSW, Janelle Montgomery – a researcher, extension officer and organiser of the 2015 Cotton Irrigation Technology Tour – agrees.

"CottonInfo's mandate is to connect growers with research," Janelle said.

"We're essentially the conduit of information, providing a two-way

street for researchers and growers to connect and to ensure research gets to where it is needed: on the ground.

"Our role is to provide an avenue for those involved in managing cotton crops to speak directly to researchers – to find out more about how their technology works, how best to apply it on farm and discussing what they see as potential barriers to adoption.

"This tour was a great example of this: taking CRDC-funded researchers out into the field, via a CottonInfo tour, to growers. And the feedback from growers has been really positive, with 60 percent of growers at the field days saying they would be likely to adopt the irrigation technologies on farm.

"As one cotton grower at the Moree field day said 'There's discovery in all research, we've just got to support it.'"

Growers interested in reading more about all of the technologies showcased at the field days can download the 2015 Cotton Irrigation Technology Tour booklet here: www.cottoninfo.com.au/publications/cotton-irrigation-technology-tour-booklet

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WHAT DID THE PARTICIPANTS THINK?

- 97 percent of participants said their knowledge of each irrigation technology and how it could be used on-farm had improved as a result of the field day.
- 81 percent would like to see more extension of the irrigation technologies in their region, generally preferring field days and farm trials as their preferred extension method.
- 61 percent of participants are likely to adopt the irrigation technologies on farm (on average across all six irrigation technologies featured).
- 95 percent of participants rated irrigation R&D as being important to their business.



RENEWABLE ENERGY SOURCES HOT TOPICS AT COTTONINFO BIG DAYS OUT

Ian and Anne Brimblecombe hosted the first day at their St George farm, “Burgorah”, while day two was on Scott Morgan’s property “Kensal Green” near Gunnedah in the Lower Namoi Valley.

CRDC R&D Manager Jane Trindall said bringing growers together on-farm to see how the innovative alternative energy infrastructure operates and to hear from the host growers and specialists contributed to the success of the days.

Held in February, the days attracted 140 participants keen to hear from experienced growers, energy researchers, auditors, consultants and system providers.

AgriRisk High Achiever of the Year and Narabri grower Brendon Warnock spoke at the days, sharing insights into strategic planning, human resource management and expansion.

“With fuel, oil and electricity costs now the third biggest input cost for cotton farms, there is growing demand for information on alternative and renewable energy sources,” Jane said.

“The CottonInfo Big Days Out allowed growers to tap into the experience of our two host farmers and specialists working in all aspects of the energy sector.

“Another primary focus was to increase attendees’ understanding of the value of on-farm energy assessments to increase energy use efficiency and reduce emissions.”

CottonInfo and its associated partners, CRDC, Cotton Australia and Cotton Seed Distributors (CSD), ran the events, with funding assistance from the Commonwealth Department of Industry and Science.

More information

www.cottoninfo.net.au
myBMP Energy and Efficiency Module
at www.mybmp.com.au



On-farm energy assessments can be arranged by contacting the CottonInfo regional development officers.

Go to www.cottoninfo.net.au for details and more tools for improving energy use efficiency.



The first of two Big Days Out was held at Ian Brimblecombe’s (second from left) St George property, where he shared his knowledge and experience about his move toward solar power.

THINKING OUTSIDE THE POWER BOX

ENERGY EXPENDITURE INCREASES OF AROUND 10 PER CENT PER YEAR COUPLED WITH CONCERNS ABOUT EMISSIONS PROMPTED IAN AND ANNE BRIMBLECOMBE TO INSTALL 400 SOLAR PANELS WHICH GENERATE 700 KILOWATT HOURS OF ELECTRICITY ON AN AVERAGE DAY.

Ian Brimblecombe believes solar “is the future” and has backed up his belief with the installation of impressive solar energy infrastructure on his farm “Burgorah” near St George in Queensland.

Ian and Anne purchased “Burgorah” 15 years ago and now irrigate 320 hectares of cotton.

The first solar arrays of 400, 250-watt solar panels were installed four years ago, and their electricity outlay is minimised whenever possible by taking advantage of discounted night and weekend tariffs to power three electric pumps.

The recent addition of 262 panels has enabled a 70 kilowatt fixed-speed pump to be powered by solar alone on sunny days.

“Prior to the installation of solar, energy costs were getting out of control and it got to the point where we had to go solar or convert back to diesel,” Ian said.

“The tariff I’m paying at the moment is 42 cents per kilowatt hour during the day, and I can make electricity for about eight cents with the solar, or 15 cents at night and weekends.

“A lot of the energy we produce goes back into the grid and I’m paid a feed-in tariff of 44 cents per kilowatt hour for it, so it certainly reduces our power bill, and allows us to reduce our contribution to climate change.

“Fifteen years ago solar wasn’t an option because it was so expensive, but the feed-in tariff encouraged us to invest in it because it was an area where we could gain some kind of control over rising input costs.

“While we have 100kW of capacity from the 400, 250-watt panels, we can’t use that

power on our 200 kilowatt motor as they’re in different locations.

“We can only use solar to offset the power used on the pump that it’s attached to, even though there’s a powerline between the two sites.”

The Brimblecombes still use three diesel pumps to supplement their three electric units, and are waiting for a drop in price of batteries to store solar-generated electricity on-farm before investing in replacement pumps.

“I think there’ll be more interest in solar from growers and all people in general as electricity gets more expensive and batteries get cheaper – from my research there’s a lot of potential for saving to be had in the very near future.

“As it stands now solar is the cheapest power I can buy during the day: and in five or 10 years’ time it will be the cheapest power - day or night.”

Ian has also explored the economics of floating solar panels to reduce evaporation from his storage while simultaneously generating power.

“The floating panels have the advantage of not only reducing evaporation, but they run cooler which increases efficiency by up to 15 percent,” he says.

“There is so much potential in solar power, and I’d really encourage other growers to look closely into it.

“I hope through days like the Big Day Out we can open people’s eyes up to these possibilities and provide an idea of what is involved in going solar.”



BROAD APPROACH TO REDUCING ENERGY COSTS

SCOTT MORGAN SAYS HIS REDUCTION IN NET ENERGY OUTLAYS HAS COME FROM PUMPING WATER MORE EFFICIENTLY AND THE SALE OF SOLAR POWER TO THE GRID.

Scott Morgan's "Kensal Green" at Gunnedah covers 730 hectares and relies predominantly on bore water to irrigate 300 hectares of cotton per year.

The road to improved energy use efficiency began five years ago.

"My reliance on bore water, which requires a lot of energy to lift, is what eventually motivated me to explore ways to save energy," he says.

Scott installed a travelling irrigator fed by a two-kilometre pipeline which has eliminated the need for two lift pumps; replaced a fixed-speed pump with a variable-speed unit on one of his two bores; and more recently installed a 9.6kW solar array of 160 panels.

"If there's one thing Gunnedah has in abundance, it's sunlight hours, and that's one reason why installing solar panels made economic sense," Scott said.

"I generate an average of 40 kilowatt hours per day of energy with 160 solar panels, and all that energy is exported at the feed-in tariff of 60 cents per kilowatt hour which has given us a good return on our investment.

"The solar panels have been installed next to the remaining lift pump so when the 60 cent tariff expires I can utilise the panels to offset energy

use directly on that pump."

The success of these projects also delivered further savings with regard to labour and repair and maintenance costs, largely associated with the elimination of the two lift pumps. It also co-benefits to the environment from reduced emissions.

He said growers who are considering installing solar photo-voltaic generation to reduce their pumping costs should aim to use as much of the generated solar energy as possible in order to make the project a viable option, as he "doubts it would provide a short payback period on the investment for irrigators that only used their pumps for three months of the year".

One of the challenges Scott faced with his energy-saving changes to his irrigation infrastructure was the complexity of the new variable-speed drive on the electric bore.

"If you are considering installing a variable-speed unit, you need to line up a competent local service agent before you make your purchase," he said.

"They are more complex than fixed-speed pumps and if you're a long way from a servicing point, downtime could be days which would be detrimental to a crop."

The variable-speed pump has allowed Scott to slow the operating speed when peak delivery is not required during the growing season, sav-



CRDC NRM R&D Manager Jane Trindall and Scott Morgan.

ing on energy costs. And while Scott is a qualified electrician, he said anyone can determine the peak efficiency of a variable-speed pump by reading the flow rate and input power displays.

"While the set-speed submersible ran at 2900rpm, the inverter on the variable-speed pump has meant I can run it at 2700rpm, which has reduced its power usage by 10 per cent.

"It's one of those areas where you could be wasting money on power and not

realising it."

Efficiency has been further improved with the addition of corrosion-resistant bronze turbines, fitted to the 75kW submersible electric motors which are attached to a high-strength flexible hose which can be easily lifted out for repairs.

Looking forward, Scott says without the ability to currently store solar energy cheaply, ideally he'd like to be able to use the energy he generates to pump water into storages to use as needed.

"Naturally any storage system would have to be geared for low evaporation to make that viable," he says.

"I'd also like to have the ability to share excess energy we generate within our local or regional area, for example councils, cotton gin or other farmers – whoever needs it locally."

POWERING UP FOR SOLAR

SOLAR POWER COULD SOON BE A LOT MORE ACCESSIBLE AS STORAGE TECHNOLOGY IMPROVES AND COSTS DECREASE.

According to a CSIRO report released last year, wholesale electricity price rises are set to more than triple over the next 15 years. The Australian Electricity Market Analysis report to 2020 and 2030, projected a rise in the region of around \$45 per megawatt hour (in 2015) to \$100-\$140/MWh by 2035 (from overall electricity demand growing by between 1.5 to two percent per annum).

Growers have already experienced significant electricity price rises. Since the year 2000 electricity costs, adjusted for annual use, have increased by approximately 350 percent, while cumulative inflation has only been in the order of 45 to 50 percent over that period.

With figures like this, it is no surprise cotton farmers are looking for renewable and plentiful energy sources like solar power alleviate these costs

While interest in solar power is high among

cotton growers, as was evident at the recent Big Days Out, according to CottonInfo Carbon and Climate Technical Specialist Jon Welsh, currently there is a major barrier to adoption – the cost of storage. Good news for growers however, is that experts are predicting this cost to dramatically decrease in the next five to 10 years.

"A new report by a leading investment bank predicts that energy storage will be technologically ready and cheap enough for large-scale use within the next five years, saying a 20 to 30 per cent yearly cost reduction is likely (for lithium-ion batteries), which could bring them at commercial/utility scale to the point of mass adoption potential before 2020," Jon says.

"The report said using conservative assumptions and no incentives, its model indicated that the incremental cost of storage will decrease from approximately 14 cents per kilowatt hour today to two cents per kilowatt hour within the next five years.

"According to the report, when overall system cost decreases are considered, we believe solar plus batteries will be a clear financial choice



Host Ian Brimblecombe, St George grower Cleave Rogan and CottonInfo Carbon and Climate Specialist Jon Welsh.

in mature solar markets in the future," Jon said.

"While growers like Big Day Out hosts Scott Morgan and Ian Brimblecombe have made inroads into what can be achieved with current solar technology, they both agree that like storing water, we need to store renewable energy and utilise it at times of peak demand.

"Affordable battery storage technology would give irrigators flexibility to manage energy, save costs and do our bit for the environment.

"The Big Days Out showed us that growers are very keen to find out how to incorporate solar energy on their farms and offset the cost of energy."



myBMP MANAGER LOOKS TO THE FUTURE

Rick Kowitz is the newly appointed *myBMP* Manager and brings with him extensive experience in the development and implementation of best management practices and sustainable agriculture programs.

Having just finished developing Fert\$mart, a new program for the Australian dairy industry to assist producers with fertiliser and nutrient management, Rick is no stranger to utilising on-line technology for practical outcomes.

Rick has a strong interest in natural resource management and was previously the Queensland State Landcare Co-ordinator responsible for managing the state's National Landcare Program and supporting sustainable agriculture projects across Queensland and the Torres Strait.

Observing how management practices have evolved in the Australian cotton industry since BMP was introduced during the late 1990s, Rick became interested in working in this progressive industry.

"*myBMP* has strong relevance now to product quality, market access and profitability" Rick says.

"The program has much to offer cotton growers. It contains vital information and resources to improve farm practices and provides assistance to meet legislative requirements.

Rick is encouraging growers to contact him



Interested in having a look? It's easy, simply register on-line at www.mybmp.com.au or ask your Cotton Australia Regional Manager or CottonInfo Regional Development Officer for assistance. Registration provides full access to the information and resources, and you can see what is required to become *myBMP* certified.

directly to provide feedback on how *myBMP* can better meet their needs into the future.

More information

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NEW FACE FOR COTTONINFO IN UPPER NAMOI

Bringing growers together to extend the latest research or discuss the adoption of new methods and technologies is a specialty for the new AgVance network development officer (and CottonInfo regional development officer) Katie Slade.

The role is a partnership between CottonInfo and AgVance in the Upper Namoi.

Growing up on her family's cropping farm on the Liverpool Plains, Katie began working in the cotton industry as co-ordinator of the agronomy team for Pursehouse Rural in Quirindi.

In February, Katie moved to the development officer role with AgVance and CottonInfo, where she is responsible for co-ordinating the sharing of resources and knowledge from growers in the two partnering groups in the region, the Upper Namoi Cotton Growers Association (UNCGA) and AgVance Farming.

"I will also be ensuring information transfer between these groups and the CottonInfo team, research organisations and government bodies," Katie said.

CottonInfo Program Manager, Warwick Waters, says the partnership between AgVance, UNCGA and CottonInfo provides a great opportunity for one dedicated person to be providing a farming systems support role for local growers.

"The role covers both cotton and grains and the partnership gives Katie access to all of the resources and technical specialist support of CottonInfo," Warwick said.

"This is an area with dynamic growers who employ varying crop rotations and have the ability to relatively easily alter these to encompass both dryland and irrigated cotton," Katie said.

"My aim is to support the newer cotton growers, while also supporting the more experienced growers in the unique challenges that the short season nature of the Upper Namoi creates for them."

More information

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WHICH RESEARCH TO SUPPORT?

In any given year, CRDC invests in up to 200 cotton research and development projects on behalf of cotton growers and the Australian Government. But how do they decide which projects to fund? CRDC's general manager of R&D, Ian Taylor, explains.

CRDC's investment in cotton R&D happens on a rolling cycle, so while we have 200 projects underway at any given time, they start and finish at different times.

Generally each year CRDC has funding for up to 50 new projects, but, under the current procurement process, we can receive as many as 120 preliminary research proposals.

Determining which to fund involves the input of growers through the Cotton Australia grower advisory panels, and the CRDC R&D Managers. Researchers who submit successful preliminary proposals are then asked to submit full research proposals, which then go back to the panels and the R&D Managers for review, with recommendations made to the CRDC Board (who make the final determination) on which projects to fund.

The process is conducted a year in advance, with the final decision on projects made by the CRDC Board each February. So, those projects deemed successful now will commence in 2015-16.

But the process is about to change. For the 2016-17 financial year, researchers will no lon-

ger be asked to submit a preliminary research proposal that broadly fits under one of the five key programs of the CRDC R&D Strategic Plan.

Instead, CRDC, Cotton Australia and the grower panels will be reviewing progress against the Strategic Plan before the process starts: determining where we're up to with implementing the Plan, and setting clear direction for researchers on exactly what research is needed and where the gaps are. Guidelines on specific research issues will be provided to researchers as a result of this review, and they will be asked to submit full research proposals in response.

This simple change will streamline the process, making it more efficient and more focused on the specific outcomes the industry needs. This benefits everyone – growers will get to provide input and advice up front via the grower panels; and researchers will be able to focus their efforts on writing a proposal that clearly meets the identified R&D priorities for the industry.

This new process will commence in May 2015 for projects funded from the 2016-17 financial year. We'll be bringing you more as the process gets underway.

Contact CRDC 02 6792 4088 for more information.



WORKING WITH THE WEATHER IN CENTRAL QUEENSLAND



PAUL GRUNDY

COTTON PLANTED AT EMERALD IN CENTRAL QUEENSLAND SIX WEEKS AHEAD OF THE SEPTEMBER WINDOW OPENING HAS PERFORMED WELL, AVOIDING MONSOONAL RAIN AND WITH YIELDS AROUND 10 BALES PER HECTARE.

The variable and sometimes extreme climatic conditions experienced in January and February in Central Queensland can cause lint yield and quality losses. CRDC-funded researchers are experimenting with tactics that may enable earlier flowering in spring, potentially bringing forward the time at which crops mature thus avoiding boll-fill during these variable conditions.

Part of the trial was planted with the use of degradable plastic film, to determine how well films can overcome the effects of cool nights that could otherwise hamper seedling vigour and growth. The oxo-degradable and carbon-based biodegradable films are being tested as part of the research in an effort to manage impacts from cold soil temperatures and frosts that may be a problem in some years during August. At each planting date, cotton was planted both uncovered and covered by slotted degradable films.

The cotton was planted at four separate times between early August and mid-September. Plots were full field

length and eight rows wide to allow for commercial picking and ginning of the treatments like any other commercially grown crop. Currently Bollgard II growers in Central Queensland have a six-week planting window (September 15 – October 31) and as such are unable to take advantage of an early sowing date.

This is the second season of trials being conducted as part of a CRDC funded collaborative research project led by DAF's (QLD) Paul Grundy, with Gail Spargo and Ngaire Roughley, CSIRO's Steve Yeates, and Jamie Iker from Spackman and Iker Ag Consulting. The experiments have been generously hosted at "Orana" by Carlo Strangherlin and Dougal Millar of Cowral Ag, Emerald.

Researchers are pleased with how the early planted trial plots have performed this season, with the crops finished and pickers out of the paddock by mid-January, avoiding much of the threat of poorer weather due to monsoonal influences during mid to late summer.

Early indications positive

"We have only just completed picking but early indications from the unginmed module weights are that the August sown treatments have performed very well," says project manager Paul Grundy.

"For a change this season's weather in terms of radiation and temperature has been similar to the long term mean without the more extreme cloudy monsoon bursts or humid heatwaves that have been prominent during recent seasons.

"Under this scenario we are not expecting to see the major differences between treatments compared to the 2013-14 experiment where a post-Christmas humid heatwave curtailed boll size and retention in the later



PAUL GRUNDY

sown plots which left the August-sown treatments mostly maturing well ahead.

"Interestingly temperatures during August reflected the long term average with only four days with overnight temperatures above 12°C.

"Despite the daily minimum temperatures the August-sown cotton established and developed well both with and without film.

"This underscores the limitations of just looking at the usual historical measures of minimum and maximum temperatures. A cool night is typically followed by a warm sunny day in Central Queensland with minimum temperatures lasting a matter of hours.

"This is a very different proposition to the same overnight minimum temperature further south where the day warms more slowly, peaking around midday, before cooling off rapidly as nightfall approaches."

Using film for establishment

There has been a lot of interest in the performance of crops planted with degradable films used in these experiments however Paul says it is really just a means to an end.

MAIN IMAGE: The trial plots were planted at four separate times between early August and mid-September, with early planted crops ready for picking on January 16.

ABOVE: Crop samples are taken and measured for dry matter production, retention, leaf area and partitioning.



“The whole emphasis in all of this has been to fill bolls earlier during spring and then get the crop off as quickly as possible in January before summer gives way to a more variable period of radiation, rainfall and temperature”.

“We decided to use film as we wanted to find a way to warm the soil up to more reliably establish a crop in August.

“Ironically two years in a row we have established a crop really well, even without film, however we have not had a cooler than average August yet to measure how the film might assist with crop survival under colder or frosty conditions and therefore it is too soon to speculate on the ultimate viability of film application.

“We hope that over the next few years we will capture a broader cross-section of seasonal variability,” he says.

All about the ‘odds’

The development of a data set of actual crop responses to a range of seasons will enable the researchers to better model likely crop performance against the 80-year historical climate record for Emerald. They will then be able to make robust projections on likely crop performance and risk profiles associated with different cotton production strategies.

“It is all about the odds” says Paul.

“We are developing data that will enable a grower to contrast the yield potential, variability and likelihood of discounts that might be associated with an earlier maturing crop with crops of later maturity or the risk of replanting in some seasons due to conditions that are too cold for effective August crop establishment.

“How films will feature within this range of scenarios is uncertain at this stage but we are gathering valuable crop performance data associated with late winter sowing with and without films.”

Already the researchers have found that during the last two seasons, the August sowings result in a plant that has high retention and is much more compact than the typical CQ crop. If this pattern continues across a broader spectrum of seasons, scope exists to make changes to other parts of the production system that might increase the yield potential of early-sown crops.

“For example narrower row spacing might be advantageous with a more



PAUL GRUNDY

Researchers are pleased with how the early planted trial plots performed this season, with the crops finished and pickers out of the paddock by mid-January, avoiding much of the threat of poorer weather due to monsoonal influences.

compact cotton plant and could also suit rotation crops such as mungbeans which become a distinct cropping possibility in a farming system with early maturing cotton,” Paul said.

“With the release of Bollgard 3 varieties, growers will have greater planting window flexibility and be able to take advantage of sowing earlier.

“Clearly there is some distance to go before the merits or otherwise of August sown cotton are fully understood but there are some interesting systems questions that arise from having earlier maturing cotton crops.

“Even for traditional back-to-back cotton production with earlier fallowing during February and March, benefits from higher rainfall that facilitates stubble breakdown, germination and control of volunteer cotton”.

Avoiding downfall of a wet finish

The research project was established following a benchmarking study in 2012 of 25 crops in Central Queensland (CQ Cotton Survey 2012, Central Highlands Cotton Growers & Irrigators Association – CHCG&IA) that found crop yields tend to be extremely variable both within farms and across the region. It was also found that quality discounts for the region have been gradually increasing and in 2011-12 averaged over \$40 per bale. A comparison of seasonal yield and quality results with climate data revealed a very strong correlation between poor yields and quality with significant weather events in January and February.

“Historical climate data shows that spring and early summer has an optimal temperature, rainfall and radiation profile that is much less variable. On average, October through until December are very favourable months for photosynthesis and therefore flowering and boll production, compared

to January and February.

“If cotton crops are trying to set fruit and fill bolls in January, climate records indicate that they are more likely to have yield potential affected by weather events such as extreme heat and humidity, heavy or prolonged periods of rain causing water logging, and reduced radiation from cloud cover.”

This point was emphasised at the project’s field day on January 19 this year.

“Our early planted crops had been ready for picking since January 16 but we had held off on picking to show the crops to the field day participants,” says Paul.

“The forecast was for 200mm of rain later that week due to an embedded low pressure system in a monsoonal trough line which had a number of growers wishing they had crops were also reading for picking ahead of imminent bad weather.

“In the end the area only received around 50mm with the larger falls occurring further east.

“And just four weeks later Cyclone Marcia crossed the Capricorn Coast just as commercial picking in the region was getting properly underway.

“Again the region was spared any major effects of this event as it tracked close to the coast but provided another stark example of the risks associated with monsoonal influences that are active at that time of year in this region.

“If the early predictions for the track this cyclone had eventuated, it could have severely impacted the region’s cotton.

“These types of events are exactly what we are working to avoid.”

More information

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THE CROPS WERE FINISHED AND PICKERS OUT OF THE PADDOCK BY MID-JANUARY



SMART SEED FINGERS INCREASE GROWERS' GIN TURN-OUT

DEVELOPMENT OF A NEW GINNING SEED FINGER MECHANISM COULD INCREASE THE AVERAGE AUSTRALIAN COTTON GROWER'S TURN-OUT BY AN EXTRA 120 BALES.

Testing has shown that a new seed finger mechanism developed by CSIRO with support from CRDC has the capacity to add an extra 0.8 percent turn-out. This translates to an extra 120 bales for the average grower (based on an average 10 bales/ha for 600 ha) and also means more cotton for the ginner to process.

During ginning it is important that as much lint is removed from the seed as possible so the grower receives the highest yield or turn-out from their crop. Turn-out is the percent lint yield per weight from a grower's modules.

Achieving a high turn-out is dependent on many operating factors in the gin and the condition of the harvested seed-cotton. The seed fingers, a hinged shaft that extends across the gin with a set of steel fingers or shallow ledge protruding from the shaft into the roll box, is of all the mechanical elements in the gin, one of the most important controls affecting gin turn-out.

"If the seed fingers are set too widely then partly ginned seed will fall from the seed roll and the fibre still attached will be wasted," says CSIRO Manufacturing Flagship's Senior Research Scientist, Dr Andrew Krajewski.

"If the seed fingers are set too tightly then they will infringe upon the rotation of the seed roll, increase the load on the gin motor and reduce ginning efficiency."

The patented new seed finger mechanism has the array of seed fingers partitioned into three sections which can self-adjust during ginning in response to the pressure of the seed fingers on the rotating seed roll.

"Previous research by CSIRO had shown the density of the seed roll changes constantly across the gin stand and that the ends of the seed roll were less dense than the middle," Andrew said.

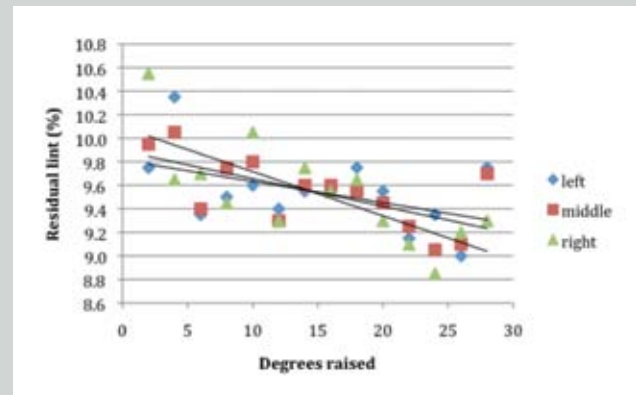
"IT IS IMPORTANT THAT AS MUCH LINT IS REMOVED FROM THE SEED AS POSSIBLE SO THE GROWER RECEIVES THE HIGHEST YIELD OR TURN-OUT"

CHANGE IN RESIDUAL LINT VALUES WITH INCREASED SEED FINGER ANGLE

The effect of seed-finger angle on residual lint during trials in a commercial gin in 2014 can be seen in this graph. The zero-degree setting represents a relatively open gap between the seed fingers and seed roll. Higher residual lint values are expected when the seed fingers are in this position (showing 10 percent in the graph). Increasing the angle to 30 degrees setting means the seed fingers apply greater pressure on the seed roll.

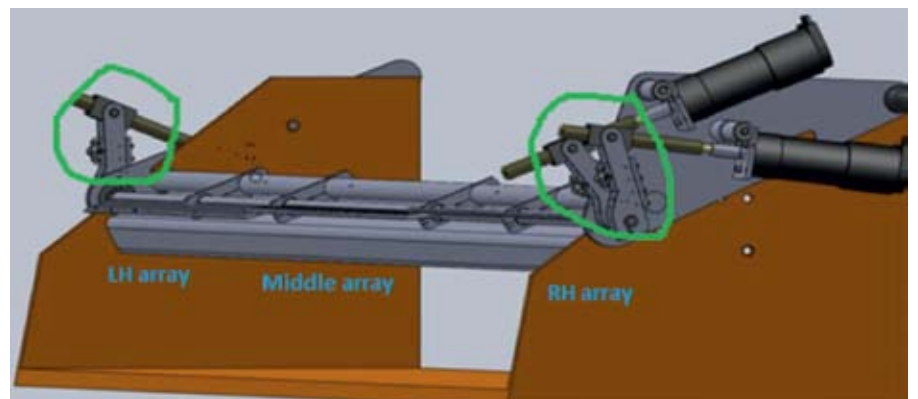
The increase in pressure and seed-roll density reduced residual lint content (to 9.2 percent); increased seed-roll density has also shown to increase fibre staple length.

Based on a 10 bale/ha average yield, the seed fingers will deliver an extra 120 kg lint/module or an extra 0.2 bale/ha, which translates as an extra 120 bales for the average grower (600 ha).



Change in residual lint values with increased seed finger angle.

Figure 1. Seed finger partitions and their connection to actuators (circled in green) that control their angle of orientation to the seed roll (not shown).



"Yet while seed roll density changes significantly many times over a short period as seed cotton is charged and seed discharged from the seed-roll the seed fingers are typically fixed in the same position for the whole season.

"The research showed that a high but not too high seed roll loading produced lower residual lint on the seed (higher turn-out) and longer fibre length, while low seed roll loadings meant more residual lint (lower turn-out) and shorter fibre length."

The seed-finger mechanism combines seed fingers partitioned along a rotating shaft with electrically controlled actuators that are able to adjust the angular position of each partition separately in correspondence to the load exerted by the seed-roll on this partition (See Figure 1).

The mechanism and its control overcomes current limitations of ginners not being able to adjust the seed fingers during ginning in response to production objectives and the mechanism itself being able to self-set the seed fingers to a calibrated pressure point that automatically optimises both grower and ginner returns.

More information

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Cottonspec partner mills have shown substantial savings in their raw material and operating costs using Cottonspec – in one case AU\$1million, by replacing more expensive Pima cotton with Australian cotton that was able to be used to spin fine count yarns.

AUSTRALIAN TECHNOLOGY MAKES CHOOSING THE RIGHT MIX EASIER FOR COTTON MILLS

CHOOSING THE RIGHT MIX OF COTTON IN A SPINNING MILL'S LAY-DOWN IS OF GREAT ECONOMIC IMPORTANCE TO SPINNERS, AND WITH TECHNOLOGY FROM CSIRO, THESE CHOICES ARE MADE EASIER.



Dr Shouren Yang

Choosing the right mix of cotton in a spinning mill's lay-down allows the most cost-effective raw material price to be achieved while meeting the needs of the mill's customers. To help spinners using Australian cotton achieve this goal, CSIRO developed Cottonspec - a cotton fibre and yarn quality management software package which predicts the quality of yarn a mill can expect to spin from a particular quality cotton.

Developed in conjunction with CRDC, DAFF and the Cotton CRC, Cottonspec gives both the Australian and world cotton industry a valuable tool with which mills can use to deliver high quality yarn.

"The type of support that Cottonspec gives to spinners and merchants alike is important in supporting cotton as a viable fibre in textile manufacture," says CRDC R&D Manager Allan Williams.

"Man-made fibre production has increased at the expense of natural fibres (cotton, wool, silk and baste

fibres) in both textile and industrial markets, so in order for cotton to remain viable it will need to embrace tools such as Cottonspec.

"Moreover, providing such tools to mills allows for Australian merchants and cotton growers to receive first-hand feedback about the fibre mills require and the opportunity to respond to market signals on fibre quality."

The feedback from mills using Cottonspec has been extremely positive.

CSIRO Manufacturing Flagship's Senior Principal Research Scientist Dr Shouren Yang said Cottonspec partner mills have showed substantial savings in their raw material and operating costs using Cottonspec.

One particular mill used Cottonspec's high prediction accuracy to choose the most suitable cotton to minimise their material costs. The mill, which operates 250,000 ring spindles, saved in the order of one million Australian dollars in raw material costs during 2012 using Cottonspec to determine the best priced growths in terms of micronaire, length and strength properties. These savings were made by replacing more expensive Pima cotton with Australian cotton that was able to be used to spin fine count yarns.

"Cottonspec allowed the mill to select fibre properties based on a trade-off system in which the premium quality of some growths was traded (substi-

WHAT IS YARN COUNT?

Yarn count is the term used to describe a yarn's fineness or linear density. Count is often described in terms of English cotton count, notated Ne, which measures the number of 840 yard wraps of a cotton yarn in a pound of cotton. The higher this number the finer (or lighter) is the yarn. The metric unit for count is tex, which is the number of grams of yarn per km of yarn (g/km), so the lower this number, the finer the yarn.

tuted) for other less costly growths that retained the fibre properties of value," Shouren said.

"Cottonspec also enabled spinners to reduce raw material costs by reducing operator dependency on experience in interpreting trial test results and lifting product development efficiency, (the timeline between conducting yarn trials and establishing production)."

Cottonspec utilises a very large database of industrial spinning results from high quality mills and theoretical yarn structure models to achieve high prediction ability.

"Fibre quality is measured using high volume instrument (HVI) lines, the data of which is widely used to class cotton for trade," Shouren says.



Cottonspec has uses for merchants and spinners alike: as it can be used to select the most suitable cotton that best meets the needs of spinners and textile manufacturers.

“Sixty percent of the world’s cotton is classed by HVI, and Cottonspec is particularly good at predicting the quality of fine count yarns, that is those that are Ne 50 and finer”.

Cottonspec can be used by merchants and spinners alike: it can be used to select the most suitable cotton that best meets the needs of spinners and textile manufacturers respectively. It can also be used by spinners as a quality control tool to benchmark their yarn quality against “best commercial practice”.

Shouren said CSIRO has used fibre and yarn results from one of China’s premier mills in Cottonspec’s database to provide a benchmark for excellence in spinning performance and yarn quality.

“As a tool for cotton merchants Cottonspec can be used to demonstrate and promote the value of a particular growth or variety in terms of its potential yarn quality and cotton breeders can similarly use it to assess the technical merits of new cotton varieties.

“Cottonspec’s models reflect the collective behaviour of various cotton fibre properties in the yarn structure and the dependence of these properties on the spinning method, yarn count and twist.

“Without a viable and robust spinning prediction model it is difficult to determine the relative importance of fibre properties on yarn quality on a scientific basis.”

Over the past two years Cottonspec

has undergone extensive upgrading to its database and models and as a result validation results confirm Cottonspec’s prediction models now works very well over a wide range of fibre and yarn qualities.

Defining and quantifying yarn quality

Utilising Cottonspec, the relative importance of HVI fibre properties on yarn quality can be clearly defined and quantified. For example in terms of trade-offs that can be made between fibre properties in order to maintain a particular yarn quality. Examples of trade-offs between cotton fibre properties are shown in Table 1.

As seen in Table 1 the trade-off between fibre fineness and fibre length for their effect on yarn evenness is that for every 0.1 increase in Micronaire an increase in fibre length of 1.3 mm (UHML) is required to achieve the same yarn evenness.

In other words, a coarser fibre can be compensated by having a longer fibre length for their effect on yarn evenness. For example, yarns spun from the two cottons with the differing characteristics indicated in Example 1 would have the same yarn evenness, if all other fibre properties were equal.

The trade-off between fibre tenacity and fibre length is that an increase of 1 cN/tex in fibre tenacity is equivalent to an increase of 1.7 mm in mean fibre length.

“In other words, a weak fibre can

The right mix for bale lay-down

Dr Shouren Yang says given the complexities of the cotton supply chain and the huge variations in cotton fibre quality on the market, it is not an easy task to choose the right mix of cotton for a bale lay-down. Accomplishing this task has traditionally required extensive knowledge and many years’ experience. To ensure a new yarn’s quality meets the customer’s specifications, pre-production spinning trials are typically required and this practice is expensive in terms of time, materials and labour costs. Cottonspec can help spinners accomplish this task with confidence, and allows spinners to choose cotton with the most suitable combination of micronaire, mean fibre length and fibre tenacity to achieve the desired yarn quality.

be compensated by having a longer fibre length as far as their effect on yarn tenacity is concerned,” Shouren said.

“For example, from Table 1 the two cottons shown Example 3 would have the same yarn tenacity, if all other fibre properties were equal.

“Note the trade-offs shown in Table 1 are applicable only to ring spun fine count yarns in the range of Ne 50 to Ne 100. For different yarn count range or other spinning methods the trade-off may be different. Nevertheless, the principle is the same.”

More information

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Yarn property	Trade-off		Example
Evenness	Example 1	0.1 Mic ~ 1.3 mm L	For every 0.1 increase in mic, an increase in length of 1.3 mm is required to maintain yarn evenness Mic =4.0 & L=30 mm ~ Mic =4.1 & L=31.3 mm
	Example 2	3% SFC ~ -0.1 Mic	For every 3% increase in SFC, a decrease of 0.1 in mic is required to maintain yarn evenness 15% SFC & Mic=4.1 ~ 12% SFC & Mic=4.2
Tenacity	Example 3	1 cN/tex ~ 1.7 mm L	For every 1.7 mm decrease in length, a 1cN/tex increase in strength is required to maintain yarn tenacity 30 cN/tex & L=31.7 mm ~ 31 cN/tex & L=30 mm
	Example 4	1 cN/tex ~ - 0.2 Mic	For every 0.2 increase in mic, a 1cN/tex increase in strength is required to maintain yarn tenacity 30 cN/tex & Mic=4.0 ~ 31 cN/tex & Mic=4.2
	Example 5	1 mm L ~ - 0.1 Mic	For every 0.1 increase in mic, a 1 mm increase in length is required to maintain yarn tenacity L=30 mm & Mic=4.0 ~ L=31 mm & Mic=4.1

Table 1. The trade-off between fibre properties for their effect on yarn properties.



HEADSTART FOR GINNERS

GINNING SCHOOLS FOR NEWCOMERS TO THE GAME ARE PROVING A VALUABLE TOOL FOR SUPPLYING THE INDUSTRY WITH A BETTER SKILLED AND COMPETENT WORKFORCE.

For more than a decade now prospective ginner have had to learn on the job from experienced ginner while working their way up through the ranks. However this trend is changing with the ginning training schools supported by CRDC, CSIRO and the Australian Cotton Ginners Association, which are receiving praise from head ginner and the trainees themselves.

The first school was held in 2013 as the industry kicked back into near-full production after a prolonged drought which resulted in many experienced gin staff leaving the industry. It also aimed to upskill those who had remained.

This year the schools were open to prospective ginner in the industry. The five-day courses in November at Moree and Narrabri trained 58 participants. The course was comprehensive, with 29 modules, which not only covered all important aspects of ginning (air systems; moisture and moisture restoration; drying; hydraulics; maintenance and settings), it also provided some general information about crop management, physiology, marketing and quality.

Brighann Ginning is a privately-run gin situated west of Moree in the Gwydir Valley which gins its own cotton grown on neighbouring properties, and in some years gins for other growers.

Mick Seery says their main aim at Brighann is to turn out a quality, consistent product for both growers and mills. This gives their customers surety of supply and Brighann has had staff attend both courses now.

“Having a core group of knowledgeable gin staff is part of this aim and it is important they have an affinity with what we aim to produce and the need to have control over your product,” Mick said.

“You also need staff with a good knowledge of a gin to run it cost-effectively. For example, if they can see a problem before it becomes one it keeps costs down.”



Brighann’s Mick Seery, ginner Terry Dunn, trainee ginner Luke Shepherd and head ginner Damian Tonkin. Terry Dunn has been at Brighann for three years and had good words to say about the course experience. “The information helps us in a practical way because we understand all the factors at play in a gin, how they affect the end product and why we need to maintain a good product at the end. “It also gives a better understanding of how the effects of how cotton is grown ties in with what we do. “I’d really recommend this course as it puts you ahead of the game and really helpful if you’re looking for a future in the industry.” Luke Shepherd is a trainee ginner and says the research angle of the course showed how the scientific information comes into practice in the gin and gave him a more in-depth and overall understanding of the ginning process. Both Terry and Luke agree they are now more aware of the effects the processes have on the end product and the importance of managing them to maintaining consistency and avoid any issues such as contamination.

Brighann’s head ginner Damian Tonkin has been in the industry since 1987, starting off as a casual gin hand and progressing upwards from there, learning while on the job. Overall he’s had about 24 years in the game and has seen the industry struggle to find and maintain experienced staff.

“Over the last seven or eight years particularly it has been a struggle to get experienced people,” Damian said, “We have even had trouble getting good seasonal workers over that time.

“Most of our training is on the job, hands on, but then we can’t be sure we comprehensively cover all aspects of the job.

“This is where the ginning school is most beneficial to our training, as the school covers most things to an extent.

“The training gives the ginner a bit more experience and it shows them that we care and we are willing to spend the money to put them through these courses so they have the ability and the confidence in doing the job.”

Textile Technologist and Advanced Fibre Innovation Project leader René van der Sluijs at CSIRO Manufacturing Flagship oversees the course and says feedback from participants rated the schools highly.

“We are really pleased with what we are hearing from head ginner and gin managers about the skills we are giving their less experienced staff,” René said.

“We continually update information to reflect changing gin technology and best practice. We hope to add fibre physiology and agronomy; and BMP to the course, and bring more experts to cover specific topics.”

More information

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MELANIE JENSON

SCIENCE IS SECURING COTTON'S FUTURE

AUSTRALIAN AND INTERNATIONAL COTTON INDUSTRY RESEARCHERS AND THE EXTENSION COMMUNITY WILL COME TOGETHER IN SEPTEMBER TO PRESENT AND DISCUSS CONCEPTS, KEY ISSUES AND LATEST FINDINGS.

The Australian Association of Cotton Scientists' Science Securing Cotton's Future biennial conference will showcase current cotton industry science and research to secure the industry's vibrant and sustainable future.

The conference will cover all aspects of cotton research from breeding through to developments in agricultural engineering and, in particular, provide a platform for postgraduate students to network with Australia's R&D community and present their research findings.

It will be the second research conference held by the Australian Association of Cotton Scientists and will be hosted by the University of Southern Queensland's Institute for Agriculture and the Environment at the Toowoomba campus from September 8 to 10.

DAF QLD Senior Research Scientist Dr Paul Grundy is involved with organising the conference and says they expect to also attract international delegates working in areas ranging from plant breeding and physiology to agricultural robotics and pest management who are keen to present ideas as well as see the best that Australia's cotton research community has to offer.

"The first conference in Narrabri attracted nearly 170 delegates and was an excellent forum that very much filled a gap left by the completion of

the Cotton CRC by enabling a forum for the presentation and consideration of science conducted across the Australian cotton industry," Paul said.

As a founding sponsor CRDC are again supporting the event in 2015.

"CRDC is very keen to support this event to help create an environment where the industry's researchers can come together to share and discuss their scientific endeavours, methods and results," says CRDC R&D General Manager Ian Taylor.

"Research has underpinned the development of the cotton industry and its importance in helping the industry shape its future cannot be understated.

"We believe this forum enables participants to share their findings and contemplate future directions in a rigorous and structured way."

The three-day conference will include a daily plenary lecture from a renowned speaker as well as research talks with a wide range of themes throughout the program.

More information

Registrations open in March 2015. Researchers are invited to submit an abstract for presentation at the event. Details available at www.cottonresearch.org or contact paul.grundy@daf.qld.gov.au

GET NOMINATING NOW FOR THE 2015 AUSTRALIAN COTTON INDUSTRY AWARDS

THE 12TH AUSTRALIAN COTTON INDUSTRY AWARDS WILL RECOGNISE EXCELLENCE AND HIGH ACHIEVEMENT IN AUSTRALIA'S COTTON INDUSTRY THROUGHOUT THE SUPPLY CHAIN: FROM GROWERS AND GINNERS TO PRODUCT SUPPLIERS, CONSULTANTS, AGRONOMISTS, RESEARCHERS AND EXTENSION.

Cotton Australia CEO Adam Kay says the Awards recognise those individuals who have made an important contribution to the industry, and stressed that the Awards are not designed to decide 'who's 'best'.

"The cotton industry is one of the most innovative agricultural sectors in Australia, and the annual Awards program is the best way for us to shine a light on those leading the way," Adam said.

"I encourage everyone in Australia's cotton industry to consider nominating those who deserve recognition - it's a fantastic way to celebrate the industry's achievements and share the great work and commitment of people throughout the cotton supply chain."

The 2015 Australian Cotton Industry Awards has five categories:

- Monsanto Grower of the Year
- AgriRisk High Achiever of the Year
- Chris Lehmann Trust Young Achiever of the Year, sponsored by Bayer CropScience
- Cotton Seed Distributors Researcher of the Year
- Incitec Pivot Fertilisers Service to Industry Award

Winners will be announced at the Awards Dinner on August 5 2015, as part of the Cotton Collective held at Narrabri, NSW. Cash prizes are on offer for the recipients, with a travel and education bursary for the Young Achiever of the Year and research bursary to the Researcher of the Year.

The Cotton Awards Dinner also has a great reputation as a fantastic night of networking and socialising, as well as paying tribute to our Award recipients, and has been sold out for the past two years running.

Individuals can nominate others or themselves, and are encouraged to use the on-line nomination form at:

www.australiancottonawards.com

Entries close March 31, 2015.





THE IMPORTANCE OF KNOWING:

SEVERE CASES OF BOTH FUSARIUM AND VERTICILLIUM WILT HAVE BEEN FOUND IN THE SAME PADDOCK THIS SEASON: CAN YOU TELL THE DIFFERENCE?

Industry pathologists say this season has been different in terms of the location and severity of both Fusarium and Verticillium wilt.

While Verticillium wilt favours cooler weather and is rarely observed in Queensland, DAF QLD pathologists recently visited cotton fields in St George and Darling Downs regions as part of this season's annual disease survey, where they detected wilting plants due to suspected infection with *Verticillium dahliae*, the causal agent of Verticillium wilt.

DAF QLD Pathologist Dr Linda Smith said the disease has not been observed in these regions since 2008-2009 when an incidence of 0.1 and 0.3 percent respectively was confirmed through the surveys. A significant level of severe Verticillium wilt has also been detected this season in the Macintyre Valley.

"In one field a 'good acre' of severely diseased plants was observed in one patch with scattered diseased plants in smaller patches throughout the field," Linda said.

"Another field thought to only be infected by *Verticillium dahliae*, and following testing was actually determined to also have Fusarium wilt – the first recorded case in that area."

The presence of both pathogens has led pathologists to warn crop managers to be mindful that misidentification can and does occur, and crops may harbor both diseases.

Meanwhile testing of numerous diseased stems received by DAF pathologists from consultants near Moree, who were concerned about the level of Verticillium wilt being observed,



IMAGES LINDA SMITH

ABOVE: Extensive Verticillium wilt infection observed by DAF QLD pathologists this season.

RIGHT: Fusarium wilt.



confirmed fields infected with only Verticillium as well as several fields with both wilt pathogens.

"Knowing where Fusarium and Verticillium wilts occur, field by field, is essential," Linda said.

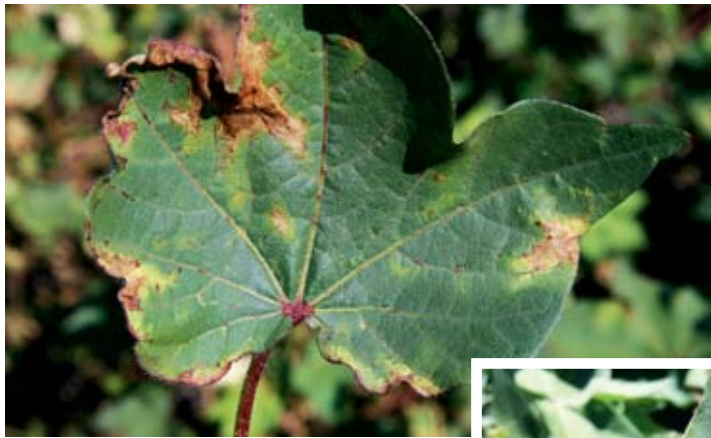
"Disease identification must be confirmed through laboratory testing as visual identification in the field can be difficult as symptoms can appear very similar.

"It is especially important in regions that can get both types of wilt to con-

firm which type is present so that the variety best suited to reduce disease is selected, and other management strategies such as stubble management are



WHICH WILT



LEFT: Verticillium wilt symptoms on leaf. Leaf mottle with yellowing between the veins, followed by death of leaf tissue starting at the leaf edge.

correctly implemented as this differs for the two diseases.”

Linda says even if a grower/crop manager has previously had a particular wilt pathogen diagnosed in a field, if symptoms look different or the disease is worsening, check (through laboratory testing) which wilt pathogen is present.

“It may be that a field that previously had Fusarium also has Verticillium, which will not be managed if the high F-ranked 75BRF variety is being grown as it has a V rank of only 68,” Linda said.

Recently DAF QLD pathologists determined that there is more than one strain of *Verticillium dahliae* affecting Australian cotton. The pathologists are currently working to identify the wilt



pathogen and also determine the strain of the pathogen to get a better understanding of any influence of strain on virulence.

ABOVE: Fusarium wilt symptoms on leaf. Plant death, wilting, yellowing and defoliated plants are typical of disease symptoms.



Verticillium wilt symptoms in stem. Brown discoloration in the woody tissue appearing as peppery-looking spots in stem cuts.



Fusarium wilt symptoms in stem. The vascular tissue of affected plants exhibits a brown/chocolate discoloration through the entire main stem, continuous browning rather than flecking.



Stuart Doyle

Crop Consultants Australia (CCA) is urging consultants who see plants exhibiting wilt symptoms to have plants tested to determine which wilt is present, as purely visual identification is not a reliable method in many cases.

CCA Vice-Chair Stuart Doyle says the spread and severity of verticillium wilt is concerning for the industry and has the capacity to severely impact production over large areas.

“Feedback from CCA members suggests we need to urge all consultants to have affected plants tested as we are hearing of many cases where symptoms are being assumed to be from Fusarium, but testing has showed otherwise,” Stuart said.

“This is probably due to the fact that the Verticillium damage is so severe in some cases it could be assumed to be Fusarium.

“Being that the management of these two wilts is different, particularly at this time of year in regard to stubble management; and for next season in terms of variety choice - it’s vital we all know exactly what we are dealing with before we make seed choices.”

SENDING A PLANT SAMPLE FOR DIAGNOSIS

Both DAF QLD and NSW DPI provide free and confidential cotton pathology diagnostics. If plants are expressing wilt disease, send a plant sample to your state pathologist for diagnosis (details below). Please phone first before sending any samples to confirm the address and to ensure that samples will be processed appropriately on arrival.

What to send: Several sections of stem about 10cm in length exhibiting vascular discoloration should be collected and placed in a paper bag and kept cool (refrigeration) until posting.

What to include: Please provide information

on symptoms observed, number of plants affected, variety etc – a form and checklist on sending plant samples for diagnosis is available on page 126 of the *2014-15 Cotton Pest Management Guide*.

How to send: Send samples in an overnight Postpak to ensure quick delivery. Avoid sending samples late in the week when they may be delayed over the weekend.

Where to send: If in Queensland: phone Dr Linda Smith (QLD DAF) or in NSW: Dr Karen Kirkby (NSW DPI) for details on where to send samples.

Queensland:

Dr Linda Smith, DAF QLD
07 3255 4356, 0457 547 617
linda.smith@daf.qld.gov.au

NSW:

Dr Karen Kirkby
02 6799 2454, 0428 944 500
karen.kirkby@dpi.nsw.gov.au



PRINCIPLES OF DISEASE MANAGEMENT

Growing a healthy crop and general disease management principles are important for management of both wilt diseases.

- Throughout the season avoid over-watering waterlogging.
- Minimise tailwater to reduce risk of spread.
- Both Verticillium and Fusarium wilts are also favoured by excessive use of nitrogen which results in late season growth.
- Potassium is important for natural plant defences and potassium deficiency is associated with more severe symptoms.
- Avoid inter-row cultivation with knives if possible as this causes root damage and provides an entry point for the pathogen.
- Weed management, particularly host weeds, is important. A zero tolerance approach to ratoon/volunteer cotton in fields should be maintained.

	Verticillium wilt	Fusarium wilt
Resistant varieties	Cotton varieties with high level of resistance to Verticillium wilt are the cornerstone for management of this disease. The level of resistance is communicated through the V-rank which is assigned to each variety.	Cotton varieties with high level of resistance to Fusarium wilt are the cornerstone for management of this disease. The level of resistance is communicated through the F-rank which is assigned to each variety. All cotton seed is treated with BION®, a natural 'plant activator' that triggers the natural defences of the plant before it is exposed to pathogens.
Seasonal Impacts:	Verticillium wilt is favoured by cooler temperatures. Varieties that are resistant at 25-27°C are susceptible at 20-22°C. Verticillium wilt is most severe during extended wet weather and or waterlogging and in late maturing crops. Extending the period of crop growth late in the season increases this risk.	Cool, wet early season conditions are conducive to infection and the development of Fusarium wilt. The best way to avoid such exposure is to plant as late as possible within the planting window, when soil temperatures are at least 16°C and rising.
Irrigation management	Throughout the season avoid over-watering and waterlogging where possible and avoid late season irrigations that extend maturity. Minimise tailwater to reduce risk of spread.	
Nutrition management	Both Verticillium and Fusarium wilts are also favoured by excessive use of nitrogen which results in late season growth. Potassium is important for natural plant defences and potassium deficiency is associated with more severe symptoms. Avoid inter-row cultivation with knives if possible. This causes root damage and provides an entry point for the pathogen.	
Non-host crop rotation	Crop rotation with non-host crops (i.e. sorghum and cereal crops) may help reduce Verticillium wilt incidence. It is unlikely that rotation alone will provide satisfactory results. Research suggests that the greatest benefit from rotation would be observed when the rotations are initiated early, before inoculum builds up to high levels in the soil.	Rotate with non-hosts for up to 3 years. A summer sorghum/maize-fallow-cotton rotation can increase yield in the third year compared to continuous cotton. Fusarium can survive on non-host crop residues, so residues should be buried or baled as soon as possible after harvest. Avoid green manure crops.
Avoid/Control alternative hosts	Including volunteer and ratoon cotton, sunflowers, soybeans. In addition to alternative crops, the pathogen that causes Verticillium wilt can also infect common weeds found in cotton growing regions such as noogoora and Bathurst burr, saffron thistle, thornapple, caustic weed, bladder ketmia, burr medic, black bindweed, pigweed, devils claw, turnip weed, mintweed, blackberry nightshade and others.	Hosts such as legumes can potentially increase disease. Bladder ketmia, sesbania pea, dwarf amaranth, bellvine and wild melon are weed hosts that show no external symptoms. These weeds may act as an on farm reservoir for the disease and need to be managed in-crop and during fallow periods.
Stubble management	Aim to ensure that crop destruction occurs soon after picking to reduce the build-up of inoculum. Incorporation of cotton residues soon after harvest is beneficial allowing for the rapid breakdown of plant material.	Ideally root pull, with crop residues slashed and retained on the surface for at least one month prior to incorporation. Raking and burning the whole field is NOT an option as raking is likely to spread the disease.

BEING

WITH AN INCREASING PRESENCE OF VERTICILLIUM WILT THIS SEASON, MANAGEMENT OPTIONS NEED TO BE EXPLORED TO HELP INDUSTRY CONTROL ITS SPREAD AND IMPACT.

In recent seasons there have been a number of severe and widespread cases of Verticillium wilt. NSW DPI Pathologist Dr Karen Kirkby spoke with *Spotlight* about what she is seeing as well as current Verticillium research.

Karen says the incidence and severity of Verticillium wilt has increased in some regions over recent years and this season reports from growers and consultants suggest that it has increased substantially in some regions of NSW.

“Without a doubt, favourable conditions for disease development such as varietal choice, cool weather conditions and level of inoculum in the soil all have contributed to the severity of disease observed,” Karen said.

“When we complete our annual Cotton Industry Disease Surveys undertaken by our NSW DPI Pathology team and funded by CRDC, we will have a clearer indication of the extent and severity.”

Karen is collaborating with the Plant Health Diagnostic Service (PHDS) at NSW DPI’s Elizabeth Macarthur Agricultural Institute working towards the optimisation of a molecular technique used in strawberry fields to quickly quantify the concentration of *Verticillium dahliae* in cotton growing soils.

“If inoculum levels in the soil can be correlated to an effect to cotton yield, then it is hoped that the PHDS will be able to provide a service for growers to assess their Verticillium wilt risk in each field prior to planting allowing for informed management decisions,” she said.

“We are also working with pathologists from DAF QLD to better



ALERT TO VERT



MELANIE JENSON

Knowing which wilt is present in fields is vital for correct post-harvest field management, which varies between the two diseases.

understand the contribution of strain-to-disease incidence and severity that is being observed.”

Multiple strains identified

Recent diversity studies by DAF QLD Pathologist Dr Linda Smith have identified more than one strain of *Verticillium* affecting cotton. Work is ongoing to better understand virulence between strains. With uncertainty about the significance of *Verticillium* strains, Karen is keen to encourage growers to focus on best practice.

“Early research suggests that strain won’t necessarily be an indicator of how severe the disease may be,” Karen says.

“I would encourage growers to adopt measures that reduce the build-up of *Verticillium* wilt and other diseases in the field.

“Resistant cotton varieties are the industry’s primary tactic to managing this disease and the level of resistance is communicated through the V-Rank which is assigned to each variety.

“If growers have *Verticillium* wilt on their farm they must revert to the highest V-Rank variety in planting to minimise their losses due to this disease.

“It has long been recognised that

MULTIPLE STRAINS MEAN NEED FOR TESTING

CRDC-funded research has found that there is more than one strain of *V. dahliae*, as well as variation in virulence within strains in Australian cotton.

The newly identified strain is called VCG 2A, whereas previously all Australian cotton strains were thought to be VCG 4B. At this stage, we don’t know how widespread this new strain is. Both are regarded as non-defoliating types.

To understand the diversity of the strains of *V. dahliae* we have in Australian cotton and where they are located, diseased stems from fields need to be collected and the pathogen analysed by a pathologist – see details page 15.

the resistance of cotton to the pathogen that causes *Verticillium* wilt is temperature sensitive. Varieties that are resistant at 25 to 27°C are susceptible at 20 to 22°C.”

To reduce exposure to late season cooler temperatures, Karen recommends growers manage for ‘earliness’ which include measures such as avoiding late irrigations that extend maturity.

She said nutrition management is also important. *Verticillium* wilt is favoured by excessive use of nitrogen which results in late season growth. Potassium is important for natural plant defences and potassium deficiency is associated with more severe symptoms.

Management options

The NSW pathology team are currently looking at *Verticillium* density across the bed, and have noted some patterns across rows and are investigating if this is related to fertiliser placement. NSW DPI has also conducted research into cropping rotations. Karen says care must be taken when selecting rotation crops as *Verticillium dahliae* has a wide host range.

“Crop rotation with non host crops such as sorghum and cereal crops may help reduce the incidence of *verticillium* wilt, when compared to the continued plantings of susceptible hosts,” Karen says.

“Incorporating non-host crops into a rotation may limit the build-up of inoculum but it is unlikely that rotation alone will provide improved results.

“Research suggests that the greatest benefit from rotation would be when the rotations are grown before inoculum builds up to high levels in the soil.”

Investigations into bio-fumigation

“WE ARE ALSO WORKING WITH PATHOLOGISTS FROM DAF QLD TO BETTER UNDERSTAND THE CONTRIBUTION OF STRAIN-TO-DISEASE INCIDENCE AND SEVERITY THAT IS BEING OBSERVED.”



by NSW DPI determined it not to be a viable option, as the research did not show consistent suppression of either black root rot or Verticillium wilt using a range of different bio-fumigation crops.

Farm hygiene: keep weed-free

The pathogen that causes Verticillium wilt can also infect common weeds found in cotton growing regions. Growers should also adopt a zero-tolerance approach to volunteer and ratoon cotton.

“It is important that growers control alternative hosts to prevent the build-up of inoculum - *Verticillium dahliae* has a large host-range which includes sunflower, soybean, noogoora and bathurst burr, saffron thistle, thornapple, caustic weed, bladder ketmia, burr medic, black bindweed, pigweed, devils claw, turnip weed, mintweed, blackberry nightshade and others,” Karen said.

“I encourage growers ensure crop destruction occurs soon after picking to reduce the build-up of inoculum.

“Research has found that where Verticillium wilt is present, incorporating cotton residues soon after harvest is beneficial as it allows for the rapid breakdown of plant material, preventing further build-up of inoculum.”

Most importantly growers should limit the spread of Verticillium wilt by following Come Clean. Go Clean.

“Like so many soil borne diseases, prevention is better than a cure and growers across NSW are really embracing Come Clean. Go Clean strategy for reducing the spread of disease.”

CRDC is interested in holding a forum with interested growers, consultants and researchers to discuss Verticillium research gaps and opportunities. Please register your interest by e-mailing susan.maas@crdc.com.au

email us

THE COTTON INDUSTRY HAS BEEN REMINDED OF THE CRITICAL PART VEHICLE CLEANLINESS PLAYS IN THE FIGHT AGAINST THE SPREAD OF DISEASE AND WEEDS ON AND WITHIN FARMS.

COME CLEAN. GO CLEAN IS THE ONLY WAY TO KEEP YOUR FARM CLEAN

At a recent event in Central Queensland, dirt samples were taken randomly from under vehicles for testing, with one vehicle found to be carrying reniform nematodes.

CottonInfo’s Disease Technical Specialist Ngaire Roughley said the discovery was a reminder that Come Clean. Go Clean is paramount and an industry standard that requires vigilant adherence to.

“This mirrors a similar situation in the late 1990s, when the pathogens for black root rot, and verticillium wilt, as well as a species of fusarium (not cotton fusarium wilt pathogen) were found on vehicles at an event in the Namoi Valley in North West NSW.

“This recent finding highlights the importance of best practice when it comes to farm biosecurity, and ensuring vehicles and machinery are thoroughly cleaned and disinfected,” Ngaire said.

“As we head into harvest we often focus on equipment moving between farms and into fields. This equipment is viewed as particularly high risk, however we must remember that all movements on and off-farm, people, farm inputs vehicles and equipment at any time of year can potentially carry pest, diseases and weeds.

“Coupled with preliminary findings from the latest QLD disease surveys, along with anecdotal evidence from many cotton growing valleys indicating a high presence of verticillium and fusarium wilts, we really want the industry to have Come Clean. Go Clean in the front of mind.

“While a farm cannot be entirely barricaded from all pests, as some are spread by wind or animals, adopting and ensuring compliance to a few routine best practice procedures can greatly reduce risks.”

Central to protecting farms from new threats is to ensure that all machinery, vehicles and equipment entering and leaving cotton production areas are cleaned and disinfected with Farmcleanse in a dedicated wash-down area.

Ngaire also encourages growers to assess their biosecurity risks. Planning can help ensure that Come Clean. Go Clean is a manageable part of the farm routine.

“Sit down with a map of your property and work out where entry risks may be and how they are or could be managed,” Ngaire said.

“Think about your whole farming oper-



MELANIE JENSON

Central to protecting farms from disease and pests is to ensure all machinery, vehicles and equipment entering and leaving cotton production areas are cleaned and disinfected with Farmcleanse in a dedicated wash-down area.

ation including other crops and animals which can also be affected by biosecurity incursions.

“Almost anything moved onto your property can be a potential source of pests and diseases for livestock and plants so it is important to have plans in place to manage this risk.

“Look for practical solutions that work for your farm. For example if cleaning every vehicle isn’t practical, establish a visitor parking area away from production areas.

“myBMP provides guidance on the types of practices that are recommended by industry and links to useful resources to help with planning.”

DAF QLD Senior Pathologist Dr Linda Smith says it is important to remember that chemical disinfectants are not a substitute for thorough cleaning of machinery, because the more soil and trash that is removed by high pressure washing, the less chance that fusarium will be spread within and between farms.

“The adoption of more hygienic farm practices and attention to minimising spread is essential not only for the management of this disease, but also impedes the spread of other soil-borne diseases and weed species as well,” Linda says.

More information

Come Clean. Go Clean fact sheet: www.cottoninfo.net.au
www.myBMP.com.au
 Ngaire Roughley
ngaire.roughley@daf.qld.gov.au

see our website

email us

STAMPING OUT RESISTANCE: PATCH MANAGEMENT TO KILL GLYPHOSATE SURVIVORS

COMING INTO WINTER, ATTENTION TURNS TO WEED MANAGEMENT IN FALLOW FIELDS. THE CONTROL OF POTENTIAL HERBICIDE RESISTANCE SHOULD BE A PRIORITY ACCORDING TO DAF QLD SENIOR RESEARCH SCIENTIST JEFF WERTH.

Reports of glyphosate resistance in weed species in cotton growing systems are on the rise, prompting concern within the industry about the financial and logistical implications of widespread herbicide resistance.

“Tackling emerging patches of resistance early is critical to maintaining the viability of a glyphosate-dependant cropping system,” Jeff said.

“Glyphosate-resistant awnless barnyard grass (*Echinochloa colona*) is the biggest worry as it is widespread throughout NSW and Queensland.

“While we’ve had only one confirmed case of resistance in a cotton rotation a number of resistant populations have been confirmed in grain (only) rotations.

“Given this scenario it’s likely there will be more resistant populations emerge with a high risk of spread to irrigated cotton.

“Fleabane has also developed widespread glyphosate resistance.

“Resistant fleabane has already been found in a number of grain crop regimes, and it’s logical to assume it will emerge in cotton systems.

“Herbicide resistance generally appears in small patches. Ideally weed control will be targeted in the spring and early summer before seed set, but farm managers need to be vigilant in removing survivors still in the fields now.

“These plants may have survived due to glyphosate resistance, so the time and cost involved in eradication should be viewed as a small down payment on preventing a much larger and more expensive weed control problem down the track.

“Mature grasses are less susceptible to Group A herbicides such as haloxyfop (Verdict) and clethodim (Sequence), although spot spraying at



Jeff Werth (pictured) says glyphosate-resistant awnless barnyard grass is currently the biggest worry for researchers as it is widespread throughout NSW and Queensland.

high doses can be effective using these chemicals. Glufosinate may also be useful as a spot spray.”

However, he says, this late in the season, cultivation and chipping are likely to be more effective options.

Furthermore, pupae busting tactics can also be useful in burying small weed seeds at a depth that prevents emergence, particularly for the smaller seeded species such as fleabane and sowthistle.

“Aside from mechanical tactics, research shows that using two non-glyphosate tactics, such as a group A herbicide in a double knock, is probably the most effective strategy for controlling emergences and preventing survivors from setting seed,” Jeff said.

“We need be aware that group A herbicides have a very high resistance risk, this makes controlling survivors critical in fallow as well.

“Some people find the double knock method difficult to fit into their regime in terms of labour and logistics, but putting in that effort over three, four or even five years to knock out all survivors, will dramatically reduce the seed bank and the extent of the problem in the future.”

Barnyard grass management

Barnyard grass produces small seeds that are not wind-blown and have a relatively short seed life (generally less than six years), making eradication a real possibility if resistance is detected

early and the right management strategy is adopted.

Through long-term crop trials at the Hermitage Research Facility near Warwick in Queensland, Jeff and his DAF QLD colleagues are investigating the commercial feasibility of complete eradication.

“So far the established ‘2 + 2’ Best Management Practice (outlined in the cotton industry’s Herbicide Resistance Management Strategy) of two non-glyphosate tactics in crop and two further tactics in fallow, has been effective in significantly reducing the number of awnless barnyard grass survivors remaining at the end of the season,” he said.

“We’re looking at what additional tactics need to be applied, and with what timing, to wipe out the resistant seedbed.

“This research will provide growers with information about whether it is not only possible, but commercially realistic to attempt eradication of resistant patches of barnyard grass”

More information

The Australian cotton industry Herbicide Resistance Management Strategy is available at:
www.cottoninfo.net.au
www.mybmp.com.au



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KNOW YOUR WEEDS FOR BEST MANAGEMENT

SUCCESSFUL WEED CONTROL RELIES FIRSTLY ON ACCURATE IDENTIFICATION, FOLLOWED BY TIMING AND CHOOSING THE CORRECT MODE OF ACTION.

The WEEDpak Weed ID Guide has again been updated to reflect the changing weeds landscape in Australian cotton growing systems.

The updated Weed ID guide now contains information to identify nearly 200 weeds and information on management of weeds that are most commonly problems for the industry. It has been designed for use in the field, and is available for download on tablets and smart phones as well as the desktop version.

With the increase in herbicide-resistant weeds in cotton systems, the guide has been updated to reflect changing weeds and management tactics.

“The guide is an integral document in any farm’s integrated weed management (IWM) plan, as it’s a total weed ID package, and should be used in conjunction with the cotton industry’s Herbicide Resistance Management Strategy,” says NSW DPI weeds researcher Graham Charles.

“Quick and accurate weed identification is integral to IWM. The guide’s colour photographs including all growth stages (seed, seedling and adult plant) are shown along with weed biology and ecology information.

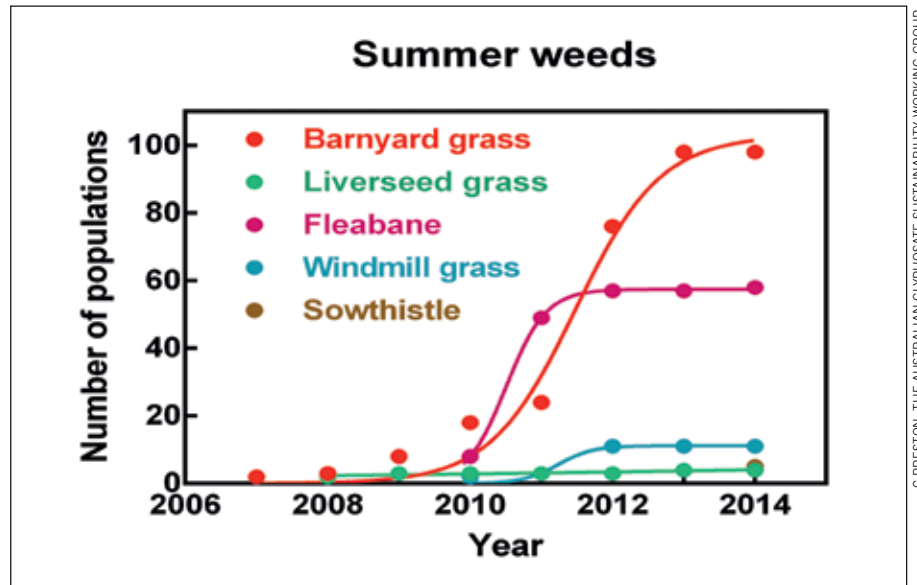
“The seasonal Weed Growth and Development Guide is important because it gives information about timing weed control – which is perhaps the most important aspect of weed and resistance management.

“Timing of control is imperative for avoiding seed set, which is a key factor in IWM, and is crucial in managing the spread of herbicide resistance.

“The guide offers information about timeliness and the identification information of weeds at various growth stages can ensure seedlings are targeted, well before seed set.”

The guide also contains weeds to

The current register of glyphosate-resistant weeds in NSW and Queensland includes annual ryegrass, barnyard grass, awnless barnyard grass, fleabane, windmill grass and most recently sowthistle (*Sonchus oleraceus*) and sweet summer grass (*Brachiaria eruciformis*).



Increase in confirmed cases of glyphosate resistance in summer weeds 2007 – 2014.

be on the look-out for, which may have entered the farm from overseas or even another area within Australia.

“Palmer amaranth has been added to the Weed ID Guide, even though it is not known to be in Australia, because it could easily arrive here in machinery imported from the US where it has caused major management and financial burdens for growers in some states,” Graham said.

“We are already having problems managing Group M resistant weeds, adding a super weed, such as palmer amaranth, with Group B, C and M resistance would really hurt the industry.

“Australian conditions are suited for palmer amaranth to flourish here, so with that as a case in point, we are really asking people to please be on the lookout for new weeds on farms – particularly after a picker break down. If possible, it is best to take the machine back to the workshop to work on it or an area where any new weeds may be easily detected.

“If this is not possible and the machine is fixed in the paddock, please go back to this area and check regularly for any unusual plants.

“And not just palmer amaranth, there are other foreign weeds from we should be on the lookout for and weeds from outside our particular area or even farm we’ve not seen.”

Farm hygiene

“Even the most careful growers using best practice IWM and farm hygiene will encounter resistant weeds on their farm,” Graham warns.

“Because resistant seeds are also carried by water, wind and animals, it

is imperative that farms are still closely monitored for problematic weeds.

“This is a signal to all involved that vigilance and management is imperative - the upshot is to prevent survivors setting seed.

“No-one is immune, so managers must be aware of how effective a treatment has been, go back and check the survivorship and take note of those plants.

“Fleabane, sowthistle and windmill grass in particular should be closely monitored after spraying.

“It would be wise to consult the Cotton Industry Herbicide Resistance Management Strategy (HRMS) when making decisions about managing survivors.”

Cotton industry weeds researchers are encouraging growers and consultants to take samples they of any weed they suspect could be herbicide resistant and have them tested.

“There would be weeds other than those we’ve already identified that would be building resistance to glyphosate - this in itself should be enough impetus for testing.

“If you see a new weed on your farm and are unsure of what it is, or are having management issues with a particular weed, we encourage you to send take samples and have them tested.”

More information

WEEDpak, theWEEDpak Weed ID Guide, and the Herbicide Damage ID Guide are available on the CottonInfo website for use on smart phones, tablets and desktop.

www.cottoninfo.net.au
www.weedsmart.org.au

TO SEND WEEDS FOR TESTING: Go to www.glyphosateresistance.org.au for more information.

Graham.charles@dpi.nsw.gov.au

C PRESTON, THE AUSTRALIAN GLYPHOSATE SUSTAINABILITY WORKING GROUP. WWW.GLYPHOSATERESISTANCE.ORG.AU





SURVEY SHOWS A CHANGING WEEDS LANDSCAPE

IN AN EFFORT TO BUILD KNOWLEDGE ABOUT THE TYPE OF WEEDS AND FREQUENCY OF GLYPHOSATE RESISTANCE ON COTTON FARMS, NSW DPI AND CRDC RECENTLY APPOINTED A NEW WEEDS RESEARCHER.

Based at the Australian Cotton Research Institute at Myall Vale, Dr Sudheesh Manalil has been surveying cotton farms to gather data on weed populations and the presence of glyphosate resistance.

The current register of glyphosate-resistant weeds in NSW and Queensland includes annual ryegrass, barnyard grass, awnless barnyard grass, fleabane, windmill grass and most recently sowthistle (*Sonchus oleraceus*).

The last weeds survey was undertaken in 2010 and the latest survey shows that since then, in general, pigweed, volunteer cotton, feathertop rhodes grass and windmill grass were more prevalent. Numbers of other dominant weeds were similar to 2010 findings, with flaxleaf fleabane, bladder ketmia, sowthistle, dwarf amaranth (*Amaranthus macrocarpus*), cow vine, caltrop, barnyard grass and Australian bindweed the most prevalent weeds.

Regional differences

In the Emerald region, Sesbania pea and feathertop rhodes grass were dominant weeds. A shift in dominance of feathertop rhodes grass toward windmill grass was observed moving from Emerald, Darling Downs and St George into the Gwydir and Namoi valleys.

Barnyard grass, awnless barnyard and annual ryegrass were the dominant grass weeds surveyed in Southern NSW.

Of particular concern is Southern NSW, where the survey found many patches of annual ryegrass outcompet-

ing cotton despite repeated glyphosate applications. Seed was collected from these plants and will be germinated and tested in glasshouses experiments.

“This is an alarming situation, unlike many grass weeds, ryegrass has the potential to spread widely as it is cross-pollinated and resistant pollen can travel up to three kilometres,” Sudheesh said.

“Therefore it is likely this weed could become a dominant resistant weed across the cropping regions in Southern NSW.

Farming systems considerations

“The cotton fields are well managed, especially the flood irrigated fields, and I rarely encountered weed plants with seed bearing heads in flood irrigated fields,” Sudheesh said.

“This indicates that the contribution of weeds in the field to soil seed bank enrichment may not be of high magnitude.

“However any surviving weeds are likely to have had multiple selections for glyphosate resistance so even a few are of concern.

“Furthermore, dense population of weeds in irrigation channels and crop boundaries were often found to be at maximum reproductive potential with healthy growth, which could be a major source of seed migration into cotton fields if not correctly maintained.

Similarly weed seeds produced along laneways and boundaries could eventually end up in cotton fields. These areas should be managed as outlined in the industry



Herbicide Resistance Management Strategy (HRMS).

Weeds in no-till systems

The survey found a relatively high frequency of small-seeded weeds such as fleabane, sowthistle and grass weeds were present at high frequency in minimum till systems, including dryland and overhead irrigation.

“Small-seeded weed plants with abundant seed production thrive in many conservation-till agro-ecosystems around the world,” Sudheesh said.

“The HRMS outlines recommendations for summer fallow as well as in crop to reduce the risk of glyphosate resistance as well as manage the seed bank.”

“Initial observations from this survey indicate that weed management in cotton systems could be more diversified and refined to suit individual systems (irrigated or dryland) and should be region-specific based on the dominant weeds prevailing in a region.

“In addition, farm hygiene should be given top priority to minimise weed pressure and subsequently reduce the rapid evolution of herbicide-resistant weeds in cotton systems.”

The weeds survey found that problematic weeds like fleabane in channels and other areas outside fields were at maximum reproductive potential with healthy growth, providing a seed bank to make its way into fields.

“THE HRMS OUTLINES RECOMMENDATIONS FOR SUMMER FALLOW AS WELL AS IN CROP TO REDUCE THE RISK OF GLYPHOSATE RESISTANCE AS WELL AS MANAGE THE SEED BANK.”



Dr Sudheesh Manalil

More information

Cotton industry Herbicide Resistance Management Strategy
www.cottoninfo.net.au
www.glyphosateresistance.org.au





UNDERSTANDING HELICOVERPA SURVIVORSHIP

SPOTLIGHT SPOKE TO CSIRO ENTOMOLOGIST DR SHARON DOWNES AND COTTONINFO STEWARDSHIP TECHNICAL SPECIALIST SALLY CEENEY TO FIND OUT MORE ABOUT HELICOVERPA ‘SURVIVORS’ AND HOW BEST TO MANAGE THEM IN BOLLGARD II CROPS.

Each cotton season there are reports of medium to large *Helicoverpa* larvae in Bollgard II crops. Occasionally larvae reach numbers which are greater than threshold levels. In these situations growers are mainly concerned about potential economic damage but there may also be concerns relating to resistance management.

What are ‘survivors’ and are they resistant to Bollgard II?

Work conducted by CSIRO and Monsanto showed that larvae did not survive on Bollgard II due to high level Bt resistance or because of the absence of Bt genes in the cotton. Sharon leads the industry’s Bollgard II Resistance Monitoring Program and says larvae can exhibit a strong behavioural response to the Bt proteins in Bollgard II plants.

“Larvae are showing some ability to detect and avoid Bt toxins and are moving frequently within and between plants, resulting in an apparent feeding preference for flowers,” she said.

“This may help explain why most fields with above threshold numbers of medium to large larvae are at mid to late flowering stage.”

In combination with this, plant stress can also be a factor.

“Within a field of Bollgard II there is probably variation among plants in degree of Bt expression,” Sharon says.

“Usually all plants control larvae but sometimes a whole or part field could be stressed and expression might be reduced so that plants expressing the lowest Bt levels temporarily fall below



the threshold needed to control larvae.

“Larvae that hatch on these poor expressing plants may be more likely to survive, but those on adjacent plants that are expressing well, could feed and die or feed and move on. This could explain why there is often a non-random distribution of damage and larvae in affected Bollgard II fields.”

According to Sharon, it is probably a combination of preferential feeding on flowers, coupled with the sometimes temporal and spatial variability of Bt toxin expressed in Bollgard II cotton that can result in a proportion of larvae becoming established on some plants in a field.

CCA survey data

To investigate how widespread survivors were in the industry and if

numbers were increasing each season, Sharon conducted a survey with Crop Consultants Australia (CCA) members, covering seasons from 2005-06 to 2013-14 and included representatives from all cotton growing regions.

The results of the survey show that: The presence of survivors in Bollgard II is:

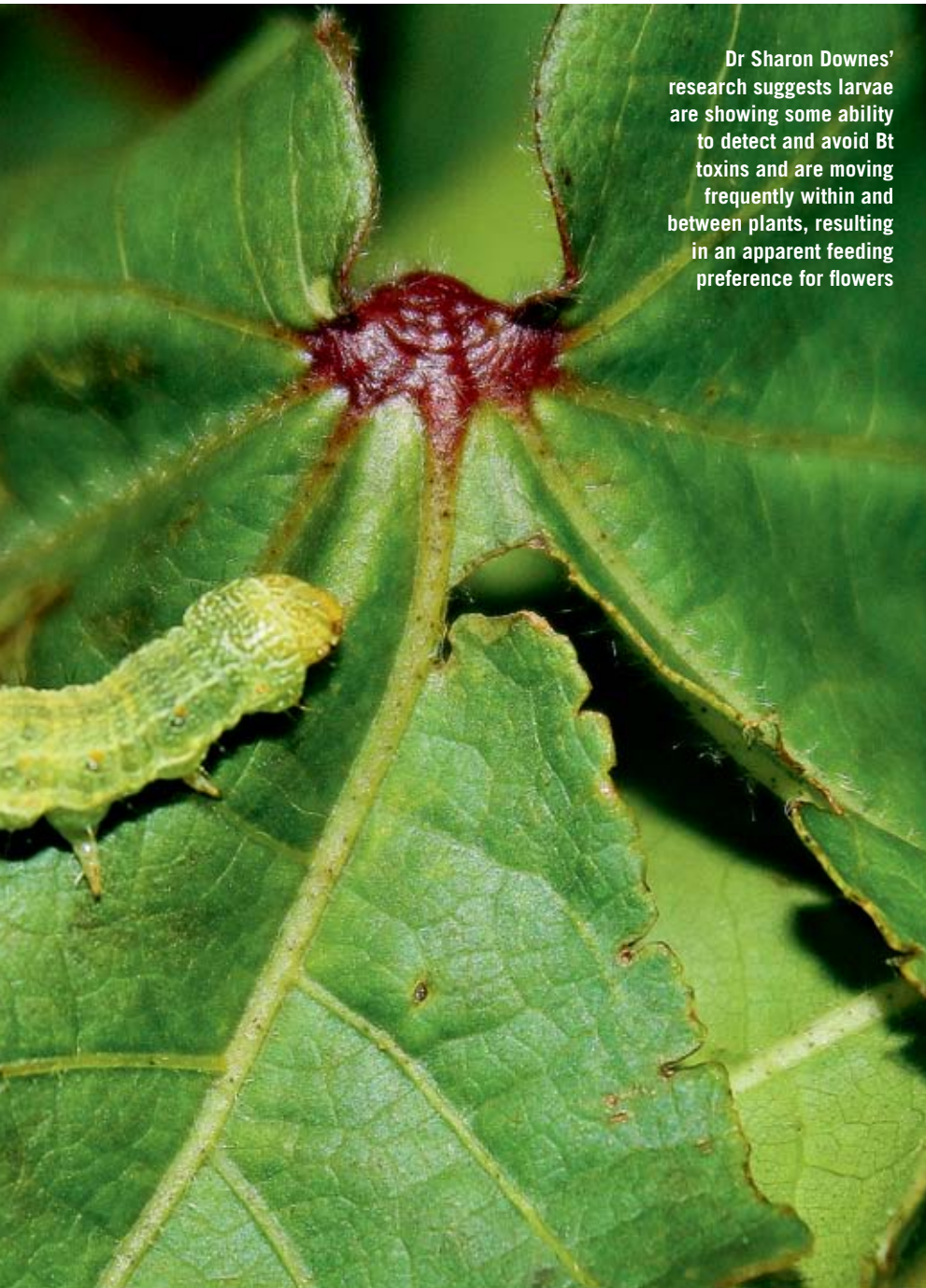
- Not increasing (during 2005-06 to 2013-14)
- Widespread among valleys and climatic regions
- Bollgard II is often sprayed for larvae below threshold

The survey highlighted that it is common for Bollgard II fields to be sprayed for *Helicoverpa* below threshold. An economic threshold has been developed for *Helicoverpa* in Bollgard II and both CSIRO and Monsanto have done work that validates it.

A recent study used the distribution of damage in fields that carried larvae at the current thresholds as the basis for an artificial damage experiment.

“Bollgard II plants could tolerate up to 100 percent square loss at early

“HELICOVERPA LARVAE CAN EXHIBIT A STRONG BEHAVIOURAL RESPONSE TO THE BT PROTEINS IN BOLLGARD II PLANTS.”



MELANIE JENSON

Dr Sharon Downes' research suggests larvae are showing some ability to detect and avoid Bt toxins and are moving frequently within and between plants, resulting in an apparent feeding preference for flowers

INSECTICIDE SELECTION FOR BOLLGARD II

When controlling *Helicoverpa* within Bollgard II crops, insecticide selection should comply with the cotton industry's Insecticide Resistance Management Strategy (IRMS).

The predator to pest ratio (described in the *Cotton Pest Management Guide 2013-14*) should also be given careful consideration when considering applying an insecticide. If an insecticide is required, try to choose the most effective product that is the least disruptive to the beneficial complex. Refer to the *Impact of insecticides and miticides on predators, parasitoids and bees in cotton* table contained in the Guide (pp 8-9) for more information.

It is also important to consider the risk of flaring other pests, such as silverleaf whitefly or mealybug when making a spray decision as the benefits of spraying the *Helicoverpa* larvae could be outweighed by the risk of having to control other pests later in the season. While foliar Bt can be used on Bollgard II crops, it is a requirement of the Bollgard II Resistance Management Plan that foliar Bt not be used on any refuge crops.

With the increased risk of resistance to Cry2Ab in *Helicoverpa* it is critical that we monitor the distribution and proportions of fields that are affected by surviving larvae, and the number of fields that are sprayed to control *Helicoverpa*. Part of the end of season general survey of CCA members includes questions about control of *Helicoverpa* in Bollgard II fields.

THE IMPORTANCE OF CONTROL

While the work shows that spraying Bollgard II fields below thresholds is unlikely to give any economic advantage, CottonInfo Stewardship Technical Specialist Sally Ceeney says it is equally important that *Helicoverpa* in Bollgard II fields that are above threshold are controlled.

"Controlling *Helicoverpa* above threshold in Bollgard II fields may deliver an economic benefit to the grower, and is also important for resistance management," Sally said. "While both CSIRO and Monsanto have shown that survivors in Bollgard II fields do not carry genes to the common recessive Bt resistances that have been identified so far, it is possible that a proportion of individuals surviving in a field may have a very rare non-recessive Bt resistance. These mechanisms are yet to be detected in Australian *Helicoverpa* populations.

"If this was the case, once Bt cotton starts expressing well again, the resistant insects could have a better chance of surviving on Bt cotton than susceptible insects and this could select for them to become more common in the population and for the new resistance to become prevalent."

flowering, up to 100 percent square removal alone or in combination with 30 percent boll damage at peak flowering, and 30 percent boll damage at late flowering, without impacting yield or quality," Sharon said

"Bollgard II cotton seems to compensate well for damage caused by

larvae and the current threshold can be used in most situations without causing significant yield reduction."

Helicoverpa thresholds in Bollgard II

Do not include any larvae less than 3mm long in spray threshold counts. For economic management of

Helicoverpa, larval populations should be controlled with an insecticide if a threshold of:

- Two larvae per metre greater than 3mm in length are found over two consecutive checks; or,
- One larva per metre greater than 8mm in length is found in any check.

When using the above thresholds to make a spray decision, it is critical that consecutive checks are used across a number of different areas in a field.

It is common for *Helicoverpa* survivors to have a patchy distribution within a field and for larvae to be above threshold in one check, and then numbers reduce to below threshold numbers in subsequent checks.

More information

More information on how to effectively sample crops can be found in the *Cotton Pest Management Guide 2013-14* (pp 51-52). Available from www.cottoninfo.net.au





INDUSTRY TAKES PROACTIVE APPROACH TO WHITEFLY MANAGEMENT

THIS SEASON IS SEEING MANY LATER MATURING CROPS AS GROWERS NEEDED TO DELAY PLANTING IN A BID TO CONSERVE VALUABLE WATER ALLOCATIONS AND AVOID EARLY HEAT. WHAT DOES THIS MEAN FOR SILVERLEAF WHITEFLY MANAGEMENT NOW?



Silverleaf whitefly (SLW) have the ability to contaminate cotton lint with honeydew (creating sticky cotton), have a large host range, reproduce rapidly and can rapidly develop resistance to insecticides.

The industry continues to take a proactive approach to SLW management, with the recent preparation of new management guidelines and thresholds for growers, as well as forums between industry experts and growers to discuss best practice management.

CSIRO Entomologist Dr Lewis Wilson (pictured) recently travelled to the Macquarie Valley, where SLW pressure was felt last year. SLW is a relatively new pest in this region and growers were keen to hear about best practice control methods.

“We discussed a really broad range of issues, especially the excellent

Threshold Matrix developed by Dr Richard Sequeira, as a key question from growers in this region was around spray decisions,” Lewis said.

CottonInfo’s Regional Development Officer for the Macquarie, Amanda Thomas said as a result of Lewis’ visit growers were confident about that they now had the tools to better manage SLW.

According to Lewis, the main issue coming to the end of this season is making decisions with crops close to having open bolls, managing crops with delayed maturity and making control decision where crops receive large influxes of SLW adults from other fields.

“Effective and regular sampling of SLW and use of the threshold matrix will help to identify if and when to control whitefly,” Lewis says.

“Growers should be aiming to have low populations at the time the crop starts to have open bolls.

“It is tempting to spray SLW very early but preventing honeydew on leaves is not necessary, and treating too early also runs the risk they will rebuild requiring further expensive control.

“Conversely, some managers choose to push to the limit and control late, when bolls are starting to open.

“This can be a rational decision

if numbers are low but increasing quickly, and honeydew levels are also very low – the insecticide will probably pull SLW numbers down before the population builds to the level that significant contamination of lower bolls can occur.

“But if there are high numbers of SLW increasing quickly and there is already honeydew on bolls then earlier control would have been better, but control methods should still be undertaken to prevent further contamination of crops”.

Growers with late maturing crops may inherit SLW from nearby farms as they defoliate crops.

“There is not much you can do to avoid this,” Lewis said.

“But you can sample effectively and use the threshold matrix to manage the SLW population so as bolls begin to open in these crops the SLW population is low and little or no honeydew exists on bolls.

“Growers should continue to sample so you know when influxes of adults occur.

“Managing late crops to have a low ‘resident’ SLW population when bolls open and during opening puts you in a better position to manage any late adult influxes because you don’t have



KEY FACTORS IN SPRAYING DECISIONS

- Sample regularly so you can track changes, especially as SLW will build very slowly where there are lots of predators and parasites. Sample at fifth node below the terminal, but if it's hot also look a bit lower to see what the overall population is doing as SLW adults may stay lower in the crop in very hot weather. Also look for the presence on eggs or nymphs which indicates the population is breeding and potentially building.
- Use the threshold matrix but also factor in other information to modify decisions for your circumstances
- Look for honeydew – this is ultimately what you are managing – so if node five sampling was below threshold, but there was a lot of honeydew being deposited on lower leaves, the weather is hot and first open bolls are only a few days away, you might need to look lower in the crop. If there is a large SLW population then it would make sense to control the population.
- If crops are delayed they may not line up well with the threshold matrix because they will have accumulated more day degrees than they should for their stage of development. The easiest solution is to try to do a simple re-alignment – e.g. if you are about 10 days away from first open boll then back track from first open boll on the threshold matrix by 10 days' worth of day degrees and work forward again
- If crops are late they may inherit SLW from nearby farms as they defoliate crops in advance of yours. So best to try to manage your own crop to reduce the risk from SLW and control if necessary. Continue to monitor and if there is an influx of adult SLW use the table on page 29 in the *Cotton Pest Management Guide 2014-15* to help make a decision.

IT'S VITAL TO MAINTAIN OUR GOOD NAME

AUSTRALIA HAS AN ENVIABLE REPUTATION AMONG SPINNING MILLS GLOBALLY AS A RELIABLE SUPPLIER OF CONTAMINANT-FREE, PREMIUM QUALITY, UPLAND COTTON. THIS INCLUDES A REPUTATION FOR SUPPLYING COTTON FREE OF WHITEFLY HONEYDEW, THE CAUSE OF STICKY COTTON, WHICH IS A MILL'S NEMESIS ACCORDING TO AUSTRALIAN COTTON SHIPPERS ASSOCIATION (ACSA) CHAIR ARTHUR SPELLSON.

“While some other countries have struggled to avoid sticky cotton contamination, Australian growers have been successful in avoiding this issue through good whitefly management, underpinned by research and extension support from the industry,” Arthur said.

“ACSA understands the issues around whitefly management for growers, and appreciates that we are all aware of the importance of continued vigilance, as the repercussions for the industry don't bear thinking about.

“A good reputation often takes a long time to build, but is easy to lose and even harder to get back.”

A reputation for stickiness has a negative impact on domestic sales, export orders and prices for cotton from regions suspected of stickiness.

“This became clear from the experience of Arizona in the US, which felt the effects for many years after a whitefly outbreak there in 1992. Spinners then avoided their cotton for a sustained period and with reduced demand the value of cotton from the region fell significantly,” Arthur said.

“This was despite the fact they had rectified their whitefly management and were no longer supplying sticky cotton.”

This is due to the fact that cotton price is reduced for stickiness by the market at a rate proportional to the perception of risk. Reductions in the market value of lint are applied regionally and indiscriminately. Regional penalties are a consequence of the difficulty in measuring stickiness in cotton. Because there is currently no rapid method that is accepted as an industry standard for the measurement of stickiness, there can be no formal, bale-specific schedule of discounts for stickiness.

Sticky cotton can literally stop cotton gins and stickiness may mean special handling and processing requirements at the gin, reducing output by up to 25 percent.

Typically however, stickiness is first encountered when the sugar-contaminated cotton lint is carded at the textile mill. This results in reduced processing efficiency, and in severe cases total mill shut down and ultimately lower yarn quality. Mills lose income due to decreased processing efficiency and may lose additional income from discounts applied to off-quality yarn.

“It's really good news and commendable that our industry is taking a proactive approach to whitefly monitoring and management, which has included interaction between growers and researchers like CSIRO's Lewis Wilson to investigate best practice whitefly management, and be on the front foot in control,” Arthur said.

“According to Arizona University, who studied the effects of sticky cotton on their industry, well-implemented integrated pest and plant management plans are the best defences against the stickiness problem.

“Growers in the western United States have minimised the risks of sticky cotton by putting these plans into action.”

the compounding problem of a large 'resident' whitefly population with many nymphs and adults plus a large number of immigrant adults arriving.

“If large migrations of adults are detected I would urge people to consult Page 29 of the *Cotton Pest Management Guide 2014-15* which has some excellent information on making decisions on the need for control.”

More information

Cotton Pest Management Guide 2014-15

and Subscribe to the CottonInfo fortnightly newsletter at www.cottoninfo.net.au

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MATRIX HELPS SIMPLIFY SLW SPRAY DECISIONS

The CottASSIST Silverleaf Whitefly (SLW) Matrix web tool allows users to enter regular sampling information to track the development of SLW populations over time. The tool then compares these populations with the control thresholds, which are based on the pest population size, day degrees and crop stage.

CottonInfo's Sandra Williams says the tool is easy to use and navigate.

"Once you have set-up farms and crops, the only required information is SLW sample data," she said.

"The recommendation page presents the industry's threshold matrix with your whitefly population data overlaid. In addition to this is a full explanation of the threshold that applies to your current SLW population and crop stage."

SLW management can be complicated as they have a very large host range, quick reproduction rate and can rapidly develop resistance to insecticides. Therefore to prevent risk of honey dew and resistance developing to the small number of registered products, it is fundamental to follow industry thresholds developed from research.

DAF QLD SLW researcher Dr Richard Sequeira says the CottASSIST SLW Matrix Tool reduces a multi-dimensional whitefly spray decision and takes the process down to a simple and practical exercise that any crop manager will be able to use with confidence and ease.

The industry's SLW threshold matrix is contained in the *Cotton Pest Management Guide*, however the CottASSIST SLW Matrix tool also automatically calculates the day degrees needed to use the matrix.

The tool can be accessed through www.cottassist.com.au

More information

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RESEARCH IS ONGOING TO DETERMINE, IN THE EVENT OF AN INCURSION, IF AUSTRALIAN WHITEFLIES TRANSMIT COTTON LEAF CURL DISEASE.

CAN WHITEFLIES SPREAD EXOTIC DISEASE?

One of the subtleties of whiteflies (*Bemisia tabaci*) is that they are not one species, but a complex of at least 28 different species that look identical. On closer inspection however, they differ in their biology, genetics, and even their relative abilities to transmit plant viruses.

CRDC is supporting ongoing, cutting-edge whitefly research by Dr Sharon van Brunschot, a Research Fellow at The University of Queensland (UQ), to assess this pest's potential to vector the group of viruses that cause cotton leaf curl disease, in the event of an incursion. Sharon is part of an established group of cotton researchers at UQ led by Professor Gimme Walter, who are working together to better understand the ecology of various cotton pests.

"There are underlying complexities in the virus-vector interaction that require testing and research in order to understand and estimate the risk cotton leaf curl disease poses to the Australian cotton industry," Sharon said.

"While the viruses that cause cotton leaf curl have not been found in Australia, the disease continues to be a major constraint to cotton production across Asia and Africa. We have at least three different whitefly species in Australia, but we do not know if they would be competent vectors of these viruses.

"From a biosecurity perspective, this research will allow us to determine the actual risk this disease poses to Australian cotton."

Sharon will travel to the UK in July to undertake transmission experiments using virus isolates sourced from the Indian subcontinent, Australian whitefly species and cotton cultivars to determine if the whitefly species we have in Australia are efficient vectors of these viruses

"It would be a very high-risk exercise to do this research in Australia, so it is fortunate that we have strong collaborations with world experts at The University of Greenwich, via our collaborator at CSIRO Dr Paul De Barro," Sharon said.

Improving diagnostic capability

Sharon is also in the process of developing diagnostic tools for the quick and reliable detection of the virus in infected plants as well as in whiteflies. These diagnostic tests will improve the industry's capacity to prevent and respond to any incursion of exotic cotton leaf curl disease that may eventuate.

Furthermore, on a research expedition to China last year, Sharon identified that a likely incursion pathway for cotton leaf curl disease to Australia is via the importation of ornamen-



Sharon Van Brunschot will travel to the UK to test the ability of whiteflies to vector the cotton leaf curl disease as part of a CRDC-funded project.

tal hibiscus. Utilising this information, CRDC researcher Dr Cherie Gambley (DAF QLD) then successfully negotiated the tightening of import conditions for hibiscus entering Australia. This change will strengthen the protection of the Australian cotton industry from this devastating disease.

New management potential

Further subtleties exist in the interaction of these viruses and their whitefly vectors, including the potential involvement of endosymbiotic bacteria. Whitefly harbor an array of microbes in specific cells and parts of the insect's body, which may influence important processes including reproductive capacity, lifespan, susceptibility to insecticides and plant virus transmission.

"I have discovered that there are significant differences in endosymbionts harboured by the native and introduced whitefly species that are present in Australia," Sharon said.

"I am currently examining the influence these microbes have on processes including reproductive capacity and virus transmission.

"Knowing more about these relationships may inform new methods for whitefly management in the future."

More information

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PREPARING FOR CHANGE

LOOKING MUCH FURTHER DOWN THE TRACK: CRDC'S RESILIENCE ASSESSMENT WILL HELP THE AUSTRALIAN COTTON INDUSTRY PREPARE FOR AND MANAGE CHANGE WELL INTO THE FUTURE.



MELANIE JENSON

CRDC has taken an innovative approach to safeguarding the Australian cotton industry's long-term prosperity, commissioning a resilience assessment to identify future trends and drivers of change. Agricultural production is becoming an increasingly complex business. Major uncertainties about global economics and international markets, shifting national policies and social values, demographic changes, competition for key resources, rapid technological change and the impact of an increasingly variable climate dominated by extreme events mean agricultural industries must continually adapt to changing circumstances.

Industries need tools and approaches that continually update their understanding of how they fit into this bigger picture and to develop and maintain the capacity to navigate the challenging times ahead. 'Resilience thinking' is one such approach that is now being widely adopted globally to help communities, industries and governments deal with uncertain futures.

Understanding the Australian cotton industry's capacity to cope with uncertainty and manage critical tipping points, where that capacity is well developed and where it is weakest, will allow the industry to target future research and development, planning, capacity building and extension activities to ensure all facets of the industry are best placed to cope with an uncertain future.

The Cotton Industry Resilience Assessment will look at how the industry functions across the entire value chain, from production

through to marketing and processing, and how it might evolve as a result of social, economic and ecological developments.

An example of a driver of change all growers are familiar with is an increasingly variable climate. The aim of the Resilience Assessment is to identify and understand such drivers, trends and tipping points as a way of helping the industry plan for the future.

CRDC Executive Director Bruce Finney believes this type of research is ground-breaking for Australian agriculture.

"The Australian cotton industry has always been at the forefront of innovation, particularly with respect to environmental concerns," he said.

"This research will help the industry prepare for and manage change so that we're not caught off-guard by emerging challenges.

"The research so far suggests the cotton sector is in a strong position to deal with 'future shocks', having remained resilient in the face of previous challenges.

"That resilience is attributed in part to the inherent and unique attributes of our industry and flexibility of the system.

"That flexibility is around cotton as an annual crop which requires minimal regional processing, is relatively cheap to transport and can be grown as part of a diversified farming system.

"The cotton industry is characterised by a sense of optimism and an ability to respond well to threats and future challenges, according to the key findings of a survey conducted during the 2014 Cotton Australian

Cotton Conference as part of the assessment.

"Furthermore the survey found as the cotton industry has benefited from major technology advances, has strategically invested in R&D and training and skill development, is benefitting from the legacy of past decision-making regarding allocation and pricing of water resources and the provision of public infrastructure such as dams and favourable periods of climate and commodity prices."

However the researchers suggest there will be major challenges to ongoing resilience, due to issues such as the rapid increase in alternative fibre technologies, rising input costs and climate change.

Project leader Dr Francesca Andreoni believes the cotton sector's inherent unique attributes will be an advantage in dealing with these challenges.

"The industry sees itself as having the positive attributes of a culture of open communication and information sharing, of being innovative and adaptive, well organised with a strong sense of engagement among industry members, and having members who display a good level of management and business skills."

The project team will run workshops in 2015 to allow growers and other industry members to provide their perspectives and feedback on the Resilience Assessment.

More information

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THE ROAD TO RIPARIAN REGENERATION



RESEARCHERS ARE INVESTIGATING PATTERNS IN THE REGENERATION OF RIPARIAN VEGETATION ACROSS THE NORTHERN MURRAY-DARLING BASIN TO DETERMINE WHAT DRIVES REPRODUCTION, SEED DISPERSAL, GERMINATION AND SEEDLING GROWTH AMONG RIPARIAN TREES, SHRUBS AND UNDERSTOREY PLANTS.

The riparian regeneration project is being undertaken with support from CRDC by Dr Sam Capon from Griffith University's Australian Rivers Institute. The research seeks to inform best practice for managing riparian lands on farms in the Northern Murray-Darling Basin's cotton growing regions.

"The project is exploring the notion that successful recruitment (the successful regrowth of reproductively mature individuals into a population) of many riparian trees and shrubs is often rare and extremely patchy temporally and spatially," Sam said.

Surveys in 2013 and 2014 of riparian sites along the Macintyre, Weir and Balonne rivers (and their tributaries) and the Barwon-Darling River found very little regeneration of river red gum (*Eucalyptus camaldulensis*), coolibah (*E. coolabah*) or lignum (*Duma florulenta*). In contrast, significant numbers of river cooba (*Acacia stenophylla*), whitewood (*Atalaya hemiglauca*), creek wilga (*Eremophila bignoniiflora*) and weeping myall (*Acacia pendula*) seedlings were recorded.

"Our study indicates that soils, surface litter and animal droppings are all important seed sources for riparian vegetation with litter emerging as particularly significant for trees and shrubs," Sam said.

"We have observed that the composition of existing vegetation is different from both the regenerating vegetation and the seed sources present at sites suggesting a potential for changes in riparian vegetation composition and structure to occur over time.

"In particular, shrubby, fast-growing and woody species more commonly seen away from rivers and wetlands could be encroaching on the relatively narrow bands of taller and more open eucalypt-dominated riparian woodlands that fringe most rivers and creeks in the region."

So-called 'woody thickening' has been observed in a wide range of ecosystems around the world, especially in arid regions, and is widely attributed to increasing concentrations of atmospheric carbon dioxide.

While factors such as climate, topography, soil types and hydrology have a clear influence on riparian vegetation dynamics, the research also highlights the importance of local factors, for example canopy and litter cover.

"Our experiments suggest that shade may promote the abundance and diversity of understory vegetation during drier periods while, with wetter conditions, leaf litter can inhibit seedling emergence from riparian soil seed banks that, according to our research, are

MAIN IMAGE: Riparian regeneration research suggest there is the potential for shifts in riparian vegetation composition and structure to occur over time.

INSET: The study indicates that soils, surface litter and animal droppings are all important seed sources for riparian vegetation.

dominated by weed species," Sam says.

"Land management activities that impact on canopy and litter cover, including clearing and grazing, therefore have the potential to affect vegetation regeneration.

"Clearing, for instance, may lead to reductions in the cover and diversity of understory vegetation during dry periods while disruptions to litter cover resulting from clearing of grazing may favour the establishment of weeds. "Any woody thickening of riparian woodlands that might be occurring could also be aggravated by planting or movement of fodder crops.

"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."

More information

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COMMUNITY AND GROWERS CARING FOR RIVERS

Macquarie Valley cotton growers are working to improve riverine health with the release of native fingerlings into the Macquarie River.

CottonInfo Regional Development Officer Amanda Thomas was involved in the event at Warren and said many organisations had come together to make it a “great day out on the river with a great result for riverine health”. The event involved the Warren Youth Group, led by cotton grower Tony McAlary in releasing 6000 golden perch fingerlings. Prior to the release, the youth group researched which habitats in a river are best suited to fingerlings’ survival. They then identified areas along the Macquarie near Warren that met the criteria and the fingerlings released into these habitats from canoes.

Amanda said the event had a strong focus on the youth, as we got them to seek out the



Warren Shire Council General Manager Ashley Wielinga, Warren youth group members Isabella Gordon, Paula Gordon, Jade Gordon, CottonInfo Macquarie RDO Amanda Thomas, Warren Shire Council Mayor Rex Wilson and (at front) youth group members Amber Gordon, William Gordon, Lilly Gordon and Airlie Thomas.

habitat that would protect the fingerlings, and calculations on populations of fish, based on previous releases.

“The growers here are behind this as they are seeing the improvement of perch numbers and are connecting the timing of previous releases with the number of certain size fish

they are seeing in the river,” Amanda said.

“Carp have been a problem here and we all know the damage they can cause to our rivers and native fish populations.

“However, these releases, combined with the regular carp musters are really tipping the balance in favour of the native species in the river.”

SETTING THE BENCHMARK FOR GROUNDWATER HEALTH IN COTTON CATCHMENTS

RESEARCH INTO GROUNDWATER ECOLOGY IS REVEALING NEW SPECIES AND BIODIVERSITY IN THESE UNDERWATER SYSTEMS.

A CRDC-funded research project is now revealing the intriguing biodiversity in these systems, and making it possible to accurately monitor the ecological health of our bores and interconnected groundwater systems.

Despite the significance of groundwater for irrigated agriculture and economic development generally in Australia, there had been little reliable information on record about groundwater ecology prior to this study.

“Research focused on the biological components of groundwater is a relatively recent endeavour in eastern Australia; consequently, the majority of the stygofauna (highly specialised invertebrate that live in aquifers) found in this study belong to species, or even genera, that are entirely new to science,” CRDC NRM R&D Manager Jane Trindall said.

“Uncontaminated groundwater is vital for agriculture, and the research has highlighted the importance of natural aquifer ecology in maintaining water quality.

“Specifically, the researcher Dr Kathryn Korbel is interested in the roles of two broad groups of organisms: groundwater microbes, and stygofauna.

“Together, these groups of organisms effectively maintain water quality and potentially

maintain flow in aquifers, so that it remains suitable for drinking and agricultural purposes.”

Dr Kathryn Korbel and her team at Macquarie University’s Department of Biological Sciences developed the Groundwater Health Index (GHI) for the cotton industry in 2011. This framework for assessing groundwater ecosystem health is being refined to create a tool that can be applied across the industry. In this project, the index will be used to specifically benchmark aquifer health in the Gwydir, Namoi, Condamine and Macquarie catchments.

“We will use this index to establish a baseline inventory of stygofauna and microbes within the target catchments, and analyse data to better understand how diversity within these communities responds to environmental conditions and land-use practices,” Kathryn said.

The GHI has already been trialled in the Gwydir and Namoi catchments and overseas with promising results, but before it can be implemented on a broader scale across cotton catchments, the impact of regional variations and the influence of local environmental factors will be tested to ensure the robustness of the framework. Previous research in the Gwydir and Namoi catchments has identified biological differences in ecosystems under irrigated and non-irrigated land. Preliminary evidence in these catchments indicates increased diversity and abundance of both stygofauna and microbes at sites adjacent to irrigated farms. The implications of these findings in terms of groundwater health and quality are unclear at this stage.

“The GHI combines a range of measurements including complex DNA sequencing tests which will reveal the richness of microbes and stygofauna macroinvertebrates living in the groundwater,” Kathryn said.

“Other tools incorporated into the Index are relatively simple, such as the use of calico strips. “The tensile strength of the calico is tested before and after immersion in the bore for up to six weeks.

“The tensile strength at the end of the experiment indicates how much of the strip has been eaten away by microbes. It’s a very accurate measure of microbial activity.

“We’ll be adapting the GHI for use by farmers, catchment managers and consultants, and we’ll simplify it for easier interpretation by water managers and regulators.

“This framework is the first framework anywhere in the world that attempts to measure the health of groundwater using a combination of ecological, environmental and water chemistry measurements.

“This project will perpetuate the cotton industry’s reputation as a leader in groundwater management, promote ecological sustainability and fill significant knowledge gaps about groundwater health, while also improving the capacity for future management of this resource.”

More information

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GRASSROOTS GRANTS

2015 GRASSROOTS GRANTS OPEN IN JULY

CRDC's Grassroots Grants can assist farmers keen to set up their own local project, be it a weather station, support to undertake tactical research to solve a particular on farm issue or other initiatives that build capacity within the industry.

The Grassroots Grant program encourages groups of cotton growers and Cotton Grower Associations (CGAs) to apply for funds to support capacity building projects in their region.

Up to \$10,000 in funding is available to CGAs to help fund a project that will increase the engagement of growers in the industry, solving specific regional issues and improving their skills, knowledge base and networks.

Applications for the next round of Grassroots Grants will open on July 1 2015 and close on December 20 2015, with applications reviewed on a first-come first-served basis.

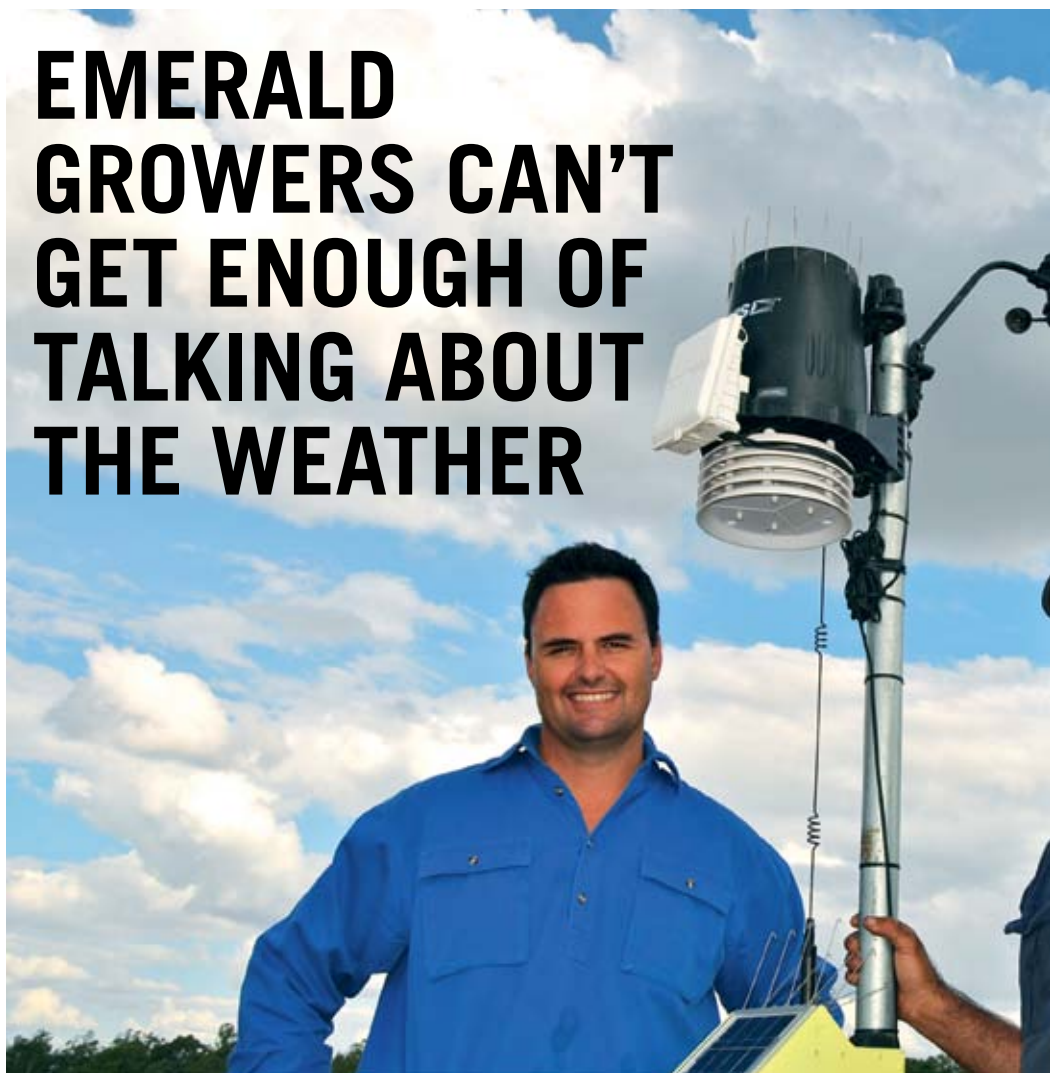
For more information about Grassroots Grants
Sally Hunter
0459 944 778

sally@fundbase.com.au
Or log on to the 'For Growers' section at www.crdc.com.au then click on the COMMUNITY AND GROWER SUPPORT tab.

see our website

email us

EMERALD GROWERS CAN'T GET ENOUGH OF TALKING ABOUT THE WEATHER



WE ALL KNOW FARMERS LOVE TALKING ABOUT THE WEATHER, BUT COTTON GROWERS AT EMERALD ARE LOOKING DEEPER INTO METEOROLOGICAL DATA WITH THE INSTALLATION OF NEW WEATHER STATIONS.

Two new weather stations in the Emerald region, installed with support from CRDC's Grassroots Grant program are improving growers' decision-making ability and creating greater awareness of variability in localised weather conditions.

"We're getting users checking the website about 15 times a day!" says Emma McCullagh, president of the Central Highlands Cotton Growers & Irrigators Association (CHCG&IA), when asked about farmer interest in the weather station project, and she insists that's no exaggeration.

"It's a great success - growers, consultants and contractors are all utilising the technology. There are up to 30 growers locally logging on, and they're checking the site frequently.

"The new devices add to two other stations and have been installed in optimal positions so that the greatest coverage for the area is received."

Access to accurate data and weather information is important to landholders as it allows for improved spray application efficacy and results in savings in chemical costs.

"Gaining the CRDC Grassroots funding meant we could expand the network

to increase grower and industry capacity in the region," Emma said

"Better data and greater knowledge about how to utilise weather monitoring tools is definitely an advantage for farm managers."

Emma says an interesting side benefit of the weather stations has been the increased community connection and dialogue between growers.

"Farmers across the district are feeling more connected, and being able to see exactly what's happening with the weather in different parts of their district, has given them a better understanding of the regional variability in conditions" she said.

"It's not been uncommon to see a disparity in rainfall amounts of 30mm within a five kilometre radius."

The network of four stations was launched in December last year. The stations installed under the Grassroots Grant added to two existing stations, which increased the geographical reach of the network to growers.

Biosecurity QLD Crop Protection Officer Michelle Janes initially identified the need for a weather station network that would enable greater accuracy in on farm decision making for growers by



BETH BURNETT

Brothers Nigel and Ross Burnett "Colorada", Emerald, with one of the four weather stations installed on properties in the region.

capturing local weather conditions in real time, leading to the installation of the first two stations last year. The CHCG&IA then applied for a CRDC Grassroots Grant to install another two stations to increase the reach to growers.

This network launch included a workshop for growers to explain how the network operates and provide information about how the data can be used in spray applications.

The weather station network now provides irrigation and dryland farmers in the Emerald region with free, around the clock on-line access to real time weather data. This information enables more accurate calculation of optimal chemical application and off site weather monitoring, complementing spray application technology and mitigating the risk of spray drift.

The CHCG&IA has taken on the management of the network, to ensure the ongoing sustainability of the project, providing scheduled maintenance, correct calibration, and grower access.

"Our association is very happy to take on ongoing responsibility for this project because the benefit to our members and the wider community are immeasurable," Emma said.

More information

Log on to Emerald weather station data at: <http://ozforecast.com.au/cgi-bin/weather.cgi?station=Emerald.QLD&radar>



WATCHING THE WEATHER AT WALGETT

THE WALGETT COTTON GROWERS ASSOCIATION (CGA) HAS TAKEN ADVANTAGE OF A CRDC GRASSROOTS GRANT TO MAKE DETAILED WEATHER DATA AVAILABLE TO LOCAL FARMERS.

The Walgett CGA wanted to gain a better understanding of weather patterns and improve their knowledge of the many forecasting and modelling tools available on-line. By increasing the number of weather stations in their area, and learning more about how to use the data recorded, a key goal is for local farmers to more accurately predict weather events.

Equally as important, better data and greater skill in interpreting weather information will assist famers in monitoring and predicting wind changes to reduce the issue of spray drift.

Four weather station units were installed by the CGA on properties around the Walgett district in spring 2014, just in time for the new planting season. Unfortunately due to dry conditions, total plantings in the area were well below average, but there's still been strong interest in the new technology.

One of the new units has been installed on Wal Friend's property, "Carlton".

"Using these devices is giving us an even more comprehensive picture of what the weather's doing in this part of the world," Wal said.

"It's been surprising to see how much variation there is over a relatively small area, and this new information adds to the tools we can use for irrigation scheduling and spraying.

"It's particularly useful to have that real time record of wind data, temperature and humidity. I can look that up while I'm on the job out in the paddock, which is pretty handy."

Each unit consists of a solar panel, a wind vane, and gauges to record rainfall, temperature and humidity. Data is automatically logged every 15 minutes to a website that can be accessed by farmers throughout the region, whether they're growing cotton, chickpeas, sorghum or any other crop.

"Many growers weren't aware of the detailed wind direction and strength models that were already available on the Bureau of Meteorology website," says CottonInfo Regional Development Officer Geoff Hunter.

"We held a training session for growers and advisors where CottonInfo Carbon and Climate Technical Specialist Jon Welsh explained how our new weather station data and the various BOM models can be used to minimise



A weather station has been installed on Wal Friend's property, "Carlton", as part of a CRDC Grassroots Grant project.

drift and interpret forecasts.

"The Walgett CGA farmers are also now firmly aware of the fortnightly Moisture Manager newsletter distributed by CottonInfo, and how they can make the best of use of that information thanks to Jon's presentation.

"The feedback from the evening was excellent with growers showing a great deal of enthusiasm for the project.

"It was also a very beneficial social event and despite a less than inspiring season, there was animated discussion about other potential projects the CGA could get involved in."

Growers contributed financially to project costs, and supplied materials for the installation. They're also involved in ongoing maintenance increasing their engagement in the project.

"We've started a discussion about mitigating risks associated with weather and what other areas of knowledge we need to tap into," Geoff said.

"And we're now looking to run some webinars throughout the year looking at the key models which affect our weather at Walgett."

More information

View the Walgett Weather Station data: <http://ozforecast.com.au/cgi-bin/weather.cgi?station=Walgett.NSW&radar>
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THE SAFETY IMPERATIVE: MAKE YOUR FARM WHS PLAN A PRIORITY

FARM SAFETY IS AN ONGOING PART OF RUNNING A VIBRANT, SUCCESSFUL COTTON FARM.

CRDC is committed to helping make cotton farms the safest in Australia. This includes continued involvement in the Primary Industry Health & Safety Partnership (PIHSP), a group of RDC's under the helm of RIRDC, that look collaboratively at national farming operations to identify the 'big ticket items' affecting health and safety in farming communities. CRDC representative, Sally Knight has recently flagged some messages for the cotton industry to encourage increased participation in farm safety.

As a farmer for 30 years, living and working on the family farm near Wee Waa in North-West NSW, Sally fully understands what is involved in making farms as safe as possible and looks constantly through 'new eyes' at farm safety issues.

"All farmers are aware that the 'right thing to do' is to protect our employees and contractors, as well as our family and visitors," Sally said.

"And there are a range of basic steps we can enact to ensure we are doing just that.

"We are still seeing far too many WH&S incidents on Australian farms – and the majority could be prevented according to research by the Australian Centre for Agricultural Health and Safety."



MELANIE JENSON

Farm safety is everyone's responsibility, and the first step in managing farm safety is developing a Work Health and Safety plan and being sure all those who come onto the farm are aware of it.

Recent PIHSP research - Mapping work health and safety risks in the primary industries-involved an analysis of workers compensation data from 2008-09 to 2011-12 shows that for every 1000 workers in the cotton sector, 387 weeks of work were lost due to injury. The median time off work was 1.35 weeks with a cost of \$2150 per injury.

"While these figures highlight the economic impact of WH&S incidents, CRDC is first and foremost mindful of the devastating impact of workplace death and serious injury for the workers affected, their families, their friends and the broader community," Sally said.

A Cotton Industry Injury and Safety Profile identified nine deaths related to cotton production between 2001 and 2013, with fatalities resulting from incidents involving aircraft, cotton pickers, farm utes, forklifts, module builders, irrigation pumps and other plant, as well as the drowning of one child on farm.

Start with a farm safety plan

The first step in managing farm safety is developing a Work Health and Safety (WHS) plan that can save lives and money, reducing the tragic human cost of serious injury and the financial burden of lost productivity. There are four key steps in managing the risks on-farm:

- Identifying hazards
 - Assessing the risks
 - Controlling or eliminating risks
 - Reviewing risk control measures to ensure they are effective in practice
- "Systematically working through

these requirements will also provide evidence to defend against prosecution or fines in the event of an incident occurring," Sally said.

Another crucial issue, particularly as the season progresses, is managing fatigue.

"If you and your staff have been working long hours over an extended period, there is a cumulative effect," said Dr Tony Lower, Director of the Australian Centre for Agricultural Health and Safety.

"You need to think about how long people have had off between shifts, factoring in travel time if they're traveling some distance to the farm.

"Rotating shifts and varying tasks between workers to maintain their concentration can be helpful, and ideally you want to ensure workers have at least one day off a week.

"The cost of employing an extra staff member to manage fatigue during busy periods could also be a cheaper option than a serious injury or repairs to machinery worth hundreds of thousands of dollars."

Workers also have a responsibility to come to work well rested and fit for work. However Tony encourages the promotion of a work culture which allows staff to admit they are tired and also encourages general communication about safety concerns.

"Most producers know the risks on their property better than anyone else, but bringing in other perspectives can highlight risks and hazards a farm manager may not have identified," Tony said.

MORE INFORMATION

- Sally Knight said she would love to hear from farm managers with any tips and solutions to managing WHS on their cotton farm, and what they would like to know about WHS. Contact Sally on 0427 955 133 or pandsknight1@bigpond.com
- The *myBMP* website www.mybmp.com.au provides the industry's most complete source of industry information and resources.
- State Work Health Authorities in NSW and Queensland will provide free assistance to help with WHS issues.
- Australian Centre for Agricultural Health and Safety Centre's report and wide range of material www.aghealth.org.au/index.php?id=111 or call 02 6752 8210.
- A detailed guide to WHS requirements- www.rirdc.infoservices.com.au/items/14-088
- The report Mapping work health and safety risks in the primary industries at www.rirdc.gov.au/PIHSP

