Cotton Research & Development Corporation

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Spotlight on Cotton R&D

Winter 2008

- Resistance management: crucial to our future
- Future climate: how will you cope?
- Contamination: more to a bale than cotton

Cotton farming in a climate of change

- 2008 Conference holds the key

Australian Government
Cotton Research and Development Corporation

Winter, June 2008

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

CRDC is a research and development partnership between the Australian cotton industry and the Australian Government.

Cotton Research and Development Corporation
ABN: 71 054 238 316

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Our vision: A globally competitive and responsible cotton industry

Our mission: Invest and provide leadership in research, innovation, knowledge creation and transfer.

Our outcome: A more sustainable, profitable and competitive cotton industry providing increased environmental, economic and social benefits to regional communities and the nation.

Corporate background
CRDC was established in 1990 under the Primary Industries and Energy Research and Development Act 1989 (PIERD Act.) which outlines its accountability to the Australian Government and to the cotton industry through the Cotton Growers' Research Association (ACGRA). CRDC is responsible to the Australian Government through the Minister for Agriculture, Fisheries and Forestry, Tony Burke MP.

CRDC is committed to fulfil its legislated charter to: Invest in and manage an extensive portfolio of research, development and extension projects to enhance the ecological, social and economic values associated with cotton production systems and to benefit cotton industry participants, regional communities and the Australian community.

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Spotlight

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Taking responsibility for our future

There are many factors that can influence the health of an industry, some are controllable, others are not.

The cotton industry continually strives to identify these issues and move to mitigate their effects throughout the whole supply chain before the issue has a negative effect on the industry participants, or alternatively to harness the issue to use it in a positive way.

This attitude is evident in the way the industry responded to the challenge to reduce pesticide use, resulting in the development of genetically modified cotton and 'softer' control methods for insect pests.

With this technology, however, comes much responsibility and it is a given that unless the responsibility is taken seriously, the benefits it presents can quickly turn into disadvantage.

In the light of the cotton industry's pro-active and far-seeing attitude to future hurdles and opportunities, in this edition of Spotlight we examine the status of resistance in Bt cotton, in particular Bollgard II and the critical need to reiterate the importance of handling this technology through correct procedures and adherence to the Resistance Management Plan.

With more than 80 percent of cotton area in Australia planted to GM cotton and a huge reduction in the use of pesticides, the industry would be significantly challenged to go back to the ways of full conventional cotton. The 2007/08 data set indicates Cry 2Ab resistance in H. armigera being significantly higher than previous years.

Through the articles (Pages 3 to 7) we examine the current status of resistance and offer advice from leading experts on how to manage refuges and management plans to ensure that all growers are aware of the need to take stewardship of this technology.

In the constantly 'changing climate' of cotton production, growers and industry bodies need to keep updated and informed about future challenges particularly in relation to resource management.

Therefore, this year's Australian Cotton Conference themed "Cotton in a climate of change" cannot afford to be missed. Leading researchers into the fields of climate change and how to mitigate the 'possible' effects fortunately for us, work in the cotton industry.

From developing more heat tolerant varieties of cotton, to improving the use of natural resources, and reducing the use of greenhouse gas producing elements in the production chain, will be covered when these experts come together at the conference to offer advice to growers and other industry partners.

To ensure all growers and their staff are aware of the methods to adapt to cotton in a changing climate, admission is free for cotton producers and their staff on the third day (August 14) of the Conference. I urge all within the industry to take advantage of this outstanding opportunity to 'be prepared' and ensure the longevity of their business and the industry as a whole.

Spotlight has included an outline of conference details, and highlighted some of the high-profile and leading speakers who will be in attendance, along with some must-know information from these experts in climate change from Pages 8 to 19, which highlights that the need has never been greater to attend a conference of this calibre.

Contributors: Editorial and photographic contributions to Spotlight are welcomed. All intending contributors should in the first instance contact the Editor.

Cover Photo: By Rossina Gall. Cotton farming is ushering in a new era of technology which will be showcased at this year's Australian Cotton Conference.

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GM Technology

STEWARDSHIP

Powerful but not bullet proof

By CRDC program manager, Ian Taylor

The introduction of Bt cotton technology, in particular Ingard® and Bollgard II®, transformed pest management in Australian cotton farming systems.

The technology has enabled growers to better manage *Helicoverpa* spp. and has also led to significant improvements in IPM systems as well as reducing environmental impact of cotton production.

As Ingard® cotton depended on a single gene (cry1Ac), industry scientists recognised that the success and longevity of the technology would depend on the content and implementation of stewardship programs. When Ingard® cotton was first introduced to Australia, the area that could grown to this product was restricted (capped) to a maximum of 30 percent of the area planted to cotton on any farm unit.

Additionally growers were required to plant non-Bt refuge crops so that Bt susceptible moths would dominate matings should any moths resistant to Cry 1Ac emerge from Ingard® cotton. With the introduction of Bollgard II® the refuge strategy was retained, however the cap on the area planted was removed leading to the current scenario where up to 95 per cent of Bollgard II® cotton can be grown on any farm unit.

This position was adopted because scientific information indicates that the two genes in this product are distantly related and do not share a common binding site. It is therefore thought unlikely that one mechanism could enable resistance to both toxins.

CSIRO have used an F2 test as the primary method for screening for resistance genes in Helicoverpa populations (see article on page 4 by Rod Mahon and Sharon Downes). No alleles conferring resistance to Cry1Ac have been detected to date.

However the F2 tests indicate that for *H. armigera* the baseline frequency of alleles conferring resistance to Cry2Ab is approximately four (4) in 1000.

In 2004 CSIRO developed protocols for testing the frequency of resistance using a modified and shorter version of the F2 method called an F1 test. This method assumes that the various isolates of Cry2Ab detected so far are of the same kind. These protocols were immediately adopted by Monsanto.

During the following two years CSIRO performed experiments which verified that the same mechanism appears to confer resistance in all of the isolates of Cry2Ab detected to date.

Late in 2006 CSIRO began F1 tests to determine the frequency of this particular type of Cry2Ab resistance and have continued these tests at a larger scale in 2007/08.

Results from these two tests with *H. armigera* indicated that the Cry2Ab resistance frequency for F1 screens was at least six times higher than that determined with the F2 tests.

In particular, the frequency of Cry2Ab alleles at the end of the 2007/08 season was approximately three (3) in 100 individuals.

Unfortunately, the frequencies obtained from the F1 screens are likely to most accurately reflect the situation in the field. This is because, compared to F2 screens, the F1 screens involve one less mating cycle in the laboratory and do not involve mating among siblings, which in nature is not likely to occur often.

This is of course concerning, however even more critical for resistance evolution was whether the results recorded in 2007/08 in fact represented a shift in the number resistant individuals being detected in the field.

For the past four years Monsanto have used the F1 protocol developed by CSIRO to screen for resistance at a field level. In the three years from 2004/05 to 2006/07 the frequency of resistance detected in the field had remained fairly consistent with no significant differences between years.

The 2007/08 data set however indicates a deviation from this trend with Cry 2Ab resistance in *H. armigera* being significantly higher than previous years.

This will present some challenges for the industry.

In particular it will be imperative that we all take responsibility for technology stewardship on farms. We know well from previous experience that there is no silver bullet for resistance. We will need to ensure that we pay closer attention to managing our refuges, certainly more so than we have in the past, and it will also be critical that pupae busting occurs in a timely fashion.

Based on simulations from resistance models the technology has suffered in terms of reduced expected longevity now that the resistance frequency has suddenly increased, and its continued efficacy will depend even more on how the industry manages its refuges and implements other management options.

TIMS will also be looking to implement a range of management strategies based on the outcomes of discussions with various industry and grower groups undertaken during the resistance road show held in late May.

RESISTANCE MANAGEMENT

Cotton varieties that produce Bt toxins for the control of Helicoverpa species have revolutionised the Australian cotton industry.

However, it is risky to view Bt-cotton as a silver bullet and also to fail to take responsibility for the appropriate stewardship of this technology.

Considerable care has been devoted to producing a Resistance Management Plan (RMP) for Bollgard II® which is based not only on sound scientific principles but also considers the practicality of the requirements from the perspective of a grower.

Recent results from the CRDC funded Bt resistance monitoring program suggest that it remains as important as ever to pay attention to the reasonable requirements of the RMP.

CSIRO entomology's Rod Mahon at work assessing resistance levels

GM longevity under threat

By Rod Mahon and
Dr Sharon Downes (CSIRO Entomology)

Dr Sharon Downes: Higher frequency of SP15-like alleles using F1 screens.

Since 2002 CSIRO has used a method called an F2 test to screen for resistance genes in populations of Helicoverpa.

This screen tests the grandchildren of single mated pairs of insects collected from the field to identify rare resistance alleles that may be completely recessive. A main advantage of this screen is that it can detect heterozygote (RS) individuals that contain only one copy of a resistance allele. This is important as while resistance remains rare, nearly all R alleles occur in heterozygotes.

The data from these tests suggest that, for *H. armigera* and *H. punctigera*, the frequency of genes conferring resistance to Cry1Ac remains low after 11 years exposure to cotton containing this toxin (initially Ingard® and now Bollgard II®).

However, we have known since 2002 that there is a higher than expected baseline frequency of alleles conferring resistance to Cry2Ab in both *Helicoverpa* species.

Recently CSIRO tested five of the 15 isolated cases of Cry2Ab in H. armigera and found that resistance was caused by the same gene as the first detected case called SP15. While extrapolating a little, it is reasonable to assume that all instances of resistance so far detected are caused by the same SP15-like gene.

This means that it is now appropriate to use an alternative screen known as an F1 test (crossing field individuals with individuals from a CSIRO colony resistant to Cry2Ab) to look specifically at the frequency of SP15-like Cry2Ab resistance genes.

Monsanto have been performing these F1 tests for several years and their data suggests that the frequency of alleles in natural populations may higher than that found using F2 screens.

In 2006/07 and more intensively during this past season, CSIRO also began investigating the frequency of SP15-like Cry2Ab resistance alleles using F1 crosses.

Our data thus far confirm the earlier reports by Monsanto of a higher frequency of SP15-like alleles using F1 screens compared to F2 screens.

Unfortunately, F1 screens are likely to most accurately reflect the situation in the field. This is because, compared to F2 screens, the F1 screens involve one less mating cycle in the laboratory and if resistance is associated with deleterious effects (fitness costs of resistance – see below) such fitness costs will have little opportunity to be expressed. While fitness effects are thought to cause the difference in resistance frequencies as detected in F2 and F1 tests, we are uncertain and the issue is actively under investigation.

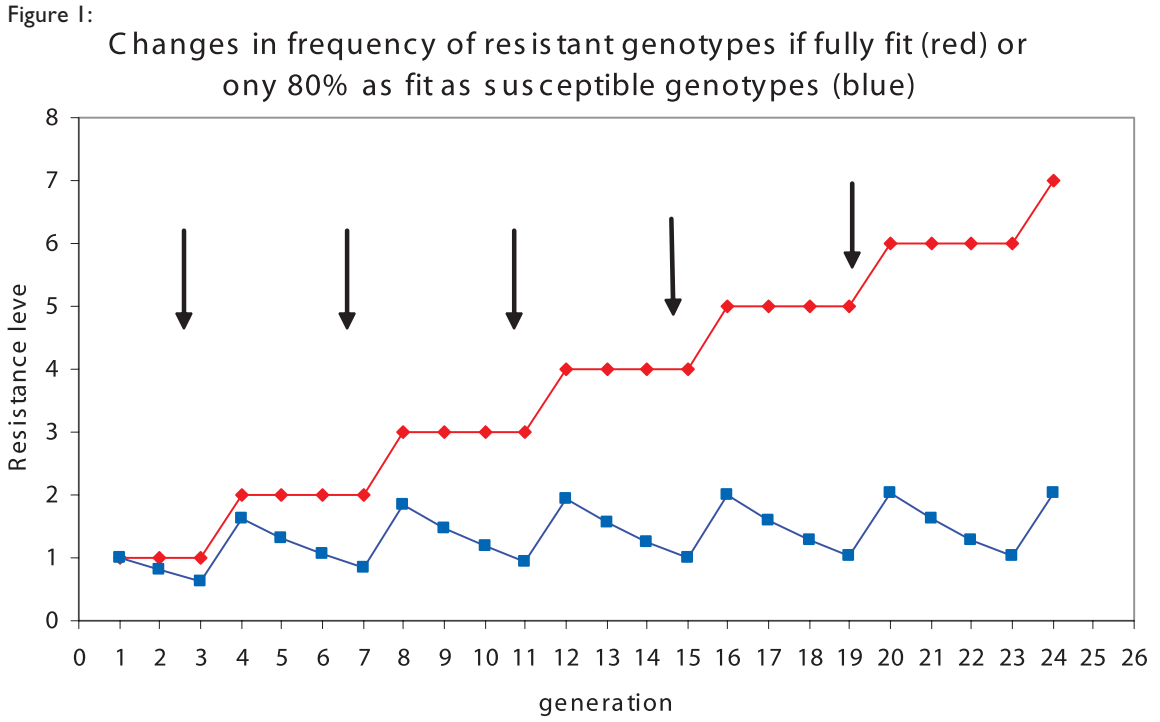
Many forms of resistance make the carrier less fit in environments that do not expose it to the insecticide or toxin. This 'fitness cost' can lead to a decline in the frequency of the resistance.

We have compared the performance of Cry2Ab resistant and susceptible insects in a range of environments that we considered would expose any 'weakness' of the resistant strain. Despite extensive analyses we failed to detect an effect of Cry2Ab resistance in *H. armigera* on larval growth, survival, pupae size, moth emergence, time to pupation, time to emergence, or fertility. This means that whenever Cry2Ab resistant insects are favored, the frequency of resistance alleles may increase, and in the absence of fitness costs, remain at that frequency until the next set of conditions arise to favor another cohort of resistant individuals.

This "ratchet effect" is demonstrated in Figure 1 which shows the changes in frequency of two theoretical populations containing resistant individuals that are exposed to selection every fourth generation.

Following the selection event (indicated by the arrows), the frequency of individuals that are resistant jumps one 'unit'. For one population, there are no fitness costs associated with being resistant (indicated by the red line) while for the other population there is a 20 percent cost to being resistant which means that only 80 percent of offspring in the next generation survive as

Figure 1:



susceptible genotypes in the absence of selection (indicated by the blue line).

Clearly, in the absence of fitness costs of this magnitude, resistance frequencies increase quickly even when only one generation in every four is subjected to selection pressure.

Based on our laboratory tests it is likely that only homozygous resistant insects will be able to tolerate Cry2Ab toxin. With a resistance frequency of 0.03 (as per F1 screens), homozygous individuals that are capable of surviving on cotton expressing Cry2Ab toxin will occur at the square of that frequency $(0.03)2 = 0.0009$. Thus nearly one in every 1,000 individuals would be functionally resistant to Cry2Ab. The frequency of resistance to Cry1Ac is extremely rare and Cry2Ab resistant insects are susceptible to Cry1Ac. So, the frequency of insects that are resistant to both toxins would be vanishingly small.

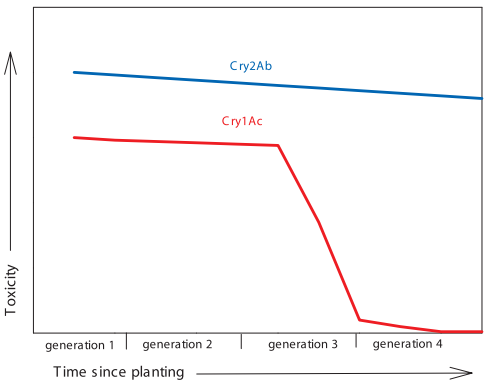
However, the titre of both toxins in Bollgard II® vary markedly (Cry1Ac range 0.39 – 4.19, Cry2Ab 4.55-33.3 mg/kg fresh weight of leaf material) which may provide opportunities for insects that are resistant to only one toxin.

In particular, homozygous Cry2Ab resistant insects may be favored on Bollgard II® whenever the Cry1Ac titer declines to levels that Cry1Ac-susceptible insects can tolerate. Such events are more likely to occur late in the season on mature Bollgard II® cotton. Our laboratory studies that exposed Cry2Ab resistant insects to field-grown Bollgard II® confirmed that there was limited survival on early squaring cotton, but numbers increased on late season cotton.

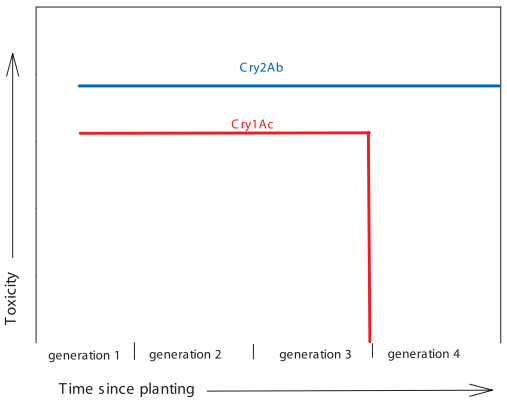
While we do not know why the frequency of resistance derived from F1 and F2 tests differ, we accept that F1 values provide the best estimate and therefore will need to reassess our expectations about the resilience of Bollgard II®.

Using computer models of the evolution of resistance can help us understand the likely consequences.

Schematic representing toxicity of Cry1Ac and Cry2Ab during the growing season



Simplified version used in the mode



In the figures above, we present two schematic diagrams of the concentration of two toxins in a two-gene Bt crop.

In the figure on the left, we show our guess of what the concentration of the two toxins may be during the growing season in a Bollgard II® crop. It is important to note that this is based on our extensive data on Cry1Ac toxicity in Ingard and has not been confirmed for Bollgard II®.

An important feature to note is that because the Cry1Ac toxin declines with plant age, by the end of the season the impact of Bollgard II® on Helicoverpa larvae may only be due to Cry2Ab.

The figure on the right is our simplified version of this schematic that we used to model the evolution of resistance to Cry2Ab. In this figure, we assume that there are four generations of *Helicoverpa* a year. The first three generations of *Helicoverpa* exposed to Bollgard II® are faced with Cry1Ac and Cry2Ab toxins at lethal concentrations. Because genes conferring resistance to Cry1Ac are rare (we haven't found any) all insects will die during those generations. However, we hypothesise that the larvae hatching from eggs laid on Bollgard II® in the last generation will only have to cope with Cry2Ab toxin.

In the model we also input details about the resistance from our research over the last few years.

We assume that the resistance is recessive (an individual needs two copies of the resistance gene to survive Cry2Ab) and there are no fitness costs. We further assume that all insects in the population mate at random which is presently being examined by our colleagues Geoff Baker and Colin Tann.

The other parameter assumed in the model is an effective refuge of the size and type defined in the RMP. Lastly, we assume that the mandated refuge is the only alternative to Bollgard II® for *H. armigera* survival. We are interested in exploring the impact of differing initial resistance frequencies.

The model 'digests' the input parameters and generation by generation calculates new estimates of the frequency of the resistance gene, R.

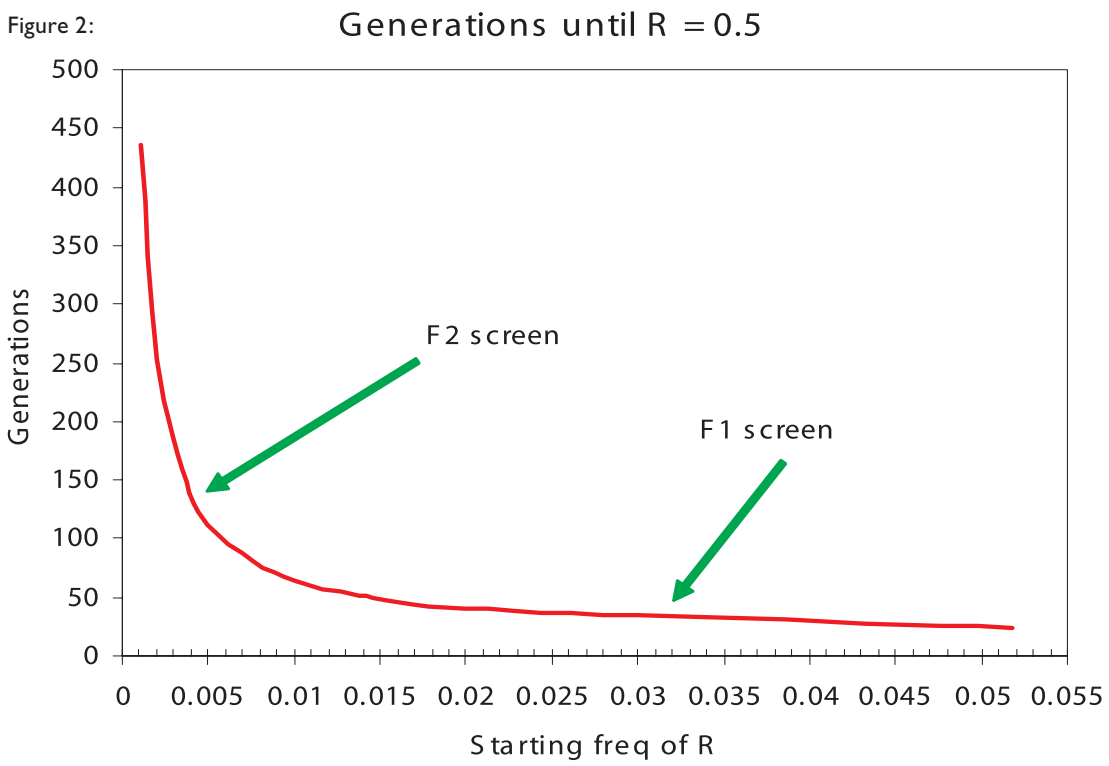
Figure 2 (next page) shows how many generation until R = 0.5 (which is when we would expect field failures) with differing starting frequencies. Highlighted is the expected longevity of Bollgard II® when the starting frequencies are the current estimates from the F2 versus F1 data.

Accepting the F1 frequencies rather that the F2 estimates means we face resistance far more quickly.

Because our model is a gross simplification, the actual number of generations (approximately convertible to years if you divide by four) can only be taken as a guide. It is more appropriate to consider relative length of time, i.e., when we use the F1 estimate the number of generations until failure is nearly four times lower than when we employ the estimate from F2s.

Resistance Management

Figure 2:



The main point is that the new data on F1 frequencies have alerted us to the fact that the longevity of Bollgard II® is likely to be much less than we thought when we were relying on the frequencies we obtained from F2 tests.

It is important to note that according to our model we have already passed a critical inflection point.

At frequencies of R below 0.003, the number of generations increases dramatically, while once resistance frequency exceeds 0.007, the number of generations until field resistance occurs declines quickly and then plateaus.

The main point is that the new data on F1 frequencies have alerted us to the fact that the longevity of Bollgard II® is likely to be much less than we thought when we were relying on the frequencies we obtained from F2 tests.

If refuges are not managed correctly, their productivity declines. If we re-set the model to vary the efficacy of refuges while maintaining the current starting R frequency (at 0.03) we can generate new expectations to demonstrate the importance of the refuge. A poorly managed refuge produces fewer susceptible moths which has the same effect as reducing refuge size.

There is a clear linear relationship between refuge size (efficacy) and the time before resistance develops (see Figure 3 below).

If refuges are well managed, we could assume that 0.1 of the eggs laid in each generation are not exposed to selection for Bt resistance and with normal levels of larval survival, produce viable adults. In this case, the model predicts that we would have 28 generations before field-scale resistance to Cry2Ab occurs.

If refuges are poorly managed and only produce half the expected number of moths, resistance develops earlier, after 20 generations. Again we stress that it is more appropriate to consider the relative loss (28 percent) rather than actual number of generations.

It is critical that the industry maintains the rigour of the Resistance Management Plan for Bollgard II®, including improving the efficacy of refuges.

We continue to develop and implement more sensitive tests to detect changes in the frequency of resistance alleles.

In the short-term, this involves using F1 tests that will enable an increase in the number of SP15-like alleles scored but it is still important that we perform F2 screens to detect any other forms of resistance to Cry1Ac or Cry2Ab.

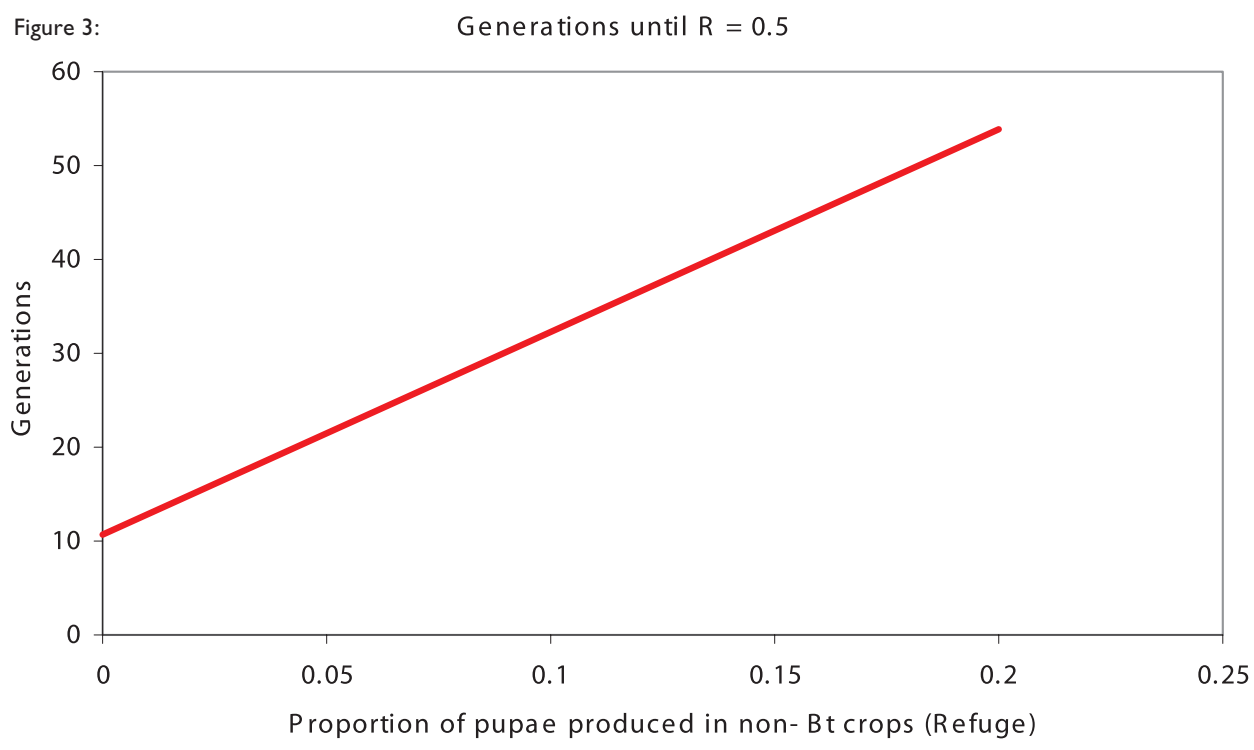
Longer term, the likely answer will be fundamental research to isolate the gene conferring resistance which should allow the development of DNA-based techniques to score resistant alleles.

Such techniques will enable vastly increased numbers of insects to be tested for resistance and therefore enable the detection of subtle changes.

Importantly, this approach may enable an increase in frequency to be detected earlier, and thus provide the Australian cotton industry with more time and opportunities to undertake remedial action to slow the rate of evolution of resistance.

There is a clear linear relationship between refuge size (efficacy) and the time before resistance develops

Figure 3:



STEWARDSHIP

Managing refuges critical

Managing refuges to the best of their ability and within the guidelines of the RMP is a crucial factor for growers.

Colin Tann and Geoff Baker, CSIRO Entomology

The long-term success of Bt cotton relies heavily on effective and cost-efficient strategies to counter the development of Bt resistance in *Helicoverpa*. This includes the deployment of refuge crops to generate susceptible moths.

Refuges need to be attractive and well managed to ensure they have the capacity to attract *Helicoverpa* moths to lay eggs and therefore produce a population of susceptible moths that are capable of inter-mating with Bt resistant survivors from the transgenic crops.

Not all refuges are going to perform, but they do at least need to be of such a standard as to have that capability.

Given the continued drought and importantly the lack of water available for irrigation, many growers are increasingly questioning the science behind the refuge strategy for Bt cotton. In immediate economic terms, the strategy is costing them money.

In recent years, it has been apparent that many unsprayed refuges have been growing very poorly. In some cases they appear to have not been managed at all, and would not have performed as required.

This has been very disappointing considering that growers have initially agreed to the refuge requirement when they plant Bollgard II, and this agreement is in place to ensure a future with this technology.

In years with low cotton plantings, such as we have experienced recently, some growers believe the need for refuges is reduced. However, the value of refuges in fact increases, because the general availability of moths elsewhere in the landscape is most probably lower.

There is an ongoing need for growers to recognise that refuges are a necessary part of growing Bt cotton and that the cost of such needs to be factored in to farm management.

There are many refuge options available (including both sprayed and unsprayed), and research is presently focused on improving these options by making them more practical for the grower and indeed less of a burden.

For example, alternative five percent options for both dry-land and irrigated situations are likely to be investigated in the coming cotton season.

At present, sorghum and maize can be grown in three plantings as an unsprayed option for irrigators, but pigeon pea and unsprayed cotton have generally been more favoured due to their lesser (area) requirement. Pigeon pea in particular, at five percent requirement, has become the most popular unsprayed option and continues to attract *Helicoverpa* on a more consistent basis, though there are some recent concerns about the survival of these developing populations and hence the moth production resulting.

The clear benefits of pigeon pea are that the plants are very resilient and they will continue to regenerate, and hence re-establish attractability, with the potential of hosting many generations during the cotton growing period.

Being in synchrony, in terms of producing moths, to the transgenic cotton is clearly ideal, but becomes less important when a refuge plant is performing well on a continuous basis. Good management is therefore critical.

If unsprayed options prove to be not suitable for growers, they do have the option of growing conventional lines of sprayed cotton, and in that context they do not have the frustration of a potentially unproductive crop and land.

Growers should study the RMS guidelines for growing Bollgard II cotton carefully and decide what works for them. Unsprayed refuges are just an option but are generally attractive due to less land requirement.

Present research is also addressing issues of refuge efficiency such as the degree of inter-mating of moths from different crop sources (current refuge strategies assume such mating occurs at random), the degree of movement of moths and the possible differences in fitness costs between Bt survivors and refuge reared moths that may effect inter-mating.

There has been some suggestion in overseas scientific literature that moths generated from different crop types may not mate at random. Our data thus far (albeit collected for only a limited number of refuge crop types) has however suggested that there is in fact sufficient random mating occurring on the landscape.

CSIRO will continue to evaluate the importance of other factors contributing to, or inhibiting refuge performance, especially the abundance of other invertebrate pests and beneficial species.

Managing this aspect of refuge success may well prove a problem in the future as we continue to move away from the more disruptive pesticide products.

In light of recent resistance findings the use of refuges has never been more important and if growers wish to take up the many advantages of growing Bt cotton they need to also accept the responsibility of growing a good quality, well managed refuge that has the potential to perform well.

Good preparation, adequate weed control, and sufficient watering (within an irrigated environment) are essential to ensure the success of a refuge.

If this refuge concept is unacceptable to a grower for whatever reason, they should not attempt to grow Bt cotton and potentially put at risk the future of this industry!

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Super conference: COTTON IN A

Attend the third day for free - Solutions for managing your water

Cotton growers wanting to make the most of their water can't afford to miss a free day on practical solutions for managing water, during the 14th Australian Cotton Conference at the Gold Coast on 14th August 2008, thanks to Department of Agriculture, Fisheries & Forestry (DAFF) and Cotton Australia (CA).

Titled "Growing Cotton's Future: Practical Solutions for Managing Your Water", the free day for growers and their staff will provide key research and practical water use efficiency advice, focused on how to improve production with limited water.

The free day is supported by the Department of Agriculture Fisheries & Forestry (DAFF) through the Irrigated Agriculture Workshop Program and will complete the three day "Cotton in a Climate of Change" conference.

"Growing Cotton's Future: Practical Solutions for Managing Your Water" demonstrates government and industry working together to ensure a more resilient and adaptable industry for the future.

"Cotton Australia is very grateful to DAFF for their significant support, particularly in such difficult financial times," says Adam Kay, chief executive officer, Cotton Australia.

"This free day offers growers relevant, practical advice from other growers and leading researchers and the chance to interact with experts in the field of drought management and water use efficiency.

"Growers wanting to make their water go further should not miss this valuable knowledge day," he said.

Topics include business management during drought, developing more efficient irrigation systems, cotton varieties that handle heat and effects of climate change.

This year spouses and partners will also attend the entire conference at half price.

? More information: www.australiancottonconference.com.au

Pete Johnson

Chairman Australian Cotton Shippers Association (ACSA)

This year's conferwence will bring together a far more diverse group than either ACSA or ACGRA have experienced at their individual conferences before.

We are expecting excellent attendance, with a varied and extremely relevant program for the entire cotton industry supply chain, from growers to brand owners and retailers.

Merging of the conferences is efficient use of our resources and experience, and sponsors and exhibitors will benefit from receiving more 'bang for their buck'.

In the future, we hope the Australian Cotton Conference becomes the penultimate cotton function on the Australasian cotton calendar catering for the entire cotton industry supply chain. Together, we can map out a way forward as our industry begins to gear back up.

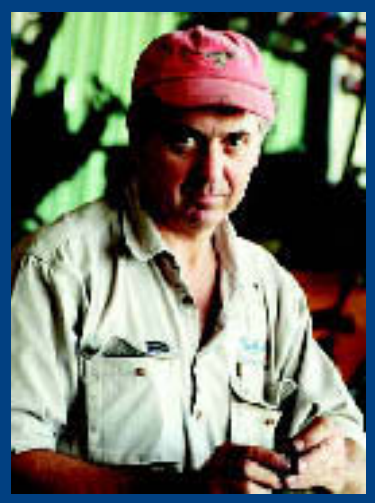
Joanne Grainger

Chairperson Cotton Australia

As part of the DAFF 'Managing the Drought" project, Cotton Australia identified the conference as an opportunity to support the industry and growers by providing a day free to growers and their staff. We encourage them to attend and register for the whole program at a time when most are watching every dollar.

The day will provide information and support for growers contributing to their capacity to recover from drought and enabling them to set future directions for their enterprises. It's all about developing resilience and managing challenging issues, whether it is drought or any risk.

As a result, growers will be able to review their cotton growing enterprises and adapt their practices to manage a changing business. Above all Cotton Australia hopes to provide a positive outlook for continuing to produce cotton as the industry progresses through these testing times.



Mike Logan

Chair Cotton Research and Development Corporation (CRDC)

This year's cotton conference is shaping up to be very important.

We are forever in a state of being challenged, but now the challenges are all new.

The competition for available land and water is becoming intense and the cotton industry needs to be prepared.

We now have the opportunity to focus on the quality of our product that will allow sustainable access to markets for years to come. The relationships and understanding along the cotton supply and processing chains are sufficiently strong for us to work collaboratively to improve our cotton products.

This conference will highlight the strengths of these relationships and identify opportunities throughout every aspect of the industry.

I commend the conference to you as something we all need to be a part of.

Australian Cotton Conference 2008

CHANGING CLIMATE

australian cotton conference

This year's 14th Australian Cotton Conference to be held at the Gold Coast from August 12-14 reflects a new era of industry co-operation, with the Australian Cotton Growers Research Association (ACGRA) and Australian Cotton Shippers Association (ACSA) combining forces to unite the entire cotton industry - from research and production through to marketing and consumer requirements, at one biennial conference.

"The conference theme, "New Beginnings – Cotton in a Climate of Change", reflects current challenges and future opportunities for the industry as it recovers from drought and begins to build for the future," says ACGRA chairman Ben Stephens.

He said traditionally the cotton industry is renowned for its proactive and innovative approach and it will continue as a leader in agriculture in terms of research, development and productivity.

ACSA chair Pete Johnson said that ACGRA and ACSA joining forces sent a strong message for both the Australian industry and to the markets we serve that we are united in seeking a customer-focused future.

He said it "will assist us in raising the profile of Australian cotton internationally while establishing a joint forum for information sharing up and down the value chain."

The program features informative, relevant and diverse presentations by passionate professionals and experts including the 2007 Australian Scientist of the Year, Australia's only Professor of Climate Change and a Nobel Peace prize recipient.

The event offers tremendous value with high calibre keynote speakers and expertise under one roof.

For the first time cotton growers can expect special offers including free admission to the third day of the conference, titled "Growing Cotton's Future: Practical Solutions for Managing Your Water", brought to them by Cotton Australia (CA) and Department of Agriculture, Fisheries & Forestry (DAFF). An additional bonus this year for attendees is the offer for spouses and partners to attend the conference for half price.

"Aside from the quality speakers and information packed days, we hope participants can take advantage of the Gold Coast while they are here and enjoy a break before heading home again," say event organisers.

The conference offers free child minding and trade demonstration and displays from more than 70 exhibitors.

One-stop knowledge shop

In a climate of change, technology is often at the forefront and the fastest moving driver.

In keeping with this and the 2008 theme of "Cotton in a climate of change", participants will for the first time receive all the information presented at the Conference in a convenient and transportable package, via a USB flash drive.

The flash drive will contain all presentations and posters from our leading experts together with general information about the conference, including exhibitors and sponsors as well as a link to the newly created website www.australiancottonconference.com.au

Organisers are well aware of the challenge attendees face in retaining all the must-have information presented over the three days, which is hoped will be used well after the conference, especially by cotton growers, to improve and enhance farming systems through increased efficiency and profitability which translates to the entire value chain.

The new website forms a permanent information base and reference for the Conference. This will be continually updated to keep participants up to date and ahead of the pack in terms of research and developments in the industry.

The Conference flash drive is available exclusively to attendees, and the website will also contain audio and visual of speakers' presentations together with information on presentations from previous conferences.

Beyond the conference, the website will be continually updated with the latest information from all aspects of the industry, to form a comprehensive knowledge base available to conference participants at the click of a mouse.

The www.australiancottonconference.com.au website is currently up and running and is the first port of call for conference registrations, speaker information and profiles, program of events, accommodation options and all other relevant information to make it easy for you to get to the conference!

www.australiancottonconference.com.au

australian cotton conference

SPEAKER PROFILE

Professor Peter Grace
Director, Queensland University of Technology (QUT)

Ground breaking research into greenhouse gas

Professor Grace is the Professor of Global Change at QUT and is the only such qualified person in Australia.

He is an agro-ecologist and natural resource management specialist with more than 15 years' international experience in carbon cycling, greenhouse gas emissions and agricultural risk management in the Americas, Asia, Australia and Africa. He was formerly lead scientist, Climate Change for the Consultative Group for International Agricultural Research (CGIAR) under the World Bank and FAO.

Through a range of agencies he has been heavily involved in international global climate change issues. Professor Grace has undertaken projects and consultancies for more than 20 international organisations and government agencies (including the International Energy Agency, United Nations Environment Program and the Australian Greenhouse Office). He is also an Adjunct Professor at the W.K. Kellogg Biological Station of Michigan State University in the US.

He has undertaken ground-breaking research into greenhouse gas emissions with the cotton industry funded by both the Cotton Research & Development Corporation (CRDC) and the Australian Greenhouse Office including the development of some of the first websites in the world for growers to easily estimate their on-farm emissions.

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SPEAKER PROFILE

Julian Cribb

Biggest issue facing the human race"

"The global food crisis – a turning point for agriculture" is the topic to be presented by Julian Cribb, Adjunct Professor of Science Communication at University of Technology, Sydney.

"Agriculture has been neglected by the world, only now after 10 or 20 years have governments started to wake up to this food crisis," Julian said.

"The turning point occurred when the cost of food rose dramatically in the developing world. Staples such as rice have trebled in price.

"In developed countries people are starting to see prices rise at the supermarket and are beginning to feel the pressure.

"Cotton production has suffered the same neglect as other agricultural industries and will be impacted by future decisions to use water for food or fibre production."

"Some countries will need to decide whether they can sustain their industry and produce cotton."

Julian Cribb is principal of Julian Cribb & Associates, consultants in science communication, and editor of the ScienceAlert website. He has an extensive background in the media as a journalist, editor and correspondent, receiving 32 awards for journalism. He has produced more than 7000 published articles and is the author/editor of eight books.

Julian was director, National Awareness, for the CSIRO and has served on several committees and foundations. He is a fellow of the Australian Academy of Technological Sciences and Engineering (ATSE).

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SPEAKER PROFILE

Dr Greg Constable,
Dr Michael Bange
CSIRO

Cotton farming systems for a changing climate

With their combined areas of expertise, Dr Greg Constable with Dr Michael Bange will present the topic "Cotton farming systems for a changing climate" at the conference.

"We will address limitations to cotton's yield potential and discuss possible impacts of climate change along with rising costs and regulatory issues," explains Dr Bange.

"We will then compare current cotton farming systems and their efficiencies with future scencarios that may be possible to allow adaptation and sustainable production systems in response to climate change."

Dr Bange (B Appl Sci, PhD) is a Principal Research Scientist at CSIRO Plant Industry, Narrabri. In partnership with other researchers, he conducts studies into crop physiology and agronomy of cotton crops, including fibre quality management. Dr Bange also implements methods to improve the cotton industry's access to climate information.

Dr Constable (M Sc Agr, PhD) is a leader in cotton research, investigating plant breeding, higher yield management packages, and genetically modified cotton varieties. He is Program Leader for Cotton Management and Improvement in CSIRO Plant Industry, Narrabri. He is also an Adjunct Professor at the School of Crop Sciences, University of Sydney.

Free childcare

It's often difficult for parents with young children to attend important events that will enhance industry knowledge and introduce new ideas ... especially when they're away from home.

This year, parents attending the 14th Australian Cotton Conference can relax knowing that their children can be cared for by professional and qualified early child care workers from Heaven Sent Help. Over four days, children between the ages of two and eight can participate in a range of fun activities and receive morning and afternoon tea and lunch.

The crèche is located at the Gold Coast Convention and Exhibition Centre in Room 9. Crèche opening times:

Monday, August 11, 12.30pm – 6.30pm
Tuesday, August 12, 9am – 6.30pm
Wednesday, August 13, 8am – 6.00pm
Thursday, August 1, 8am – 5.30pm

Please indicate on the registration form your interest in using this facility and also provide information on the ages of your children attending.
Numbers for this facility are limited, so book early to avoid disappointment. For child minding outside of these hours, please contact Heaven Sent Help on 07 5598 7067.

Australian Cotton Conference 2008

SPEAKER PROFILE

John Hamparsum
Cotton Farmer

Preparing our cotton farms now for 2020 and how we might get there.

"Farmers need to consider the challenges of operating in a global market and remaining competitive in the future," explains John Hamparsum, a cotton and grain farmer from Breeza, NSW.

He produces irrigated and dryland cotton, sorghum, sunflowers and wheat on his 1500 hectare property, "Drayton", and is also the president of the Upper Namoi Cotton Growers Association and secretary of ACGRA.

John with his sister, Juanita Hamparsum, will discuss "positioning our farms to meet those challenges" at this year's conference.

"We also need to confront our domestic problems and look at ways to deal with issues that affect us today and tomorrow. We need to plan to overcome the challenges of the skills shortage, competition for water and the strong Aussie dollar," Miss Hamparsum said.

In the "how we might get there" John plans to share the ways in which the Hamparsums have tackled some of these challenges.

"With a shortage of skilled labour we can't compete with the mining companies and other industries in relation to remuneration but we can attract staff by offering an attractive lifestyle on the land with family-friendly hours and other incentives."

In this globally competitive environment for fertilisers and fuel, John is also investigating other means of power such as solar energy to sustain his farm into the future.

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SPEAKER PROFILE

Dr Mark Howden,
Senior Principal Research Scientist CSIRO.

"Climate change and its implications for cotton production"

Dr Howden has been a major contributor to the International Panel on Climate Change (IPCC), sharing the 2007 Nobel Peace Prize with other IPCC authors including Al Gore.

An expert in the area of climate change and agriculture, Dr Howden leads a team of researchers working with community, government and industry stakeholders to enable agriculture, fisheries, forestry, and other primary industries, prepare for and adapt to the effects of climate change and ongoing climate variability.

Dr Howden has developed the national and international greenhouse gas inventories for Australia's agricultural sector and assessed sustainable methods of reducing greenhouse emissions from agriculture.

He has been a major contributor to the Intergovernmental Panel on Climate Change (IPCC) Second, Third and Fourth Assessment reports, the IPCC Regional Impacts Report and the IPCC Special Report on Land Use, Land Use Change and Forestry that addressed issues of carbon sequestration and the Kyoto Protocol.

According to Dr Howden, "Australian farmers will need to be adaptable to cope with and even take advantage of, climate change".

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SPEAKER PROFILE

Dr Judith Stubbs and
Dr Roy Powell

Community well-being in cotton communities

In a joint venture, Dr Judith Stubbs and Dr Roy Powell have conducted a 12-month research project for the Cotton CRC to better understand community well-being in rural areas. Some of these research findings will be presented at this year's Australian Cotton Conference.

"Understanding a community is a complex task, with a range of social, economic and environmental factors contributing to people's desire to live in an area and ability to remain there," explained Dr Stubbs.

"We developed a framework to better understand life in 'cotton communities' both at a desktop level and from the point of view of local residents, businesses and services.

"We've piloted this framework in six communities in Northwest NSW and Southwest Queensland, and have found some strong similarities and some significant differences about life in these areas."

Dr Stubbs is the Principal of Judith Stubbs & Associates, a company that conducts research and publishes on a wide range of issues including regional economic development and sustainable development. Dr Stubbs is also an Adjunct Professor at the University of NSW and is involved in several state government advisory bodies on housing and for the federal government on regional economic development.

Dr Powell is a leading professional in the field of regional development. He is the executive chairman of CARE, the Centre for Agricultural and Regional Economics, an organisation based in Armidale, NSW, which provides consultancy and research services in regional, resource and business economics.

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SPEAKER PROFILE

Dr Ian Rochester
Experimental Scientist,
CSIRO Plant Industry,
Cotton CRC

Cost savings with fertiliser use

Dr Ian Rochester, Experimental Scientist, CSIRO Plant Industry at Cotton CRC will be presenting the topic "Efficiency and Optimisation of Fertiliser Use".

"With the increased price of fertilisers and other associated costs such as diesel for tractors, the industry is looking for ways to optimise use of fertilisers," Dr Rochester says.

Dr Rochester's research into improving the use and efficiency of nitrogen and other fertilisers has found that "many growers can still produce very high yields but with less nitrogen fertiliser".

"There's a belief out there that higher rates of nitrogen fertiliser produce higher yielding cotton crops, when in fact it is more closely related to better irrigation management."

"Nitrogen and water are closely linked and should be managed together," said Dr Rochester.

"In terms of economics, we can improve the efficiency of fertiliser use by using soil and plant testing technology for more effective fertiliser use.

"One of our aims in improving fertiliser efficiency is to reduce our emissions of greenhouse gases, such as nitrous oxide, which result from over-use of nitrogen fertilisers."

Dr Rochester specialises in assessing and understanding issues of soil fertility with a specific focus on how it impacts on growing cotton. He has a background in assessing soil fertility and diagnosing nutritional problems in cotton crops. His earlier research involved improving nitrogen fertiliser use and efficiency. More recently his research has encompassed other nutrients important to cotton production.

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www.australiancottonconference.com.au

Conference Program

DAY ONE - Tuesday 12th August 2008

** Program subject to change

7.am – 7pm	Registration desk open
10am – 10.30	Morning tea in trade exhibit area
10.30am	Welcome and openings
10.30 – 10.45	Welcome to country
10.45 – 10.55	**The Cotton Industry; new beginnings in a climate of change**
10.55am	Opening and launch CRDC new strategic plan 2008 - 2013
11.30am	**New Beginnings and Innovation**
	• Preparing our cotton farms now for 2020 and how we might get there.
	• The global food crisis - a turning point for agriculture
12.30 – 1.55pm	Lunch
	People
1.55 – 2.15	People for a new beginning; innovation, it relies on people.
2.15 -2.35	Young Leaders on new beginnings for the cotton industry
2.35 – 2.55	Measuring community well being in cotton communities.
3pm – 3.30	Discussion
3.30 – 4.15	Afternoon Tea
4.15 – 6pm	Understanding Climate Change and carbon emissions
4.15 – 4.35	Climate change and its implications for cotton production.
4.35– 4.55	A cotton farm's carbon and greenhouse footprint.
4.55-5.15	Demystifying the carbon economy and its implications for agriculture.
5.15– 5.35	Cotton farming systems for a changing climate
6pm	Welcome Drinks

DAY TWO - WEDNESDAY 13th August 2008

7am – 7pm Registration desk open

8.30 – 10.30 **Australian Cotton Shippers Association Trading & Markets**

- ACSA Welcome/introduction & session
- Commodities, interest rates, AUD & economic outlook
- Commodity futures outlook – Cotton's potential
- Physical price outlook
- Extreme volatility in the cotton futures market – problems & ramifications
- The changing world textile

10.30 – 11.15 Morning Tea

11.15 – 12.30 Australian cotton - new beginnings for BMP

- Australian cotton – Getting a tick of approval around the globe
- What we're doing with your BMP cotton/opportunities for BMP
- What do consumers want from cotton?

12.30 – 2pm Lunch

2pm – 3.30 **Defining Markets**

- Winning back markets
- Defining Aussie cotton – mainstream or niche?
- Role of long staple upland & pima cotton–opportunities for medium & ELS types.
- Technopak report .

Crop protection and importance of resistance management

- The changing resistance landscape for crop protection and management for it
- Cotton entomology update and secondary pests.
- Managing weed resistance to herbicides
- Health impacts of biotech cotton.
- Cotton disease trends and research update and impacts of soil properties on Fusarium wilt

3.30 – 4.15 Afternoon Tea

4.15 – 6pm **Getting to markets**

- R&D (post farm gate) – where is the future?
- Infrastructure capacity constraints & competition
- Institutional investment in Agriculture.
- Cotton Industry Infrastructure Forum.

4.15 – 6pm **Cotton and Grains Farming Systems Forums**

- Nutrition forum
- Efficiency and optimization of fertilizer use.
- Novel ideas for nutrition

Irrigated Farming Systems Forum

- Production of sorghum and cotton on 30 inch rows.
- Cotton and irrigated wheat crop rotations,
- Irrigated maize in cotton systems R & D
- Managing for high cotton yields

Half price for better halves

Mark and Melissa Harms, of "Loch Eaton" near Dalby will be taking advantage of the discounted spousal rate this year and have welcomed the 50 percent discount at this year's cotton conference.

Event organisers said spouses and partners play a significant part or are equal working partners in a farming business, and although they were offered social registration in the past, most wanted to attend some plenary session as well.

The grower spousal registration allows partners to attend any session that may interest them as well as attend the welcome reception and all lunches.

"The discount is an added bonus to an already terrific event. We both pick up on different ideas over the three days and basically two sets of eyes and ears is better than one," say Mark and Melissa.

The offer does not include the cotton awards dinner on Thursday evening.

**Early bird Registrations ends June 30. Costs:

- Grower – Early Bird: $300, Standard: $350 (this price already includes the free day)
- Grower's spouse – Early Bird: $150 Standard $175 (50% discount)
- Beat the Drought – $0, $0 (for growers and staff only)
- Day pass – Early bird: $300, Standard:$330
- Fulltime Delegate – Early Bird: $440, Standard: $495
- Multiple Delegate – Early Bird:$400, Standard: $445
- Student – Early Bird: $195, Standard: $220
- Exhibitor day pass – $75, $75

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DAY 3 – Free to growers and staff

THURSDAY 14th August 2008

Growing Cotton's Future: Practical Solutions for Managing Your Water. Supported by Cotton Australia and Department Agriculture Forestry & Fisheries

7am – 7pm Registration desk open

8.30 – 10.30 Growing Cotton's Future: Practical Solutions for Managing Your Water

- Cotton Australia Update
- Farming limited water in dryland and irrigation systems.
- Selecting cotton types for hotter temperatures
- Commercial trait development for drought management and water use efficiency.
- Irrigation scheduling and cotton productivity during the drought.
- Responding to drought - Industry growth regions. Expansion in southern NSW and a move north in the Burdekin. Murrumbidgee
- Biosecurity, in a changing climate critical for our future

10.30 – 11.15 Morning Tea

11.15am **Growing cotton in a water scarce environment**

- Presentation from The Australian Government on Water Reforms.
- Furrow Irrigation systems comparisons and lessons to improve
- Alternative irrigation systems .
- Working with regional natural resource management bodies to improve water management

12.30 – 2pm Lunch

Dryland and Limited Water Research Farming Systems Workshop. Hands-on-research Sessions

- Water Storage management
- New approaches for fertilizer management
- Disease management
- Insect management
- Fibre quality
- Groundwater research
- Irrigation systems (drip, machines, bankless channel)
- Getting the best from people
- Spray application
- Precision agriculture

3.30 – 4.15 Afternoon tea

4.15 – 5.30 **Hands-on-research Sessions Continue**

6pm Conference & awards dinner.

Growing Cotton's Future:
Practical Solutions for Managing Your Water

Thursday 14th August

Topics:

- Managing through drought
- Farming with limited water in dryland and irrigation systems.
- Selecting cotton varieties for warmer temperatures
- Commercial trait development for drought management and water use efficiency.
- Agronomic performance of irrigated cotton during drought.
- Responding to drought - Industry Growth Regions. Expansion in southern NSW and a move north in the Burdekin. Murrumbidgee
- Biosecurity in a changing climate critical for our future
- How do we respond?
- Growing cotton in a water scarce environment
- The Australian government: How it can work with cotton for mutual benefits.
- Furrow irrigation systems comparisons and lessons to improve
- Lateral moves - the golden rules
- Sub surface drip irrigation.
- Bankless irrigation channels
- Reducing channel distribution losses
- Working with regional natural resource management bodies to improve water management

Workshops:

- Dryland and Limited Water Farming Systems Workshop.
- Hands-On-Research for Limited Water
- Hands-On-Research – New R&D including soil and irrigation.

Recognising industry's highest achievers

The Australian Cotton Conference will culminate this year with the 2008 Australian Cotton Industry Awards, a gala dinner to recognise the industry's highest achievers. This is your chance to help celebrate individuals and farming operations showing innovation, leadership, foresight, commitment and resilience – through what has been the industry's toughest years.

Finalists and winners will be honoured in five categories:

- Monsanto Grower of the Year
- AgriRisk Innovative Grower of the Year
- CSD ACGRA Researcher of the Year
- Australian Cotton Industry Young Achiever of the Year Award
- Cotton Service to Industry Award

Come along to support your local finalists and be part of this industry showcase event, proudly hosted by Cotton Australia and ACGRA.

Event and Booking Details

When: 6.30pm for pre-dinner drinks
Thursday 14th August 2008

Where: Arena 2, Gold Coast Convention & Exhibition Centre

What: Three course dinner and alcohol included (cash bar after midnight), high profile MC and dance band

Dress: Coat and tie, semi-formal

Cost: $120 per person (GST inclusive). This is not included in the conference registration fee.

Bookings: Book your tickets through the Cotton Conference registration process.
A table plan and facility to organise your table bookings will be available at the conference registration desk. Dinner seating bookings must be completed no later than 12 noon on Thursday, August 14.

Cotton on to climate

How can the cotton industry respond to the challenges of climate change?

By Bruce Pyke

There have been many predictions made about the impacts of climate change on agriculture in Australia. Whether they prove to be correct does not matter much in the end because Australia has signed the Kyoto Protocol and the new Australian Government has confirmed that we will have a national greenhouse gas Emissions Trading Scheme (ETS) in place by 2010. Even if the real changes to our climate don't have a major impact on the cotton industry over the next five to ten years, the Government policy directions for climate change will. Being unprepared for these changes is not an option.

If the predicted changes to our climate and climate variability are correct we will need to adapt to higher temperatures, greater variability and more extreme events, lower or more variable rainfall and reduced runoff as well as higher evapotranspiration. Fortunately the cotton industry is well placed to deal with any of the physical changes to our climate due to past and current research. In this issue of Spotlight, we re-cap what climate science is telling us about our future and talk to some of our leading scientists about the research that will help us to adapt to the predicted changes.

In future issues of Spotlight we will continue discussion surrounding the research that can provide us with better knowledge of greenhouse gas emissions in cotton production systems together with the best management practices available to mitigate these emissions and the implications of an ETS on the cotton industry.

Spotlight will highlight the research that will be commissioned under the new Climate Change Research Strategy for Primary Industries (CCRSPI) which has been developed jointly the Rural R&D Corporations, state and Australian governments to address common challenges for agriculture due to climate change.

By Tristan Viscarra Rossel

There's no doubt that climate change is a very complex issue – for policymakers, for businesses and for consumers. But the Australian cotton industry should accept that climate change is a reality – and learn all it can to be prepared for the inevitable environmental and regulatory changes it will incur.

Theme Leader of the CSIRO's Climate Adaptation Flagship, Dr Mark Howden, outlined the environmental evidence of global climate change.

"At a global scale we know that the climate is warming up with a range of associated changes, as evident with changes in extreme climate events such as heavy rainfalls, storms and frosts, changes in wind fields, rapid breakdown of ice sheets, melting of the Arctic ice cap, melting of glaciers, and changes in the response of plants and animals," he said.

"For example, growing seasons in the Northern Hemisphere are coming earlier and earlier. For example, we have records of 70 to 80 year old fruit trees in Spain that are flowering over a month earlier than they did several decades ago. Nothing else has changed except the climate."

Australian climate

And in Australia it's no different.

Dr Howden said that our records show that Australia experienced two sustained periods of warming – one prior to World War II, which was partly natural and partly human, and the other since the mid-1970s that has a strong human fingerprint.

In real terms, the earth has warmed by 0.76°C in the past 100 years.

"And 0.76 degrees is really quite a marked difference," Dr Howden explained.

"At the current rate of change, by about 2020 the coolest year that we experience in Australia will be hotter than the hottest year our grandparents experienced.

"When we actually get to that point – and that's only a bit over 10 years away – we will have had a fundamental change in climate in Australia.

"When I talk to farmers about this and show them the data any reluctance to acknowledge that the climate is changing and how much it is changing tends to evaporate fairly quickly."

Climatology knowledge gaps

The effects of this change will certainly be felt at farm level but there is still some uncertainty about the short-to-medium term outlook.

In terms of climate forecasts, Dr Howden said that scientists are very good at predicting what might happen in the short term (one to six days); have some skill in predicting climate over a six-month period using El Niño and La Niña; and a reasonable understanding of changes on a 30 to 50-year time scale.

"But there's a knowledge gap in the middle, which goes from a couple of years up to a decade or more," he said.

"In that period we do not expect to be in a completely different climate state, but we expect some variation on what we currently get.

"For example, we'd still get hot years and cold years but the average temperature will have gone

up – and that temperature range will have started to separate out from the historical range."

Similarly with rainfall, there might be a declining trend that could be explained by both natural variation and a human component. Studies in both south-west WA and south-eastern Australia have both concluded that the rainfall declines cannot be explained by natural climate variations alone.

Preparing for climate change

According to Dr Howden, there is a whole range of actions that the Australian cotton industry can be doing to prepare for climate.

"Some are simply extensions of the work that is already underway, such as improving on-farm efficiencies, better use of water and other resources, developing more effective and transparent water allocation systems and investigating water trading," he said.

"Some are related to sustainability, such as improving biodiversity values and caring for waterways. And then there's a series of decisions that the industry might want to think about in terms of its strategic positioning."

For example, identifying those regions where there might be viable industry options that are currently not around.

"While increasing agriculture up north into Ord-type areas deserves some evaluation, the longer term climate scenarios in those regions actually indicate increasing dryness rather than wetness," he said.

"This is quite different from what we've seen over the past couple of decades in the north west of Australia where rainfall has increased significantly – but simply extrapolating what we've experienced previously is not necessarily what might happen in the future.

"But certainly with higher temperatures - provided we have enough water - there'll be a possibility of growing cotton further south. This is a potential opportunity."

Dr Howden emphasised that while water was going to be the biggest issue for the industry, it also needs to be investigating new cotton varieties that take advantage of the change in climate in terms of temperature and higher carbon dioxide concentrations.

"I also think some research needs to be done in terms of how cotton systems can be managed and altered to deal with increased variability, including the inclusion of other crops as part of a mix in those systems," Dr Howden said.

"And better managing existing climate variability will continue to be important, which perhaps means improved integration of more reliable climate forecasts at different scales into farming operations."

Emissions trading

The recently elected Australian Federal Government has announced Australia will have a greenhouse gas emissions trading scheme operating nationally by 2010. Agriculture is not expected to be part of the scheme initially but could be included fully at a future time.

It is difficult to understand what this might mean for cotton growers because there has been little modelling of the effect of an emissions trading scheme on Australian farms.

We can surmise that fuel and electricity costs will increase and that Australian cotton may become less competitive against countries that have not ratified the Kyoto Protocol.

The Kyoto Protocol is a 1997 international treaty which came into force in 2005. It binds most developed nations to a cap and trade system for six major greenhouse gases - carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons, and perfluorocarbons.

Under the treaty, for the five-year compliance period from 2008 until 2012, nations that emit less than their quota will be able to sell emissions credits to nations that exceed their quota.

However, the Kyoto Protocol does not impose emissions caps on a large number of developing countries, many of which are competitors of the Australian cotton industry.

If Australian farmers become covered under the emissions trading scheme after 2010, they might operate at a competitive disadvantage to those countries without emission caps.

During the course of 2008, we can expect further clarification of the impact of an emissions trading scheme on agriculture and, more specifically, on the cotton industry.

The issue will be discussed at the 14th Australian Cotton Conference at the Gold Coast in August and further detail will be included in the final release of the Garnaut Review in September and in reports currently being commissioned by CRDC and other RDCs.

Dr Mark Howden

Reducing greenhouse gases

And what about our greenhouse gas emissions?

Australian agriculture is the second highest emitter of greenhouse gases of all Australian sectors, contributing to around 16 percent of total emissions directly but perhaps another 12 percent through net emissions from landuse change and forestry plus energy use involved in farming and transport of agricultural goods.

Through cotton growing, carbon dioxide is released through the decomposition of soil organic matter, especially after cultivation, and through use of fuel, fertilisers and some chemicals. Nitrous oxide is released from fertiliser and organic nitrogen sources, and methane from any areas that get waterlogged.

"In order to reduce emissions, the industry as a whole needs to store more carbon in the system, reduce nitrous oxide emissions, reduce on-farm fuel usage and look for renewable energy options. There are other industries that are in the same boat" Dr Howden said.

Spotlight on the IPCC

The Inter-governmental Panel on Climate Change (IPCC) was established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) to provide decision-makers and others interested in climate change with an objective source of information.

The IPCC assesses global scientific, technical and socio-economic literature relevant to the understanding of the risk of human-induced climate change, its observed and projected impacts, and options for adaptation and mitigation.

In its Working Group I report, Climate change 2007: The physical science basis (2007), the IPCC concluded that global atmospheric concentrations of carbon dioxide, methane and nitrous oxide have increased markedly since 1750 as a result of human activities. The global carbon dioxide increase was primarily due to fossil fuel use and land use change, while methane and nitrous oxide were primarily due to agriculture.

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The role of R&D in adapting to climate change

CSIRO Plant Industry program leader, Dr Greg Constable says the reduced rain, low humidity and longer droughts associated with climate change will have a much greater consequence on cotton industry productivity than the average temperature increase.

By Tristan Viscarra Rossel

The real challenge is how Australian agriculture can adapt to climate change and reduce its overall greenhouse gas emissions while remaining a sustainable and profitable farming enterprise. Cotton is no exception.

Through good strategic and applied science, and the successful extension of research outcomes, the cotton industry can prepare for the environmental impact of significant changes in our climate.

Climate change scenarios

Fortunately for the cotton industry, in the area of plant breeding and physiology, research and development is already underway to address many of the environmental impacts of climate change.

The key climate change scenarios being addressed are increased carbon dioxide concentrations; increased temperature and more frequent heat waves; reduced rain; lower humidity and longer droughts; and higher evaporative demand.

For example, CSIRO Plant Industry program leader, Dr Greg Constable, said that plant breeders have bred for heat tolerance because we've always experienced heat waves.

"We've always been breeding for heat tolerance so it's not like we are starting from scratch," he said.

"The average temperature increase induced by climate change will be relatively small compared to the day-to-day variability we experience and the variability from one region to the next."

According to Dr Constable, the impact of climate change on rainfall, humidity and drought length will be of most concern to the Australian cotton growers.

"The reduced rain, low humidity and longer droughts will have a much greater consequence on cotton industry productivity than the average temperature increase," Dr Constable said.

"Higher temperature and reduced humidity together equate to a higher evaporative demand. This will increase the need for water on a per hectare basis and probably reduce water use efficiency itself."

Work by CSIRO Plant Industry covers plant breeding and physiology, and their research strategy aims to address the key climate change scenarios with current projects and new initiatives.

Addressing the knowledge gaps

The CRDC held industry meetings in February this year with around 80 industry representatives to reflect and assess the future role of R&D in securing the long-term future of cotton production in Australia.

The environmental and regulatory impact of climate change was high on its agenda, and the meeting heard submissions about the current and future directions for research and development to address the different climate change scenarios.

From these discussions, a new Strategic R&D Plan to guide investments from 2008 to 2013 will be prepared and enacted from July 2008, following industry and government approval.

Higher temperatures

In the area of high temperatures, it is not all bad news but Dr Constable was quick to point out that the "tiny little positives aren't the same magnitude as the negatives".

The positive impacts of higher average temperature are that plant emergence might be a bit quicker in the spring and the incidence of some diseases might decrease, such as Verticillium and Fusarium.

However, higher temperatures will decrease yield by affecting pollen sterility - reducing boll size and potentially yield – and increasing respiration. They will also increase the incidence of some diseases, such as Alternaria.

"The work we have been doing in breeding for heat tolerance has been trying to address performance under high temperature conditions," Dr Constable said.

"We know high temperature increases pollen sterility and increases respiration, but we are trying to understand and exploit plant tolerance mechanisms. We've made good progress in developing heat tolerant varieties that provide a good foundation for further work."

Other work in this area includes breeding for longer finer fibres to address reduced fibre length and increased micronaire which may result from higher temperatures or evaporative demand; and continuing to breed for disease resistance.

Higher evaporative demand

The net effect of high temperature and low humidity increases the evaporative demand, necessitating a change in irrigation scheduling.

Dr Constable noted that they've undertaken "a substantial amount of research" in this area but stressed more research was needed to understand how climate change affects plant physiology under increased evaporative demand.

Other research underway in this area is measuring how sowing dates can be altered to avoid the periods of lowest humidity to increase water use efficiency; and applied research on management to improve fibre quality.

Less water

In the scenario of less available water, Dr Constable warned that there will probably be an added policy effect of tighter water allocations, so the total area of irrigated crops is expected to decrease.

"Naturally there'll be more dryland crops grown - cotton or grains - and that's occurring already, particularly rotations of cotton with wheat," he said.

"As with the recent drought, the irrigation system will require large rain events to fill the dams - when those dams fill, there will be a lot of irrigation; when those dams are empty, there will be none."

"Fortunately, the soil quality after a grain rotation is improved and the long fallow that occurs after that grain rotation improves the storage of moisture in the soil, which reduces the irrigation requirement."

CSIRO will continue to breed cotton varieties with water stress tolerance, particularly for crop characteristics such as indeterminate growth habit, deep root systems, and the okra leaf trait.

"We've made really good progress in that over the years and that progress is continuing," Dr Constable said.

"That type of variety is grown all round the world. Sixty per cent of Texas is under a CSIRO variety because it is so well adapted to those dry conditions."

Dr Constable said CSIRO Plant Industry will initiate more temperature and water stress tolerance research in the next financial year.

Other projects underway to address the effects of less available water include research into crop-water relations; analysis of water use efficiency; irrigation scheduling research; analysis of rotations and soil condition under rotations; and refining skip row plant spacing to improve soil moisture supply under dryland sowing.

New work includes researching specific production systems for regions that may be more, or less, affected by climate change.

Resilient farming systems

In response to the recent drought and the IPCC conclusions about climate change, the Cotton Catchment Communities CRC modified its research direction in 2007 to place more emphasis on developing resilient cotton farming systems.

Chief scientist of the Cotton CRC, Professor Peter Gregg, explained that the CRC decided to emphasise development of cotton farming systems that were resilient to climate variability and climate change.

Cotton is grown in association with other crops, and farming systems which can vary the mix of these crops, the rotations in which they are grown and the agronomic practices they require, according to changes in climate, will be more resilient.

"We need to develop farming systems that enable us to maintain yields, quality and profitability under a whole range of climate scenarios, whether those changes are human induced or natural," Professor Gregg said.

At present, the research program is not so much about commissioning new research but drawing together the lessons learned from research that's already underway – and identifying knowledge gaps for future work.

"We are somewhat limited by our current reduced budget but we're hoping to partner with other organisations in the area of climate change research to address these gaps in the next two years," Professor Gregg said.

The future

Dr Constable warned that although research could mitigate the impact of climate change on Australian cotton growing, the reality will be that with reduced water supply – from longer droughts or superimposed policy - the industry will be smaller.

"We will develop management systems and varieties to minimise the problem but it will not go away," he said.

"People will grow more dryland cotton and grains than they used to and their total income will reduce with the reduction in irrigated crop area.

"Water use efficiency may increase by 10 percent but if the irrigated crop area is halved, the increase in efficiency will not make up the deficit."

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Screening for heat tolerance

By Tristan Viscarra Rossel

There are many research and development projects already underway in Australia that can help the cotton industry mitigate the environmental impact of climate change.

One such project is being conducted by PhD candidate, Nicola Cottee, at The University of Sydney in conjunction with CSIRO Plant Industry.

Nicola's work aims to determine the best methodologies to simulate heat stress in cotton and then develop techniques for screening a range of cotton cultivars for tolerance to high temperatures.

The consistently higher average temperatures associated with climate change may limit the growth and development of cotton cultivars, reducing both yield and quality.

Nicola is exploring a variety of techniques that can measure leaf function throughout photosynthesis and also cell damage after exposure to periods of high temperatures.

Her preliminary results look promising too. Some of the techniques Nicola has identified may infer difference in cotton cultivars under high temperatures.

Ultimately – if successful – this work will facilitate improved selection of cotton cultivars for production in warmer cotton growing regions – and may assist with selection for hotter environments as a result of climate change.

Nicola's project, Screening cotton cultivars for thermotolerance under field conditions, is supported by CRDC and CSIRO.

Cotton greenhouse gas calculator

Cotton growers can use the Cotton Greenhouse Gas Calculator available at www.isr.qut.edu.au/tools/index.jsp to estimate their farming enterprise greenhouse footprint by comparing the relative contributions from fuel, soil and nitrogen.

The calcuator was developed by Professor Peter Grace of QUT (See page 10) who will be one of the speakers at this years Australian Cotton Conference, to be held at the Gold Coast in August.

He has undertaken ground-breaking research into greenhouse gas emissions with the cotton industry funded by both the Cotton Research & Development Corporation (CRDC) and the Australian Greenhouse Office.

Changing planting date an option?

One project is investigating whether date of sowing can improve water use efficiency – a potential management option in areas with longer growing seasons if the climate change scenario indicates less available water and lower humidity.

CSIRO Plant Industry is assessing management options, like sowing time, as a tool to improve fibre quality and improve or maintain yield as well as to improving resource use, such as water use efficiency.

Principal research scientist with CSIRO Plant Industry, Dr Michael Bange, said that in well watered crops, higher evaporative demand can potentially increase transpiration and soil evaporation, thereby reducing water use efficiency.

With limited water, however, he said crops will struggle to transpire enough to keep the canopies cool, and leaf temperatures will increase to a point that impairs photosynthesis and growth.

"We know that at certain times in summer the humidity, or the vapour pressure deficit, is quite different, and that has implications on the amount of water used," he said.

"If we can change the time when the crop is most actively growing to avoid exposing it to the highest vapour pressure deficit, we might actually be able to maintain yield and reduce water use efficiency."

Jointly funded by CSIRO and the Cotton Catchment Communities CRC, this work has been developed on the premise that by changing the sowing date to avoid periods of extreme evaporative demand can improve water use efficiency in terms of bales/ML of evapotranspiration.

A number of cultivars with varying growth habits and maturities are being sown at different times and measured for crop growth and water use.

"We've already shown that changes of sowing time can maintain yield and actually improve quality because we are missing the time when the bolls have been exposed to high temperatures that reduce fibre length," Dr Bange said.

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Resource use on agenda

Dr Michael Bange

By Tristan Viscarra Rossel

Land & Water Australia has commissioned CSIRO to report on climate change impacts and adaptation across the primary industries – and cotton has come under the spotlight.

Principal research scientist with CSIRO Plant Industry, Dr Michael Bange, has written a chapter of the report on Australian cotton production. He said the report aims to capture the capacity for adaptation that exists within the industry.

"As a result of climate change, less available water resources will increase competition for different crops, so we have emphasised the need for continual improvement of water-use efficiency over the whole farm and at the crop level," he said.

"This presents opportunities to develop tools to help growers select the crop that maximises their water-use efficiency and profitability."

Dr Bange said that the industry needed to maintain and increase cotton profitability through practices that increase both yield and fibre quality, while improving resource use, especially water and nitrogen use.

"There is a need to research resource-specific effects in the dominant cotton regions. Research into integrated effects of climate variability and climate change is critical", according to Dr Bange.

"Integrative research is not just about yield and quality; it's about resource use, accounting for the differences in temperatures, vapour pressure deficits, and carbon dioxide concentrations."

"We need to look at the integrative effects of those things; to focus some investment on that."

The report also flags some significant issues with insects, pests and diseases related to different climate change scenarios.

The final point was to maintain research and development capacity in these areas. Complementary to this will be the importance of open communication to inform and support growers as they adapt to climate change and increasing climate variability.

The report is scheduled to be released by Land & Water Australia in June–July.

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"As a result of climate change, less available water resources will increase competition for different crops"

Soft option to beat cotton pests

Headed by Dr Robert Mensah, director, research leader and principal research entomologist of NSW DPI's Cotton Health Unit at the Australian Cotton Research Institute in Narrabri, a new fungal insecticide research project is well underway and is being funded by the CRDC, NSW DPI and Becker Underwood. Becker Underwood is the commercial partner in the development of the product.

The key fungi in the research are a *Metarhizium* spp. Isolate (codenamed BC639) and *Beauveria* spp. Isolate (codenamed BC 667).

Since 2001 approx $3.8 million will have been committed to research in this project from CRDC, NSWDPI and Becker Underwood.

Dr Mensah, who has been working on developing these two fungal isolates since 2001, explained: "These two fungi are known to have significant potential for development as commercial fungal insecticides.

"Our research has improved the pathogenicity of these two fungal strains and made them more adaptable to our harsh and dry cotton conditions.

"Thus the strains we have developed can survive and cause significant mortality to specific cotton pests.

"We found in studies carried out in 2006-07 and 2007-2008, that the fungal strains caused high mortality in green mirids, killing over 70 percent of adults and nymphs when applied at the rate of 0.5 – 1.0 L/ha of BC 639 and BC 667. Applied at these rates, the fungal insecticides were as effective against green mirids adults and nymphs as Fipronil applied at half the label rate. (see graphs).

"Our research has found that this fungal insecticide is 'softer' than Fipronil which is regarded as a 'soft' insecticide in the cotton industry - and of course it is therefore friendlier to the environment."

Dr Mensah said the fungi killed green mirids within three to four days.

"The fungal strains can cause secondary infection to green mirids so that the death of an infected mirid or insect can produce more spores, which in turn will continue to infect and kill insects," he said.

"In some of our trials in commercial cotton crops, dead insects were found 21 days after we applied the treatment.

"This shows that the fungi when applied to cotton crops can remain in the field and suppress the build up of pest numbers.

"The fungi are effective against most soft bodied insects such as sucking pests and *Helicoverpa* spp. larvae etc, and hard bodied insects, which comprise most of our key predatory insects in cotton, are unharmed."

A new fungal insecticide which kills cotton bugs such as green mirids and other sucking pests in Bollgard® and conventional cotton is being developed by Dr Robert Mensah and colleagues from the Australian Cotton Research Institute in Narrabri .

Dr Mensah said that their studies showed no significant differences between the number of predatory beetles, bugs, lacewings and spiders per metre in plots treated with fungal insecticides and unsprayed (control) plots.

In contrast, the number of predators recorded on the plots treated with the fungal insecticides was significantly higher than the commercial insecticide (Fipronil) indicating that the fungal insecticide is 'softer' than Fipronil.

"We found that the average cotton yield harvested from commercial cotton fields at Norwood and ACRI from 2004-2008 showed that yields from fungal insecticide treated plots were not significantly different ($P>0.05$) from the transgenic cotton fields, where green mirids were controlled with Fipronil insecticide," Dr Mensah added.

"The other discovery was that, as well as destroying the green mirids, the fungi were found to cause some mortality to cotton stainers, apple dimpling bugs and green vegetable bug nymphs. The fungi can also cause mortality to *Helicoverpa* spp. small larvae when sprays were targeted to *Helicoverpa* spp. egg hatch.

"The fungal spores are in an oil formulation and presently we are gathering data for product registration, with a view to launching it on the market as soon as possible," Dr Mensah said.

The results from these trials support the fact that these biological control agents are environmentally friendlier as beneficial insects have not been negatively affected.

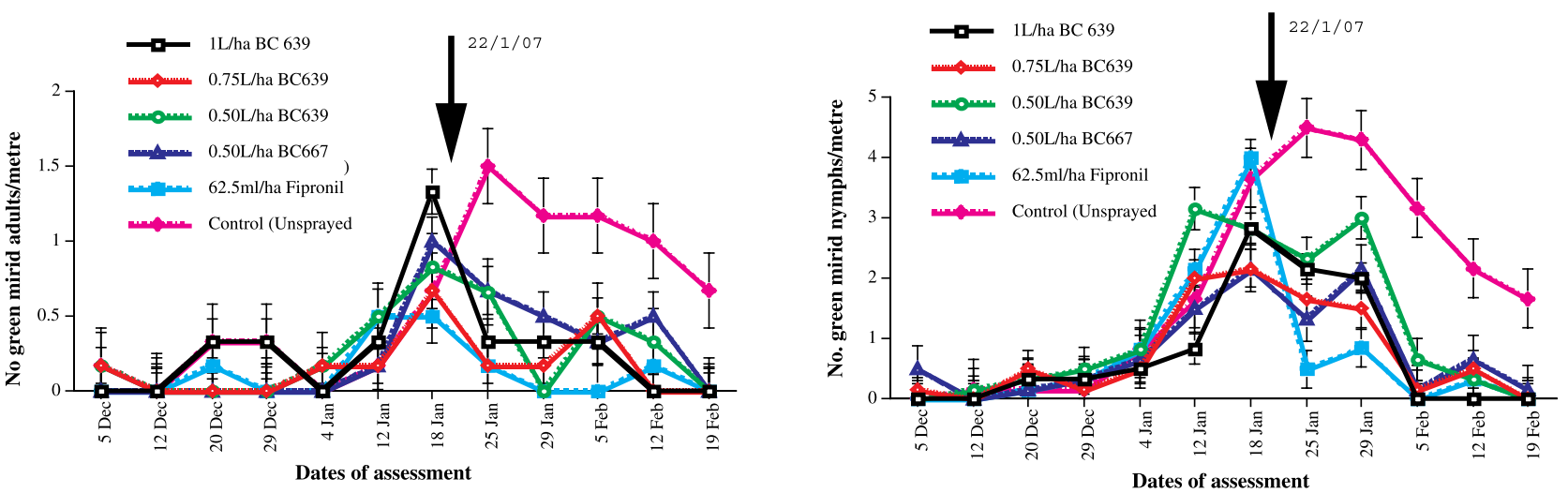
Dr Ian Taylor, CRDC research program manager, Crop Protection & Farming Systems, said: "This product is more environmentally friendly than Fipronil and as it is a naturally occurring fungus that already exists in Australia, its impact on the environment is minimal. It is highly selective and will not kill the majority of other insects which may also visit cotton.

"Researchers are hopeful that the product will be available to market to growers by January 2011"

Somersby-based Becker Underwood Pty Ltd. is the Australasian arm of the world wide group, Becker Underwood.

Becker Underwood is the world's leading developer, manufacturer and marketer of innovative, leading edge agri-biological products used across a broad range of applications in agriculture, turf and amenity horticulture, and commercial horticulture.

Becker Underwood is committed to the research, development and manufacture of cutting edge legume inoculants, biological pest management technologies, agricultural productivity tools and advanced technologies for turf management and landscaping globally.



Graph showing the efficacy of different rates of BC639 and BC 667 fungal insecticides against green mirid adults and nymphs in Bollgard cotton crops at ACRI in Narrabri, 2006-07.

Participation of young people in leadership roles

"Building knowledge, capacity and experience into future leaders will help in understanding the needs of an individual's nation as well encouraging a united front in tackling common challenges in a global, strategic and professional manner," said Hamish Millar who attended a congress of young farmers in Argentina (right).

By Terri-Ann Crothers

Last year, Hamish Millar, past ACGRA chair, of "Tandawanna", Emerald was one of 10 Australian delegates who attended the 2nd International Federation of Agricultural Producers (IFAP) World Congress of Young Farmers in Argentina.

The Australian delegates, aged between 25 and 34, were chosen from more than 100 applicants across the country and represented a cross-section of agricultural industries and States. One hundred and fifty young farmers representing 30 developed and developing countries worldwide attended the congress.

"In agriculture we all understand the urgent need to address the challenges we face in a timely and efficient manner," Hamish said.

"The IFAP Congress is a small but productive step in encouraging effective leaders for tomorrow's agricultural industry."

Hamish enjoyed his time at the conference and found that "the interaction between members reinforced that we share a common perspective on agricultural policy" which he believes is "the foundation for better outcomes".

He learned from one of the four sessions at the congress *"Strengthening and effectiveness of young farmer groups or associations"* - that there is a "lack of inclusiveness and involvement of younger farmers' groups in longer-term policy and decision-making in existing farmers' groups".

Hamish believed it was more common in developed countries "where policies and advocacy framework models had been in place for decades".

"We all agreed there needs to be a mechanism in place to encourage younger farmer participation at a policy development level that considered the longer term risks and rewards of such decision-making," he said.

"The importance of education and training is key to strengthening our effectiveness.

"Building knowledge, capacity and experience into future leaders will help in understanding the needs of an individual's nation as well encouraging a united front in tackling common challenges in a global, strategic and professional manner.

"Australia is investing strategically into young farmer training and education, encompassing a range of disciplines. I think it's fair to say that Australia's commitment in this area far exceeds many other IFAP countries."

Hamish believes in "getting involved" and accepting leadership roles. He was the former chairman of the Australian Cotton Growers Research Association (ACGRA) and is a director of Cotton Australia and a Fellow of the Australian Institute of Company Directors.

He believes that the cotton industry is a "stand-out" for encouraging young people to take on leadership roles.

"I was approached to join ACGRA in 1998 and as I gained confidence and became familiar with this and other industry groups I found I wanted to participate more," Hamish explained.

"Decisions that are made by these groups could have an affect on your livelihood. By becoming involved you have the opportunity to be a part of the decision-making process."

Hamish is convinced that a good mentoring program is essential for young people to succeed.

"The mentoring process can be compared to the ideal family succession plan where both the mature, experienced mentor and the younger person can learn from each other. It can become a mutually beneficial relationship and will only help our industry to develop," he said.

"Existing leaders have a responsibility to mentor our potential leaders for at least 10 to 15 years, guiding them through to succeed them in the future.

"The challenge today is that the industry is shrinking and we have more pressure from government regulations and other sources. Our industry needs to respond by encouraging young people to get involved and step up to leadership roles. We need everyone to become more efficient and effective in lobbying for our future.

"The individual also needs to take the initiative to become involved and utilise programs like the Future Cotton Leaders where people can experience life-changing learning," suggested Hamish.

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Capacity in our greatest resource

By Terri-Ann Crothers

"The Future Cotton Leaders program is about building capacity in our greatest resource – people. In turn, these future leaders will help build the capacity of the various organisations and enterprises they are involved in," explains Helen Dugdale, CRDC program manager.

"The extent of industry involvement is also encouraging, to both the participants and the organisers of the program.

"Feedback from participants included comments about how rewarding it was that the cotton industry was getting behind them and showing an interest in their careers.

"They appreciated that industry organisations still had the time and funds to support the next generation of leaders despite these tough economic and climatic times."

Participants conducted their own leadership projects, putting into practice the skills they learnt and utilising the contacts they made during the FCL program. Communities also benefited from the enthusiasm, drive and commitment of these future leaders.

Helen Dugdale

"We were very pleased to see the results of our small investment into each of these projects. They had such rewarding results for both the participants and all the investors into this program, including DAFF and Cotton Australia who initiated this valuable program," said Helen.

"The CRDC is very proud to be involved in such a worthwhile program."

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Annabel Wiseman

Developing more self-confidence was one of the key benefits of participating in the Future Cotton Leaders program for Annabel Wiseman.

"With the support of the entire group I found my confidence grew during the course -something I'd struggled with in the past," said Annabel, Central Queensland business manager for Monsanto.

The former Sydneysider is now based in Emerald and enjoys her diverse role with Monsanto and her involvement in various agricultural committees.

Annabel believes the FCL program was beneficial to both her personal and professional life, giving her "more of an insight and understanding of the industry" and the opportunity to "meet and network with a wonderful group of people, passionate about the future of Australian cotton".

Annabel is also implementing the skills she learned from the FCL program in her daily life.

"We did a lot of work in understanding what makes an individual and different personality types," she explained.

"I've learned to mould my conversation, focusing on and addressing the individual

personalities of my customers, taking my customer relationships from strength to strength."

When asked about the prospects of the cotton industry, Annabel suggested that in managing for the future there should be a "focus on the next generation".

"We must do our best to continually educate young people about agriculture and its importance to our economy and beyond. We need to break the perception barriers down and show the benefits of agriculture and a cotton industry in Australia."

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Fleur Anderson

Fleur Anderson has combined the "best of both worlds". She assists her husband on the family property at 'Wilcannia', Theodore and has established "Rhubarb", a gift and accessories store and online business.

"I can get out and help on the farm to satisfy my love of agriculture and be involved in agricultural associations," explained Fleur.

"I also have my shop and personal businesses to satisfy my interests in entrepreneurship and creativity."

Fleur listed networking, "broadening your knowledge" and "challenging yourself" as the major highlights of the Future Cotton Leaders program.

"The FCL program enabled me to meet and learn from people in different valleys and business areas, expanding my knowledge outside the family farm," she said.

"The program also encourages challenging yourself to have a good look at where you are now and where you want to be, discovering what motivates you and opening doors."

When asked what the cotton industry will look like in 2030, Fleur suggests

"It's right on track for a bright 2030 but unless some good policy decisions are made regarding water and GM, who knows."

Her recommendations for the future are to "keep your finger on the pulse and stay informed of new technologies and policies".

"Get involved, particularly in your local cotton grower association, and be open to learning and sharing with other growers to succeed in the future. Also communicate with our researchers and policy makers."

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Rose Roche

"I would encourage anyone interested in a career in science to join the cotton industry," says Rose Roche, Post-doctoral Fellow, CSIRO Plant Industry, based at ACRI, Narrabri, NSW.

"The Australian cotton industry is extremely progressive and supportive of the research community. It is so rewarding to know that your work is making a difference."

Rose's participation in the Future Cotton Leaders Program has enabled her to meet other young and enthusiastic people in the industry. She has also enjoyed the Mentor Match component of the program as it gave her an opportunity to discuss issues and gain advice from a leader in agricultural research Dr Peter Carberry, CSIRO Sustainable Ecosystems.

As part of the program Rose was involved in a joint project that aims to connect researchers and growers.

"Taking part in this project I learnt a great deal with the help of my project partner and the FCL facilitator."

In the future she plans to focus on her

science and its outcomes implementing some of the skills learned in the FCL program.

"I'm looking forward to focusing my research on ways to harness the cotton plant's natural ability to survive under stress and still maintain good yields," explained Rose.

"I also want to focus on providing knowledge and tools to growers to help them adapt to climate and market changes."

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The issue of contamination

Improving, but we must remain vigilant

By Marinus H. J. van der Sluijs CSIRO Textile and Fibre Technology

Contamination, even if it is a single foreign fibre, can lead to the downgrading of yarn, fabric or garments or even the total rejection of an entire batch and can cause irrepairable harm to relationships between growers, ginners, merchants and textile and clothing mills. Most contamination arises from impurities being incorporated into the bale as a result of human interaction during harvesting, ginning and baling. Contamination represents a significant cost to spinning mills and this has led them to implement methods to cope with contamination. These include:

- Avoiding or minimising use of cotton from origins that are known to be contaminated.
- Spinning mills situated in countries where labour costs are comparatively low employ large numbers of people to manually remove contamination from bales (pictured, courtesy Apac Inti).
- Equip factories with systems for automatic detection, separation and measurement of foreign material.

Figure 2 – Manual removal of contaminants from cotton before release to spinning mill.

Despite all the methods and approaches mentioned, to reduce the risk of claims due to contamination there is still no guarantee that the yarn or fabric produced will be totally free of foreign matter. To complicate matters there are no international standards for acceptable levels and size of contaminants in fabrics.

International Textile Manufacturers Federation (ITMF) Contamination Survey

The ITMF conducts a survey of cotton spinners on their perceptions of contamination found in world growths. In the survey spinners are asked to rate the degree of contamination in cotton lint according to 16 categories of foreign materials which include:

- String and Fabrics made of;
  - Woven plastic
  - Plastic film
  - Jute and hessian
  - Cotton
- Organic matter including leaves, feathers, paper and leather.
- Inorganic matter including;
  - Sand and dust
  - Rust
  - Metal and wire
- Oily substances/chemicals including;
  - Grease and oil
  - Rubber
  - Stamp colour
  - Tar

The issue of contamination

As one would expect, the degree of contamination varies widely from region to region. According to the ITMF surveys the most contaminated cotton continues to originate from India, Turkey and Central Asia. The least contaminated cotton continues to originate from the US, Israel and Australia. No growths are contaminant free. Analysing the results of the surveys since 1989 one discovers that:

ALL COTTONS

The degree of contamination in all growths has steadily increased from 14 percent in 1989 to 26 percent in 2003, although a decrease to 22 percent in 2005 which remained constant in 2007 was recorded (see Figure 3, blue line).

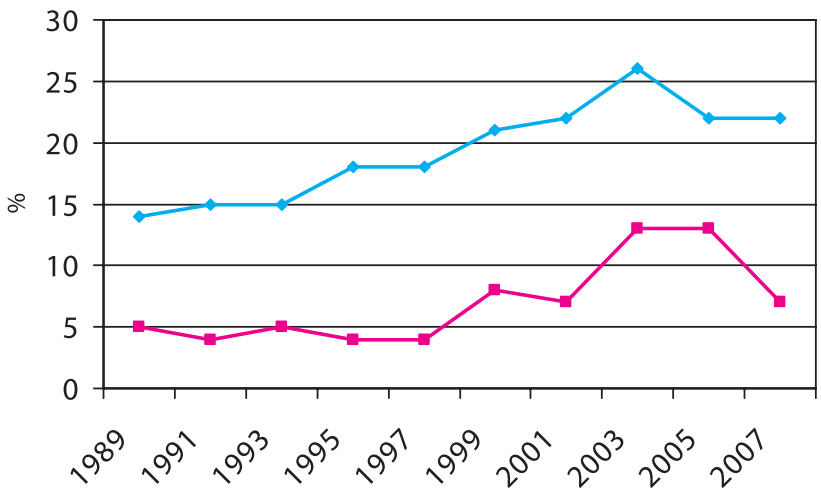

Figure 3 – ITMF Contamination survey results from 1989 to 2007 [1].

The major source of contamination continues to be organic matter such as leaves, feathers, paper, leather, etc, followed by fabrics and string made from cotton, woven plastic, plastic film and jute/hessian.

FOR AUSTRALIAN COTTON

Although the overall level of contamination is low, over recent years there has been an upward trend as illustrated in Figure 3 (pink line), increasing from a base level of approximately 5 percent in the 1990's to 13 percent in 2003 and 2005, with a reduction to 7 percent in 2007.

In parallel with the world data, the major single source of contamination is organic matter such as leaves, feathers, paper and leather followed by string and fabric made from jute/Hessian, followed by plastic film fabric and string, cotton string and fabric and woven plastic.

Although very useful it is important to note that mills participating in the survey make a largely subjective assessment of the contamination found in a growth, and moreover whether the occurrence of contaminants in a particular growth has been insignificant, moderate or serious.

Detailed assessment and management of contamination in Australian cotton

In order to overcome the limitations of the ITMF contamination survey and as the first step towards eradicating contamination levels in Australian cotton, it is necessary to obtain more accurate and thorough information through a comprehensive survey. The activities of this comprehensive survey include:

- Surveying Australia ginners during the ginning season to determine the degree and type of contamination found in cotton delivered in modules to the gin yards. This is aimed at identifying the magnitude of the problem of foreign matter in Australian cotton and gives a better sense of how contamination events occur in the field and gin.
- Co-operation with a large overseas spinning mill that uses a sizeable proportion of Australian cotton in its mill to accurately and objectively assess the extent and amount of contamination being sent in Australian cotton bales and other growths.

CONTAMINANTS IN MODULES

During the previous two seasons over 450 contaminants were recorded. Figure 4 shows a breakdown of contaminants found in modules during the 2006 and 2007 ginning seasons.

The survey showed that the majority of contaminants found in modules were metallic pieces from harvesters, module builders and from transportation of modules to the gins. This is followed by module ropes and covers and a category 'other', which included items such as mobile phones, shotgun shells, beer cans, oil cans, two-way radios, hats and rubber mats.

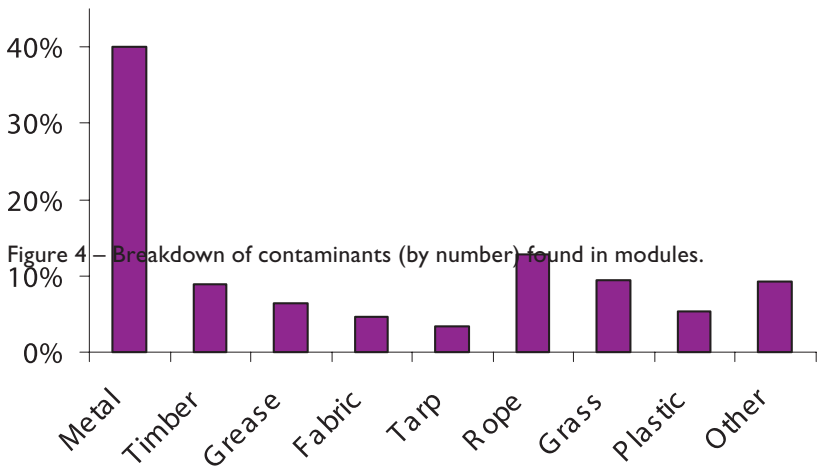

Figure 4 – Breakdown of contaminants (by number) found in modules.

Figure 5 – Examples of contaminants collected from modules

"There has been and upward trend in contaminants in Australian cotton"

Figure 7– Examples of contaminants collected from Australian lint bales

P.T. APAC INTI CORPORA

Apac Inti Corpora is a large cotton spinning mill in Indonesia that performs a unique process at their mill; every bale of cotton is manually inspected before processing and contaminants, even single human hairs, are removed and collated. This allows for a direct measurement by weight and by type of contaminants exported with Australian cotton. Since 2000 Apac Inti has cleaned (de-contaminated) some 200 million kilograms of cotton sourced from around the world and have generated a large and accurate database on the levels of contaminants found in a wide range of growths.

Apac Inti has been sending data and the actual contaminants removed from shipments of Australian cotton to CSIRO since December 2005. The data shows that in 2006/07 at 0.6 grams/ton, contamination found in Australian cotton is the lowest of all growths imported by Apac Inti. The data also reveals that contaminants found in Australian cotton's major competitors such as Brazil, West Africa and some growths from the US have decreased over the same period (see Table 2).

Table 2 – Contaminants by country of origin in grams/ton found in bales shipped to Apac Inti

Country	1999/2000 Grams/Ton	2004/2005 Grams/Ton	2006/2007 Grams/Ton
Australia	1.4	1.9	0.6
China	2.2	3.0	*
Brazil	3.2	2.7	2.4
US#	2.8	2.0	1.4
Uzbekistan	*	9.1	2.4
West Africa	3.7	7.0	2.5

Ave of various locations * No information available

Figure 6 shows the proportion by number of the contaminants found in Australian cotton. The major contaminant found in bales delivered were yarn made from either cotton or polyester or blends thereof followed by pieces of cloth from either rags or clothing made from either cotton or polyester or blends thereof. This was followed by polypropylene yarn in various colours, followed by plastics including shopping bags, lolly papers and garbage bag fragments, followed by feathers, jute/hessian yarn, human hair and paper from newsprint and notepads and metallic pieces such as nuts, bolts and wire.

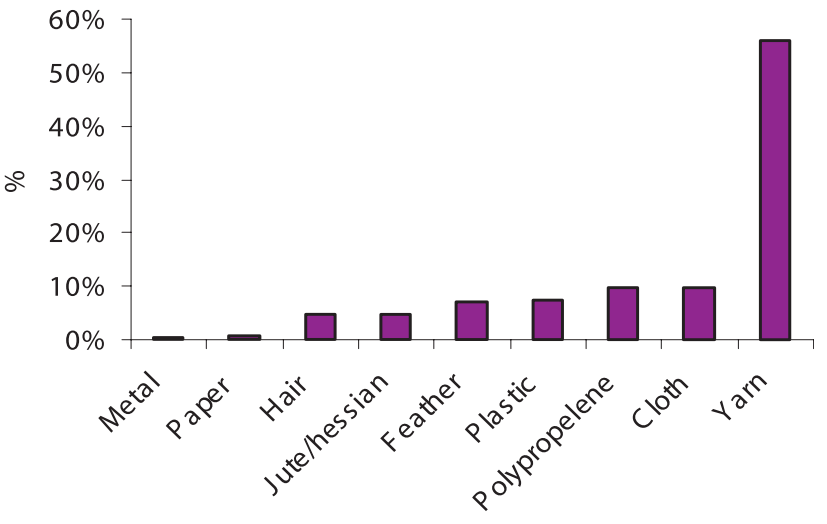

Figure 6 – Breakdown of contaminants (by number) found in Australian cotton shipments

There is no doubt that the continued and increasing presence of foreign matter in raw cotton is a serious issue for textile processors and it is pleasing to note that the amount of foreign matter found in Australian cotton bales continues to be small relative to other growths. One must not lose sight of the fact that during yarn formation cotton is processed through a large number of machines which can lead to further disintegration of the contaminants which will subsequently lead to quality and production issues. The challenge for the Australian cotton industry is to provide cotton with zero contamination. In response to this challenge, the Australian ginning sector is implementing Best Management Practices (BMP) and the industry is currently investigating the possibility of integrating decontamination systems into the gin. These measures will reduce and possibly eliminate the occurrence of foreign matter in modules delivered to the gin yard and subsequently the bales delivered to the spinner.

Irrigation information is flowing

The National Program for Sustainable Irrigation (NPSI) has a vision for Australian Irrigation that is valued for its environmental, economical and social contribution

The National Program for Sustainable Irrigation is a partnership between 14 research and development investors from industry, government, and water providers. The Program provides leadership to invest in research useful to irrigators with the aim of substantially improving the productivity and sustainability of irrigation.

The Cotton Research and Development Corporation (CRDC) has been a funding partner of the program since 2003.

Andrew Parkes, manager of 'Keytah' has a strong involvement as a member of the Program Management Committee, providing strategic overview of the program's direction and investments. Andrew was nominated by CRDC and brings an irrigator's perspective to the program.

Guy Roth leads the NPSI team as program co-ordinator, bringing 20 years' experience in the cotton and irrigation industry.

The program is working with partners to ensure their communication channels and irrigation networks are better used to share research outcomes with end users. NPSI will be working with CRDC to deliver important irrigation research through CRDC publications, workshops, training and field days.

Current research includes developing effective knowledge management systems for irrigated cotton and grain. This project has produced new publications and irrigation training currently being run throughout the cotton industry.

A new website with plenty of new information on irrigated cotton and grains is available at http://www.cottonandgrains.irrigationfutures.org.au/

Other new research is underway to produce new ways to reduce evaporation losses from water storages.

NPSI will also have a presence at the Australian Cotton Conference in August.

Information on the Program and its research can be found at www.npsi.gov.au or you can contact Sarah Leonardi on (02) 6263 6031 or Guy Roth on (02) 6792 5340.

Bruce Pyke, R&D Manager at CDRC said" "The cotton industry has many common challenges and opportunities that we can learn from other irrigation industries. Our involvement in the National Program for Sustainable Irrigation will help the cotton industry with closer ties to other irrigated crops."

Stubble promotes water savings

Mayfield Farming Company, based 11km west of Dalby, has pioneered a promising new method of achieving water efficiency for its cotton crop.

Owned and operated by the Fresser family, Mayfield Farming has developed a new two-metre row planting system using a zero-till approach to make the most efficient use of available water.

The method involves planting cotton in the centre of a two-metre bed leaving the remaining sorghum, corn or wheat stubble untouched.

Mayfield Farming's Shawn Fresser said the method was working particularly well on the cracking clay black soil.

He said the farm first trialed two-metre rows last season with 65 hectares of cotton grown (following a sorghum crop) in extremely dry conditions.

"The idea came from my father Glenn, who wanted to come up with a better way to keep the stubble standing. With this approach, the only groundwork we do is some cleaning out of the furrows and discing-in fertilizer," Shawn said.

"Last season, we flushed the paddock after planting to guarantee establishment and were able to give the crop one in-crop watering, but there was no effective rainfall after planting."

Considering the lack of water, the results of the 06-07 crop were quite impressive. The crop achieved a high quality, which Shawn said, may not have occurred with a full planting. With a reasonable yield of 4.9 bales to the hectare, the Mayfield team was keen to try it again in the 07-08 season.

Hopeful of more favorable conditions, they planted 320 hectares of cotton using the two-metre method. It has proven very worthwhile. This season has been a completely different story; with some excellent summer rains and two in-crop waterings, the crop flourished.

By mid May, Mayfield Farming had almost completed cotton picking and was reporting yields of over seven-and-a-half bales to the hectare and even pushing over eight-and-a-half bales to the hectare in some patches.

"We're excited to think that this year we been able to achieve such strong yields.

"The ultimate goal is to achieve the equivalent to full-crop yields, while using less than half the water …"
Shawn Fresser.

"The ultimate goal is to achieve the equivalent to full-crop yields, while using less than half the water and half the planted area. This season has proven to us that we are well on the way to reaching that goal."

There is no doubt, the new method is resulting in great water savings - Mayfield's cotton crop is now using less water per hectare than its grain crops. But it's not just the water savings that are impressing the Mayfield team; it also has a substantial financial benefit.

"We're using less seed, less insecticides, less labour and most importantly, we're paying only 50 percent of licensing costs," Shawn said.

He said the system was working really well using the technology of Round-up Ready Flex – enabling Mayfield to control weed throughout the season without having to use chippers or cultivation.

On top of this, the system is allowing irrigations to a have longer lasting impact causing crops to stress less compared to a full plant. Mayfield's been able to reduce the number of waterings needed – meaning labour costs are also significantly lower.

Retaining the stubble has a number of benefits. It allows Mayfield Farming to plant on rain; the stubble protects the young growing plants; and importantly, the retained stubble harbours beneficial insects lending itself to an excellent insect pest management (IPM) program.

Due to space between rows, Mayfield is able to ground spray throughout the whole season including defoliation. Less insecticides are used because all sprays are able to be banded to suit the rows. Since starting the system, aerial spraying has not been used on cotton at Mayfield.

Shawn said the system gives them the flexibility in being able to produce good yields no matter how much water is applied.

"When there's plenty of water about, the system can be 'ramped up' - with additional fertilizer and irrigation - to achieve greater yields. During low water years, this planting method will give the crop the best chance to hold on and still produce reasonable yields."

Mayfield Farming Company has always been a strong supporter of research and trying new ideas. The farm has been involved with CSD variety trials over the past 20 years. CSD was so impressed with the new two-metre-centre-of-the-bed growing system that it was keen to continue its trials at Mayfield this season.

At a recent CSD field day at Mayfield, many attendees commented on the system and its many advantages.

Shawn said developing the new system had been a team effort with father Glenn, brother-in-law Simon James, former farm manager Brian Strand and workshop manager Keith Nilon all doing their bit to adapt farming practices.

"We had to do some interesting modifications to planting, spraying and picking equipment to suit the new spacing," Shawn explained.

The team extended a four-row picker to essentially a six-row width, then modified shoots, blocking off the fourth shoot, to accommodate picking of just three heads.

In the right soil, Shawn believes this method is a good alternative to double-skip cotton, as the two-metre rows have the advantage of being evenly spaced.

Based on the results so far, the Mayfield team is confident that the time spent in labour on modifications is well worth it.

Even if the future seasons look like bringing better rainfall, Shawn said they would continue to farm this way.

"Anything that stretches the water a little bit further and gives us more options for how we use our water is the way to go."

GM health benefits to be studied

By Megan James

In the early days, there's no doubting that cotton production was not considered in glowing terms when it came to health and safety.

At the heart of this were concerns in relation to the impact of chemical use on those engaged in cotton production on farms, and on rural communities associated with cotton production.

However, over the years important changes in farming practices and technology have resulted in a very different picture.

According to CRDC Research Program co-ordinator Helen Dugdale, these industry changes and impacts are of significance for the industry and also for other cropping industries – but have never been comprehensively studied or fully reported.

CRDC, together with the Australian Centre for Agricultural Health and Safety and other industry bodies, is planning to start an exciting project to document and quantify the positive impact new technologies have had on health and safety in the industry.

"We know that the introduction of genetically modified cotton and other 'soft' chemicals has reduced the number of insecticide applications and potentially the degree of exposure to hazardous substances," Helen said.

"This project will identify the key changes in the industry that have impacted on health and safety of the industry and suggest ways that future health impacts can be addressed."

In particular the study aims to:

- identify and describe potential factors that have influenced the health and safety of people associated with cotton production in Australia; and
- establish the health impact of introduction of genetically modified cotton has had on the health and safety of people associated with cotton production.

The first stage will involve consultation with key stakeholders to identify health and safety risks to cotton industry in Australia and any key initiatives and developments impacting on health and safety of people associated with cotton production in Australia. The second phase of the study will involve more formal surveying.

On the basis of findings, the study intends to recommend a more integrated approach to health and safety risk assessment, management and reporting for the industry and assess potential health impacts of future technological developments.

Cotton farmer Barb learns how to lead the way

By Mary-Ann Day

After winning the Innovative Cotton Grower of the Year Award in 2007, along with husband Ralph, cotton farmer Barb Grey has found a whole new world opening up for her. For Barb has just won a scholarship onto the Australian Rural Leadership Program (ARLP).

The ARLP offers people like Barb a unique opportunity as selected rural and regional leaders, to undertake a program of personal growth and develop the skills, knowledge and networks needed to be effective in regional, state, national and international arenas.

"I was thrilled to be selected for this program, which is a chance for me to make a difference," explained Barb, who at 48 has been cotton farming for more than 20 years.

"I think we are doing some very good work in agriculture in the bush, but perhaps not getting the message across to our city cousins."

The two year program is aimed at creating a network of highly skilled leaders, with a view to making a difference in rural and regional Australia.

Barb, who is one of 36 people in the program from all walks of life, is being sponsored by the CRDC, Auscott Ltd and Cotton Australia.

"I was recommended to apply for the program after we won the Innovative Cotton Grower of the Year Award," said Barb, who farms at Mungindi in North-Western NSW.

Barb and Ralph won the award last year for their contribution to recruitment in the bush – something Barb feels very passionate about.

"When we found there was a growing labour shortage, we decided to recruit farm labour from South Africa. We now have a South African and Zimbabwean labour force and are in the process of helping other farmers to recruit from South Africa too," Barb said.

Barb and Ralph have since set up Workforce Partners (Qld), a recruitment company focused specifically on helping farmers and businesses in regional NSW and QLD resolve their skill shortages by recruiting South Africans and Zimbabweans who are looking to migrate to the rural sector in Australia.

With a successful 1500 hectare farm - which over the past three years has grown consistently higher yielding crops than previously – and three daughters aged 17, 22 and 24, Barb leads a busy life, but is ready to meet the challenge of the ARLP.

"It's about looking outside the box," Barb said.

"The award has opened new doors for me and I am very excited about how this Program can help me to help rural Australia."

? For more information about the Australian Rural Leaders Program contact CRDC, Cotton Australia or Auscott Ltd.

Ann Frizell (Armidale) Tiffany Hunt (Warialda) James John (Wee Waa) Brittany Valentine (Wee Waa) with PhD Student Baoqain Lu at the ACRI recently.

Students check out careers

By Mary Ann Day

A group of high school students from Wee Waa, together with a Rotary Youth Agricultural Group (RYAG) from Moree recently had a chance to experience life on a cotton farm and learn about some of the many careers available in the cotton industry.

The 21 students, aged 15 and 16 from years 10 and 11, had a glimpse behind the scenes at the Australian Cotton Research Institute near Narrabri.

The visit was organised under the Rotary Youth Agriculture program, which offers students opportunities to see and talk to experienced employees in the cotton industry. The day was hosted by Trudy Staines, education officer with the Cotton Catchment Communities and Helen Dugdale, Research Program Coordination with the Cotton Research and Development Corporation (CRDC).

Helen Dugdale, has been helping Moree Rotary Club for five years to conduct these information tours for secondary school students about "Careers in Cotton".

"This is always a wonderful opportunity for students from non cotton growing areas to see the different employment options available within the cotton industry. It gives them a chance to think about careers in fields such as Science and Agriculture," Helen said.

While Moree Rotary have had students from all over Northwest NSW, Helen also invited local high school students from Wee Waa and Narrabri.

"Their careers teachers are usually very impressed with the range of jobs and career paths available right under their nose," she said.

Graeme Hollis, agribusiness team manager, Premium Business Services Agri Northern, and one of the organisers of the visit, said the tour allows students to see what opportunities exist within the cotton industry, from office jobs to ginning, whether they want to be farm hands or entomologists, researchers or agronomists.

"Today there are a wide range of jobs, including IT, environmental, economic, as well as irrigation engineering," Graeme said.

"We have run four camps in the last five years.

"The students arrive on Thursday afternoon and leave on Sunday- this year they stayed at Moree Rugby Club. It gives them a chance to see and experience the whole cotton industry, from research and processing to growing and harvesting.

"They can see during this time that it is not just about growing cotton, but there are a whole range of careers available too.

"One student who visited us two years ago has actually taken up a career in the cotton industry following the Rotary visit- she now has a cadet traineeship with the Catchment Management Authority, in administration," Graeme added.

Each day the students tackled a different activity, starting with a visit to the Australian Cotton Research Institute followed by a visit to a farm to see how cotton is processed. They also learned about new technology being used on farms.

One of the highlights of their stay is an exercise where the students become cotton growers and have to enact the role, selling cotton and learning about the markets.

"The visit was a great success," Graeme said.

"If the industry could help even one student in their career choice to obtain work within the industry and to stay in the country, then these trips are worthwhile."

Trudy Staines, education officer with the Cotton Catchment Communities CRC , added: "Building people's capacity starts even at primary schools. Encouraging students to consider a career in science and agriculture is important to the sustainability of the cotton industry and rural communities."

Students heard from a wide scope of employees, stretching from CSIRO, Namoi CMA, NSW DPI, CRDC and Cotton CRC research scientists, technical assistants and administration staff at the Australian Cotton Research Centre.

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Jo and Scott Begbie: hard work, but it pays.

Jo shows it's not just for the boys

By Mary Ann Day

Jo Begbie, at 27, is one of a rare breed - a woman cotton farmer who farms alongside her husband Scott. Jo and her husband farm 5060Ha in total on two properties in Hay, NSW, of which 300 hectares is for cotton.

"Farming is more of a male oriented field, but it's changing, and women are becoming more actively involved," said Jo, who is a key member of Wincott.

"Wincott provides invaluable access to information for women in the cotton industry and I am keen to promote their activities and help women to keep in touch within the industry."

Jo came into cotton growing just four years ago when she married Scott (31), having met him in 1998, while they were both studying- he was at agricultural college at Geelong, while Jo was at university nearby.

"We operate the farm as a partnership," said Jo. It's a small family operation and all hands on deck are required. It's a bit of a learning curve here down south.

"There is a shorter growing season and the potential of running into cold, wet weather. But despite the drought, cotton has been grown in this area, and we know we can do it and bring our expertise on board.

"We are very happy with what we have achieved here, although it has had its ups and down for both of us. Scott grew up with farming and grew cotton on his parents' farm at Moree since 1997," added Jo.

When the farm was sold, Jo and Scott moved to Hay. Jo is still tied into the cotton industry through her involvement with Wincott.

For Scott, farming has been his life, but for Jo it was all new.

She had a nine to five job in an accountancy firm as an accounts clerk at Moree - now she spends her day starting at 7am, working a full day as a hands-on farmer.

"On a typical day I could be doing anything from feeding cattle, spraying channels and driving a tractor," said Jo.

"I am also very involved with irrigation work, and really all the manual jobs on the farm. It's hard work and sometimes a 12-hour day, but it pays off."

Besides the farm labouring, Jo also does the books and administration for the farm and even has time to work one day a week for the Department of Juvenile Justice. And in addition to the long days on the farm, she is very active in the local tennis club and is president of the Hay netball club.

Plus there is her membership of Wincott, which she is very passionate about. She also spends time helping to organise conferences and field days for the Lachlan and Murrumbidgee Cotton Growers Association.

"We have absolutely enjoyed our time here farming. I really enjoy the outdoor life and the variety cotton farming offers, as well as the prospect of overcoming the challenges we face," Jo added.

NEW GENERATION COTTON FARMERS

tell why they are enthusiastic and positive about their industry

By Yvette Cunningham

Christian Powell

"Castlebar" Burren Junction, NSW

As a youngster, Christian Powell would always accompanying his father in the tractor and when his legs where long enough to reach the pedals, he was promoted to a member of the farm workforce.

Knowing he would eventually return to the land, Christian enrolled in a Bachelor of Applied Science - Agronomy, at the University of QLD, Gatton.

"I spent the first year on campus having a ball, but I was keen to get back to the farm so I completed the degree externally," said the enthusiastic 28 year old who currently works in the family farming business consisting of mixed broad acre and irrigation cropping including wheat, barley, chickpeas, faba beans, cotton and sorghum.

"The most enjoyable aspect of being a farmer is the ability to play an active role in the farm process, from the planting of a crop to nurturing it through to a healthy high yielding crop is extremely satisfying.

"I also really like knowing that we are working with leading edge technology in our farming systems."

Christian said he feels the future of farming in Australia looks positive, with world food shortages and strong commodity prices.

"We just need some decent rainfall now," he said.

NEW GENERATION COTTON FARMERS

Andrew Watson

"Brigadoon" Boggabri, NSW

"Growing record yields (for us) without an insecticide spray this year" is how Andrew Watson describes a highlight of being a cotton grower.

When Andrew's dream profession of becoming a V8 racing driver was tragically cut short by reality, he tackled various other careers including teaching Japanese at high school, working for the Department of Agriculture, in a bank, buying cotton, and in a couple of business development roles.

Now Andrew and his partner Heike own and lease 2500 ha of mixed cropping and grazing land at Boggabri, NSW.

"Irrigated cotton is our main enterprise, but we also grow irrigated cereals and legumes, dryland cereals and legumes, graze cattle and grow native and imported grass seed," Andrew said.

"The Australian cotton industry is dynamic and I enjoy the challenge to grow a very technical crop and I find the management advice available to us regarding cotton growing to be far more advanced than any of our other enterprises."

NEW GENERATION COTTON FARMERS

Dave Turnbull

"Bellevue" Bourke, NSW

When asked why Dave Turnbull loves being a cotton grower, he replies "the endless opportunities to learn something new and be the best grower you can be."

"In cotton farming there is always something new to learn in a vibrant industry."

After school Dave had no desire to work the family farm or stay in Bourke, so worked as merchandise salesman and then merchandise manager for Landmark in a few different locations.

It was the indecision of what to do with his future that took him back home to the farm and Bourke.

"To my surprise I ended up really enjoying being back on the farm and I now love the small close knit community of Bourke," he says.

"Bellevue" has 325Ha developed for irrigation along with 40,000Ha of grazing country.

"Having a number of different enterprises means you never get bored or stuck in a routine, work is very seasonal, busy times and quiet times, summer cropping is very busy whereas winter stock work is a bit more relaxing," Dave says.

"The future of farming in Australia is changing, it is becoming more and more important to be able to diversify your farming system to grow the most profitable crop at the time.

"Regardless of the coming challenges, I thoroughly enjoy working in the agricultural industry – it allows you the freedom to be outdoors, even though it is tough in the middle of a Bourke summer."

"Finding the right balance between autonomy and accountability is essential if we are to foster a culture of innovation."

Innovation: All about implementing new ideas to create value

By Bruce Finney

Innovation at the core of R&D investments

Innovation is about the adoption of new ideas and inventions but more importantly it is about people; after all, it is people who innovate. Our scientists and farmers are renowned innovators, and the question for an industry-based R&D organisation like CRDC, is how can we help them innovate?

In our new Strategic R&D Plan, CRDC has identified a number of targeted goals geared to enhance the cotton industry's capacity to innovate.

Many of these goals see farmers more at the heart of the innovation process in R&D and include increasing participatory research, establishing and empowering creative forums, while recognising and rewarding innovation. Finding the right balance between autonomy and accountability is essential if we are to foster a culture of innovation.

? The CRDC Strategic Plan 2008-2013 will be available on the CRDC website when it is launched at the Australian Cotton Conference August 12-14.

The Australian government is currently conducting a review of the National Innovation System. In response, CRDC has through the Council of Rural R&D Corporations (RDCs) made a submission on the importance of innovation to the rural sector and the RDC model. It is also a key plank of the proposed CRDC Strategic Plan 2008-2013.

The Australian Government review on innovation is important in these times as it recognises the vital role that innovation plays to national productivity growth while dealing with the challenges Australia faces. It will examine the full range of innovation needs and endeavor.

According to information put to Government in the review, Australian agriculture contributes on average approximately 3.2 per cent of Gross Domestic Product (GDP) (as measured between 1999-00 and 2005/06). However, when all of the value added activities that occur post farm, and all of the activities supporting farm production (inputs) are added, agricultures contribution to GDP rises to 12.1 per cent (Econtech, 2005). Cotton has also shown that it too can be an important player in the national economy.

To produce this total contribution to GDP, agricultural inputs and value adding sectors collectively employ approximately 1.6 million people or 17.2 per cent of the Australian work force (Econtech, 2005). These people are primarily employed in rural and regional Australia and in the major urban centres.

Underpinning agricultures contribution to the Australian economy is innovation. Australian agricultural enterprises have maintained steady rates of productivity improvements in the face of extreme climate variations, significant changes in the value of the Australian dollar and increasingly competitive international markets.

Australian agriculture is innovative and consistently out performs most other sectors of the Australian economy in productivity growth. The majority of the growth in productivity comes from domestic R&D.

The RDCs are major investors for R&D in Australian agriculture. They collaborate extensively with each other, the CRCs and research providers in universities, state departments and the CSIRO.

RDCs strive to deliver high rates of return on R&D investment, and they do this by influencing the full range of interactions along the innovation chain. Although RDCs invest in basic research, a high proportion of their activity is in applied R&D aimed at both the long and short term impacts.

This means that R&D investments are targeted and not designed to generate new knowledge for its own sake, as in blue sky research. Maximising returns on investment according to stakeholder priorities leads the RDCs to apply significant resources to taking basic research outputs and converting them into practical and commercially viable outcomes, that is, innovation.

By ensuring that the model is tuned to the needs of levy payers and government, adoption rates of the successful innovations are higher than if produced by a government agency or directly by the researcher themselves. It is this unique researcher, industry and government interaction that makes the RDC model so effective and efficient.

While the productivity performance of Australian agriculture has been substantial, if current predictions of climate change impacts are correct, Australian agriculture will need to substantially increase its performance to mitigate the impacts. In the future agriculture is likely to play a more central role in the economy as human health and wellbeing, energy, information communications technology (ICT), and biotechnology become more integrated. Critical to Australia's ability to participate in the emergence of a new bioeconomy will be a sophisticated well resourced domestic rural R&D capacity.

? For further information, contact CRDC. 02 6792 4088 www.crdc.com.au

Why industry-based R&D?

For almost 20 years, RDCs has specialised investment strategies to strengthen the innovation system in Australia by:

- Being a key institution that coordinates industry and government objectives
- Efficiently and effectively removing the disincentives associated with market failures and delivering the incentives of government funding
- Supporting the development of scientists and R&D adoption services
- Providing a conduit through which each of the elements – institutions, incentives and human resources – interact for greatest national benefit.