Finding new value in the value chain
**E-learning pilot to assess online skills value for cotton**

The Australian cotton industry has a well deserved reputation for tackling challenging. Insects, disease, pest and disease control and for the efficient and effective use of water. The industry response to drought and by drought climate change has been phenomenal. Yield improvements of 25 percent over the last six years have been critical in assisting the short term survival of farm businesses and positioning the industry to continue to meet the demands of an expanding global market. Credit is due to our growers, consultants and researchers. These gains stem from growing innovation and adoption of the products of R&D including improved varieties, new technologies, information and practices. All of which has contributed to the development of the long term partnership between the Australian Government and cotton growers in R&D.

Industry stakeholders and E-learning specialists met in Sydney in May to discuss how the industry could go about introducing and supporting E-learning and online training for industry-wide skills development. Already well-proven in other industries, cotton soon will have a pilot program to test E-learning using internet links from specially-developed training courses for their marketing and branding efforts. The forum gave the retail brand owners a greater understanding that the local brand owners who participated came away with improved understanding of the opportunities and risks for creating sustainable competitive advantage through differentiation of our product. The Initiative is seeking to realise the full advantage through differentiation of the product. Cotton Australia. CRDC’s recent forum “We’re Aussie, Wear Aussie”, held in February, Farm Manager Andrew Parkes in the industry’s most recent recipient of the innovation award for the year awarded and the industry was invited to “Kayfah” and his team have underway in farming practices, water use efficiency and involvement with trials and research. The farm’s move to reduced tillage for cotton has produced tangible results in improved water use efficiency. Importantly the difficulties and questions that arise were also tabulated in an open and productive manner.

Grouwer interest in these issues is highly evident with the turnout on the day – around 180 people from around NSW to Central Queensland. It was a unique opportunity for growers to compare Kayfah’s farming practices to their own, share experiences about how to improve or test the merits of the practices they already have in place.

About a million miles away from farming systems R&D - but equally connected - is the CRDC/ACSA and Premium Cotton Fibre Initiative. Under the Initiative, commercial spinning mill trials in India have shown the potential for Australian producers to develop a ‘niche’ product. Australia’s first commercial long staple (spun variety) 302HBR, has received the highest quality results consistent with, or better than, other premium cotton fibres. The Initiative in bringing together our growers, agronomists, merchants and researchers with overseas spinners is equipping the industry to take advantage of these opportunities and built a successful competitive advantage through differentiation of our product. The Initiative is seeking to realise the full benefits of the products of R&D as they become available. Already there are better varieties in the pipeline, best practices being developed and adopted for quality from farm to warehouse and new technologies for fibre measurement that may assist prediction of textile quality and efficiency of textile production. E-learning pilot to assess online skills value for cotton

*About a million miles away from farming systems R&D - but equally connected - is the CRDC/ACSA and Premium Cotton Fibre Initiative. Under the Initiative, commercial spinning mill trials in India have shown the potential for Australian producers to develop a ‘niche’ product. Australia’s first commercial long staple (spun variety) 302HBR, has received the highest quality results consistent with, or better than, other premium cotton fibres. The Initiative in bringing together our growers, agronomists, merchants and researchers with overseas spinners is equipping the industry to take advantage of these opportunities and built a successful competitive advantage through differentiation of our product. The Initiative is seeking to realise the full benefits of the products of R&D as they become available. Already there are better varieties in the pipeline, best practices being developed and adopted for quality from farm to warehouse and new technologies for fibre measurement that may assist prediction of textile quality and efficiency of textile production.*

E-learning pilot to assess online skills value for cotton

**Ready to E-learn?**

The pilot project involves assessment of needs in on-farm human resources management. This is to be backed up by a specially developed E-learning course delivered online.

**Interested?**

Email Mark Hickman, National Training Coordinator - mark.hickman@crdc.com.au

---

**Contributors:**

Editorial and photographic contributions to Spotlight are welcomed. All intending contributors should be the first instance contact: The Editor, Postal PO Box 262, Narrabri NSW 2390. Tel: 02 6792 4088, Fax: 02 6792 4400. Email: spotlight@crdc.com.au

**Disclaimer and Warnings:** CRDC accepts no responsibility for the accuracy or completeness of any material contained in this publication. Additionally, CRDC disclaims all liability to any person in respect of anything, and of the information from the identified source. Trademarks acknowledgement: Where trade names or products and equipment are used, no endorsement is intended nor is criticism of products not necessarily implied.

---

**A multi-skilled and competent workforce are vital ingredients for a resilient cotton production sector:**

Mark Hickman, National Training Coordinator

---

**A multi-skilled and competent workforce are vital ingredients for a resilient cotton production sector:**

Mark Hickman, National Training Coordinator
More than 180 people from all cotton growing regions of Australia attended the cotton industry’s ‘Big Day Out’ at Sundown Pastoral’s ‘Keytah’ 35km west of Moree on February 26 to learn more about the “no till” road to cotton and overall management strategies to optimise farming operations.

The day was an initiative of CRDC under the farming systems research program and was partnered by the Cotton CRC and offered a first hand look at the inner workings of a leading farming enterprise.

“CRDC recognises that there are three very important factors which have contributed much to the success of the cotton industry in Australia over the years,” said CRDC Program Manager Bruce Pyke.

“These are:
• capacity of growers to rapidly adopt high quality R and D;
• progressive growers who believe in on-farm trials and innovation; and
• a willingness to share information (successes and failures).

“The BDO enabled all three of these factors to be integrated in a single event which attracted a high level of interest from growers from at least six cotton growing valleys.

“CRDC’s farming systems investment manager Tracey Farrell convened the day and said the Australian cotton industry has demonstrated its strong interest in applying outcomes of the latest research to meet its challenges. She said research presented at the field day proved how changing farm practice can lead to significant energy savings and the potential for improving nitrogen fertiliser use efficiency. These factors contribute to both increased farm profitability and a lightening of farm’s carbon footprints.

On-farm research is part of Andrew Parkes’ management philosophy. Years of on-farm trial work has built the farm’s confidence to adopt a dual row spacing system comprising both narrow row (73.5cm, 30 inch) and wide row (147cm, 60 inch).

On-farm trial work continues this season with more detailed investigation of the comparative water use efficiencies of Bollgard II and conventional cotton varieties under full and supplementary irrigation regimes.

The day showcased many other topics and research a specialists Sally Ceeny, James McMillan, Dave Larsen and Letitia Cross.

There is reasoning behind all the trial work done on “Keytah”. Decisions to trial a new management system are not made off the cuff, Andrew Parkes said in introducing the group to the Bollgard versus Conventional irrigation trial on “Cudgildool”.

“We, as individuals and as an industry need to stay ahead of the group in terms of research and on-farm trials help achieve this – we are interested in whatever is an issue at the time – in the future it is likely to be for example carbon.

Andrew said the farm’s management had been involved in many different types of trials, some incorporating a number of different sciences.

“Trials often are not a hard thing to do – there is a lot of support from CRDC, Cotton CRC and other bodies and CRCs,” he said.

Getting the support of both independent researchers and agribusinesses had allowed them to undertake on-farm research with gusto.

“In the past, trials are often done and the results are shared with the research community or the available funding, then go through the CRDC, Cotton CRC, or Cotton Australia.

“If you are not sure how to connect with the research community or the available funding, then go through the CRDC, Cotton CRC, or Cotton Australia.

“You have to approach research believing that it’s going to give you a result one way or the other. But, if you are approached to run a trial and you don’t think it’s going to give you a result that’s of value, then just don’t go there.

“Being a part of on-farm trials helps give answers to questions about better ways to approach farming systems.

“With varietal trial work, we get to see new varieties coming along first, FCS do all the technical work, while we have the opportunity to compare the crops side by side to varieties we are already working with.

“One of the most beneficial research projects has been the investment made by the cotton industry into plant breeding industry.

“However when we do have a new variety trialled here and it is better, we don’t completely switch over, for the next year it takes a while and we have to feel our way.

“Some trials are more complex than others. Water use efficiency can be one of those, when we have used all sorts of measures – C probes, EM surveys, maps from tractors for field height and firmness.

Andrew says the path to growers conducting their own on-farm research, starts with a question.

He gave the farms’ shift to 15 then 30 and 60 inch row spacings as an example.

“We, had a question in our own minds, there was a lot of empty space in the one metre rows with continued page 6 >
On-farm research a win-win

Ten Whan, Harley Sheridan, consultant Steve Madden and Rod Smith found time to catch up before boarding the buses for what was a big day out looking over the many forms of innovation on the Sundown Pastoral properties.

Making the most of water

Water use efficiency (WUE) has been a large focus for all growers in situations of limited water availability, but for Sundown Pastoral, long term irrigation in better ways to use their water has resulted in a 58 percent increase in WUE.

How did they improve so dramatically from 1.06 bales/ML to 1.89 bales/ML in one season?

Managing water better has come through a multi-faceted approach, by measuring the amount of water used more closely and investigating soil moisture and its water-holding capacity.

“There are some great tools available now to help improve water use efficiency,” Andrew said.

“We have made real improvements in water use by allowing us to more accurately time irrigations and put the water on and off the field in the most efficient way.

“These tools are now allowing us to change things as we are irrigating in real time or for the long term to get the most value for our water.”

Irrigation scheduling

Poor irrigation scheduling can lead to reduced yield and fibre quality and poor water use efficiency. Deciding when and in what order to irrigate no longer needs to be a headache for growers.

The progression to better scheduling has incorporated a variety of measurement tools, including C-probes, EM surveys, maps, field height maps from tractors and formed software – on top of close physical monitoring of crops.

EM38 surveys were used to determine C-probe positioning to determine the average water holding potential of the whole field.

“A C-probe is only as good as the soil you are putting it in,” Andrew said.

“We wanted to ensure we positioned the probe to ascertain the average water holding capacity for each individual field.

“Through constantly ground truthing what the C probes were indicating and by closely monitoring the crop we have been able to steadily increase the refill point for the crop between each irrigation.”

“Rather than setting a refill point we tried to push the refill point a little deeper in between each irrigation, but it is still vital for growers to looking at the crop and there are other factors like variety and configuration to be taken into account. Through this approach the actual physical number of irrigations during a season has been decreased. This has numerous benefits including reduced labour and costs, increased opportunity to utilise rainfall in crop as well as a number of agronomic positives.”

In an attempt to continue to increase WUE Andrew is now measuring variables on a larger scale. How much irrigation water is being applied, how much tail water is being returned, how much rain is being utilized by the crop and how much is running off are measurements that “Keytah” is starting to capture on a field by field basis.

Before deciding the size and number of siphons to be used to improve water use efficiency, the Sundown Pastoral experience has shown it is first necessary to understand the hydrology of irrigation fields.

“By understanding the hydrology of our fields, we have found up to a 50 percent difference is regularly seen in flow rates within a field and between fields.”

Where the water in the head ditch provides “less head” over the field to be irrigated, the larger the size and higher the number of siphons is needed to ensure an even irrigation within a field.

“By increasing the size and number of siphons the flow rate is also increased which ensures water is applied and removed from the field as quickly as possible which reduces the risk and impact on the crop from water logging.”

“By putting into practice what we know about the hydraulic factors, the irrigation “net” is then finished more evenly which allows for more efficient use of irrigation labour and ensures a higher irrigation efficiency.”

Row configuration

All cotton is grown on 1.5m beds and from an irrigation perspective there is less distance for the water to get to the soil in a “water up” situation when cotton is being grown on the 30-inch configuration.

“We are not waiting for moisture to work up and through the hill, as was the case in the traditional hills,” Andrew said.

The decision of how much cotton will be planted in 30 and 60-inch rows depends on the water allocation for the season with the 30 inch having priority.

The 60-inch farming system is akin to growing dryland cotton in irrigated paddocks but with the ability to irrigate at any point during the season and if additional water becomes available.

“We plant as much 30-inch cotton we can grow with the available water and everything else goes into 60-inch spacings.” Andrew says.

“The 60-inch cotton is a buffer for us, if we have the water available, it will be irrigated, otherwise it relies on in-crop rain.”

“This has allowed us to move to a lower number of irrigations in a 60-inch program – especially in limited water scenarios. The crop production potential is still high and if water becomes available we see no reason why yields of between eight to 10 bales per hectare can’t be achieved.”

Storages and deep drainage

One of the storages on “Keytah” which was previously thought to be one of the most efficient because of size and depth may actually not be performing as well at all, with concerns about seepage being the cause.

Through monitoring to ascertain seepage losses, the storage was found to potentially be losing up to 7.5mm per day through deep drainage – which would equate to a yearly seepage loss of 1062 megallitres or $43,800 of water value per year.

This assumption that the storage was efficient was particularly concerning to Andrew, as “at the end of the season all the water on farm was being directed to that one because we thought it was most efficient. We are re-checking the measurements to ensure the results are correct before looking at mitigation efforts.”
Bollgard vs Conventional: understanding performance

"Understanding the plant and what happens to it in physiological sense is really the key to understanding its performance and how it uses water."

The way the crops mature makes quite a bit of difference to the yield potential and the amount of water you require.

What we found here at [Keytah] was that the system for growing conventional was already very good, that nearly 100 percent tipping out created a plant that has a higher yield potential.

"Combining that with a very high capacity to manage insects after tipping out saw good yields and high water use efficiency."

"In the case of Bollgard II we found that the plant is incredibly sensitive to stress as the boll load comes near cut out, far more so than conventional."

The other side is what we saw last season, with a lot of in-crop rain and milder weather, where we could run irrigations on much greater deficits, Stephen said.

"That is where we should be looking to more research as there are big savings to be made in terms of water use."

"We need to be able to measure the plants' stress a lot more accurately and know it is safe to do that and the plant is staying cool."
Energy use in decline

Machinery and specific farm practices were linked to determine fuel (energy) use. This was based on a combination of machinery specifications, workrates, loads, and data obtained from previous work conducted by the NCEA. RESULTS were qualified with general farm records and observations. Energy Assessments were made using the on-line EnergyCalc technology, which is a tool for farm assessments being developed for growers and advisors.

According to the farmer’s own data and calculations by Mr Baillie, a dollar per hectare saving under a reduced till system of $177/ha has occurred since 2000 (from $430/ha to $253/ha), representing an 18 percent reduction in energy use. Carbon Dioxide emissions have fallen from 511 kg/ha to 413 kg/ha.

Table 2 Cost Differentiation between Three Systems

<table>
<thead>
<tr>
<th>RESULTS</th>
<th>Total Energy (GJ/ha)</th>
<th>Energy Costs ($/ha)</th>
<th>GHG Emissions (kt of CO₂)</th>
<th>Since 2000</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000 Benchmark</td>
<td>16.32</td>
<td>402</td>
<td>637634 (1266 kg/ha)</td>
<td></td>
</tr>
<tr>
<td>Reduced Till</td>
<td>14.33</td>
<td>353</td>
<td>509958 (107 kg/ha)</td>
<td>-12%</td>
</tr>
<tr>
<td>Towards Zero Till</td>
<td>12.44</td>
<td>206</td>
<td>481616 (935 kg/ha)</td>
<td>-24%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diesel Only (as Assummed)</td>
<td>13.76</td>
<td>232</td>
<td>511 (511 kg/ha)</td>
<td></td>
</tr>
<tr>
<td>Diesel Gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

There is even greater scope for savings in looking toward a zero-till situation, with energy costs per hectare falling from $335 to $230/ha or a further energy saving of 13 percent.

In relation to the 2000 benchmark this equates to a total reduction in energy (diesel) of 24 percent and an estimated cost saving of 49%, 645 across Keytah (assuming fuel price of 89.90/L; cropped area of 5200ha).

To facilitate the adoption of zero till at Keytah, surface irrigation fertigation is currently being explored to eliminate heavy primary tillage operations which in the past have been used to drive deep plug fertiliser into the soil profile. The fertigation system consists of a large tank containing liquid nitrogen based fertiliser (N26) that is applied into the head ditch at a constant flow rate (via a constant head device) where water is then applied to the field via aphon fed furrows during irrigation.

Andrew says the efficiency of this form of fertiliser application also requires some additional research and development as a comparison to traditional methods.

“There is some anecdotal evidence that suggests this application technology may provide benefits of greater N efficiency, which could lead to a reduction in the total N applied each year,” he said.

“Also it allows for the use and cost of N to be applied at the point when the crop needs it rather than ‘up front’ which has additional cash flow benefits.”

Emissions were also measured with the engine running at 1400rpm, the speed at which it does most of its work. There was a 26.7 percent reduction in nitrous oxide emissions and 1.9 percent reduction in carbon dioxide.

There are even greater opportunities to improve their efficiency. In addition to these emission figures, exhaust gas exit temperatures were dropped about 5 percent, showing an increase in engine efficiency,” he said.

“If the motor runs more efficiently, it runs better, needing less diesel to maintain its load, extending engine life thus making it more cost effective and also reducing the carbon footprint.

In addition to these measures, potential savings of $10,000 to $30,000 can be made per season for fairly simple improvements. Before spending money on the engine, check that the pump is operating as efficiently as possible,” he said.

“It is fairly simple to work out whether it is cost effective to repair or replace a pump.

“When the pump is right, there could be more big savings achieved by checking the engine. Having poorly performing pumps or prime movers is a waste of money and a waste of energy.

“We could make big improvements to our current irrigation engines and energy use if we got all pump stations running at their optimum efficiency.”

Short workshops on irrigation pumps available through NSW DPI or the Cotton Water Team give an understanding of the basic principles and show you how to work out your running costs and efficiencies. In NSW, it is through NSW DPI’s ProFarm, with details at www.dpi.nsw.gov.au/agriculture/programs or contact Peter Smith on 02 6781 4262. In Qld the workshops are available through the Cotton Water Team, contact Graham Harris, QDPI, Toowoomba, 07 4688 1519.

Matt Derry of Diesel Gas Technologies said the reduction in both of these emissions is also an indication of increased engine efficiency and that particular matter is also reduced.

In addition to these, he said, “there are many other benefits to be gained from reducing greenhouse gas emissions and energy use if we get all pump stations running at their optimum efficiency.”

In addition to these measures, exhaust gas exit temperatures were dropped about 5 percent, showing an increase in engine efficiency,” he said.

“If the motor runs more efficiently, it runs better, needing less diesel to maintain its load, extending engine life thus making it more cost effective and also reducing the carbon footprint.

In addition to these measures, potential savings of $10,000 to $30,000 can be made per season for fairly simple improvements. Before spending money on the engine, check that the pump is operating as efficiently as possible,” he said.

“It is fairly simple to work out whether it is cost effective to repair or replace a pump.

“When the pump is right, there could be more big savings achieved by checking the engine. Having poorly performing pumps or prime movers is a waste of money and a waste of energy.

“We could make big improvements to our current irrigation engines and energy use if we get all pump stations running at their optimum efficiency.”

Short workshops on irrigation pumps available through NSW DPI or the Cotton Water Team give an understanding of the basic principles and show you how to work out your running costs and efficiencies. In NSW, it is through NSW DPI’s ProFarm, with details at www.dpi.nsw.gov.au/agriculture/programs or contact Peter Smith on 02 6781 4262. In Qld the workshops are available through the Cotton Water Team, contact Graham Harris, QDPI, Toowoomba, 07 4688 1519.
Industry services: there for your protection

The Crop Protection National Priority team is a group of extension staff prioritising the extension of disease, pest and weed-related research information. The team is made up of Cotton CRC regional extension officers and partner staff including NSW Department of Primary Industries and QPI Primary Industries and Fisheries, CRDC, Namoi CMA and Cotton Australia.

How does the team help industry?
- Assist with the development of extension plans to deliver research findings to industry
- Develop extension resources to support extension officers
- Assist with development and planning of trials and benchmarking processes in regional areas
- Promote crop protection research work and issues through cotton post-management guides, Cotton Tales, fact sheets, media releases and other publications
- Facilitate workshops, field days and farm walks to promote research and current industry best practice
- Provide feedback to researchers and industry on current industry issues

Integrated Disease Management Extension
The Crop Protection Team has worked with a range of pathologists to ensure that industry publications are up to date and that disease information is readily available. This has included facilitating a review of the Integrated Disease Management Manual, and updating Cotton Pest Management Guide to include new species, host plants, and emerging issues such as Tobacco Streak Virus and potential biotic stress. The Annual Disease Surveys during back to 2004 have been recently added to the Cotton CRC website and an annual section has been added to the cotton post-management guide.

Integrated Weed Management Extension
With continued reliance on glyphosate, there is a risk of a shift in weed spectrum to weeds not controllable by glyphosate or herbicide resistance. In addition, barnyard grass which has been confirmed as glyphosate resistant, is a weed of some cotton systems.

The team has worked closely with weed agronomists on a number of projects to promote herbicide resistance risks. The team is working with the QPIF weed agronomy team to develop a herbicide resistance risk assessment tool and action learning workshop. These workshops are scheduled to be held in December and are aimed to increase understanding of integrated weed principles. The team has also worked with researchers on weed thresholds to optimise the use of herbicides.

Integrated Pest Extension
The Crop Protection team work closely with researchers to help respond to emerging issues as well as assisting in the development and extension of new research. The team has delivered IPM courses at locations where increases in capacity was required including Emerald, Hilgrove and the Burdekin.

Planning for port management in cotton in NSW now needs to include SLW. In developing management strategies it is important to consider why the outbreaks occurred and what can be done to reduce their likelihood in the 2009/10 season. SLW were first detected across northern NSW during the 1994/95 season and have been seen in cotton fields ever since. Researchers surmise that for 13 years SLW has gradually replaced the native whitefly populations. Differences in mating behaviour, SLW’s stronger rates of reproduction on cotton and the use of broad spectrum insecticides in cropping programs have favoured this transition.

When average daily temperature data is analysed, northern NSW does meet the criteria for supporting the seven whiteflies/generation/year need to produce an outbreak.

Once SLW is established in a region, the factors that drive subsequent SLW outbreaks are, in order of importance, climate, regional farming system, within crop management. This means that when grown with climate conditions favouring SLW outbreaks, the cropping strategies employed across the region and the individual grower’s consideration of SLW in crop management decisions will have much greater impacts on the cessation of SLW outbreaks than in seasons where the climate is working against the pest. For real success, SLW management needs to be implemented all year round.

Climate
SLW does not have an over-wintering diapause stage. During winter their growth rate decreases in response to the lower temperatures causing generation time to increase. Calder than average winters coupled with cooler than average spring and summer conditions delay population expansion, helping to avoid outbreaks. However it is a misconception that frosts act as strong regulators of the population.

How do frosts influence the survival of SLW in winter?
Light frosts common to winters in northern NSW cannot be relied upon to stop SLW dead in their tracks. Nymphs are highly cold tolerant, having something akin to antifreeze in their system. Adults are mobile and able to withstand frosts by sheltering in the warmest part of the plant canopy or moving to hosts in protected locations. Sustained heavy frosts have a greater impact on population survival, and do occur in northern NSW in some winters. The impact is partly by causing death of the whiteflies and partly by causing death of the plant hosts.

Regional farming system
In order for a SLW outbreak to occur, a long period of continual hosts is required. It is important for growers across a region to maintain very good farm hygiene to reduce the risk of outbreaks. Very good hygiene will limit access to preferred alternative hosts. Remove cotton volunteers from all around the farm—fields, roadways, irrigation channels. Many broadleaf weeds are also excellent hosts for SLW. In autumn and winter pay particular attention to control of sowthistle, turnip greens, volunteer sunflowers, and volunteer sunflowers in spring look out for blattend kotelis, cow vole and bell vole. Where possible work with neighbours to create a host-free period within the cropping rotation. Non-host crops include sorghum, maize, winter cereals and chicory. The combination of tight planting windows may all that is required to achieve this. Host-free periods are most effective when conducted across large areas.

Within crop management
As many growers discovered first hand in 2008/09, whitefly can be controlled to a considerable degree of an insect and manage the pest's development and management. Growers are asked to be alert to any signs of whitefly being able to withstand heavy frosts have a greater impact on population survival, and do occur in northern NSW in some winters. The impact is partly by causing death of the whiteflies and partly by causing death of the plant hosts.

Regional farming system
In order for a SLW outbreak to occur, a long period of continual hosts is required. It is important for growers across a region to maintain very good farm hygiene to reduce the risk of outbreaks. Very good hygiene will limit access to preferred alternative hosts. Remove cotton volunteers from all around the farm—fields, roadways, irrigation channels. Many broadleaf weeds are also excellent hosts for SLW. In autumn and winter pay particular attention to control of sowthistle, turnip greens, volunteer sunflowers, and volunteer sunflowers in spring look out for blatemala kotelis, cow vole and bell vole. Where possible work with neighbours to create a host-free period within the cropping rotation. Non-host crops include sorghum, maize, winter cereals and chicory. The combination of tight planting windows may all that is required to achieve this. Host-free periods are most effective when conducted across large areas.

Within crop management
As many growers discovered first hand in 2008/09, whitefly can be controlled to a considerable degree of an insect and manage the pest's development and management. Growers are asked to be alert to any signs of whitefly being able to withstand heavy frosts have a greater impact on population survival, and do occur in northern NSW in some winters. The impact is partly by causing death of the whiteflies and partly by causing death of the plant hosts.

Regional farming system
In order for a SLW outbreak to occur, a long period of continual hosts is required. It is important for growers across a region to maintain very good farm hygiene to reduce the risk of outbreaks. Very good hygiene will limit access to preferred alternative hosts. Remove cotton volunteers from all around the farm—fields, roadways, irrigation channels. Many broadleaf weeds are also excellent hosts for SLW. In autumn and winter pay particular attention to control of sowthistle, turnip greens, volunteer sunflowers, and volunteer sunflowers in spring look out for blatement kotelis, cow vole and bell vole. Where possible work with neighbours to create a host-free period within the cropping rotation. Non-host crops include sorghum, maize, winter cereals and chicory. The combination of tight planting windows may all that is required to achieve this. Host-free periods are most effective when conducted across large areas.

Within crop management
As many growers discovered first hand in 2008/09, whitefly can be controlled to a considerable degree of an insect and manage the pest's development and management. Growers are asked to be alert to any signs of whitefly being able to withstand heavy frosts have a greater impact on population survival, and do occur in northern NSW in some winters. The impact is partly by causing death of the whiteflies and partly by causing death of the plant hosts.

Regional farming system
In order for a SLW outbreak to occur, a long period of continual hosts is required. It is important for growers across a region to maintain very good farm hygiene to reduce the risk of outbreaks. Very good hygiene will limit access to preferred alternative hosts. Remove cotton volunteers from all around the farm—fields, roadways, irrigation channels. Many broadleaf weeds are also excellent hosts for SLW. In autumn and winter pay particular attention to control of sowthistle, turnip greens, volunteer sunflowers, and volunteer sunflowers in spring look out for blatement kotelis, cow vole and bell vole. Where possible work with neighbours to create a host-free period within the cropping rotation. Non-host crops include sorghum, maize, winter cereals and chicory. The combination of tight planting windows may all that is required to achieve this. Host-free periods are most effective when conducted across large areas.
Industry is a key investor in a project to evaluate 135 storages at no cost to growers in a bid to improve water use efficiency by mitigating storage losses.

With industry research showing that irrigation storages can contribute to major water loss on farm, many growers would be interested in the cost of evaluating their storages. Anson Cotton, a cotton farm northeast of Moree estimated that during a ‘standard’ year, the farm’s cell ullage reservoir was losing over $370,000 per annum, with 43 per cent of this due to deep drainage. At Sundown Pastoral’s ‘Keyworth’ west of Moree, manager Andrew Parkes said irrigation losses from just one of its storages had the potential to cost the company an average of $106,000 per year, or in dollar terms, $434,800 annually.

With potential losses so high, now is the time for growers to find out at no cost how their storage is performing. According to project manager Dr David Wigginton who is working with the National Centre for Engineering in Agriculture (NCEA), in Queensland, the project offers a great opportunity for growers to improve their water management and efficiency through directly identifying where losses occur.

‘Measurement, to improve the water efficiency of on-farm storages in the cotton industry’, will assess at least 135 storages across all cotton regions over three years. The Cotton Catchment Communities CRC received funding from the National Water Commission ‘Raising National Water Standards’ Program for the project, which got underway last year. The initial idea for the project came from the Central Downs Irrigators Limited who undertook a very successful storage management project with Total Agricultural Services and FSA Consulting on the Darling Downs in 2004-05, funded through Condamine Alliance. Consultants from six consulting firms across the cotton industry are undertaking storage evaluations using the Irrimate Seepage and Evaporation meter. The first few analyses are completed.

While the storage may look reliable on the surface, a true picture can only be formed by taking water measurements, and received training to deliver this service and the project supports them by funding the cost of individual storage evaluations. Furthermore, the project inputs the data collected across the industry, developing a better understanding of storage losses and solutions.

‘The project will enable individual growers to have the seepage and evaporation losses from their own storages measured with the project bearing the cost of these measurements. The whole industry benefits from testing and promotion of the cost-benefit of strategies to minimise significant losses that exist,’ he said.

‘It will identify the characteristics of efficient and inefficient storages, and build capacity and skills within the industry for the effective measurement and minimisation of storage losses.

‘This knowledge will lead to the development of best management practices for the management of water storages, further increasing whole farm water use efficiency. The project will also seek to follow up with feedback to assess how successful change practices have been for the farm.

‘Where losses are significant, and growers apply appropriate solutions to minimise them, the project will remunerate up to 70 storages in order to evaluate how effective the solutions are’, David Wigginton said.

‘In addition, the project has engaged industry consultants to undertake the measurements, helping to improve their ability to continue providing these evaluation services after the project is finished.’

Expressions of interest from growers who would like to have their storages assessed will be called for during June and July with evaluations likely to begin in August or September.

For further information on the project and the consultants providing the irrigation assessment, contact David Wigginton, at david.wigginton@opsum.net.au
0413 467 835
A short history

In both H. armigera and H. punctigera Cry1Ac resistance was first detected at unexpectedly high frequencies of around 0.001 (one in 1000 - 0.1 percent) through F1 screens. As resistant Helicoverpa colonies have been established by the testing laboratories, F2 screens have also become part of the resistance monitoring program. The detection of resistance through this screening process has also been unexpectedly high for both species. F2 screens for H. armigera began in 2004/05 recording a frequency of 0.013 (13 in 1000, 1.3 percent). F1 screens for H. punctigera have only recently commenced with a relatively small sample in 2007/08 detecting a frequency of 0.010 (10 in 1000 - one percent). Researchers are confident that the frequencies identified through the F1 screens most accurately reflect the field situation.

Researchers use two types of screens to detect resistance. Initially F1 screens are used as this process looks at the grandchildren of two insecticide treatments. F2 screens are used as this process looks at the progeny from mating a field collected insect with one from the resistant colony. When a resistant colony is established in the laboratory. When a resistant colony is produced in the laboratory does not detect increased frequencies of resistance. Researchers use a population dynamics model to make predictions about the ‘sustainability’ of Bollgard II given the known resistance frequencies. There are strengths and weaknesses in the model’s setup that require consideration when interpreting its predictions. At the time of Bollgard II introduction, the model predicted Bollgard II would have a life expectancy five to ten times longer than that of INGARD.

FACT 1: The Cry2Ab gene present in Australian populations of Helicoverpa is recessive. This means that larvae must carry two copies of the gene to survive the toxin. This makes Bt resistance different from resistance to conventional insecticides which usually only require an individual to carry one copy of the gene to survive the insecticide. The main aim of the Bt monitoring program is to detect increases in the frequencies of individuals that carry one copy of the gene so that we can modify the RMP before individuals with two copies of the gene become common.

FACT 2: In both Helicoverpa species, Cry2Ab resistance shows no cross-resistance to Cry1Ac. When Bollgard II expresses both Cry1Ac and Cry2Ab optimally, Cry2Ab-resistant insects will still be controlled. The greatest risk of selecting for resistance and potentially seeing the consequences of Cry2Ab resistance in the field occurs at the end of the season. At the end of the season expression of Cry1Ac is known to decline, meaning there is greater reliance on the Cry2Ab toxin to defend the crop.

FACT 3: Cry2Ab-resistant insects are not dose responsive. Cry2Ab resistant H. armigera and H. punctigera tolerate very high doses of Cry2Ab toxin. Indeed, the most concentrated toxin that can be produced in the laboratory does not affect the survival or growth of the resistant insects. This has consequences for the development of future Bt technologies for the industry.

FACT 4: The rate of evolution of resistance can be influenced by the presence of fitness costs. CSIRO has investigated fitness costs of individual components of the lifecycle for the resistant H. armigera have and found no evidence of fitness costs. Monsanto has examined the mating properties of a Cry2Ab-resistant colony. Resistant genotypes were found to mate less than susceptible insects indicating a fitness cost is associated with resistance.

Being prepared for future resistance

Population modelling now predicts that the control provided by Cry2Ab, most relevant towards the end of each season, could be compromised in as few as six to seven seasons time. The graph shows that the current resistance frequencies are already past the point in the ‘life expectancy’ curve where small changes in the frequency will make large changes in the number of generations until resistance is endemic in Helicoverpa populations.

When Helicoverpa become resistant to Cry2Ab, Bollgard II will be as effective as INGARD. Insecticide resistance will be costly in the future. The Monsanto has announced intentions to make a third Bt technology commercially available in Australia. This is scheduled to occur around 2015.

The population dynamics model considers that there are four generations of Helicoverpa exposed to Bollgard II cotton each season. It considers that the mechanism of resistance to Cry1Ac is completely recessive, with no fitness costs, and is due to a single gene. The model is able to crudely account for the decline in Cry1Ac toxin after flowering by considering that when Cry1Ac levels are high the larvae survive but that Cry2Ab is completely non-toxic for the final generation larvae in the season. It accommodates for the contribution of refuges by assuming that 10% of the eggs are laid on non-transgenic crops. However it is unable to consider the impacts of cross infection by the same resistance gene.

The protection of existing resistance mechanisms by introducing new Bt toxins will cost resistance management programs. The current Cry2Ab gene in Bollgard II is unlikely to provide as much protection as Cry2Ab will need to maintain the high levels of control currently available. The Cry2Ab gene present in Bollgard II would be as effective as INGARD. F2 screens are used as this process looks at the grandchildren of two insecticide treatments. F1 screens are used as this process looks at the progeny from mating a field collected insect with one from the resistant colony.

Important facts for understanding the resistance risk

FACT 1: The Cry2Ab gene present in Australian populations of Helicoverpa is recessive. This means that larvae must carry two copies of the gene to survive the toxin. This makes Bt resistance different from resistance to conventional insecticides which usually only require an individual to carry one copy of the gene to survive the insecticide. The main aim of the Bt monitoring program is to detect increases in the frequencies of individuals that carry one copy of the gene so that we can modify the RMP before individuals with two copies of the gene become common.

FACT 2: In both Helicoverpa species, Cry2Ab resistance shows no cross-resistance to Cry1Ac. When Bollgard II expresses both Cry1Ac and Cry2Ab optimally, Cry2Ab-resistant insects will still be controlled. The greatest risk of selecting for resistance and potentially seeing the consequences of Cry2Ab resistance in the field occurs at the end of the season. At the end of the season expression of Cry1Ac is known to decline, meaning there is greater reliance on the Cry2Ab toxin to defend the crop.

FACT 3: Cry2Ab-resistant insects are not dose responsive. Cry2Ab resistant H. armigera and H. punctigera tolerate very high doses of Cry2Ab toxin. Indeed, the most concentrated toxin that can be produced in the laboratory does not affect the survival or growth of the resistant insects. This has consequences for the development of future Bt technologies for the industry.

FACT 4: The rate of evolution of resistance can be influenced by the presence of fitness costs. CSIRO has investigated fitness costs of individual components of the lifecycle for the resistant H. armigera have and found no evidence of fitness costs. Monsanto has examined the mating properties of a Cry2Ab-resistant colony. Resistant genotypes were found to mate less than susceptible insects indicating a fitness cost is associated with resistance.
STEWARDSHIP

Industry Response

In February, REFCOM (Research and extension in Bt resistance) brought together researchers, growers, consultants, and representatives from the Cotton CRC’s extension team and Monsanto to discuss research progress and communication on Bt resistance.

As an outcome of this forum, the precautionary measure of a Cry2Ab resistance contingency plan is being undertaken.

The Bt Technical Panel of Cotton Australia’s TIMS Committee are working with Monsanto to develop the plan. The plan will help the Cotton Australia TIMS Committee and Monsanto to respond when ‘trigger points’ are reached in the resistance frequencies.

Under the plan it is proposed to match potential mitigation strategies with the resistance risk to current and future Bt cotton technologies.

These responses will then be available to Monsanto and the industry to modify the Bollgard II Resistance Management Plan for future seasons.

What should growers do?

It is essential that Bt resistance management measures, as required by the RMP, are followed. As a priority, growers should ensure that pupae burning of 2008/09 Bollgard II fields occurs before August 30. At the 2010/11 season approaches, plan for planting Bollgard II and the associated refuge at the right time and ensure that cotton volunteers that emerge in early spring are controlled.

During the season, manage refuges to be attractive for as long as possible through the season, and continue to control cotton volunteers in follow fields.

All growers are encouraged to participate in industry discussions about possible changes that could be implemented to the Bollgard II RMP in future seasons. Contributions can be made:

– through your local CCA (Cotton Growers’ Association),
– by directly contacting the TIMS Committee representative in your region,
– when attending the BT Information reference forum at the Cotton Collective in Narrabri, August 11-13,
– when attending a Resistance and IPM information forum being held in nine locations across the industry in late August.

To ensure that Australian cotton remains competitive internationally it is vital that growers in Australia develop a better understanding of how the opportunities exist for strengthening our market advantage.

A study commissioned by CRC and ACMA in 2007 surveyed 14 companies in eight countries to understand the demand for Australian cotton and the future course for high quality cotton in order to determine research priorities.

Dallas Gibbs, Manager of the Value Chain Investment Program for CRC and CSIRO says “We know that production from countries such as India, China and South America is increasing in both yield and quality. We need to continue to assess the changing demands placed on mills for fibre quality and how Australian cotton compares with other international cotton types in meeting these demands.”

Through the survey Australian cotton was acknowledged as a superior fibre by almost all the companies in the study, with (comparatively) low contamination levels, better uniformity and less colour variation. However, there was also found to be a need for more uniform micronaire, low neps and short fibre content, according to some companies, especially those surveyed in Thailand.

The study, carried out by independent company Technopak, found that increased global production poses a significant threat to Australian cotton growers. Even though Australia emerged as the second most favoured country for cotton after the US among the surveyed companies, they do reckon cotton producers (countries) depending on fibre price, required yard parameters and buyer demand.

Based on the findings, Technopak made the following recommendations:

– Create Demand/Pull for Australian Cotton through Supply Chain Marketing
– Generate Brand Awareness
– Focus on ELS Cotton markets.

Since the Technopak report, “The Australian cotton industry has been collaborating to look at methods by which we can enhance the quality of Australian cotton and its reputation as a producer of the highest quality cotton,” said Mr Gibbs.

“From a quality perspective, Australia may not become a major player (ELS cotton) producer, however we can focus on meeting the demands for quality cotton that we develop as ELS cotton declines worldwide,” he said.

We know that new cotton varieties like CSIRO’s Sicala 350B are being developed that have unique characteristics that are especially interesting, a recent value chain forum, Sicala 350B commercial mill trials, and the advancements in technology to give fibre-quality assurances.

Dallas Gibbs says “Our ‘We’re Aussie – Wear Aussie’ value chain forum in Sydney last month allowed open discussion about the perception of Australian cotton between growers, marketers, researchers, manufacturers and brand owners.”

“The take home message was these local brand owners are enthusiastic for an Australian cotton product and believed there was a strong fit for their marketing and branding efforts,” Mr Gibbs said.

“The forum gave participants greater understanding of the ‘story’ we are trying to tell about how the quality of our cotton together with our RMP program may provide a competitive advantage for local and international brand owners.”

“It is a reminder that Australian cotton is being recognised not only by domestic but also by international buyers,” Mr Gibbs said.

Collaborative discussions have occurred with a number of brand owners since the forum through the efforts of Australian Cotton Exporters Association and Cotton Australia.

While efforts are underway to create demand pull domestically, the same scenario is evolving internationally, on the other side of the globe, with commercial mill trials in India of Sicala 350B returning excellent results.

As part of the Premium Cotton Initiative, CSIRO textile specialist Rene van der Sluys was on-site to observe and offer advice during the trials, which found that unblended 350B could be spun successfully in high quality fine count yarns.

“It was mentioned by the mill that it could easily replace one other premium cotton being used,” Rene said.

“Our emphasis is that quality combed yarns for the weaving and knitting sector in the count range 50 to 70 Ne can be produced on traditional ring spinning and card spinning as well as with carding and combing. Furthermore, if blended with ELS cotton it could get down to 80 Ne – which is in the niche quality market.”

CRC’s role is to understand customers’ needs and to provide sound research support to the industry’s marketing efforts focused on increasing our competitive advantage and premiums.
Sicala 350B impresses in commercial India trials

Initial trials conducted in 2004 showed that Sicala 350B fibre produced superior Ne 42 and Ne 35 ring-spun carded and combed yarn, and subsequently fabric (single jersey) knitted from yarns in the range of Ne 60 to 70. The results were a win-win situation for growers and spinners. The results showed that quality combed yarns for the weaving and knitting sector in the count range 50 to 70 Ne can be produced on traditional ring spinning and compact spinning machines and furthermore, if blended with ELS cottons it could get down to 80 Ne – which is in the niche quality market.

Sicala 350B is considered for any blends it needs to be processed and we are very pleased with discussions with Vardhman it was agreed that before Sicala 350 B is considered for any blends it needs to be evaluated on its own merits,” Rene van der Sluijs explains.

“Yarn strength was also a little lower than desired.” Those high quality fine count yarns are used mainly for the production of high quality woven and knitted shirtmaking material where the incidence of neps can adversely affect the appearance of the fabric, especially on fabrics dyed to dark shades, such as black, navy, brown and green. The appearance of dyed or printed fabrics is negatively influenced by the presence of neps which appear as white spots on finished fabrics. This causes fabrics to be down graded or rejected as there are no cost effective means of covering or removing the imperfections once they are present in the fabric.

Precious Fibre Initiative chair Pete Johnson said the project is about laying the groundwork to learn as much as possible about the fibre’s capabilities so that when subsequent generations of higher yielding long staple upland varieties come on stream – and production increases - our spinners have as much technical information as possible to help market the crop.

The results showed that quality combed yarns for the weaving and knitting sector in the count range 50 to 70 Ne can be produced on traditional ring spinning and compact spinning machines and furthermore, if blended with ELS cottons it could get down to 80 Ne – which is in the niche quality market.

Australian growers have access to the niche variety and the primary advantage for the spinner in using Sicala 350B is that it is a substantial savings in raw material costs compared with other premium varieties. The results showed that quality combed yarns for the weaving and knitting sector in the count range 50 to 70 Ne can be produced on traditional ring spinning and compact spinning machines and furthermore, if blended with ELS cottons it could get down to 80 Ne – which is in the niche quality market.

The next step in the project is to assess the product as a fabric. Yarn for knitting has been sent for knitting trials and yarns for weaving trials to weaving mills. Sliver from the lots will also be used in dyability trials to determine dye uptake and also to determine suitability of blending with other cottons.

Vardhman will now conduct further trials on Sicala 350B on a larger scale both in 100 percent and in blends with ELS type cottons.

Collaborating with the Vardhman Textile group

Vardhman’s is one of the largest textile groups in India with numerous processing mills in different parts of India. They have close to 1 million spindles and are currently installing a further plant with further expansion plans for the future.

Vardhman produce a large range of staple fibres with cotton accounting for 85 percent of their production in 100 percent and in blends.

The commercial trials were conducted in the province of Himachal Pradesh in Northern India which is nestled at the foot of the Himalayas.
Cottonscan development moves up a gear

Cottonscan technology is bringing the Australian and international cotton industry significantly closer to meeting a longstanding commercial challenge. Five fibres are needed to make premium lightweight yarns and fabrics but prior to Cottonscan, the industry’s ability to accurately grade fibres on the basis of its fineness (also known as linear density) had presented a major problem.

Cottonscan can benefit both cotton growers and the textile industry, by enabling high quality, fine Australian cotton to be correctly graded and valued by the market. Additionally, an accurate knowledge of the fineness of cotton is expected to increase the productivity and profitability of the spinning sector of the world’s textile industry.

CSIRO Materials Science and Engineering (CMSE) scientist, headed by Dr Geoff Naylor developed Cottonscan with CRDC and are continuing to make groundbreaking improvements to the instrument opening the way for broader use of the technology.

CMSE has manufactured five of the faster machines, two are in the US with the others here at the CMSE site in Geelong, and all are currently undergoing inter-laboratory trials, to ensure the modifications are consistent among all five.

These inter-laboratory trials are a pre-cursor to Cottonscan’s use in large scale trials at spinning mills in China – which Dr Gordon will oversee. Cottonscan’s use in large scale trials at spinning mills in China – which Dr Gordon will oversee. Cottonscan’s use in large scale trials at spinning mills in China – which Dr Gordon will oversee.

Cottonscan was used by CMSE in the Premium Blends Initiative, testing Scoria 150b cotton before it was sent to India for trials (see article “150b impresses” page 20-21)

CMSE has manufactured five of the faster machines, two are in the US with the others here at the CMSE site in Geelong, and all are currently undergoing inter-laboratory trials, to ensure the modifications are consistent among all five.

These inter-laboratory trials are a pre-cursor to Cottonscan’s use in large scale trials at spinning mills in China – which Dr Gordon will oversee. Cottonscan was used by CMSE in the Premium Blends Initiative, testing Scoria 150b cotton before it was sent to India for trials (see article “150b impresses” page 20-21).

Cottonscan has been used in both clashing houses and spinning mills, allowing Australia to provide a quality assurance in terms of fibre linear density and maturity.

Mick Keough said the message was still the same as it was in the 90s, that Australians need to become more aware of the quality of our cotton and the processes involved in producing it.

Cottonscan was used by CMSE in the Premium Blends Initiative, testing Scoria 150b cotton before it was sent to India for trials (see article “150b impresses” page 20-21).

Cottonscan has been used in both clashing houses and spinning mills, allowing Australia to provide a quality assurance in terms of fibre linear density and maturity.

Mick Keough said the message was still the same as it was in the 90s, that Australians need to become more aware of the quality of our cotton and the processes involved in producing it.
Ultra-Narrow configurations: is it a better alternative?

Ultra-narrow row cotton (rows spaced less than 48cm apart) has long been seen as a potential alternative system for Australian cotton, especially in regions with shorter growing seasons. The aim of these systems with narrow rows has been to reduce harvest costs and achieve earlier maturity without sacrificing yield.

Advances in technology and positive commercial experience in shorter season production areas as well as access to transgenic technologies renewed interest in narrow row production across the industry.

Further interest was generated by advances in harvesting technology from John Deere that allowed spindle picking of narrow row cotton crops (38cm rows), avoiding the risk of discounts for fibre quality associated with harvest that were associated with previous narrow row picking systems.

Detailed studies to improve our understanding of differences in the growth and development of cotton in conventionally spaced (one metre) and ultra-narrow row (SNR – 25cm row spacing) production systems were conducted as part of postgraduate studies by Rose Brodrick (nee Roche), now a research scientist with CSIRO Plant Industry. Following on from this research additional comparisons have been conducted in 38cm configurations in the warmer areas of the industry.

"Conceptually, in high-input systems, the high density planting of narrow row systems reduces the time to crop maturity, as fewer bolls per plant need to be produced to achieve yields comparable to conventionally spaced cotton crops," Dr Brodrick said.

"In practice, this carbon has been difficult to achieve consistently in SNR trials in both Australia and the US despite the level of input required."

Dr Brodrick has also investigated many other variations of row configuration with different within-row spacing as that opportunities to achieve earlier maturity or higher yields can be exploited, and management strategies to allow this developed. "This will fill a significant gap in our current knowledge of crop agronomy and management in cotton crop population issues," she said.

"During the course of the project a total of 11 field experiments were conducted that investigated: growth of cotton in different row configurations; growth of cotton grown in different row configurations and populations; Bollgard II versus conventional (non-Bollgard II) in different plant populations; and agronomy of narrow row systems."

In summary the outcomes of this project that were tangible and tested included the following:

- Plant population differences from both changes in inter and intra row spacing had little or no consistent response on yield, quality or maturity.
- Narrow row systems (38cm) did not improve yield or cause earlier maturity.
- The addition of earlier and higher inputs of water and nitrogen did not overcome plant competition effects leading to improvements in yield in 38cm row spacings.
- No differences in management were identified between one metre and 38cm row spacings. Fix management was not different, re-confirming results of previous studies.

In 2006 NSW Department of Primary Industries and its team of experienced cotton irrigation extension officers received funds from the Cotton Research Development Corporation, Cotton Catchment Communities Cooperative Research Centre, and the Namoi and Border Rivers-Gwydir Cotton Catchment Management Authorities to undertake intensive water use efficiency (WUE) extension in NSW cotton growing valleys. The project Advancing Water Management in NSW was initiated by industry and government in recognition of the importance of investing in a highly effective extension team to assist the cotton industry improve WUE.

NSW DPI Irrigation Officer and project leader Rod Jackson says the adoption of water management technology and irrigation best management practices are key drivers in generating greater water use efficiency.

In order to stimulate adoption and initiate practice change a multitude of extension techniques were utilised, including irrigation training, technology demonstration, dissemination of fact sheets, case studies and cost benefit analyses, consultant support and water use efficiency benchmarking.

Henceforth, the Irrigated Cotton and Grains Workshop Series and the Centre Pivot-Lateral Move training courses were delivered to 250 cotton and grain growers, with positive results.

"Documented evidence demonstrates the training resulted in growers having a greater knowledge and understanding of irrigation best practice and has lead to genuine practice change," Mr Jackson says.

"Increased adoption of technology, better water management techniques and investment in new infrastructure has improved whole farm water use efficiencies."

The increased knowledge, awareness, skills and attitudes acquired at the training workshops allowed growers to recognise strengths and weaknesses in their water management practices.

"It also helped them identify where investment will lead to the greatest increase in whole farm water use efficiency.

Many growers are now applying WUE incentives available from Catchment Management Authorities (CMA). Border Rivers-Gwydir CMA assessed about 80 WUE incentive applications, with 66 securing funding for a variety of on-farm WUE activities, including purchase and/or upgrade of soil moisture probes, storage surveys, field and storage EM surveys, storage deepening or reconfiguration, supply and tail water system upgrades.

Similarly the Namoi CMA and Cotton CRC granted funds to nine applicants resulting in exceed of $511k coming under best practice water management.

Another major outcome of the training has been an increase in awareness of the Cotton BMP program, with the project contributing to an additional 11,814ha in the Namoi Valley now being managed and irrigated according to best practice.

"Each of the Irrigated Cotton and Grains workshops have specific linkages to the Cotton BMP Land and Water Modules," Mr Jackson said.

"Growers were encouraged to consider the advantages of obtaining formal recognition of their best practice."

Decision support tools could assist growers to manage and measure water more efficiently.

Some of these tools, Irrimate and WaterTrack were demonstrated to growers, with knowledge and awareness of surface irrigation performance evaluation particularly has increased and practice change is now being documented, according to Mr Jackson.

"Many growers have begun to reconfigure fields to minimise loss, shorten irrigation times and optimise field application efficiencies," he said.

"The demonstration of the software and storage avoage/transpiration meters also increased awareness of the magnitude of storage losses on irrigation farms."

"A growing number of irrigators are now either raising storage bank heights or consolidating water storage to minimise evaporative losses."

In an effort to stimulate adoption of current industry standard underpinning WUE, project staff conducted personal interviews on 42 farms from Emerald in central Queensland to Hilton in southern NSW to establish current WUE benchmarks for the cotton industry.

 Benchmarking facilitates continuous improvement in management and water use. The results revealed that the average WUE for the 2006-07 season was 1.31 bales/ML (water pumping) or 1.18 bales/ML (including stored soil moisture and effective rainfall).

The results also highlighted that the top 20 percent of growers achieved a WUE around 1.8bales/ML (See Spotlight, Summer 2008, pp-1-).

In 2003 the CRDC-funded project Whole Farm Irrigation Management Strategies for Cotton Production in the Macquarie Valley, established five long-term monitoring sites in the Lower Macquarie Valley measuring deep drainage and changes to the soils in the major irrigated cotton growing soils. In 2006 and 2007 members of the Advancing Water Management Project team collected and tested soil samples at these sites to build a long term picture of potential soil degradation and productivity decline due to poor water quality and irrigation management.

"An examination of the 2007 soil and water analyses suggest that sodium and chloride concentrations increase during the irrigation season but decrease during the winter (non-irrigation season)," Mr Jackson said.

"Presumably this is due to leaching of the salts out of the crop root zone with winter rainfall.

"In time, it is likely that they will move into ground water reservoirs, however there is considerable variation among locations due to variation in soil texture, ESP etc and cropping systems."

A technical paper on this monitoring will be published and presented at an industry forum this year.
Climate a pest predictor

A project undertaken by Research Fellow Angus Crossan from The University of Sydney’s Faculty of Agriculture, Food and Natural Resources, has provided a valuable review of environmental impact and development of risk assessment strategies within the Australian cotton industry.

The results of the analyses conducted within this CRDC-funded project were used to direct industry goals with respect to environmental custodianship.

It was found that GM technologies can reduce potential environmental impact by reducing or changing pesticide use practices.

Further, analysis of environmental impact of herbicide use did not show a significant reduction associated with the introduction of Roundup Ready (RR) cotton.

Dr Crossan said although the benefits of RR cotton varieties and reduced endosulfan use are well documented, a strong correlation between pesticide use (per ha) and average rainfall was observed.

“This indicates that climatic conditions offer a potential predictor of environmental impact,” he said.

“These results are based on the assumption that insect pressure is greater during wetter periods, thus requiring more insecticide use.

“We would therefore expect to observe an increase in pesticide use and potential environmental impact when growing conditions improve because of increased pest pressure,” Dr Crossan said.

Dr Crossan said these increases were unlikely to reach the levels observed when conventional cotton only was grown.

“It was difficult to determine the extent of benefit to Bellgard in reduced pesticide use because of strong climatic influences from the industry average within Cotton Consultants Australia data sets,” he said.

“However it is critical to continue collection of such environmental data to benchmark the industry’s environmental performance and the value of new GM varieties to the industry.”

In regard to another GM variety, Roundup Ready, analysis showed no significant reduction in the environmental impact of associated with its introduction, however there is potential for the newer Hex variety.

Dr Crossan said these results indicate that improvements in herbicide use scenarios could potentially be made by reducing the use of “high impact” residual herbicides with introduction of Roundup Ready cotton, but this has not appeared to occur.

“However, the use of Roundup Ready Hex and Liberty Link cotton should improve the potential environmental impact of herbicide use if such reduction in use of residuals is achieved,” he said.

A slight negative trend between herbicide application and precipitation was also identified, indicating that if climates become drier then an increase in herbicide use (g/ha) will be observed.

“We expect this was either a response of growers aiming for a higher level of crop protection for improved yields and reducing the risk of crop failure, or a more virulent response by weeds during dry periods,” Dr Crossan said.

An experiment conducted within this project showed that pesticide residues dissipate faster in actively composted cotton gin trash than in passively composted trash.

The experiment evolved from a previous study concerning potential environmental exposure and the regulation of gin trash wastes.

“Whilst composting of gin trash is recommended to reduce the concentration of pesticide residues, the resources required may be too large for an effective BMP,” it was found.

Further studies with respect to re-use of gin trash are more likely to identify a more suitable industry-wide management practice, Dr Crossan believes.

Tailwater takes the test

A project which initially set out to advance the industry’s capacity to manage tailwater quality through the development of constructed wetlands has instead yielded to irrigators’ interest in finding a way to first measure tailwater quality.

Background knowledge for the project, overseen Dr Angus Crossan, included positive results regarding increases in biodiversity and improvement in water quality from pilot-scale wetlands.

However, it was identified that the predominant concern of the industry was water availability because of drier than average climate and additionally, it was established that irrigators were more interested in whether or not the quality of their tailwater actually required improvement, but had no straightforward methods to attain this insight.

As a result Dr Crossan developed a simple water quality test kit to analyse irrigation water to provide the cotton and irrigation industry with a simple tool to seek, measure and record economic and environmental improvement.

In a pilot study, 20 water quality test kits and protocols were distributed within the industry, including some properties growing crops other than cotton.

Key water quality parameters including, turbidity, temperature, EC, pH, carbonate hardness, total hardness and nitrate, nitrite, ammonium, phosphate and chloride ion concentrations were recorded during irrigations.

“Although the feedback from participants was positive, the amount of data returned was not sufficient to enable a full analysis of water quality,” Dr Crossan said.

“We expect that reduced on-farm staffing levels, as a consequence of very limited water availability, were too restrictive to allow sufficient resources to be made available for the trial.”

However analysis of preliminary results indicated that at least 15 to 30 percent of nitrogen was lost to the tailwater systems as nitrate. This indicates that significant economic gains can be made through improving the efficiency of nutrient use.

“The main benefit of the water quality kits was that they provided a quantitative approach for environmental management,” Dr Crossan said.

“The specific water quality measurements could be collected that were directly related to local practice.

Any change in practice, that affects nutrient use efficiency, could be assessed, thereby informing and quantifying environmental management systems such as BMP.

“Economic value of improvement in practice can be readily determined from the water quality data thereby providing further impetus for improvements.

“The water quality tests provide the cotton and irrigation industry with a simple tool to seek, measure and record economic and environmental improvement.

“That is why now, under another Cotton CRC/CRDC co-funded project we’re currently developing simple tests for herbicides and pesticides that will add to the suite of water quality indicators within the kits,” he concluded.
Potential for plant based measurement investigated

Increases in crop water use efficiency have been achieved through greater precision in irrigation scheduling and the use of dynamic irrigated crop management strategies such as regulated deficit and deficit irrigation, a R&D report has found. However, limitations exist in the use of soil moisture sensors and/or the water balance approach method for irrigation scheduling. The report says a key limitation with using other of these approaches for irrigation scheduling is that they do not provide a measure of actual plant water status.

Crop growth and response to irrigation is a function of plant water status and depends on soil water status, evaporative demand, the rate of water flow through the plant and the corresponding hydraulic flow resistance between the bulk soil and the appropriate plant tissue.

In response to this, the CRDC-funded project was undertaken by researcher officer Dr Simon White and senior research officer Dr Jack McHugh at the National Centre for Engineering in Agriculture. The project investigated the potential to use plant-based measurements for commercial irrigation scheduling of cotton.

The first year of the project evaluated the potential to use stem diameter sensors for irrigation scheduling in cotton under a lateral move machine. While the results were encouraging, the second season (2006/07) conducted on furrow irrigation across a range of irrigation schedules and these crop varieties were not as positive, generally because there was significant plant to plant variation in response.

The key recommendation from this work is that stem diameter sensors can be used to identify plant stress responses associated with irrigation, however their benefits over traditional irrigation scheduling technologies appear to be marginal.

Robotic sensor platform measuring spatial variability of crop vigour in the Dawson Valley and Darling Downs.


d Dr Simon White assesses leaf water potential of cotton plants on the Darling Downs with visiting Chinese academics Dr Jing Fang Huang looking on.

Stem diameter sensors can be used to identify plant stress responses associated with irrigation however their benefits over traditional irrigation scheduling technologies appear to be marginal.

"These sensors will continue to have limited application as an irrigation scheduling and assessment tool in cotton unless appropriate threshold levels can be identified which take into account varietal differences and crop conditioning," Dr McHugh said.

During 2006/07, the project evaluated published relationships between canopy reflected energy (near infrared) data and that of plant water status and identified band widths correlated to plant water status when measured during a normal commercial irrigation cycle.

The 2007/08 trial continued to evaluate remote methods of plant based sensing to test the robustness of these approaches for irrigation scheduling across a range of irrigation schedules and senior research officer Dr Jack McHugh mchugha@usq.edu.au.

PhD student Susan Lutton of Griffith University.

Potential for plant-based measurement investigated

PhD student Susan Lutton of Griffith University/Cotton CRC has completed her project to investigate the diversity of farm storages and the structure and function of the aquatic life they support when compared with nearby natural wetlands.

The work was undertaken in the context reflecting how natural wetlands are under threat globally as water resources become directed to support growing populations and demand from agriculture.

In the Border Rivers Catchment in Queensland, a large irrigation industry coupled with a highly variable flow regime has necessitated the building of large on-farm water storages and often associated destruction or isolation of their natural counterparts. Her research was done with B&D Dissemination support from CRDC and the results may be used to apply future best management practice adopting optimised diversity and ecosystem function in storages.

Susan said with the decline in abundance of natural wetlands, the presence of irrigation storages on the floodplain has raised the question of their suitability as alternative aquatic habitats.

"To better understand the issue, initially the physical and chemical variety of water storages in the Border Rivers Catchment was described and their morphology and hydrology compared to that of natural wetlands," she said.

"Storages tended to be large, deep structures with a more regular shape, while natural wetlands were irregular and shallow with large perimeter.

"Although there was a degree of variability among storages, most fell into one group and were considered to be ‘typical’ in this respect.

"Storages primarily function as water supplies and their associated management makes them mostly unsuitable as ‘replacement’ wetlands.

"However, given the large numbers of storages across the catchment, if managed effectively, they may provide an additional source of aquatic habitat and help maintain regional biodiversity.

"To maximise the biodiversity of storages it will be essential to increase habitat diversity within storages.

"In the future, improved design of new storages and alterations to existing storages and their management could help overcome this problem of low diversity of habitats and promote the spatial and temporal variation in habitat evident in natural wetlands.”

Biodiversity, spatial and temporal, of two storage groups, a mix of typical storages with tailwater and without tailwater, was compared with natural wetlands.

"Given the large numbers of storages across catchments, managed effectively, they may provide an additional source of aquatic habitats and help maintain regional biodiversity.

Although fish species diversity was similar between the two storage types and natural wetlands, there was significant variation in total numbers, with typical storages having 10 times the average catch size of that found in natural wetlands.

In both storage types, catches were dominated by bony bream, Noniusculus cole, while in natural wetlands, there was a more even distribution of species.

The percentage of exotic species was much lower in both storage types at less than eight percent compared with natural wetlands with greater than 48 percent.

There were also significant differences in macroinvertebrates, as 34 samples from natural wetlands revealed more than 14,000 individuals across 84 taxa (category or group of organism). In comparison, 15 samples from typical storage sites and 12 samples from ‘no tailwater’ sites respectively, only 34 taxa from 2142 individuals and 34 taxa from 7611 individuals were collected.

Seventeen taxa were common to all three waterbody types while 45 taxa were specific to natural wetlands. None of the measured environmental variables explained the observed variation in macroinvertebrate life between waterbody types. Temporal patterns in macroinvertebrate and zooplankton were also investigated with the results showing typical storages’ populations were less diverse than in natural wetlands.

To further investigate the variation observed in aquatic life, two sources of colonisation of storages were examined, namely those found in extracted river water and those hatching from the egg bank.

Eight fish species including three exotics were collected during sampling of eight samples of pumped river water. As in storages, the catch was dominated by N. cole and exotic species were extremely low and less than one percent. Fish with a standard length of over 200 mm survived the extraction process, with 22 macroinvertebrate taxa and 332 individuals. This was a reduced diversity than collected from typical storages (34 taxa).

In comparison, zooplankton assemblages had similar diversity to those observed in the typical storages, 25 taxa compared with 22 taxa. Sediment samples collected from the floodplain had a more diverse but low abundant egg bank (46,463 individuals from 20 taxa) than those collected from dry typical storages (76,600 individuals from 16 taxa).

The differences observed in the three storage types suggested there may also have been variations in aquatic processes between waterbody types, while stable isotope analysis were used to investigate the major sources of energy fuelling the aquatic food webs. In general all components of the food web in typical storages were 18C and 15N-enriched in comparison with natural wetlands.

PhD student Susan Lutton hopes her study can help maximise future biodiversity in storages.

Industry is investing in ongoing development of best practices in storages management on the basis of this and other ongoing work. Greater detail concerning this project is contained in the finished research paper, or by contacting Susan Lutton susan.lutton@student.griffith.edu.au.

Storages tell nature’s story

Dr Joshen Eberhart measuring cotton plant water status using a pressure bomb at Cecil Plains, west of Toowoomba.

PhD student Susan Lutton hopes her study can help maximise future biodiversity in storages.
Quality fibre and fashion gives food for thought

Careers, fashion and quality cotton headlined a unique day out at Georgie and Andy Carrigan’s “Milchengowrie Homestead” at Boggabri in March.

Organised by Wincott, the day offered information about the many and varied aspects of the cotton industry, from employment opportunities in all sectors of the supply chain to end products from some of the industry’s well respected figures in their fields.

Around 110 visitors enjoyed the day where ‘cotton meets art and employment opportunity’ with secondary school students and other visitors enjoying a fashion parade, art and sculpture exhibitions and weaving display, and presentations from a variety of industry experts.

Award-winning researcher Rene van der Sluijs of CSIRO Materials Science and Engineering, Cotton Australia Chair Joanne Grainger, and John Hamparsum gave presentations.

Rene’s research has added to the industry in maintaining and improving fibre quality right through the production chain. His presentation outlined the production line post farm gate – describing the reasons behind the quest for a high quality product from a spinner’s perspective.

Each speaker, while outlining their role in the production chain, also defined different roles for people in the industry.

Joanne Grainger’s thought provoking address outlined the two aspects vital to the industry, from employment opportunities in all sectors of the supply chain to end products from some of the industry’s well respected figures in their fields.

“We have to present the true world and back it up with research and data,” Ms Grainger said.

“We need people in all sorts of careers in the industry – farm staff, irrigators, mechanics, agronomists, extension people, office people, finance, economists, designers, engineers, plant breeders, environmentalists, shippers, marketers, all sorts of researchers, and business people – all with the aim of producing a high quality end product.

“That is the linkage between the two main themes of the day – career options and quality cotton.”

“We have to present the true world and back it up with research and data,” Ms Grainger said.

“Cotton research has added to the industry in maintaining and improving fibre quality right through the production chain. His presentation outlined the production line post farm gate – describing the reasons behind the quest for a high quality product from a spinner’s perspective.”

Rene’s research has added to the industry in maintaining and improving fibre quality right through the production chain. His presentation outlined the production line post farm gate – describing the reasons behind the quest for a high quality product from a spinner’s perspective.

Each speaker, while outlining their role in the production chain, also defined different roles for people in the industry.

Joanne Grainger’s thought provoking address outlined the two aspects vital to the industry, from employment opportunities in all sectors of the supply chain to end products from some of the industry’s well respected figures in their fields.

“We have to present the true world and back it up with research and data,” Ms Grainger said.

“We need people in all sorts of careers in the industry – farm staff, irrigators, mechanics, agronomists, extension people, office people, finance, economists, designers, engineers, plant breeders, environmentalists, shippers, marketers, all sorts of researchers, and business people – all with the aim of producing a high quality end product.

“That is the linkage between the two main themes of the day – career options and quality cotton.”

“We have to present the true world and back it up with research and data,” Ms Grainger said.

“We need people in all sorts of careers in the industry – farm staff, irrigators, mechanics, agronomists, extension people, office people, finance, economists, designers, engineers, plant breeders, environmentalists, shippers, marketers, all sorts of researchers, and business people – all with the aim of producing a high quality end product.

“That is the linkage between the two main themes of the day – career options and quality cotton.”

“We have to present the true world and back it up with research and data,” Ms Grainger said.

“We need people in all sorts of careers in the industry – farm staff, irrigators, mechanics, agronomists, extension people, office people, finance, economists, designers, engineers, plant breeders, environmentalists, shippers, marketers, all sorts of researchers, and business people – all with the aim of producing a high quality end product.

“That is the linkage between the two main themes of the day – career options and quality cotton.”
The UN International Year of Natural Fibres – highlighting the role wool and cotton industries have played in shaping communities in regional Australia

Around the world, farmers harvest 35 million tonnes of natural fibres each year. This backdrop proved to be ideal for Australia’s cotton and wool producers and their organisations to meet in Sydney on May 20 to share the official launch of the International Year of Natural Fibres (IYNF) in Australia.

On the podium to commemorate this important event were Tony Burke MP, Minister for Agriculture Fisheries and Forestry, and Dr Jacques Diouf, Director General of the Food and Agriculture Organisation (FAO) of the United Nations. The function by the water’s edge in Sydney harbour and at the National Maritime Museum, was a location recognised for its symbolic trade link for both cotton and wool. At the ceremony, a commemorative Australia Post pre-stamped envelope also marked the occasion and symbolised IYNF in Australia.

In launching IYNF in Australia, Mr Burke highlighted the role the wool and cotton industries had played in shaping communities in regional Australia while being significant long-term players in underpinning the growth of the national economy. He heralded the input of both industries in achieving international leadership and contributing to the prosperity of the country through support of the regional and national economies. Both industries had also excelled in investing in R&D to drive productivity growth, Mr Burke said.

Recognising the uniqueness and importance of natural fibres the Minister noted that he was “confident there would never be an International Year of Synthetics”.

FAO has taken up the gauntlet of supporting natural fibre production world-wide. The prominent UN body seeks to address the dual challenges of relentless competition from synthetics and impacts for natural fibre producers resulting from the global economic downturn. FAO say these factors impact upon the livelihoods of millions of people who depend on natural fibre production and processing. IYNF 2009 aims to raise global awareness of the importance of natural fibres, not only to producers and industry, but also to consumers.

In closing the launch Cotton Australia CEO Adam Kay thanked the Director General and Minister and spoke strongly of the sustainability and socio-economic importance of the cotton and wool industries working together in Australia’s regional development and global trade in natural fibres.

Leaders of Australia’s wool and cotton organisations, Brenda McGahan, Chief Executive Officer, AWI with Adam Kay, Chief Executive Officer, Cotton Australia by the water’s edge in Sydney harbour and at the National Maritime Museum at the launch of IYNF in Australia.