10 Years of GM cotton - where to from here?

Jeff Bidstrup, Convener, Producers’ Forum
Outlook Conference, Canberra, 2006

The Australian cotton industry is justifiably proud of its reputation of having the highest yields in the world. Combined with this, we are amongst the top in world quality, and have an excellent reputation for marketing and delivery.

This has not come about by accident. Our growers are amongst the best in the world, and are at the forefront in technology adoption. We have a dedicated plant breeding team at CSIRO which are generally accepted to have bred the best varieties in the world. We have an industry that works closely together, from breeding, seed production and research, to growing, ginning and marketing/export.

(Source: ICAC)

Australia is the seventh largest producer in the world, and the third largest exporter, producing around 3 million bales per annum. Nearly all the crop is exported.

Cotton has been a profitable crop, and we are at a point where it is now grown from Hillston in Southern New South Wales to Emerald in Central Queensland. Communities where cotton is now grown have been reinvigorated with economic and employment stimulus.
WHERE DID WE COME FROM?

The modern Australian cotton industry had it’s genesis in the Namoi valley in New South Wales in the 1960’s when two Californian farming families, the Hadleys and the Kahls began growing irrigated cotton.

Cotton has been a profitable crop, and we are at a point where it is now grown from Hillston in Southern New South Wales to Emerald in Central Queensland. Communities where cotton is now grown have been reinvigorated with economic and employment stimulus.

Apart from water availability, the major threat to cotton production in Australia has been from insect pests especially the heliothis caterpillar. This pest was initially controlled with DDT until it became resistant to this insecticide. This resistance caused the much publicized and much remembered demise of the cotton industry in the Ord River region of northern West Australia. In the seventies, a new generation of insecticides, the synthetic pyrethroids (SP’s) became available, and this revolutionized cotton production and profitability.

Overuse, and a lack of understanding of insect resistance, led to the demise of SP’s, and hence a significant reduction in the usefulness of this technology. A new generation of “soft”, albeit very expensive chemicals, and an industry wide push to Integrated Pest Management (IPM) kept us in business. IPM is a system of production that works in harmony with nature, using products that preserve natural predators and intervening with hard chemicals much less, and only after considering the impact on those natural predators.

Despite improvement, our costs of insect control were rising continually. Community concerns about our heavy use of chemicals became almost unbearable in some areas. We had serious issues of environmental pollution to confront.

We stayed economically viable because our competitors in China, Uzbekistan, India, and Pakistan could not match our ability to use technology to rotate chemistry, institute IPM, and manage resistance. The cotton price stayed strong because these countries were unreliable producers due to pestilence, and individually many of their farmers could not continue to grow cotton.

Industry observers generally agree that there is little scope to increase the area of cotton in Australia with climate change and community pressures limiting water supply for irrigated cotton. Australian cotton yields are the highest in the world, and these are expected to increase as the relentless drive for more efficiency continues in a world awash with cotton. These record crops have been produced primarily because of the advent of genetically modified (GM), insect resistant Bt cotton, and a lack of weather
disasters in recent years. Traditionally, good seasons have been associated with pestilence in many parts of the world, but this is becoming a thing of the past with Bt cotton.

THE WORLD CHANGED IN 1995

In 1995 we planted the first commercial B.t. cotton (marketed as Ingard) in Australia. This is cotton that has been genetically modified to contain the genes from an ubiquitous soil bacteria which provides significant resistance to heliothis caterpillars. Following years of research, this new technology, while in its infancy, gave us the circuit breaker we so desperately needed. Australia quickly developed the varieties and systems that allowed us to maximize the value of this new technology, although we were only allowed to grow a maximum of 30 percent of our area due to resistance management protocols.

As with all new technologies, there were initial hiccups that required strong communication between technology developers, supply chain players, and growers to develop satisfactory solutions. It was generally accepted that the initial varieties didn’t perform up to expectations, and that growers and suppliers expectations were not initially met.

However, the varieties quickly improved and Ingard gave us a platform from which to build a very successful IPM system and allowed cotton to be grown in “sensitive” areas where chemical usage had been controversial.

Ingard was based on a single gene which conferred resistance against insect pests. By the time Bollgard II (GM cotton with two Bt genes) was introduced in 2004, the industry was in a mood to embrace biotechnology and dump our reliance on conventional chemistry. In the first full year around 70 percent of the crop was planted to Bollgard, and this year (05/06) the figure is 81 percent. Except in extreme circumstances, crops are generally not sprayed at all for the heliothis pest.

In the 1999-2000 season, Roundup Ready cotton was introduced. This is a herbicide resistant cotton that has revolutionized weed control. We are no longer are reliant on armies of cotton chippers with all the occupational health and safety (OH&S) issues that entails. Roundup Ready cotton is only resistant to the herbicide in its very early growth stages, and so its benefit is limited, and initially some growers damaged crops by not understanding the limitations of the technology. However, knowledge has improved and the technology provider has priced it at a level where the growers receive a fair share of the benefits. As a result, it is now widely and happily used despite its limitations. 80 percent of the total crop in Australia was Roundup Ready in 2005/6.
CURRENT ISSUES

Australia has not been the only beneficiary of this technology. The half hectare farmer in China or India has exactly the same technology, often at a lower or nil cost, as we do. The technology is in the seed and the current world record production can be largely attributed to this. Australian growers are going to have to learn to adjust to lower cotton prices.

Resistance management is something to which the Australian cotton industry is totally committed. We constantly monitor and model. The rapid swing to Bollgard insect resistant crops means we have probably lost much of the capacity to manage the whole crop with conventional chemistry. This makes it paramount that resistance management of Bollgard remains number one priority for the Australian cotton industry.

Weed species shift, and possible resistance to Roundup is a lesser issue as fields are conventionally cultivated for the fallow period, and alternative chemistry is required preplant to control Roundup Ready volunteer cotton.

The industry recognizes the need to ensure that there is competition and choice in the marketplace for cottongrowers. To provide such choice, the industry works closely with a variety of local and global technology developers and suppliers which ensures diversity in research partnerships. Access to intellectual property and technology for our elite Australian varieties is critical and this will only be obtained through workable, mutually beneficial partnerships.

At this point, I should highlight how fortunate the Australian cotton industry is to have access to gene technology. We have not been hindered, to date, by the state government moratorias or bans on GM crops. We believe that such state bans could impact on our ability to bring forward new GM solutions, because while they may not specifically target cotton, they provide uncertainty and serve as a disincentive for researchers and commercial investment in this area. We call on Australian governments to implement a solution to this ridiculous situation and allow Australian farmers to access the same technologies as our global competitors.

THE NEXT FIVE TO TEN YEARS

Initially, we have in the pipeline Roundup Ready Flex, Liberty Link, and VIP cotton.

Roundup Ready Flex will be available in limited quantities for planting in 2006. This will enable season long control with glyphosate (Roundup) and will be a great leap forward in ease of weed control, and allow the introduction of exciting new farming systems.
Liberty Link (glufosinate resistant) cotton should be available for some plantings in 2007, and this alternative herbicide tolerant cotton will alleviate the pressure put on glyphosate by continued use of Roundup Ready cotton. Alternating these technologies should give us robust weed control with little resistance risk. The products also come from different biotech companies so we should see some competition in the marketplace.

Vegetative Insecticidal Protein (VIP) is an alternative insect control gene that should become available within 5 years, and will most likely be combined with a Bt gene.

To strengthen resistance management with Bollgard cotton, VIP will provide a different mode of action.

While commercial sensitivities often delay and prevent announcements of key advances until a product is close to release, the next five-ten years presents enormous opportunities to the Australian cotton industry. This is an exciting time when we can expect continued agronomic improvement, in addition to new output traits. Anticipated developments include:

- Drought Tolerance and higher water use efficiency varieties is an area of frenetic activity in biotech labs around the world. Yield increases of approximately 20 percent are touted for grain crops, but cotton appears more difficult. Even a “minor” five to ten percent increase would change the world as we know it. Biotech companies recognize this trait as a “good news story” and are working expeditiously to bring it to market by 2011 or later.

- Cottonseed oil modification (CSIRO) to produce healthier oils is now a reality but the issue of public acceptance has halted its production. We can expect further developments in this area.

- Improved insecticidal genes could be introduced, including Widestrike from Dow Agrosciences (cry1Ac and cry1Fa from B.thuringiensis) and Hexima Ltd has field trials of cotton expressing natural plant genes NaPI from tobacco and PotI from potato (encoding protease inhibitors) for insect control.

- More efficient nutrient use, particularly nitrogen, is already in the pipeline but some years off.

- Disease and virus resistance is being researched at many public and private institutions and major advances are expected in 5-10 years.
• Fibre quality and quantity traits are being studied and again we can expect major advances in the next 10 years

• Resistance to abiotic factors such as salinity, heat, waterlogging, and cold are being studied in all crops and we can expect some of the outcomes to spill over to enhance cotton

We need to recognize that the field of plant biotechnology encompasses diverse fields with technologies and outputs far broader that just GM crop outputs. Non-GM applications of plant biotechnology can be used to improve variety selection and screening strategies in conventional breeding programs, to identify and source new variations in land races and wild relatives and to better understand the genes and proteins controlling plant responses. The use of markers to track genes or groups of genes responsible for complex traits can increase the success and greatly reduce the time required for conventional breeding programs, giving greater flexibility, more precision and better varieties sooner (BRS, 2005). The Australian cotton industry will continue to embrace the benefits of this research.

OUR VISION

In the future, Australian cotton growers will be growing longer, stronger, finer fibres, and more of them due to genetic manipulation, or the use of marker assisted breeding.

We will be using less water for the equivalent yield due to agronomic advances, “drought tolerance” from genetic manipulation and marker assisted breeding, and water use efficiencies on the farm.

We will be rotating our insect resistant crops to reduce the chance of resistance, and we will have the prospect of new traits for wider insect control on our doorstep.

We will be rotating our herbicide tolerant cotton to control weed resistance, and again new traits will be on our list.

Some of our competitors in countries with less robust resistance management plans and cotton monoculture may have found that resistance to insects and weeds is again a problem.

We may have modified the oil in the seed for better health or commercial uses and be growing specialty oils.

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We will still have disease and virus outbreaks, but we will be in a position to react much more quickly than in the past with varieties that have resistance or tolerance traits. We
will even be able to pre-empt diseases and include in our varieties disease and virus resistance from wild relatives or other plants.

Climate change will be an accepted reality, and we will be much better and more quickly able to breed to take advantage of shifts in climate patterns.

As we move further into a world where biotechnology is the dominant production system, the Australian cotton industry will still face challenges. But we will be well placed to address issues and implement solutions to the issues such as patent rights and questions about our freedom to operate which could impact on our research and development uptake in some areas.

We will still face fierce competition in export markets, and farmers terms of trade will have reduced further due to the ease of production by our competitors. Thankfully, Australian cottongrowers will still have access to GM crops to compete globally, at a time when our grain counterparts may just be accessing the technology.

We may be growing specialty fibres that dye better, are coloured, or have properties that make them more comfortable or water or fire resistant.

Finally, our environment will be much improved. We will produce more with less- less fuel, less water, less insecticide, less herbicide, and less labour and nutrients.

Failure to embrace biotechnology will be to the detriment of the rest of Australian agriculture and the Australian economy. Gene technology, or GM crops, can coexist with other production systems. We must break the agricultural censorship so ill applied at present through the state moratoria. There is no doubt in my mind that biotechnology will play a crucial role in future production systems for the sake of our children it must.

When history has run its course, and the time comes to reflect on the years past, the consumers of the world should be well pleased with us.
cotton outlook to 2010-11
world prices to remain low in 2006-07

Frank Drum, Ivan Roberts and Lachlan Smirl

> With world raw cotton supplies forecast to exceed demand in 2006-07, the world cotton price (Cotlook ‘A’ index) is forecast to fall by 4 cents to average US$3.5c/lb. Import demand in China will be a dominant factor affecting world raw cotton prices in 2006-07. With cotton production in China expected to increase, a forecast 12 per cent decline in imports is expected to place downward pressure on prices.

> Over the medium term, world cotton prices are projected to decline in real terms as productivity improvements in raw cotton production result in significant increases in supply and competition from synthetic fibres remains strong.

World outlook

Consumption growth increases prices in late 2005

Larger than anticipated cotton plantings in the northern hemisphere in 2005-06, and a substantial increase in 2004-05 year end stocks resulted in the Cotlook A index easing to US$3.5c/lb in August 2005. However, strong import demand from China and speculation that natural disasters in China, Pakistan and the United States may have reduced production in these countries led to the cotton price increasing to over US$5.8c/lb in January 2006.

In 2006-07, growth in world cotton production is forecast to exceed growth in demand, leading to an increase in stocks. Reflecting this, the Cotlook ‘A’ Index is forecast to fall by 4 cents in 2006-07 to average US$3.5c/lb.

With growth in world cotton demand forecast to ease over the outlook period and production growth expected to remain steady, world stocks of cotton are expected to remain high over the projection period. Consequently, real cotton prices are expected to ease over the projection period. In 2010-11, cotton prices (in 2005-06 dollars) are projected to be around US$4.9c/lb, 14 per cent lower than forecast 2005-06 prices.

Production to increase in 2006-07

Higher world cotton prices in the leadup to the planting of the 2006-07 cotton crop are expected to lead to an increase in the area planted to cotton in China, India and Pakistan. As

World cotton

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these countries account for approximately 47 per cent of the total area planted to cotton, this is expected to result in an increase in the total area planted to cotton worldwide in 2006-07. Average crop yields are also expected to increase over the outlook period, reflecting the rapid adoption of genetically modified cotton varieties and improvements in growing techniques, particularly in India (discussed below). Reflecting these trends, world cotton production is forecast to increase by 4 per cent in 2006-07 to 25.5 million tonnes.

China

China is estimated to have produced around 5.3 million tonnes of raw cotton in 2005-06, 16 per cent less than in 2004-05. The key factors behind this fall were a decline in the area planted to cotton and typhoon activity that reduced yields in key cotton growing regions. Higher world cotton prices in 2005-06 and improved returns to Chinese cotton farmers are expected to result in a 7 per cent increase in the area planted in 2006-07. With yields expected to return to levels consistent with recent averages, Chinese cotton production in 2006-07 is forecast to increase by 11 per cent to around 5.9 million tonnes.

United States

Cotton production in the United States is estimated to have increased by 2 per cent in 2005-06 to a record 5.2 million tonnes. This increase was driven largely by a larger area planted to cotton and yields that were around 16 per cent above the five year average.

In 2006-07, the area planted to cotton in the United States is expected to fall marginally. With the removal of the US Step 2 farm subsidy program at the end of the 2005-06 marketing year, cotton farmers are expected to take a cautious approach to plantings in the short term (see accompanying box). In addition, improved prices for corn (a close substitute crop) are also expected to lead to a reduction in cotton plantings, particularly in southern states.

With a lower area expected to be planted to cotton in 2006-07 and with yields assumed to be consistent with recent averages, cotton production in the United States is forecast to decline by 9 per cent to 4.7 million tonnes.

Productivity improvements to increase yields over the medium term

Over the medium term, increases in world cotton production will be largely contingent on the increased adoption of genetically modified cotton varieties and improvements in cotton growing techniques, particularly in India.

The International Service for the Acquisition of Agri-biotech Applications (ISAAA) estimates that the global area planted to transgenic varieties in 2005 was around 9.8 million hectares. As such, transgenic varieties accounted for only around 28 per cent of the total area planted to cotton. Consequently, as countries increasingly adopt genetically modified cotton varieties, there is significant potential for further growth in production over the outlook period.

Although the area planted to cotton in India is the largest in the world, average yields are around 0.46 bales per hectare — 35 per cent below the world average. However, since 2002-03, yields have increased by over 50 per cent in India, largely from the increased adoption of transgenic cotton varieties. In 2002-03, around 40,000 hectares were planted to transgenic cotton varieties in India. In 2005-06, this had increased to 1.3 million hectares or 14 per cent
of the total area planted to cotton in India. The increased use of transgenic cotton varieties, particularly in northern India where pest pressure is typically severe, is expected to have a significant impact on improving yields. In addition, reduced pesticide application is expected to lower production costs, increasing operating returns to farmers. Reflecting this, India’s cotton production is projected to total 4.7 million tonnes in 2010-11, around 15 per cent above the current estimate for the 2005-06 crop.

In Brazil (the world’s fifth largest producer) the country’s first genetically modified cotton variety was approved in March 2005. While access to these seed varieties was limited in the 2005-06 season, an increase in availability in coming seasons would facilitate yield

WTO decision on US cotton subsidies

In 2003 a World Trade Organisation (WTO) panel was established to hear Brazil’s challenge to the legitimacy of US cotton subsidies. Brazil claimed that US cotton subsidies were leading to significantly lower world prices by encouraging surplus production, thereby adversely affecting producers in other countries.

WTO ruling

In March 2005, the WTO appellate body ruled that various forms of payments used by the United States contravened WTO rules.

The main findings were:

> Direct payments in the US cotton support program did not qualify for exemption from WTO commitments to reduce domestic support as they were ruled to be linked to production, prices or inputs.

> That the combination of US support payments including marketing loans, user marketing (Step 2) payments and market loss assistance or countercyclical payments contributed to price suppression in the world market for cotton in the 1999–2002 marketing years.

> The Step 2 payments made on exports breached WTO export subsidy rules. In addition, the Step 2 payments on domestic sales constituted prohibited import substitution subsidies.

> Certain US export credits contravened US export subsidy commitments.

In response to the ruling the US Government has committed to eliminating Step 2 subsidies (scheduled for the end of the 2005-06 marketing year) and modified its export credit programs. However, the government has not yet addressed the nonexempt status of its direct payments or the suppressing effects of its payments on world prices.

Expected impact of US response

The elimination of Step 2 payments is expected to increase the price of cotton to domestic cotton mills in the United States, thus increasing production costs and lowering domestic consumption. In addition, the increased penetration of clothing imports from China, India and Pakistan following the removal of the Multifibre Arrangement is expected to place further pressure on domestic mills in the United States. As domestic mill consumption declines over the medium term, US exportable cotton surpluses are expected to increase as a greater proportion of US cotton production is traded on international markets.

Nevertheless, despite the elimination of Step 2 payments and changes to export credit programs, the remaining provisions under the US farm bill will still provide an incentive to plant. Accordingly, cotton production in the United States is expected to increase over the projection period (in line with further productivity improvements) and US exports are likely to continue to increase.

US raw cotton production

US response still incomplete

The US responses to the WTO decisions are incomplete at this stage, with the determinations on world price suppression and the exemption of direct payments yet to be addressed. In addition, decisions in the 2007 US farm bill could markedly affect future production and exports. In the long term, the effectiveness of the WTO case will depend on the extent to which the United States changes its support provisions which, in turn, will be influenced by international negotiations and internal politics.
increases. In addition, the application of improved fertilisers and chemicals, and better irrigation practices in countries with comparatively less advanced cotton growing practices, is expected to increase productivity over the outlook period.

World cotton production is projected to increase by 9 per cent over the outlook period to reach 26.7 million tonnes in 2010-11.

Cotton demand
In 2005-06, growth in world cotton consumption is estimated to have increased by over 4 per cent to 24.8 million tonnes, driven largely by an 11 per cent increase in growth in consumption in China, India and Pakistan.

Clothing is the primary good produced with cotton. While clothing is a necessity, it is also a semidurable product, the purchase of which can be delayed. Income growth (particularly in developing countries) and the price competitiveness of cotton relative to synthetic fibres are the key factors likely to affect demand for cotton over the outlook period.

Lower assumed economic growth in the United States and continued subdued growth in key global economies such as the European Union and Japan are expected to dampen demand for textiles and clothing over the outlook period. However, offsetting this are key developments across a number of developing countries that are significant drivers of the medium term outlook for cotton.

Significant economies and cost savings have been achieved through the relocation of textile and clothing manufacturing capacity to countries such as China, India, Pakistan and Bangladesh. Combined with lower cotton fibre costs, lower textile manufacturing costs are expected to translate into lower prices and increased demand for end products, and hence increased demand from mills for cotton fibre.

Over the past five years, developing countries are estimated to have accounted for around 60 per cent of the growth in world textile fibre consumption at the end use stage (that is, at the household level). In 2003, household fibre consumption in developing Asia was estimated to be 5.6 kilograms a person, compared with 33 kilograms a person in the United States. However, with income growth in major developing countries such as China and India expected to increase strongly over the outlook period, consumers in these countries are expected to underpin strong growth in world demand for clothing.

In 2005-06, raw cotton consumption in China is estimated to be around 9 million tonnes. As such, China will account for an estimated 68 per cent of the growth in world cotton consumption in 2005-06. China’s consumption of raw cotton is forecast to increase by around 5 per cent in 2006-07, to 9.4 million tonnes. With demand expected to exceed local supplies, China’s net imports in 2006-07 are forecast to exceed 3 million tonnes. With cotton demand in China forecast to grow strongly over the outlook period, imports by China are projected to reach 4.4 million tonnes in 2010-11, around 19 per cent above forecast 2005-06 levels.
Reflecting these trends, world raw cotton consumption is forecast to increase by 2 per cent to total around 25.2 million tonnes in 2006-07 and to rise to 26.6 million tonnes by 2010-11.

Cotton and synthetic fibre competition

In the raw fibre market, cotton competes directly with synthetic fibres and cellulosics. Significant investment in the Chinese textile and clothing industry has led to polyester production in China tripling since 2000, resulting in excess production capacity. This is believed to be the principal reason why current high oil prices (oil is the major feedstock for polyester production) are not reflected in higher prices for synthetic fibres. However, over the medium term, with oil prices expected to remain relatively high, higher input costs could be expected to pass through into higher prices for synthetic fibres, improving the competitiveness of cotton. That is, cotton is well placed to compete with synthetic fibres over the medium term.

Australian outlook

Australian production to rise in the medium term

Above average rainfall in a number of areas of northern New South Wales and southern Queensland over the past three to six months has resulted in an improvement in water storage levels in key cotton growing regions. As a result, the area planted to cotton in 2005-06 increased by 4 per cent to around 335 000 hectares. However, despite an increase in the area planted to cotton, Australian cotton production is forecast to fall by 10 per cent in 2005-

Cotton outlook

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<td>− nominal</td>
<td>A$/kg</td>
<td>2.14</td>
<td>1.88</td>
<td>1.71</td>
<td>1.62</td>
<td>1.70</td>
<td>1.66</td>
<td>1.87</td>
</tr>
<tr>
<td>− real e</td>
<td>A$/kg</td>
<td>2.26</td>
<td>1.94</td>
<td>1.71</td>
<td>1.58</td>
<td>1.61</td>
<td>1.54</td>
<td>1.70</td>
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* August-September years.  
* b In 2005-06 US dollars.  
* c July-June years.  
* d Includes cottonseed value.  
* e In 2005-06 Australian dollars.  
* f ABARE forecast.  
* z ABARE projection.  
Sources: Australian Bureau of Statistics; US Department of Agriculture; ABARE.

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Over the medium term, availability of water will remain a key constraint on cotton plantings in Australia. The recent implementation of water sharing plans in New South Wales and Queensland, and the finalisation of reductions to ground water allocations in many catchments over the next six months will encourage the industry to research alternative irrigation methods in order to improve water use efficiency. For example, currently AUSCOTT, a major cotton producer in Australia, has been trialing lateral move irrigation systems in an attempt to optimise water use efficiency and reduce the costs of inputs. Early results from the trials have indicated that the lateral irrigation systems use 30 per cent less water.

Consequently, it may still be possible for the area planted to cotton to increase over the outlook period if cotton growers purchase additional water or increase the efficiency with which they use water. However, the ability to increase plantings will be largely dependent on average seasonal conditions.
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