

2111 The Role and Achievements of a National Cotton Extension Program

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Abstract

The success of Australian the cotton industry has been built on a strong foundation of well directed and high quality research. The industry invests directly in that research in partnership with the Australian, New South Wales and Queensland governments and recognizes the importance of fast adoption of significant research results and technical innovation. As a consequence, a culture supporting a strong national cotton extension program has developed. The role and services expected and valued by cotton growers and consultants are well understood as a result of two reviews over the last 12 years and a number of surveys and workshops commissioned by the Cotton Research Development Corporation in association with each of three successive cotton Cooperative Research Centres. Coordination and leadership of the national extension program now is the responsibility of the Cotton Catchment Communities Cooperative Research Centre, a research organization which has all key industry and government stakeholders as partners. The national cotton extension program continues to provide a valuable resource through which the industry can rapidly adapt to change and continuously improve through the rapid uptake and adoption of research results.

Keywords: Extension, Capacity Building, IPM, Water Use Efficiency, Fusarium wilt, Silver leaf whitefly

Introduction

Australian cotton growers consistently produce some of the highest cotton yields in the world. They have been able to do this despite the huge challenges issued by the highly variable Australian climate and the lack of direct government subsidies. There are many reasons why Australian cotton growers have been able to maintain productivity growth

greater than many other cotton producing countries. First and foremost, the Australian cotton production system is a professional agribusiness with many cotton farmers having been educated beyond secondary school level (Cotton Consultants Australia 2006 unpublished report to the Cotton CRC and CRDC). It is supported by strong, professional service organizations and communication within the industry is open and highly effective. Acting as a foundation to all these industry attributes is the impact of the adoption of research. Constable (2004), in a review of the contribution made by research over the last 25 years, has estimated that a 180 percent increase in yield has been achieved by Australian cotton growers over that time. Of this increase, he estimates that plant breeding has contributed 45 percent, improved soil and water management 25 percent, insect management 20 percent and disease management 10 percent with research playing a significant role in all cases. Yield increases alone are no longer an adequate measure of performance unless they are accompanied by a consistent improvement in environmental sustainability. Constable (2004) also demonstrates that significant improvements have been associated with key environmental indicators over the last 25 years as well through improved water use efficiency and reduced pesticide use.

For research to be effective it must be adopted. In Australia we recognize that there is no one single method or approach that will ensure high levels of adoption in all aspects of the farming system. Therefore, the elements that contribute to adoption need to be multifaceted. Efficient and effective adoption relies upon good communication and collaboration when using a multifaceted approach.

Extension services have played an important role in supporting research and technology adoption and since the mid 1990's the Australian cotton industry has maintained a

national cotton extension program. This paper describes the establishment, role and some achievements of the national cotton extension program in relation to the success of the industry in Australia.

A National Extension Program

The modern Australian cotton industry was established in the early 1960s primarily in the eastern states of New South Wales (NSW) and Queensland apart from a short period from 1964 to 1973 when cotton production was attempted in tropical NW Western Australia. During the 1960s and 1970s, the fledgling Australian cotton industry in the East established two industry organisations that were to have a major influence on the direction and importance of research to the development of the industry from the mid 1970s to the present time. These organisations were Cotton Seed Distributors and the Australian Cotton Growers Research Association (ACGRA). The ACGRA in particular played an important role in encouraging a more focussed cotton research effort in NSW and Queensland. The ACGRA raised a voluntary research levy from cotton growers to help fund essential research conducted by CSIRO, the two state departments of agriculture in NSW and Queensland and several Universities. In this environment, involving a small closely knit industry trying to establish itself, there was strong grower support for the voluntary levy and a good relationship developed between the early cotton researchers and the industry. This relationship helped to encourage a culture where the sharing of information was essential to everyone's success and it also established a need and an expectation for researchers to be active in the extension of their research. Even though the funding arrangements changed in the mid 1980s when the Australian Government developed research investment partnerships with agricultural industries, through the establishment of the Rural Research Councils (now Rural Research Corporations) for

which the research levy became compulsory, the culture within the cotton industry did not change. Researchers themselves continue to play an important role in extension.

Until 1990, there were several extension officers in each state department of agriculture with extension responsibilities to the cotton and grain industries in the regions where cotton production occurred. Each department worked independently, without a national focus or direction and with only direct grower involvement at the local level. However, informal cooperation was established between the extension officers in each state department during the mid seventies when a series of annual workshops for cotton research and extension officers were initiated. The workshops involved officers from CSIRO, the NSW and Queensland departments of agriculture and the University of Queensland (McIntyre *et al* 2003).

The concept of a national cotton extension program in Australia had its roots in two developments in the early 1990s. The first was the funding of two new extension positions by the Cotton Research and Development Corporation (CRDC) to complement existing extension officers. The responsibility of these new positions was to the cotton industry and they were employed by the state departments of agriculture in New South Wales (NSW) and Queensland. The second was the establishment of the Cooperative Research Centre for Sustainable Cotton Production (CRC SCP) in 1993 which included an Education and Technology Transfer Program. This program provided an excellent foundation for the formation of a coordinated team of extension officers in both state departments and ensured a formal cooperation of extension for the cotton industry nationally, replacing the earlier informal collaboration that had developed over many years, but which had remained essentially state focussed.

The development of a national cotton extension program was further enhanced following a review of cotton extension in 1995 commissioned by the CRC SCP and CRDC. It was conducted by James Supak of Texas A&M University, Jeff Coutts of the University of Queensland, Allan Williams and Bruce Finney of ACGRA and was coordinated by David Hamilton from the Queensland Department of Primary Industries who was also a CRDC Board Director at the time. The review process involved visits to all cotton producing regions to conduct consultation with growers, consultants and other key groups associated with extension services in the industry.

The review found that the extension officer positions, largely funded by industry and administered by state government departments, played a key role in the process of adoption of improved practices within the industry. This was largely due to their on-farm validation work and the coordination of activities and information across districts. The role was found to be synergistic and complementary to the consultants working in the industry. The review recommended that support for these positions be continued and a cotton extension specialist be appointed to coordinate extension efforts aimed at national priorities and, in particular, integrated pest management (IPM) approaches (Coutts, Supak, Finney, Williams 1995, unpublished report to CRDC and the CRC SCP) .

Subsequent to the review, the CRC CSP and CRDC funded the establishment of extension positions in every major cotton growing region and a National Cotton Extension Coordinator. By 2002, the national cotton extension team consisted of some 38 professional staff with a core group of 8 regionally based, industry funded, extension officers referred to as Industry Development Officers (IDOs). Water use efficiency

officers, specialists in areas such as IPM, and spray application and the departments' farming systems extension officers, complemented their roles. Each member of the extension network contributed to a focus team in the disciplines of Insect Management, Disease & Weeds, Environment, Farming Systems or Water to target key national extension priorities which were identified in collaboration with the extension team, relevant researchers and the grower chair of the corresponding ACGRA discipline committee (McIntyre *et al* 2003).

In 2005, CRDC and the successor to the CRC CSP, the Australian Cotton CRC, commissioned a second Review of Extension and Education in the Australia Cotton industry. This review was conducted by Jeff Coutts and John McKenzie, specialist consultants on extension and capacity building, Bruce Roberts, University of California Fresno and Hamish Millar, Chairman of ACGRA. This review was aimed at not only assessing the national extension program, but also to consider any structural changes required given the successful bid by the industry for a third Cooperative Research Centre (Cotton Catchment Communities CRC) to replace the Australian Cotton CRC. The review recognised that many individuals and organisations other than the national extension program encouraged the adoption of research including ACGRA, researchers, CRDC, Cotton Australia, Cotton Consultants Association and the private seed companies, Cotton Seed Distributors and Deltapine Australia. They concluded a key focus of the extension program should remain the regional industry focussed extension officers, but, given that there were a significant number of extension positions funded by state and Australian government initiatives, management and leadership could be more strongly directed through the new Cotton CRC. They also recommended that stronger mechanisms for establishing and maintaining research-extension links needed to be encouraged

(McKenzie, Coutts, Roberts and Millar 2005, unpublished report to CRDC and the Australian Cotton CRC).

The two reviews, described above, considered all of the extension services funded from public and industry sources, but, in formulating their recommendations the review teams concentrated on the regional and other extension services that could be delivered utilising the industry and public funding from CRDC and the Cotton CRC. Since the late 1990s, the Australian, Queensland and NSW governments have established initiatives to support landholders and communities in river catchments to improve their natural resource management. In terms of support provided to cotton growers, these initiatives have seen the establishment of additional extension staff and activities to encourage improved water use efficiency and to develop improved knowledge, skills and practices in managing natural resources. Additional support in the form of incentives for on-farm NRM improvements has also become available through the establishment of Catchment Management Authorities or Regional Natural Resource Management Bodies as a result of the National Heritage Trust established by the Australian Government (Chapman *et al* 2007).

Role of Extension Services in the Australian Cotton Industry

The 1995 and 2005 reviews of extension and two unpublished survey reports commissioned by CRDC during this period demonstrated that cotton growers and professional agronomic advisors/consultants value having dedicated, regionally located, cotton extension officers. In 2006, CRDC and the Cotton CRC held two workshops, one with cotton consultants and the other with cotton growers to prioritise and confirm the extension services they valued the most (Pyke 2006). The most valued services included:

- Providing a regional capacity to respond to emerging or urgent issues
- Organisation and facilitation of field days, seminars, shed and grower group meetings
- Coordination of regional trials to test and demonstrate research findings
- Local newsletters
- Contribution to the development of industry extension information
- Facilitation of Area Wide Management groups
- Regional support for research (eg. coordination of egg collections for resistance testing)
- Compilation of regional trial result books
- Technical support for the cotton industry's environmental management program – Best Management Practice.

The feedback from cotton growers and consultants in 2006 on these extension services has helped to confirm that the main activities the extension team performed prior to 2006 are still highly valued and this has strengthened the definition of the role that the national cotton extension program should perform.

Coutts *et al* 2005 reviewed over 50 extension projects and programs in Australia in agriculture and other fields. They identified five key areas or extension models as well as some best practice guidelines that contribute to making extension programs successful. As shown in Table 1, all of these models are employed in Australia by members of the national cotton extension team. In many cases they are employed in concert because they are often complementary. In delivering their main services, the extension team generally contributes most to the central steps that lead to the adoption of improved practice identified by in

Bennett's Hierarchy (Bennett 1979, Christiansen et al 2003), particularly knowledge, attitudes, skills and aspirations.

Services and Achievements of the National Cotton Extension Program

Under the following headings are some selected examples of how having a national cotton extension team has been of benefit to the Australian cotton industry. These examples highlight both key areas of cotton production and demonstrate the types of services provided by the extension team. In describing these examples we have concentrated on the role that the people in our extension team play. This does not diminish the importance of the valuable and comprehensive information resources, websites and decision support tools that have been developed and are critical components of the broader delivery of information and knowledge to the cotton industry. Many of these resources have been described recently by others (Christiansen *et al* 2002; McIntyre *et al* 2003).

IPM

In 1997, a focus group analysis of industry attitudes towards Integrated Pest Management (IPM) in the cotton industry (Coutts, 1997) identified a need for clearer information on IPM in cotton systems and training for growers. The national extension team conducted this analysis which doubled as a training exercise for them on how to run a focus group. In response to this, CRDC supported the development of an accredited Short Course in IPM (Dalton *et al* 2003). A full time training coordinator was employed in 2002 to develop and deliver this course and over a three year period trained 163 growers, 47 consultants and 11 others. There were two key ingredients that contributed to the success of this course. Firstly, it was very practical and "hands-on", broken into several short sessions rather than one long session and a focus on demonstrating principles and skills in the field where appropriate.

Secondly, the IPM training coordinator enlisted the help of all of the key cotton entomologists to deliver components of the course. Achievements included 97.3 percent of participants indicating that the course had met their expectations and 98.7 percent who would recommend the course to others. More importantly 72 percent of participants indicated that what they had learned on the course would change their farming practices (Hickman, 2006). In conjunction with IPM focussed grower groups (known mainly as Area Wide Management groups) which were facilitated by regional cotton extension staff and researchers, the IPM Short Course is considered to have contributed strongly to the increased uptake of IPM practices by cotton growers in Australia between 2000 and 2005 (Ferguson and Miles, 2002; Hoque, *et al*, 2002).

In 2004/05, cotton varieties carrying two Bt-genes (Bollgard®II) replaced varieties carrying a single Bt-gene (Ingard®) allowing the industry to remove a 30 percent cap on Bt cotton plantings that had been introduced to provide added protection against the development of resistance to Ingard. A rapid increase in the planting of Bollgard II has since occurred, leading to further significant reductions in insect control spraying and costs (Pyke, 2007). This rapid adoption in the uptake of Bollgard II has seen a reduced demand for IPM training and a decline in the number of Area Wide Management groups remaining active in the industry. However, the lessons learned from the intensive IPM extension and training that occurred between 2000 and 2005 have not been lost and the commitment to applying sound IPM principles by Australian cotton growers and consultants remains high.

Water Use Efficiency

In 1999, the Queensland Department of Natural Resources established the Rural Water Use Efficiency Initiative (RWUEI) in partnership with the major irrigation industries in the state –

sugar, cotton, dairy and horticulture. The Initiative, now in its eighth year, has supported the adoption of improved water use efficiency in these irrigated cropping systems through a range of development extension programs involving a strong partnership of industry extension officers, consultants and growers. The outcomes measured in 2003 showed substantial gains in water use efficiency of 11.3%, resulting in water savings of 67,800 ML and enhanced production valued at AUS\$57M (Jeff Coutts Evaluation of the Rural Water Use Efficiency Initiative Adoption program, Unpublished Report to The Department of Natural Resources and Mines Queensland. www.dnr.qld.gov.au). A similar program in NSW commenced in 2004 and, in combination with other initiatives of the Cotton CRC and CRDC, ongoing improvements in water use efficiency continue to be made and continue to be supported as a major extension focus. A national priority team for water extension has been established within the Cotton CRC to coordinate the activities of all of the water use efficiency initiatives in the cotton industry.

Diseases – Farm Hygiene to Reduce the Spread of Fusarium Wilt

Fusarium wilt (*Fusarium oxysporum* f.sp. *vasinfectum*) was first identified affecting cotton in Australia in 1993 on the Darling Downs in Queensland. At the time, many of the cotton varieties being grown were very susceptible to this disease and the level of tolerance in the better varieties was only moderate and not capable of producing viable commercial yields in the worst affected fields. The disease was soon discovered on farms in other cotton growing valleys as well and posed a significant threat to the industry. Consequently, a major research program and an extension campaign was launched in response. Research concentrated on the development of more resistant cultivars and developing an understanding of aspects of the farming system, climate and soils that encouraged the build up of the disease, all with medium to long-term payback periods. However, the extension effort was able to focus on

farm hygiene practices that would have an immediate impact on the limiting spread of the disease from farm to farm and from region to region. A campaign was developed that involved researchers, growers, consultants and members of the national cotton extension team. It was called “Come Clean Go Clean” in reference to the need to ensure vehicles and machinery travelling from infected fields, farms or regions to non-infected fields, farms and regions were thoroughly cleaned of mud and dirt before they left each location (Kochman *et al*, 2002). It is difficult to measure the impact of this kind of extension campaign on the rate of spread of the disease when other management factors, such as replacing susceptible varieties with the most tolerant ones, are continuously being applied. However, an evaluation of the Australian cotton industry’s Best Management Practice Program by Macarthur Agribusiness in 2004 (unpublished report to CRDC) showed that there had been a major practice change in response to the “Come Clean Go Clean” campaign with 62 percent of farms having adopted best practice farm hygiene management by 2003 compared to only around 13 percent adoption for the same farms five years earlier.

Response to emerging issues (Silver Leaf Whitefly Outbreak – central Queensland)

The silver leaf whitefly (SLW), *Bemisia tabaci* Type B, is thought to have been accidentally introduced to Australia in the early 1990s from an unknown source. It rapidly infested ornamental plant nurseries and soon had spread to most cropping areas in eastern Australia including most cotton growing regions. By 2001/02 the first SLW outbreak on cotton in Australia occurred in central Queensland. This outbreak was met with an immediate and rapid response in order to avoid potentially heavy production and quality losses. The regional cotton extension officer at Emerald became one of the critical drivers in partnership with research entomologists, consultants and growers in evaluating the threat and developing appropriate short and long term management strategies. These strategies were based on

extension field trials and demonstrations, facilitation of effective area-wide management groups of growers and consultants, research reviews and an industry study tour to Arizona in 2003. The implementation of these strategies led to a successful outcome, with no sticky cotton problems in the outbreak year and SLW populations successfully managed in the following season 2002/03 (Kelly 2003) and for every season since (R. Sequeira, *pers. comm.*). The successful outcome also demonstrated one of the strengths of having a strong industry extension program, which is the capacity to respond to emerging and urgent issues. Potential outbreak situations in some other cotton regions in southern Queensland in recent seasons have also been successfully managed based on the experience and knowledge gained from the central Queensland response.

Maintaining an Effective National Extension Program

This paper has described why the Australian cotton industry, Australian, NSW and Queensland state governments invest in and support a national cotton extension program as well as the role of the program and some of its achievements. Whether the experiences of the Australian cotton industry in establishing a national extension program can be readily translated to other countries directly is debatable because cotton production practices in Australia are different to those in many other cotton producing countries. However, there have been some lessons learned from having to maintain such a program that are likely to be quite transferable to other situations where extension services coordinated over a broad geographic range are being contemplated. In brief some of these lessons are:

- Extension is largely about people and therefore continuity, experience, and communication skills are important characteristics for an extension worker if he/she is to build trust with growers.

- Developing a capacity to understand the changing needs of the target audiences is also essential.
- Being outcome rather than output focused is also important because the former implies purpose and achievement but latter can often just apply to activity.
- It is also important to understand the major elements of effective human capacity building. Aspects such as developing shared agendas and arriving at agreement by all parties, having good processes, monitoring, evaluation and measurable improvements are important as well as ensuring that there are adequate resources for the job. This becomes particularly relevant when the funding sources for extension come from different sources.

Conclusions

This paper has focussed on the role and some highlighted initiatives and achievements of Australia's national cotton extension program and that maintaining extension services to some of the most professional and efficient cotton growers in the world is a challenging and exciting task. In many respects the success of the Australian cotton industry is due to its people, their professional approach and the openness with which information and innovations are shared and communicated at all levels. It is important to acknowledge then that extension staff could not do their job effectively without the support and cooperation of researchers, or the professional agronomists who either consult to cotton growers or are directly employed by them as advisors and of course the growers themselves.

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Table 1. Examples of services provided by the national cotton extension program in Australia that align with the extension models identified by Coutts *et al* 2005.

<u>Extension Model</u>	<u>Examples from national cotton extension program</u>
Group facilitation empowerment	Facilitation of <ul style="list-style-type: none"> • Area Wide Management groups • IPM groups
Technological development	<ul style="list-style-type: none"> • Field days, seminars, shed meetings • Coordination of regional trials
Training	<ul style="list-style-type: none"> • IPM Short Course • Cotton and Grains Water Use Efficiency Workshops
Information access	<ul style="list-style-type: none"> • Regional newsletters • Contribution to industry publications • Compilation of regional trial books
Personalised consultant	<ul style="list-style-type: none"> • Technical support for Best Management Practice program • Response to emerging or urgent issues