January, August & Final Reports

*Part 1 - Summary Details*

# REPORTS

*Please use your TAB key to complete part 1 & 2.*

**CRDC Project Number:**

| | | |
|---|---|---|
| **January Report:** | ☐ | Due 29-Jan-01 |
| **August Report:** | ☐ | Due 03-Aug-01 |
| **Final Report:** | ☒ | Due within 3 months of project completion |

**Project Title:** Attend the World Cotton Research Conference (WCRC-3) in South Africa 9-14th March 2003

**Project Commencement Date:** 8/3/03 **Project Completion Date:** 14/3/03

**Research Program:** Insect Management

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## 1. Outline the background to the project.

The Australian cotton industry is one of the Australian's major agricultural exporters and provides a significant export income for Australia. A wide range of pests, however, attacks the cotton crop. To sustain production, the industry relies heavily on the use of synthetic insecticides for the control of the major pests such as *Helicoverpa* spp., green mirids, aphids and mites. The over-reliance on synthetic insecticides threatens the future sustainability and survival of the cotton industry. As a result, there is a strong push by the cotton industry to adopt an IPM program that places much more emphasis on the natural enemies of the pest and minimises the use of synthetic insecticides.

The World Cotton Research Conference (WCRC) is an initiative of the International Cotton Advisory Council, which is aimed at gathering cotton researchers, extension officers, agro-chemical companies, administrators, marketers etc around the world for a symposium covering all aspects of cotton production. WCRC is held every four years in different cotton producing countries in the world. It serves as a forum where those involved in all facets of cotton production can interact and learn from each other. Scientists, particularly renowned entomologists working in cotton, normally attend WCRC to present the papers in their area of specialty. Thus this provides an opportunity for cotton researchers to address pertinent research problems in cotton production. Therefore, it is crucial for cotton scientists to attend WCRC to update their knowledge in their specialty area of research. The venue for the 2003 WCRC was in Cape Town in South Africa. The conference was well organised and provided an excellent forum for the participants to exchange ideas, update knowledge and discuss subjects of particular interest.

## 2. Objective

The objective of attending the conference was firstly to present posters or papers relating to Australian research on pest management. Secondly, to interact and have discussion with scientists working in the same area of research to gain further knowledge in IPM development and implementation. A list of papers and presentations from Australian entomologists is given below;

*Invited Keynote Papers*

Wilson, Mensah and Fitt, Implementing IPM in Australian cotton.

Fitt, Implementation and impact of transgenic Bt cottons in Australia.

*Submitted Papers*

Mensah and Singleton, Development of IPM in cotton: Establishing and utilizing natural enemies and integration with biological and synthetic insecticides.

Strickland, Annells, Ward and Sequeira, Assessing the feasibility for cotton in tropical Australia; Research for the development of sustainable pest management systems.

Annells and Strickland, Assessing the feasibility for cotton production in tropical Australia: Systems for *Helicoverpa* spp. Management.

Baker, Fitt and Tann, Sex or bright lights – which temptation works best for monitoring *Helicoverpa* spp in Eastern Australia.

Dillon, Trap crops for managing *Helicoverpa* (Lepidoptera: Noctuidae) in Australian cotton farming systems.

Gunning and Balfe, Spinosad resistance in Australian *Helicoverpa armigera*.

Pyke, The performance of Bt transgenic (INGARD®) cotton in Australia over six seasons.

Dillon, Hoque and Farquharson, The beneficial disruption index: A tool for comparing insecticide regimes applied to crop fields.

Lei, Khan and Wilson, Boll damage by sucking pests: Tackling an emerging threat.

Cottage and Gunning, Field based pirimicarb resistance detection kit for cotton aphid in Australia.

Rencken, Rein, Silberbauer and Gregg, An investigation of the importance of native vegetation to beneficial insects and its role in reducing pest damage in cotton.

*Posters*

Liang and Mensah, Improving efficacy of biopesticides with petroleum spray oils against *Helicoverpa* in cotton.

Olsen, Mahon, Daly, Finnegan and Holt, Changes in the efficacy of Bt cotton against *Helicoverpa armigera* (Hubner): Interpretation of assays.

Fitt and Mares, Seasonal patterns of Bt concentration in transgenic cottons in Australia.

## 3. Activities

The third World Cotton Research Conference (WCRC-3) was held in the Cape Town in South Africa from the 9th –14th March 2003. The conference attracted over 400 cotton scientists, administrators, agro-chemical companies and marketers all over the world. The conference included 10 plenary lectures and 4 concurrent sessions were run.

## 4. Plenary lectures

Renowned cotton experts in different areas of cotton research gave the plenary lectures. The plenary speakers were chosen from each continent and from cotton producing countries. They were each given selected topics in cotton production to communicate to participants. Questions and informal discussions follow each plenary session. This allowed participants and speakers to interact and discuss the subject. The plenary lectures were given before the concurrent sessions. This allowed all participants to attend the session. The plenary speakers and their papers are given in Table 1.

**TABLE 1. Plenary speakers and lectures organised at the World Cotton Research Conference - 3 in Cape Town in South Africa, 9th-14th March 2003.**

| Speakers | Position | Title of paper | Date of Talk |
|---|---|---|---|
| Dr Lawrence Hunter | Divisional Fellow and Manager, Dept of Textile Science Univ. of Port Elizabeth, South Africa | Cotton quality assessment and classing in the 21st Century | 10th March 2003 |
| Dr Daniel R. Krieg | Plant Physiologist, Texas A & M University, USA | Cotton Yield and quality Genetics vs Environmental Affectors | 11th March 2003 |
| Mr Robin Frank E. Jarvis | Senior Cotton Breeder, Cotton Research Institute of Zimbabwe | Cotton Breeding for Efficiency | 11th March 2003 |
| Dr Joe C. B. Kabissa | General Manager, Tanzania Cotton Lint and Seed Board | Pest Control and Sustainable Smallholder Cotton Production: Progress and Prospects. | 11th March 2003 |
| Dr Stella Galanopoulou-Sendouca | Professor of Agronomy, School of Agriculture, University of Thesaly, Greece | Agronomic concepts and Approaches for Sustainable Cotton Production | 12th March 2003 |
| Dr Kater D. Hake | Vice-President, Technology Development, DeltaPine, USA | Biotech Cotton: Beyond Bt and Herbicide Tolerance | 12th March 2003 |
| Dr Peter Ooi | Chief Technical Adviser, FAO-EU IPM Program for Cotton in Asia | Realities of Cotton IPM in Asia | 12th March 2003 |
| Dr Thea A. Wilkens | Professor, University of California-Davis, USA | Cotton Fibre Biology: Integrating Genomics and Development for Improving fiber traits | 13th March 2003 |
| Dr Jean-Phillippe Deguine | Direction Scientifique, Cirad, Montpellier, France | Aphid and Whitefly Management in Cotton Growing: Review and Challenges for the Future | 13th March 2003 |
| Dr John Gorham | Centre for Arid Zone Studies and School of Biological Sciences, University of Wales, Bangor, UK | Compartmentation and Compatible Solutes in Abiotic Stress resistance | 13th March 2003 |

## 5. Presentations (Plenary sessions)

The plenary papers given by Drs Joe Kabissa, Peter Ooi and Jean-Phillippe Deguine are those related to entomology. Dr Kabissa's paper identified the major differences between pest management in small landholders in Africa, South America and Asia and large-scale farmers in the developed countries such as the USA and Australia. The paper showed that research priorities for a small-scale farmer are not the same as the large-scale farmers. Additionally, strategies used to achieve pest control in large-scale farms may sometimes need to be modified before they can be successfully implemented in small-scale farms particularly in Africa and Asia. As a

result, international organizations such as FAO, the World Bank, and European Union funding cotton IPM projects in developing countries need to consult with resident scientists and select experts with good knowledge of small and large-scale cotton farming systems. Failure to do this has resulted in most project failures in developing countries.

In extending research findings to farmers, a study presented by Dr Peter Ooi showed that the use of the concept of farmer field school (FFS) is the appropriate approach for educating farmers and address the inadequacies of farmers being experts and owners of the IPM technology. FFS is a learning experience for growers. In FFS farmers learn about carrying out experiments of their own to understand the dynamics of pests and beneficial insects leading to a better understanding of their own cropping systems. FFS has been carried out for resource poor farmers in many Asian and African countries. This has allowed the farmers to understand the system they are working and also the type of pests and natural enemies they are dealing with and ways and means of managing these insects with minimal insecticide use without affecting yield. FFS training has helped farmers reduce the quantity of insecticides they use in their cotton farms. The reduction of insecticide use has cut down the cost of pest control, hence cost of cotton production in countries such as Turkey, China, India, Vietnam, Kenya etc. The FFS concept was originally developed by CABI and FAO in 1996. The concept was first tested with resource poor farmers in Peru, Kenya, Bangladesh, Cambodia, China, India, Indonesia, Philippines, Thailand, and Vietnam. Dr Ooi suggested that the FFS approach would help farmers address new IPM technologies such as transgenic crops and can help to conserve the usefulness of scarce resource when it is beneficial to farmers. However, in our opinion, an FFS program without a strong research base to continue to understand the ecology of the system and to produce new tools and strategies to support IPM, will fail. This is because lack of IPM compatible tools will limit the implementation and adoption of IPM. Australia's approach has been quite different due to the scale of production (3> growers per 1000 ha compared with 2000-3000 per 1000 ha in parts of Asia). However, elements of the FFS approach can be and are being adopted in Australia, through the IPM Short Course and BMP, to help growers better understand and have a greater responsibility for pest management decisions – important in the adoption of IPM.

Dr Deguine's paper reviewed the challenges facing cotton production worldwide with the advent of transgenic cotton. She stressed that sucking pests particularly aphids and whiteflies are going to be the major pests of the future. The two pests affect cotton yields directly and indirectly by being vectors of virus diseases that can cause physiological disorders. According to Dr Deguine much funds have been invested in research into these pests by funding bodies worldwide. Despite this, the only method for the control of these pests is synthetic insecticides. The effectiveness of these chemical controls is decreasing today because of insecticide resistance. Additionally, the chemicals are expensive and endanger existing faunal balances and the environment. She suggested that the conventional approaches need to be replaced with approaches that emphasise prevention rather than cure. This included (i) Use of understanding of pest ecology to reduce develop strategies to reduce risk in space and time and enhance conservation beneficials (ii) techniques to accurately diagnose the degree of infestation and impact of beneficials (iii) curative measures should include oils and soaps, use of chemical measures as a last resort, taking into account their selectivity. The aim is in time to return to a balance between the pests and their natural enemies. She indicated that in poorer countries use of a shorter crop period may also help by limiting the exposure of the crop and reducing the resource the crop represents might be appropriate. She stressed the use of cultural

control, varietal resistance, biological control and IPM as components of an ecological approach to managing these pests.

## 6. Concurrent Sessions.

The concurrent sessions organised at the conference are given in Table 2. In all, there were 13 sessions on 10th March, 12 sessions on 11th March, 4 sessions on 12th March and 8 sessions on 13th March. Each session consisted of a series of papers on a specific area of cotton production. Different speakers and poster sessions addressed the topics. Each session has a morning (am) and afternoon (pm) sessions. The morning session started from 8.30 am to 10.30 am (Tea/Coffeee break); 11 am – 12.35 pm (Lunch); 1.30pm-2.45 pm (Tea/Coffee break); 3.15 pm- 5.15 pm (Close). Participants have the choice to attend sessions related to their area of interest or research.

There was a wide range of sessions of interest to entomologists. These included; Crop Protection and IPM, Crop protection managing and monitoring, Crop protection: IPM, Aphids and insecticides, Cultural practices, Cultural Practices and Organic Cotton and Extension, see Appendix 1. Australian scientists interacted with many scientists working in the area of biological control, IPM, cultural control and extension (Technology transfer). One of the scientists Dr Mensah spent most time with was Dr Peter Ooi. Dr Ooi is the Chief Plant Protection Advisor to the FAO and heads the FAO and EU /IPM project in Asia. Dr Wilson had discussions with Dr Oosterhuis (Univ. Arkansas) on impact of aphids on cotton photosynthesis, with Dr Adamczyk (USDA) regarding transgenic performance in the USA and emerging sucking pest problems, Dr Ooi regarding IPM in Australia vs developing countries, and Dr Briddon (John Innes, UK), Dr Royo (INTA Argentina) and Dr Natwick (UC) about Cotton Bunchy Top and other insect borne diseases of cotton.

## 7. Presentations (Concurrent sessions)

Many papers submitted for presentation at the conference were not given because most of the speakers did not turn up particularly speakers from the USA and developing countries in Africa and Asia. Lack of funds was the reason for the speakers in Africa and most of the Asian countries failing to turn up. However, most speakers from the USA failed to attend the conference for fear of terrorist attack according to the few USA scientists who were bold enough to attend.

We found the conference was a mixed bag, some excellent presentations interspersed with some fairly ordinary. Overall the quality of Australian presentations was excellent, reflecting the emphasis we place on communication within the CRC and with industry.

Insecticides and Insecticide Resistance Management were a strong theme amongst presentations. In many of the developing nations this remains focussed on managing resistance to the older chemistries such as the OP's, carbamates and pyrethroids. This probably reflects their access to these cheaper old chemistries, rather than the newer more expensive selective compounds such as indoxacarb and spinosad. These newer products are only becoming available where pyrethroids in particular are failing, a problem widely reported. The IPM strategies proposed in many cases really hinge around trying to optimise the use of these older insecticides. This is occurring by developing more complex thresholds or by improving application and reducing rates. Many of the IPM papers were IRM in disguise. For example an IPM paper delivered by a scientist from India had 14 synthetic insecticide

sprays, made up of synthetic pyrethroids, carbamates, organochlorine and organophosphates. According to the author it was IPM because the chemicals used in the study were applied to coincide with the pest thresholds. Thus the use of economic threshold in the study suggests an IPM program. This shows the level of understanding some of the scientists have in the development of IPM programs. Development of a multidimensional IPM strategy is not occurring.

IPM was a popular theme but we were generally disappointed with the scope of IPM presented. A notable exception was the excellent presentation by Peter Ooi that revealed a deep understanding of both the technical and sociological problems involved in implementing IPM in developing countries. Australia's problem seems to be at the other end of the spectrum - we have a highly mechanised and educated industry with a generally high level of education and wealth. However there are some similarities including the need to convince growers to become involved in IPM through a process of education that encourages them to take ownership of the approach taken on their farm. In general most of the IPM papers still have a very 'entomology centric' approach, often apparently failing to see IPM as a component of the farming system. Emphasis is placed, and rightly so, on beneficial conservation and utilization and selective use of insecticides but often stops there. Looking more broadly at the system and the underlying ecology with a view to preventing problems is still a rare science, a point made by Dr Deguine. There were however some interesting studies including interplant of other crops as traps for Helicoverpa and nurseries for beneficials

The role of beneficial insects in IPM was mentioned in most of the papers but surprisingly synthetic insecticides were the common tools used. There was a general lack of strategies or techniques to conserve or maximise the abundance and effectiveness of beneficial insects in most of the IPM studies presented at the conference. The continued reliance on synthetic insecticides in most of the IPM programs suggest a worldwide lack of IPM compatible tools which may be due to a general lack of developmental research.

A significant number of papers dealt with transgenic Bt-cotton, which generally received a positive report card in terms of reducing insecticide use and economics. Significant questions remain however about resistance management. In many developing countries Bt-cotton has created new opportunities for resource poor growers and communities. However, in these situations the growers often cannot afford to grow specific refuge crops for Bt-cotton. Instead native hosts must serve as refuges and a very interesting study from South Africa reported on surveys to investigate the productivity of indigenous hosts in terms of producing Bt-naïve moths. Further questions remain however on the timing and effectiveness of refuges and issues such as synchrony of production of moths between Bt-crops and refuges and actual distribution of mating between the two remain. Much emphasis is placed on efficacy and resistance management of Bt-cotton but unfortunately there seems to be a view that BT-cotton equals IPM, rather than Bt-cotton as a tool within IPM. Most of the research on Bt cotton is concentrated on the use of Bt refuge crops to manage resistance yet the core role of IPM in managing resistance to transgenics received little attention.

Among the many entomology papers presented at the conference, only two dealt with organic cotton and three on habitat manipulation to conserve beneficial insects. The implication is that unless the general research focus changes from synthetic insecticides and resistance management to studies that place much more emphasis on cultural, biological control and varietal resistance etc, the future sustainability of cotton industries worldwide will suffer. Developmental research should be

encouraged to allow new environmentally friendly tools to be developed to support IPM worldwide.

One study presented at the conference and which was of interest to our studies in Australia was the use of jasmonic acid (jasmonates) as foliar spray on Bt and non-Bt cotton plants to attract beneficial insects. The study showed that foliar application of jasmonic acid increased the number of natural enemies mostly predators on treated cotton plants. The high predator numbers reduced the number of pests on those plants. Despite the high numbers of natural enemies on the jasmonic acid treated plants, the level of parasitism and predation rates on the treated and control plants were similar. The study concluded that jasmonic acid might be a valuable pest management tool in cotton. However, several literature have shown that jasmonic acid enhances the release of abscisic acid in treated plants which causes abscission layer to be created resulting in fruit drop in treated plants. Thus jasmonic acid used in cotton to attract predators may result in fruit loss in cotton, which may affect cotton yield.

We had some interesting discussions with scientists working on insect borne cotton diseases. From these several ideas have developed including a renewed effort to look for the agent of cotton bunchy top using electron microscopy (this is underway), and the decision to place any cotton aphid collected from wild hosts onto cotton to see if they contain the agent for CBT. This may reveal the frequency of CBT in aphid populations but more significantly some of the alternative hosts. This has been instigated now as part of project CSP145C.

Another interesting approach is using the 'Cotons' model to help predict compensation for pest damage in Cameroon. The approach is very similar to that we have taken with OZCOT. A sub model allows loss of fruit due to pest attack, by simulating the demography and feeding of bollworms. Spraying rules are being developed based on predicted yields, much like SOPY SIRATAC, and are being evaluated with farmers.

All of the papers presented by Australian entomologists were well received and well supported, as indicated by larger numbers of attendees for these talks. Many colleagues have expressed interest in collaborating with us to help contribute to IPM programmes in our respective countries. Overall we found the conference valuable, particularly for the opportunity to catch up with colleagues and to make new connections.

## 8. Benefits

- The conference has emphasised the need to continue a strong research focus in IPM and beneficial insects.
- It has given us an insight into current IPM research in the world.
- The conference has improved our research standing in the international research communities and enabled us to establish contacts with professionals in international research organizations working on beneficial insects and IPM programs worldwide.
- The knowledge gained at the conference will no doubt increase our collaboration with international scientists and will facilitate and expedite the progress of research in Australia.

## 9. Itinerary

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| 7th March 2003 | Narrabri - Moree - Sydney |
| 8th March 2003 | Sydney - Johannesburg - Cape Town |
| 9th March 2003 | Conference Registration (Holiday Inn, Conference centre) |
| 10-13th March 2003 | Conference lectures, symposium and Tour |
| 14th March 2003 | Cape Town - Johannesburg - Sydney - Narrabri |

## 10. Acknowledgements

The Cotton Research and Development Corporation and the Australian Cotton Co-operative Research Centre funded our visit to Cape Town to attend the conference. Dr Mensah would also like to thank NSW Agriculture for giving him permission to attend the conference.

**Appendix 1. Concurrent sessions, speakers and symposia organised at the World Cotton Conference – 3 in Cape Town, South Africa, 9-14th March 2003.**

| 10th March 2003 | | | | |
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| **Sessions 2-5** | **Crop Protection & IPM** | **Water Stress & Irrigation** | **Crop Protection & Nematology** | **Nutrition** |
| 11.00 –11.20 | Implementing IPM in Australia: By Dr L. J. Wilson | Paper Withdrawn | Withdrawn | Withdrawn |
| 11.20-11.35 | IPM Short Courses: G. MClntyre | Performance of different cotton varieties under increased irrigation M. Aslam | Crop rotation and genetic resistance in support of Meloidogyne spp. control in cotton M.S.Botha | Responses of Gossypium spp. to salinity J. Gorham |
| 11.35-11.50 | New vistas in IRM based cotton IPM in India K.R. Kranthi | Yield and quality evaluation of cotton cultivars grown in summer dominant rainfall environments in Eastern Australia R.R. Eveleigh | Estimating losses associated with the interactions between T. basicola and the root knot nematode on cotton C.S. Rothrock | Use of GIS and geophysical measurements to determine cause and controls of soil salinisation in the lower Macquarie valley in Australia J. Triantafills |
| 11.50-12.05 | Development of IPM in cotton: Establishing and utilising natural enemies and integration with biological and | In vitro screening for drought resistance in cotton H. M. Vamadevaiah | A Chemical-biological control approach for nematodes on cotton | Variation in cotton cultivars in leaf nutrient content and Sessions 2-5tolerance to soil sodicity |

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| | synthetic insecticides<br><br>R.K. Mensah | Vamadevaiah | E.R. van Biljon | G.A. Constable |
| 12.05-12.20 | Inventory of pests and natural enemies on cotton in lowland production zone of Ruzzi Plain, Kivu, DR Con congo.<br><br>M. Theodore | Growth, Phenology and yield of rainfed cotton as influenced by different climatic factors under Dharwad conditions in South India<br><br>B.C. Patil | Introgression in tetraploid cotton of the resistance to Rotylenchulus reniformis fro the Gossypium hirsutum<br><br>O.N. Konan | Is soil quality declining under cotton production systems in Eastern Australia<br><br>I.O.A. Odeh |
| 12.20-12.35 | Integrated pest management with genetically modified cotton hybrids.<br><br>S.S. Udikeri | Investigations on drip irrigation and fertigation in cotton<br><br>V.C. Patil | Activity spectrum of spinosad & Indoxacarb:rationale for differential pyrethroid resistance management strategy in Ivory Coast: G.O. Ochou | Role of fertilizer in cotton production under increased irrigation interval<br><br>M.Ahmad |
| 12.35-13.30 | LUNCH | LUNCH | LUNCH | LUNCH |
| **Sessios 10-13** | **Crop Protection & IPM** | **Growth regulators & biochemistry** | **Crop protection managing & monitoring** | **Breeding & Environment** |
| 13.30-13.45 | Investigation of the importance of native vegetation to beneficial insects and its role in reducing insect pest damage in cotton<br><br>I.C. Rencken | The effect of some growth regulators on callus initiation and plant regeneration from different days old cotton<br><br>L. Efe | Search for indigenous host plants for bollworms on the Makhathini flats.<br><br>A. Bennet-Nel | Genotypic variation in response to heat stress in Upland cotton<br><br>E. O. Leidi |
| 13.45-14.00 | Gaining confidence in farmer participatory IPM in Uganda.<br><br>M.B. Sekamalte | Rain-washing of mepiquat chloride from cotton leaves.<br><br>C.A. Rosolem | Minimum effective insecticide application practices in cotton in India.<br><br>J. Singh | Screening of cotton for tolerance to early season drought.<br><br>S. O. Alabi |
| 1400-14.15 | Assessing the feasibility for cotton in tropical Australia: development of sustainable pest management.<br><br>G.R. Strickland | Growth and yield behaviour of different cotton genotypes as influenced by plant growth regulators.<br><br>J.J.S. Deol | Assessing the feasibility for cotton production in tropical Australia: systems for Helicoverpa management.<br><br>A.J.Annells | Drought tolerant cotton genotypes might work with present water crisis in Pakistan.<br><br>A.R. Soomro. |

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| 14.15-14.30 | An IPM for managing Pink bollworm and cotton productivity.<br>V.T. Sundaramurthy | Peroxidase activity and iso-enzymes composition in some species of Malvaceae.<br>Z. Golubenko | Sex or bright lights: which temptation works best for monitoring Helicoverpa spp. in Eastern Australia.<br>G.H. Baker | An appraisal of line performance in marshland cotton breeding experiments in Kuvu in Congo.<br>M. Theodore |
| 14.30-14.45 | Cotton IPM: Areawide approach through farmer participation.<br>V. G. Mathirajan | Translocation and metabolism of Glycinebetaine in cotton<br>Y. Shafi | Trap crops in managing Helicoverpa in Australian Cotton farming systems.<br>M. L. Dillon | Cotton research in Uzberkistan: elite varieties and future of cotton breeding.<br>A. Abdukarimov |
| 14.45-15.15 | Tea/Coffee | Tea/Coffee | Tea/Coffee | Tea/Coffee |
| 15.15-15-45 | **Poster Session** | **Poster Session** | **Poster Session** | **Poster Session** |
| 15.45-16.00 | Cotton IPM: research success and field disappointment-why are implementation projects not successful<br>A.J. Treen | Evaluation of cotton cultivars on dryland and under irrigation in Southern Africa.<br>M.M. Pretorius | Spinosad resistance in Australian Helicoverpa armigera<br>R.V. Gunning | Screening cotton lines as trap crop for the induction of abortive germination of Striga hermonthica in Nigeria.<br>S.O. Alabi. |
| 16.00-16.15 | IPM strategies for sustainable cotton yield in Thungabhadra project area of Karnataka.<br>B. V. Patil | Pleiotropic nature of uninodal branching, cluster fruiting and square drying in cotton<br>V.N. Kulkarni | The performance of Bt transgenic (Ingard) cotton in Australia over six seasons.<br>B.A. Pyke | Managing pesticide resistance and species shift in cotton using an Integrated Weed Management approach.<br>G.W. Charles |
| 16.15-16.30 | Cotton pesticides in perspective:Risk management for produce and environmental protection.<br>I.R. Kennedy | Deciphering variation in cotton yield, yield components, and fibre quality.<br>O. L. May | Partial CO1 sequence of gram pod borer, Helicoverpa armigera<br>K.R. Kranthi | Cutting edge weed science-Weedpak-A weed identification and management guide for the Australian cotton industry.<br>S.B. Johnson |
| 16.30-16.45 | Laboratory measured synergistic suppression of cypermethrin resistance by pongamia oil and Pbo and consequent | The performance of cotton cultivars on research station trials during the 1998/99 to 2001/002 seasons.<br>T.E. Alweendo | Monitoring insecticide resistance in Helicoverpa armigera in cotton crops in the Ivory Coast 1998-02 | Reducing residual pre-emergent or pre-plant herbicide use in cotton through the development of weed thresholds |

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| | field control.<br><br>A. Requpathy | | T. Martin | I.N. Taylor |
| 16.45-17.00 | Areawide insecticide resistance management in Indian cotton.<br><br>D. A. Russell | Paper Withdrawn | The beneficial disruption Index: A tool for comparing insecticide regimes applied to crop fields.<br><br>M.L. Dillon | Strategies for developing Abiotic stress tolerant genotypes of cotton<br><br>N. Gopalakrishnan |
| 17.00-17.15 | Interaction of cotton cytokinine receptor with some pesticides<br><br>S. I. Salikhov | Effect of growth regulators and chemicals on seed and seed cotton yield<br><br>M.R. Eshanna | Quantitative and qualitative effects of certain pesticides on soil arthropod fauna population in a cotton ecosystem.<br><br>S. M. Hussein | DESI Hybrid cotton for improving agricultural economy of coastal agro-ecosystem in India.<br><br>N. Gopalakrishnan. |
| **11 March 2003**<br><br>**Sessions 15-18** | **Breeding and Markers** | **Crop protection, management and monitors** | **Breeding** | **Crop protection, managing and monitoring** |
| 08.00-10.00 | Plenary session | Plenary session | Plenary session | Plenary session |
| 10.00-10.20 | Utilization of exotic cotton germplasm resources to increase genetic diversity<br><br>Prof. J. M. Stewart | Paper Withdrawn | Paper Withdrawn | Paper Withdrawn |
| 10.20-10.35 | Molecular tagging of fibre yield genes using intraspecific RI lines developed in Uzberkistan<br><br>I. Abdurakhmonov | Cotton bollworm economic injury levels based on crop model predictions: another use of the COTTONS model<br><br>S. Nibouche | Successes with early generation testing for quickening development of new cotton varieties in Uganda.<br><br>L.K. Serunjogi | Effect of diflubenzuron on deoy-ribonucleic acid content of H. armigera.<br><br>S. Uthaamasamy |
| 10.35-10.50 | Molecular markers for DNA finger printing in cotton<br><br>B. Bojinov | Insecticide induced abundance of H. armigera and upsurge of Aphis gossypii in cotton<br><br>V.G. Mathirajan | Differential display of genes expressed in somatic embryogenesis in cotton<br><br>Li Huiying | Considerations for proper use of mixture for control of H. armigera in cotton<br><br>Yidong Wu |
| 10.50-1105 | A recombinant inbred population of cotton for QTL | Reduce use of insecticides against cotton | New possibilities for some old genes improved host | Genetics of insecticide resistance and |

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| | and DNA marker association.<br><br>J.N. Jenkins | bollworms with F1 cotton hybrids possessing Bt-Gene: A myth or reality?<br><br>A.R. Soomro | plant resistance in cotton<br><br>J.A. Scheffler | resistance mechanisms in H.armigera<br><br>K.R. Kranthi |
| 11.05-11.20 | Cotton genetics and genetic collection of isogenic lines for qualitative markers<br><br>D.A. Musaev | Effect of Bt cotton hybrids on larval incidence and development of H. armigera<br><br>V.G. Mathirajan | Molecular monitoring of the introgression of Gossypium hirsutum genes controlling the glanded plant and glandless-seed trait.<br><br>H. Benbouza | Variability of Bt expression among commercial transgenic cotton varieties in the USA.<br><br>J.J.A. Adamczyk |
| 11.20-11.35 | Genetic relatedness and pedigree study through RAPD markers in the wild and racial derivatives of Gossypium and their parents<br><br>K. Thangarai | Temporal variation in expression of toxicity in transgenic cotton lines against H. armigera<br><br>S. Uthamasamy | Significance of marker traits for maintaining the genetic purity in cotton<br><br>R.K. Gumber | Quantitative and qualitative effects of certain pesticides on soil arthropod fauna population in cotton ecosystems.<br><br>S. M. Hussein |
| 11.35-11.50 | Germination test using electric conductivity<br><br>A. Montenegro | The effect of potassium fertilizers, scorbic acid and salicylic acid on inducing resistance in cotton plants against Spiny cotton bollworm<br><br>M.A. Abdul Azziz | Impact of intercrops on conservation of Chrysoperla carnea and other natural enemies in cotton ecosystems.<br><br>M. Hegde | Boll damage by sucking pests: Tackling an emerging threat<br><br>L.J.Wilson |
| 11.50-12.20 | Poster session | Poster session | Poster session | Poster session |
| 12.20-13.20 | Lunch | Lunch | Lunch | Lunch |
| **Session 19-22** | **Disease resistance** | **Physiology** | **Breeding** | **Fibre quality** |
| 13.20-13.40 | Assessment of the impact and main dynamics of cotton diseases in Southern and Eastern Africa<br><br>A. Swanepoel | Improving cotton production in Arid Region Agriculture.<br><br>Y. Saranda | Paper withdrawn | Paper withdrawn |
| 13.40-13.55 | Dynasty: Innovative and spectrum control of | Production of salt tolerant cotton plant through | Studying and employing of biodiversity of | Effect of scheduled picking and manual cotton |

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| | cotton seedling diseases<br>D. Long | invivo and invitro tolerance mechanisms: A case study<br>B.S. Janagoudar | Gossypium species for cotton breeding<br>A.A. Abdullaev | cleaning on level of honeydew contamination<br>G.E. Abdelmageed |
| 13.55-14.10 | Seed treatment with a fungal and a bacterial antagonist for reducing cotton damping-off<br>A. Kapsalis | Data based model creation in cotton research<br>J. Millitky | Characterisation of cotton germplasm and its utilization in breeding for major production constraints in Sudan<br>A. M. Ali | The status and future prospects of cleaner textile production on cotton in South Africa.<br>S. W. Broodryk |
| 14.10-14.25 | Efficacy of oxonilic acid as inducer to an antagonistic strain of Bacillus for the control of soilborne Xanthomonas campestris in cotton<br>N. E. Ahmed | Cotton modelling: advances and gaps in the assessment of climate change, crop management, economic and environmental policy decisions<br>V. R. Reddy | Population size of segregating generations in cotton breeding programs<br>D. T. Bowman | Discoloured cotton: Identification of the causal agents and the factors that govern its severity<br>E. Gat |
| 14.25-14.40 | Investigations on races of bacterial blight pathogen of cotton for disease management in Tanzania<br>T. H. Kibani | Advancements in computerised decision support for Australian Cotton systems<br>S.A. Deutscher | Studies on breeding parents of hybrids in G. hirsutum cotton in India<br>O.P. Tuteja | IPM as part of a cleaner textile production strategy for cotton in South africa<br>A. Bennett |
| 14.40-14.55 | Disease management information within the Australia Cotton Industry<br>G.R.Salmond | Scale: a reference system for determination of developmental stages of cotton plant<br>C. J. Marur | Arboreums in India in the age of the transgenics<br>V. S. Dagaonkar | CIRCOT'S appropriate R&D interventions for energy efficient high productive ginning of cotton<br>K. M. Paralikar |
| 14.55-15.10 | Diversity of cotton infecting geminiviruses<br>R. Briddon | Improvement of cotton experiments network performances using the COTONS SIG system<br>M. Cretenet | Technological and marketing problems of cotton cultivators in Northern India<br>J.S. Malik | Biochemical regulation of fibre development in cotton: An approach towards quality improvement<br>N. Gopalakrishnan |
| **Session 23-** | **Disease resistance** | **Cultural practices** | **Disease monitoring** | **Cultural practices** |

| 26 | | | | and organic cotton |
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| 15.40-15.55 | Revealing and identifying of cotton leaf curl virus in Uzbekistan<br>Z., N. Kadirova | Assessing the feasibility for cotton in tropical Australia<br>S. J. Yeates | Development and maintenance of diseased nursery for screening cotton leaf curl virus<br>H. Rahman | Effect of tillage and residue management practices on cotton/wheat cropping system in India<br>P. L. Nehra |
| 15.55-16.10 | Soilborne diseases of cotton in Australia: meeting the challenge<br>D. B. Nehl | The performance of long staple cotton under high rain forest condition in Nigeria<br>A. Y. A. Adeoti | Inheritance of resistance in cotton cultivars to the HVI isolate<br>S. O. Alabi | Assessment of the effects of plant population and sowing date on growth and yield of cotton<br>M. M. Omer |
| 16.10-16.25 | Paper withdrawn | Plant density spatial arrangement for morphologically varying cotton varieties<br>E. A. Babiker | Genetic analysis of bacterial blight resistance in some crosses of cotton<br>A. M. Mustafa | Cotton response to three plant population densities in Spain<br>J. Rossi |
| 16-25-16.40 | Host plant resistance to cotton leaf crumple disease transmitted by whitefly<br>E. T. Natwick | Factors influencing crop maturity in the Australian Cotton Industry<br>G. N. Roberts | Mapping genes resistant to Verticillium wilt using interspecific F2 population of G. Hirsutum<br>G. Yugian | Three cotton varieties grown with transparent plastic mulching in Spain<br>J. Rossi |
| 16.40-16.55 | Screening of cotton germplasm for blue disease under natural field infestation<br>O. M. Royo | Defoliation of California pima and cotton<br>S. Wright | Thrips on cotton<br>E. G. Eulitz | Studies on the cotton based crop rotations under irrigated conditions in India<br>A. Singh |
| 16.55-17.10 | The expression and gene interaction of leaf curl virus in cotton<br>N. Austin | Sustainable cotton production systems for the humid savannahs of Central Brazil<br>J. L. Belot | Monitoring fruiting factors as a tool in insect management<br>M. Hickman | Organic cotton production and trade in sub-saharan Africa: the need for scaling up<br>P. Ton |
| 17.10-17.25 | Status of resistance in cotton cultivars after resurgence of leaf curl virus disease in Pakistan | Packages for the reduction in cost of cultivation in Indian cottons | Influence of food attractants on predators and pests in cotton ecosystem | Organic cotton production in Sindh in Pakistan<br>R. A. Rajput |

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| | H. Rahman | T. P. Rajendran | M. Hegde | |
| **12th March 2003**<br><br>**Sessions 28-31** | **Biotechnology** | **Breeding** | **Extension** | **Extension** |
| 08.00-10.00 | Plenary session | Plenary session | Plenary session | Plenary session |
| 10.00-10.20 | Emerging role of public sector in cotton biotechnology<br><br>Y. Zafar | Implementation and impact of transgenic Bt cottons in Australia<br><br>G. P. Fitt | Current approaches for management of cotton pests and diseases in India<br><br>C. D. Mayee | Paper withdrawn |
| 10.20-10.55 | Poster session | Poster session | Poster session | Poster session |
| 10.55-11.10 | Genetic diversity in upland cotton cultivars from China and foreign countries by RAPDs and SSRs<br><br>Z. Longfu | Inheritance and segregation of transformants in cotton with two types of insect resistant genes<br><br>W. Jia-He | Schooling our cotton industry in Australia: sharing the knowledge<br><br>J.N.Stanley | Integrated nutrient management practices for sustainable production in cotton based cropping system under assured rainfall conditions<br><br>H. L. Halemani |
| 11.10-11.25 | In vitro culture of incompatible crosses among G. hirsutum and G. arboreum<br><br>S. Kumar | Effect of male sterile cytoplasm on manifestation of heterosis in upland cotton<br><br>B. S. Gill | Yield impacts and extension activities associated with simulated herbicide drift on a commercial cotton field.<br><br>H. Hickman | The use of precision agriculture technology by small cotton farming in developing countries<br><br>E. Jallas |
| 11.25-11.40 | Feasibility of shoot tip transformation by Agrobacterium in diploid and tetraploid cotton<br><br>S. B. Nandeshwar | Forty years of genetic improvement of cotton through interspecific hybridisation at Gembloux Agric University<br><br>G. Mergeai | Extension in Australian cotton industry: a team approach<br><br>G. T. McIntyre | Conservation tillage and poultry litter management for sustainable cotton production in SE USA<br><br>E. Nyakatawa |
| 11.40-11.55 | Co-cultivation of cotton calli with Agrobacterium tumefaciens strains | The problems of the genetic basis of cotton selections<br><br>J. A. Musaev | Role of early maturing and leaf curl virus resistant cotton varieties in sustainable cotton | Measuring the sustainability of cotton production systems |

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| | S. Kumar | | production<br>C. J. Kapoor | G. W. Roth |
| 11.55-12.10 | Heritability of earliness criteria in relation to yield in cotton in South Eastern Anatolia project<br>O. Gencer | Hirsutisation of cultivated diploid cotton<br>V. N. Kulkarni | Water use efficiency extension in Queensland cotton and grain industries: an industry partnership<br>G. T. McIntyre | An analysis for the success and failure of cotton and suggestions to sustain production in Rajasthan in India<br>A. P. Singh |
| 12.10-12.25 | Sequence characterised amplified regions for leaf curl virus resistance in cotton genome<br>J. Amudha | Genome mapping of tetraploid cotton: towards a saturated and unified map.<br>J. M. Lacape | Progress margins in productivity of cotton production by smallholders in SSA<br>M. Fok A. C. | A high yielding quality hirsutum cotton variety for sustainable agriculture in the peninsular India under irrigated situation.<br>V. T. Sundaramurthy |
| 12.25-12.40 | Studies on the cotton leaf curl virus disease in North India<br>D. Monga | Genetic evaluation and comparison of G. herbaceum and G. hirsutum varieties in different levels of rainfed and intensive management situations<br>S. S. Patil | Land suitability in salt-affected soils in Goragon region in North -eastern Iran.<br>M. Y. Naseri | Imidacloprid smearing-A new technique to control early sucking insect pests of cotton.<br>M. Bheemanna |
| 13.00-18.00 | Excursions | Excursions | Excursions | Excursions |
| **13th March 2003**<br>**Session 33-36** | **Improved yield and quality** | **Breeding** | **Fibre quality** | **Breeding-Bt cotton** |
| 08.00-10.30 | Plenary session | Plenary session | Plenary session | Plenary session |
| 10.30-10.50 | The value of biotechnology to cotton: Past Present and Future<br>Dr R. Deaton | The International Cotton Genome Initiative<br>Dr R. G. Cantrell | Paper withdrawn | Paper withdrawn |
| 10.50-11.05 | Arabidopsis thaliana as a source of candidate genes for cotton fibre quality | Localization of QTLs for some important economic traits of tetraploid cotton cultivars | Strategies for biochemical characterization of cotton fibres<br>A. K. Murray | Effects of Jasmonate on insect pests and natural enemies in Bt and non Bt cotton fields |

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| | M. Giband | Z. Xianlong | | N. El-Wakeil |
| 11.05-11.20 | Genetic modification at cellular level to improve fibre qualities of diploid desi cotton by adopting interspecific hybridization<br>K. S. Baig | Isolation and characterisation of seven alien monosomic addition lines of G. australe in G. hirsutum<br>G. Mergeai | Effect of boll location on cotton grades and quality<br>N. H. Osman | Contributions of Bt-transgenic cotton to the Israeli Insecticide Resistance Management strategy<br>A. R. Horowitz |
| 11.20-11.35 | Primitive accessions of cotton as genetic sources for improving yield and fibre properties<br>J. C. McCarty | Recombinant inbred lines in cotton<br>I. S. Katageri | Many factors affecting conversion of cotton fibres into quality products<br>R. D. Anandjiwala | Perspectives on resistance management strategies for Bt-cotton in India<br>K. R. Kranthi |
| 11.35-11.50 | Susceptibility index to study genotypic variation in cotton heat tolerance<br>E. O. Leidi | Evaluation of some exotic mutants derived from irradiated cotton seeds<br>M. A. Raafat | Limits of measuring short fibre content by high volume instrument<br>G. P. Gourlot | From insecticide resistance to Bt cotton resistance: Is insect pest management sustainable in small scale farming systems.<br>M. Vaissayre |
| 11.50-12.05 | Biocidic peptides from cotton seeds<br>S. I. Salikhov | Towards G. barbadense chromosome-specific recombinant inbreds of G. hirsutum<br>S. Saha | Determination of the critical NEP size for cotton ring and OE yarn<br>I. Frydrych | Performance of Bt cotton genotypes under unprotected conditions<br>S. S. Udikeri |
| 12.05-12.20 | Combining ability of yield and yield components in upland cotton under drought stress conditions<br>M. A. A. El-Dahan | Gossypium betaines and some of their potential roles<br>G. Blunden | Microscopic analysis of cotton NEP structure<br>M. Matusiak | Strength weakness opportunities, threats (SWOT) analysis of Bt cotton in India<br>B. M. Khadi |
| 12.20-13.30 | Lunch | Lunch | Lunch | Lunch |
| **Session 37-40** | **Nutrition** | **Fibre quality** | **Bemisia tabaci** | **Bt and Aphids** |
| 13.30-13-45 | Effect of foliar spraying of Zn, Mn, | The Quickspin Method - A new | Insecticide Resistance profile | International impacts of Bt |

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| | Fe on leaf chemical analysis, yield, yield components and fibre quality in Giza 89, Egyptian cotton cultivar<br>O. A. Nofal | way to determine the value of cotton<br>P. Artzt | from 1991-2002 for H. armigera in Pakistan<br>M. I. Arif | cotton adoption<br>G. B. Frisvold |
| 13.45-14.00 | Soil test based fertilizer recommendations for targeted yields of cotton in India<br>P. D. Sharma | A new technology for dismantling yarns in a laboratory<br>A. A. Fassihi | Hormoligosis of insecticidal sprays in Bemisia tabaci on cotton<br>N. M. M. Abdullah | Cropping system-based community approach to rainfed cotton IPM: a case study<br>O. M. Bambawale |
| 14.00-14.15 | Performance of American Cotton varieties under different fertilizer levels during summer season under irrigated conditions in Karaikal<br>V. Chellamuthu | Possibility of processing of hemp fibre in blends with cotton for apparel fabrics<br>R. Kozlowski | Biotypes of Bemisia tabaci and relevance to insecticide resistance management<br>G. J. D. Devine | Assessment of potential weediness of Bt cotton in Tropical Australia: Targeted experiments<br>R. J. Eastick |
| 14.15-14.30 | Effect of fertilizer form on cotton production under the alkaline clay soil of Sudan Gezira<br>N. Ali | Natural or man-made fibres: the question of our health<br>M. Zimniewska | Life table of Bemisia tabaci in cotton field of Cukurova in Turkey | Population and spatial dynamics of two competitive parasitoids of Aphis gossypii on cotton<br>N. G. Kavallieratos |
| 14.30-14.45 | Response of G. herbaceum cotton hybrids to fertilizer levels under summer irrigated conditions of Karaikal<br>V. Chellamuthu | Fibre quality, gin and harvest efficiency evaluation of a new stripper shaker system compared to Picker system<br>A. Montenegro | Status of Bemisia tabaci on cotton and population dynamics of its parasitoids on alternate host plants in Pakistan<br>M. Naveed | Bioefficacy and persistence toxicity of fenpropathrin against cotton aphids, A. gosypii<br>L. Nadarajan |
| 14.45-15.15 | Tea/Coffee | Tea/Coffee | Tea/Coffee | Tea/Coffee |
| 15.15-16.15 | Closing session | Closing session | Closing session | Closing session |

# *COTTON RESEARCH AND DEVELOPMENT CORPORATION*

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## *FINAL REPORT ON OFFICIAL TRAVEL TO CAPE TOWN, SOUTH AFRICA TO ATTEND THE THIRD WORLD COTTON RESEARCH CONFERENCE (WCRC — 3)*

*($7^{TH}$ — $17^{TH}$ MARCH 2003)*

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## *The Weeds Team*
## *Graham Charles, Ian Taylor & Stephen Johnson*

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***Report on travel to South Africa to attend the 3rd World Cotton Research Conference from 7 - 17th March 2003***

**EXECUTIVE SUMMARY**

The World Cotton Research Conference (WCRC) was an initiative of the International Cotton Advisory Council, aimed to provide a forum for scientists to interact, learn and discuss their areas of research with colleagues. The 3rd International Conference was held in Cape Town in South Africa from the 9th —13thMarch 2003. We attended the conference to: (1) present papers on integrated weed management; (2) interact and have discussion with scientists working in the same and other areas of research to gain further knowledge in weed management and the cotton system; and (3) undertake a short study tour of the agriculture of the southern Cape region (Charles & Taylor).

The conference attracted over 400 cotton scientists, administrators, agro-chemical company representatives and marketers from all over the world. The conference was divided into 10 plenary lectures and 40 concurrent sessions. Biogenetics, breeding and entomology dominated the papers presented at the conference, with few papers on farming systems or weed management. Nevertheless, there were beneficial opportunities to talk with colleagues from around the world.

Of particular interest was the current move in world research away from applied field research, to laboratory level and pure research, especially in biogenetics. A large number of papers featured research that appeared to have no immediate application, or gave laboratory results that had not been field tested. Surprisingly, a large proportion of these papers were from developing countries. Research from countries such as Australia and the US was generally much more applied, with emphasis on field validation of the results.

Two key speakers identified significant management problems with the cotton production systems of the US (lack of cropping rotations, soil compaction, low rainfall etc.), and several speakers identified occasional problems with genetically modified cotton.

Problems with weed management systems were discussed by NSW Agriculture scientists and by one key US speaker. Weed science appears to have been placed into the too-hard basket, with emphasis going primarily to biotechnology and gene manipulation research. The all too obvious consequences of species shift in the weed spectrum and herbicide resistance are being ignored by most countries. The prevailing attitude appears to be that the technology will eventually fail, so it is best to exploit the technology as much as possible to achieve the best return, and assume that the gene-jockeys will have an alternative available when it is needed. The Australian wheat industry is already learning the folly of this approach, with herbicide resistance already present to almost every available herbicide group.

The study tour of the southern Cape region of South Africa greatly enhanced our understanding of the climate, farming systems and challenges of agriculture in southern South Africa. These challenges are both physical and social/political.

Generally, the conference gave us the opportunity to have contact with many of the world s leading scientists, working in a range of research areas and also gave us an insight into much of the research currently occurring in the world. The knowledge gained at the conference will enable us to increase our collaboration with international scientists and will facilitate and expedite the progress of our research in Australia.

## 1. Outline the background of the projects.

Weed management is an on-going problem for the cotton industry. Management of weeds in a slow-growing, broad-leaf crop such as cotton, growing under high nutrition and full irrigation is especially difficult. Weed management costs around $300/ha of crop, representing 20% of total production costs. In 2001/2002 this was a cost of $110 million to the Australian cotton industry. The cost of lost production due to weed competition and crop damage from the management tools used would far exceed this total. A conservative estimate of a _ bale yield loss per ha due to competition and damage results in a total cost of weeds of $235 million per annum.

While there have been some recent improvements in weed control practices and the introduction of some new herbicides, weed control in cotton still relies heavily on multiple applications of residual herbicides and cultivation. These tools are relatively effective, but result in some negative side-effects to both the cotton crop and the environment. Crop damage by cultivation and residual herbicides, and the movement of soil and herbicide residues into the river systems are ongoing problems. The recent introduction of genetically modified, herbicide tolerant, Roundup Ready¤ cotton allows the Australian cotton industry the opportunity to make a quantum leap in weed control, with glyphosate potentially replacing many residual herbicide and cultivation inputs. However, increasing reliance on glyphosate as the primary means of weed control will inevitably lead to the emergence of glyphosate tolerant and possibly glyphosate resistant weeds as major problems and could result in the effective loss of the singly most important management tool in the conservation farming system. Hence, the cotton industry is faced with the dilemma of wanting to move to a glyphosate dominant system to improve production and sustainability, but this move will ultimately lead to an unsustainable system. This problem is also being faced elsewhere in the world, and especially in the US, where herbicide tolerant crops have been more widely used over a longer period. A new glyphosate resistant weed (*Conyza canadensis*) has already emerged in the US as the result of the over-use of glyphosate in Roundup resistant crops.

Research by weed scientists at ACRI, has concentrated on the management of problem weeds and the development of efficient, sustainable weed management systems. This work has culminated in the recent release of WEEDpak, a weed management support package for the cotton industry.

The World Cotton Research Conference (WCRC) is an initiative of the International Cotton Advisory Council aimed at gathering cotton researchers, extension workers, agro-chemical company representatives, administrators, marketers, and others from around the world for a symposium covering all aspects of cotton production. This forum offers the opportunity for Australian cotton researchers to discuss research problems with colleagues from all over the world. The venue for the 2003 WCRC, Cape Town, South Africa, also allows an opportunity for researchers from countries such as Australia to share information and experiences with colleagues from the developing countries of Africa that are faced with many of the same problems but limited resources. The conference provided an opportunity for participants to exchange ideas, update knowledge and discuss subjects of interest.

## 2. Objectives

The objectives of the travel were to:

- Attend the 3rd World Cotton Research Conference and present papers by:
  - Charles entitled Managing herbicide resistance and species shift in cotton using an Integrated Weed Management (IWM) approach ,
  - Johnson entitled Cutting-edge weed science — WEEDpak — A weed identification and management guide for the Australian cotton industry , and
  - Taylor entitled Reducing residual pre-emergent or pre-plant herbicide use in cotton through the development of weed thresholds .
- Establish and renew contact with and have discussions with some of the worlds leading researchers on weed management in cotton, as well as other aspects of cotton management.
- Share knowledge and experience with others working in the cotton industry.
- Undertake a short study tour of South African agriculture in the southern Cape region (Charles and Taylor only).

## 3. Activities

The third World Cotton Research Conference (WCRC-3) was held in the Cape Town in South Africa from the 9th — 13th March 2003.The conference attracted over 400 cotton scientists, administrators, agro-chemical companies and marketers all over the world. The conference was divided into 10 plenary lectures and 40 concurrent sessions.

A short tour of the southern cape region was undertaken with colleagues on 14th - 15th of March before returning on the 16th - 17th (Charles & Taylor).

## 4. World Cotton Research Conference

The conference was well organized, but not well attended. Many of the intending participants were not able to obtain funds to travel and many of the concurrent session speakers failed to attend and present their material. Consequently, the range of material presented was greatly reduced.

Papers were presented covering nearly all aspects of cotton production, but the conference was very heavily biased towards biogenetics, breeding and entomology. Numerous papers discussed aspects of genetically modified cotton, gene mapping, the value of inter-specific hybrids and pest management.

## 5. Plenary lectures

The conference opened with an introduction from the acting Minister for Agriculture in South Africa and a colourful and superb exhibition from a local native African choral group. Short talks were then given by eight dignitaries who were heavily

involved with the organization of this or the previous two World conferences. Amongst these speakers:

Terry Townsend (Executive Director of the International Cotton Advisory Committee) caused consternation in the audience by predicting that the real price of cotton on the world market would continue to fall over the next 50 years. Production efficiency will have to be continually improved for cotton producers to remain viable in this scenario. This is particularly a challenge for Australian producers, as Australia already has the highest average yields in the world. The negative impact of the current weed management tools on cotton yields is especially significant in this scenario. Terry did not discuss the impact of current US farm policy in depressing the world price of cotton. Trade liberalization should lead to an increase in world prices, alleviating the long-term reduction.

Ralph Schulze (CRDC, Australia) made the point that cotton production needs to be sustainable in economic, social, ecological and moral terms. This goal is a challenge to all involved in an industry heavily reliant on chemicals (insecticides, herbicides and fungicides), and becoming increasingly involved in genetic engineering.

The plenary talks were given by experts from different areas of cotton research. Plenary speakers were chosen from each continent. They were each given selected topics in cotton production. Questions and informal discussions follow each plenary session. This allowed participants and speakers to interact and discuss the subjects.

Speakers who included information relating to weed management included:

Dr. Krieg examined the affect of genetics and environment on poor yields achieved in the US cotton belt over the last 5 years. He determined that the poor yield was almost entirely due to adverse environmental conditions, namely high temperatures and low rainfall. The impact of the weed management environment on yield was not considered, but would have an important impact on production.

Dr Galanopoulou-Sendouca also looked at factors affecting crop production and concluded that a lack of cropping rotations was a significant contributor to poor crop performance. Mono-cropping with cotton is leading to problems with soil fertility, pests, weeds and diseases. The use of transgenic cotton was also identified as a source of problems, leading to poor yields and poor agronomic performance on some occasions. The use of transgenic varieties is not always leading to improvements in productivity or profitability.

Dr. Hake talked about the future for genetically modified cotton, with the release of Twinguard, VIP and a 2nd pair of Bt genes, as well as enhanced Roundup Ready¤ cotton, and Liberty Link¤ cotton in the short-term. In the longer term there is a huge potential to release new and novel traits, but he questioned the economic viability of this approach, with limited returns to development companies as they compete for a finite market. He also questioned the future prospects when gene patents run out and traits are freely available on the open market.

Dr. Wilkens gave a fascinating talk on work with genetically modified cotton. She and her co-workers have found that by changing the tissue culture media used in plant regeneration they have been able to remove the previous limit whereby only Coker cotton could be modified directly, with all traits introduced into Coker cotton (an inferior, old variety), and then back-crossed into elite lines. Using a new media, they have had equal success transforming elite varieties, removing a large bottleneck in the transformation process, greatly speeding up the time between transformation and commercial release of transgenic material. They have also identified a simple gene that affects fiber length, with the potential to produce cotton with improved fiber length and improved fiber uniformity.

## 6. Concurrent Sessions.

Thirty nine concurrent sessions were organised at the conference. Each session consisted of a series of papers on a specific area of cotton production, although a lot of papers did not seem to fit well into the specified areas. Concurrent poster sessions were also used.

Many papers submitted for presentation at the conference were not given because many of the speakers did not turn up. This was particularly true of speakers from the US and developing countries in Africa and Asia. Lack of funds was the reason for the speakers in Africa and most of the Asian countries failing to register. However, most speakers from the USA failed to attend the conference for fear of terrorist attack according to the few USA scientists who were bold enough to attend. Many weed scientists also chose not to attend as there was a weed science conference running in the US at the same time.

Four of the five weed science papers presented were given by Australian scientists. The remaining paper discussed the screening of cotton lines as trap crops for controlling stiga (a parasitic weed) in Nigeria. The Australian papers were well presented and showed a well thought out, disciplined approach to weed science. There was opportunity to discuss each of these papers following their presentation.

Dr. Rowena Eastick (CSIRO) discussed the likelihood of Bt cotton becoming a significant weed in the Australian top end. Work on seed germination indicated that the Bt gene inferred no improvement in the plants fitness, and so would not impact on the weediness of cotton. She observed that cotton is already a weed in the top end, with some plants naturalised and growing as perennial plants.

Over the course of the conference we listened to a variety of speakers and discussed a range of topics including:

- The evaluation of cotton cultivars under dry conditions, showing that improvements in production were possible with more water efficient material, but that conventional breeding programs have inadvertently selected for less water efficient lines.
- Difficulties with in-vitro screening for salt tolerance. This paper was typical of many from the Indian region. The scientist reported major difficulties with this approach, but did not explain why he couldn t simply screen material in the field, nor whether there was any correlation between the material he had selected and in-field salt tolerance. The science was excellent but the practical application was dubious.

- IPM in a range of countries
- Various aspects of genetics and crop breeding
- Managing cotton production on small holdings in Africa
- The use of computer models for production and IPM

- Dr. Belot from the wet tropics in Brazil, has developed a triple cropping system, where cotton is grown as one crop in the rotation. One of his options was to plant cotton into a *Cynodon dactylon* sward. He showed a field where cotton was sown directly into sorghum stubble and was doing well. An adjacent strip was badly infested with *Cyperus rotundus*, suggesting that sorghum stubble was effective in suppressing nutgrass. This observation will have application in Australia if it is borne out.
- Improvements in cotton fiber characteristics by crossing elite cultivars with primitive cotton lines. Fiber strength in particular was greatly improved in some of the F2 and F3 crosses.
- The impact of GM cotton on the world cotton supply, price and consumption. The introduction of Bt cotton in the US and China has caused an increase in production and a consequent drop in the world price. Countries that have not adopted a 100% use of Bt and Roundup Ready¤ cotton are at a production disadvantage and will lose money. Australia is such a country, where Bt adoption was limited to 30% of the cotton area.

During the conference we had extensive talks with Steve Wright, University of California, Cotton, Grains & Weed Control Advisor regarding the performance of various herbicides, Roundup Ready¤ cotton and weed management in the US. We appear to be ahead of the US in much of our work, but it was useful to compare results. He had seen no problems with the combination of Roundup Ready¤ cotton, Roundup and water-run-urea, in contrast with the problems we have identified with this combination here. Envoke¤ herbicide is not yet registered in US (it was registered last season here). Staple¤ herbicide is very effective on their annual morning glory, whereas it is quite weak on our species. Cyanazine was a useful herbicide for morning glory, but the registration had lapsed in the US. It has never been registered for cotton in Australia.

We also talked to a number of Africans and Indians about the difficulties of cotton production on small holdings. They have a lot of problems relating to very limited infrastructure and resources. Many Indians reported that they were experimenting with the use of residual herbicides, but with little success due to limited equipment, resources etc. Many small scale African farmers also had a practical problem due to their traditional practice of keeping their own planting seed and ratooning cotton for up to 4 years. The use of kept seed and ratoon cotton would cause problems with the use of GM cotton where a licence fee is payed annually, based on the planted area and is normally based on seed sales. This system also has major implications for cropping rotations, insect and disease management. Australian scientists and advisory officers could help them a lot with their management as many of their

problems are not dissimilar to ours, with similar weed species and farming systems (with some variations).

On Wednesday afternoon we went on an organized tour of Table Mountain and the botanical gardens in Cape Town. It was fascinating to see how many Australian weeds (such as bitou bush and cape weed) and ornamental plants are from this region of the world. It was also interesting to see the weeds of the gardens, which included *Cyperus rotundus*, *C. connicus*, pig weed, caustic weed and several grasses that are also problems in Australia.

## 7. Study tour

A short study tour was organized by Jeff McIntyre, Principle Extension Officer, QDPI Dalby. Together with colleagues from NSW Agriculture and QDPI, we (Charles & Taylor) traveled through the southern Cape region, from Cape Town to Port Elizabeth. Unfortunately this region does not include any cotton production. Cotton production begins around 1000 km north of Cape Town, so it was impractical to travel to this area in the time available.

The area we traveled through had a huge variety of land types, soil types and land uses. Leaving Capetown, Stellenbosch and Franscbhoek are in fertile valleys, with small holdings and intensive agriculture. The main industry was wine production, with some forestry (radiata pine), orchards and livestock. As well as the traditional breeds, some paddocks included native ruminant species that were being commercially farmed. Many of these areas have no native timber. Stands of eucalyptus and black wattle have been established and grow very well, but have now become serious weeds in some places, especially the richer river valleys. Further east, we traveled into much drier, undulating country, with extensive areas of native vegetation (fynbos, a fragile ecosystem dominated by proteas and other shrubs), and cereal cropping, with sheep, goats, cattle and ostriches. The rainfall in these areas is winter dominant and generally quite light. Nearly all the cereal stubble had been removed for hay, with the remnant stubble burned and plowed, even on relatively steep slopes. Erosion was obviously not a serious problem, although most paddocks had contour banks. Rainfall has been unusually light in these regions over the last 7 years, and many holdings are near bankruptcy due to poor yields. Traveling on to Oudstoorn, the country was poor and very dry, with the occasional oasis of an irrigation system. Oudstoorn is famous for its ostrich industry, with some very large, intensive ostrich farms. We also saw a few wild ostriches.

From here we returned to the coastal strip, dominated by forestry (radiata pine), and dairying, with many centre pivot irrigation systems. Interestingly, it appeared that much of the best country (soil type and rainfall) was being used for forestry, while much of the poor and steep country is used for livestock. The lack of significant areas of native forestry obviously places a very high value on timber in South Africa.

The cost of unskilled labor was very low and large squatter settlements were obvious around Cape Town, with smaller settlements apparent around most other towns. There were however, few intensive industries, with many large agricultural holdings.

The scope to use unskilled labor appeared quite limited, with farmers tending towards machinery and larger holdings. The one exception was with fencing, which consisted of many wires, supported by small branches and posts cut from the scrub.

One particularly interesting aspect of South African agriculture is game farming, which is now big business, and has become a significant income earner for South Africa. Many of the African wildlife species that were threatened with extinction are now being protected and bred in game farms. The game farm industry has become established over the last decade with a change in Government policy. Under earlier policy, all native game belonged to the Government, but was often seen by farmers as a threat to their productivity, and was legally or illegally killed. Farmers are now able to own and trade game animals, which consequently now have a significant monetary value. Game farming (the breeding and sale of game animals) is still regulated to some extent (controls on what species in which areas), but gives a much higher return per land area than did conventional farming. As game animals also primarily utilise areas of native vegetation, game farming is effectively resulting in the return of many farming areas to areas of managed native vegetation. Some significant weeds of these areas are prickly pear (the cactoblastis moth was recently released in South Africa), and introduced eucalyptus and black wattle. These weeds are being managed with fire, which is a necessary part of the lifecycle of the native species, but the Australian trees are themselves relatively fire tolerant.

In some ways, game farming is a small niche market that is unique to South Africa. There is a demand for these native species from many of the African countries, where indiscriminate land clearing, population pressure, poaching and political unrest have resulted in large reductions in their populations. There also remains a world-wide demand for these species from zoos etc. The current high prices for farmed animals will no doubt decline rapidly as the market becomes saturated. Nevertheless, the ability to farm and sell native wildlife has established its own market and established a value for these animals. An initial assessment suggests that a similar, more open policy in Australia, could greatly increase the value of native animals, and result in a reduction in their culling and the creation of a game industry with associated tourism income and the re-establishment of significant areas of managed native vegetation. However, the game hunting side of this industry may be politically unpalatable in Australia.

In summary, the area we traveled through covered a wide rage of soil types, climatic, and land use areas, ranging from intensive agriculture with orcharding and wine production, through to large areas of fynbos native vegetation. With the exception of intensive agriculture in the better areas and game farming, the general outlook for farming in this region is one of declining returns and few viable future options. Land degradation did not appear to be a major issue due to a mild climate with few storms.

## 8. Benefits

- The conference allowed us to share our experiences and observations on weeds and weed management with scientists from around the world. We were also given many

opportunities to share with colleagues from a diversity of backgrounds from developed through to third world countries.

- It has given us insight into the lack of current weed management research around the world, but the obvious need for this research. Weed science appears to have been placed into the too-hard basket, with emphasis going primarily to bio-technology, gene manipulation research. The all too obvious consequence of species shift in the weed spectrum and herbicide resistance is being ignored by most countries. The prevailing attitude appears to be that the technology will eventually fail, so it is best to exploit the technology as much as possible to achieve the best return, and assume that the gene-jockeys will have an alternative available when it is needed. The Australian wheat industry is already learning the folly of this approach, with herbicide resistance present to almost every available herbicide group.
- The brief study has greatly enhanced our understanding of the climate, farming systems and challenges of agriculture in southern South Africa. These challenges are both physical and social/political

## 9. Itinerary

| | |
|---|---|
| 7th March 2003 | Narrabri - Moree - Sydney |
| 8th | Sydney - Johannesburg - Cape Town |
| 9th | Conference Registration (Holiday Inn, Conference centre) |
| 10-13th | Conference and Tour of Table Mountain & Botanic Gardens |
| 14th | Cape Town — Oudtshoorn |
| 15th | Oudtshoorn — Knysna |
| 16th | Knysna — Port Elizabeth - Johannesburg — Sydney |
| 17th | Sydney - Narrabri |

## 10. Acknowledgements

We gratefully acknowledge the funding by the Cotton Research and Development Corporation and Australian Cotton Cooperative Research Centre that enabled us to attend and present at this conference.

# Report on WCRC-3

## Breeding and biotechnology

WCRC-3 had approximately 96 presentations in the breeding and biotechnology subject areas. About one-third were poster, the rest as oral papers – there was no clear difference in standard of papers between poster, paper, keynote or plenary presentation. Given the large number of no-shows at the conference, there were good poster subjects which could have had better exposure and discussion.

The standard of papers varied widely from poor reports on variety trials through to excellent reviews and results of ground-breaking research. The following table is a list of my selection of the best papers in this subject area, in rough order of merit.

Greg Constable

Program Leader

CSIRO Cotton Research Unit

April 4, 2003

| Author | Title | From | Reason for interest |
|---|---|---|---|
| Lacape et al | Genome mapping of tetraploid cotton: towards a saturated and unified map. | France | Molecular markers have the potential to dramatically improve the speed and efficiency of breeding. This paper combines results from four different laboratories to develop a unified map. |
| Wilkins | Cotton fiber biology: integrating genomics and development for improving fiber traits. | USA-CA | Many laboratories are working towards genetically engineering cotton to improve fibre quality. This paper describes transformation of an expansin gene to improve fibre length by 0.2". |
| Saha et al | Towards G barbadense chromosome-specific recombinant inbreds of G hirsutum. | USA-MS | These workers have developed 18 lines of G hirsutum with one G barbadense chromosome. The lines will be of benefit in map and marker research. |
| Hake | Biotech cotton: beyond Bt and herbicide tolerance. | USA-MS | A review of potential traits for the future. Of interest are comments on methods of increasing yield potential: cotton price will halve in the next 50 years and we need new ways of increasing yield. |
| Saranga | Improving cotton production in arid region agriculture. | Israel | This paper identified markers-map of QTL affecting water use efficiency. |
| Benbouza et al | Molecular monitoring of the introgression in G hirsutum of G sturtianum genes controlling the glanded plant and glandless seed trait. | Algeria | The glanded plant and glandless seed trait is of interest for oil quality and in Australia this same source is of interest for fusarium resistance. |
| Bowman | Population size of segregating generations in cotton breeding programs. | USA-NC | It is of interest to optimize population size in breeding – to identify good lines and to avoid unnecessarily large populations and consequences on resources. |

**TRAVEL REPORT**

**WORLD COTTON RESEARCH CONFERENCE — 3**
**CAPETOWN, SOUTH AFRICA**
**March 9 — 13, 2003.**

**Mark Hickman, Industry Development Officer and IPM Training Coordinator**
**NSW Agriculture, Toowoomba.**

**Purpose of Travel**

The purpose of the trip was to attend and participate in the World Cotton Research Conference 3 in South Africa as a member of the Australian delegation representing the Australian cotton industry and its RD&E programs. Three reasons for attending this conference were :

- To establish and continue to foster previously established contacts with international extension personnel;
- To increase my knowledge base in all areas of cotton production. With particular focus on the IPM related research;
- To present 2 papers at the World Cotton Conference and to chair a session relating to Water stress and irrigation. My papers related to extension and IPM programs in the Australian cotton industry:

Papers that were presented by Mark Hickman were titled:

- D. Gibb, M. Hickman, and I. MacPherson —*Monitoring fruiting factors as a tool in insect management.*
- M.Hickman, A.Storrie and T.Cook — *Yield impacts and extension activities with simulated herbicide drift on a commercial cotton field.*

**The Soils Perspective Report**

Unfortunately soils research was not listed as a broad theme topic at the world cotton conference. Rather, the topic of soils was addressed in the broader themes of agronomy and farming systems. The primary soil focus was matters pertaining to sodicity and salinity as evident by the references below. Soil biology was rarely discussed. Within the proceedings only one example could be aligned with this area and it is listed below. It appears that soil biology ands soil health is more a topic being focused on in Australia rather than the international community.

- J. Triantafillis — *Use of Geographic information system and geographical measurements to determine cause and control of soil salinisation in the lower Macquarie valley, Australia.*
- I. J. Rochester and G. A. Constable —*Variation in cotton cultivars in leaf nutrient content and tolerance to soil sodicity;*
- I. O. A Odeh , A. B. McBratney and J. Triantafillis — *Is soil quality declining under cotton Production systems in eastern Australia*;
- Y. Naseri — *Land suitability in salt affected soils in Goragan region, north-eastern Iran*
- S.M. Hussein, M.A. Abdel-Aziz, A.A.Abedel-Alim and A.A. Mohamed — *Quantitative and qualitative effects of certain pesticides on soil arthropod fauna population in a cotton ecosystem.*

Key messages in these papers were :

- J. Triantafillis; Identification using a geographic information system analysis of poor soil conditions prior to the establishment of reservoirs and other features such as fields is the key to avoidance of soil salinity. From this research a set of BMP guidelines can be established to help avoid problem areas.

- I. J. Rochester and G. A. Constable; The paper addresses the interaction that exists between sodic soils and the leaf nutrients content of P- K. This paper also discusses the practice aspect of the research by using the data collected from different varietal responses for future breeding selections.

- I. O. A Odeh , A. B. McBratney and J. Triantafillis; This paper utilises the extensive field survey, grower interviews and other historical data that has been conducted with the Australian cotton industry to monitor changes and indicators in soil quality. Depending on the farm results indicated both a positive and negative trend in soil quality indicators.

- Y. Naseri ; This paper discusses the land evaluation that was performed on the salt effected areas of northeastern Iran s Goragan region. The program was matching the soil physical and chemical characteristics with potential irrigated cotton production.

- S.M. Hussein, M.A. Abdel-Aziz, A.A.Abedel-Alim and A.A. Mohamed; the paper outlines how 3 pesticides ( ai. Terbuphos, carbofuran and amidacloprid) were assessed for their effects on soil arthropods. The results found carbofuran and amidacloprid to have a medium selectivity on soil arthropods. While terbuphos was classed as selective.

One poster that related to soils research was:

- J. Singh, N.D Mannikar and C. D. Mayee- *Soil and crop productivity changes due to cotton based cropping systems and nutrient management.*

Concluding remarks:

While soil research was not exhaustively addressed at the conference. It was encompassed in other factices of cotton production the areas of farming systems and general agronomy. With salinity and sodicity being the driving focus of soil research reported at this venue.

By attending this conference I did gain an extensive wealth of knowledge in numerous other topics. Topics that addressed areas like general agronomy, physiology, IPM , breeding, diseases, farming systems and extension . In particular, the experience of attending and addressing an international conference has developed my skills personally as an extension officer. These skills will be reflected through my role as an extension officer. In addition, I was able to foster and develop new relationships with fellow extension personnel at an international level. I would like to thank the CRDC for providing the assistance in obtaining these experiences and opportunities.

Ivan Kennedy

**Environmental Research at WCRC-3**

Only a small number of papers and posters presented at WCRC-3 involved environmental issues as their central focus, although environmental values were often mentioned in matters of more general perspective, and in some papers directly on cotton production. Stella Galanopolou s plenary presentation from Greece on sustainable cotton production adopted this approach.

Of the ten or so research papers presented specifically targeting environmental issues, most were presented by Australian research workers. Two papers were presented on organic cotton, one from India and one from Africa. The environmental papers included several from the Australian Cotton CRC on soil quality (Odeh et al.), the cause and controls of soil salinisation (Triantafilis), issues related to the use of more environment-friendly petroleum oils (Liang and Mensah), general papers including material on the beneficial environmental impact of Ingard cotton (Pyke; Fitt), and on risk assessment from pesticides in produce and the environment (Kennedy et al.), and their remediation (Crossan and Kennedy). There are environmental issues related to the introduction of Roundup Ready cotton that require attention, but these were not covered in the WCRC-3 program.

Guy Roth s paper on measuring sustainability of cotton production systems provided an excellent summary of the advances made in this area since the Environmental Audit was conducted in the early 1990s. The clear benefits from the introduction of Ingard cotton on the declining extent of riverine contamination with pesticides such as endosulfan have been quantified by the ongoing monitoring program funded by water users and the NSW Department of Land and Water Conservation.

Judging by its input to the Cape Town conference, the Australian cotton industry and its research providers can take considerable credit for a pro-active approach to environmental issues. This also reflects the Cotton Research and Development Corporation s decision to include protection of the environment and of agricultural produce as a major goal in its research funding profile.

## Plant pathology, WCRC III

**David Nehl**
*Australian Cotton Cooperative Research Centre, Narrabri NSW 2390*

### Cotton pathology

*Nematodes*

Dr M.S. Botha (ARC Institute for Industrial Crops) discussed plant pathogenic nematodes on cotton in South Africa. These include:

Root knot nematode, *Meloidogyne incognita* Race 4
Root lesion nematode, *Pratylenchus* spp.
Stubby root nematode, *Paratrichodorus* spp.
*Xiphinema* spp.

Root knot nematode is the most important pathogenic nematode on cotton in South Africa. Control involves a combination of crop rotation and resistant cotton cultivars. Root gall index and a reproduction index were used to assess host resistance in the glasshouse. Some Australian varieties had a higher root gall index than the standard.

Professor Craig Rothrock discussed yield losses associated with the synergistic interaction between black root rot and *M. incognita*. In cotton in Arkansas, plant stand was not reduced by the black root rot pathogen, *Thielaviopsis basicola*, but was reduced 26% by *M. incognita*. When both *M. incognita* and *T. basicola* were present in the soil plant stand was reduced by 43%. Yield losses of 33 and 21% were caused by this interaction in 2000 and 2001 respectively. Maps of the distribution of these pathogens within fields are being used to develop precision application of controls, such as soil fumigants and nematicides.

Dr Elizabeth van Biljon (ARC Institute for Industrial Crops) discussed management of *M. incognita* and *Pratylenchus teres* in South Africa using the following biocides, biological control agents, and organic amendments in an integrated manner.

| | |
|---|---|
| Biological control agents: | Biostart® 2000 (*Bacillus* spp.) |
| | PI Plus® (*Paecillomyces lilacinus*) |
| Biocides: | Ethylene dibromide |
| | Aldicarb |
| | Oxamyl EC |
| Organic amendments: | Chicken manure |
| | R.U.M.® (vermicast) |

None of the biological control agents or organic amendments were successful controls on their own. R.U.M. and chicken manure increased numbers of *M. incognita*, although R.U.M. did increase yield as a fertiliser. In combination with aldicarb, R.U.M.® and Biostart® 2000 increased yield more than aldicarb alone.

*Seedling disease*

Dr Apostolos Kapsalis (University of Reading) conducted glasshouse and laboratory studies of the potential for biological control of Rhizoctonia solani using *Pseudomonas oryzihabitans* (a bacterium that is usually symbiotic with an insect-parasitising nematode) and *Gliocladium virens* (a soilborne fungus). *P. oryzihabitans* did not parasitise *R. solani* but did inhibit its growth *in vitro*. *G. virens* parasitised *R. solani in vitro*. Both bio-control agents decreased disease severity and increased seedling establishment and growth in the greenhouse.

Dr David Long (Syngenta Crop Protection) described the results of seed treatment with mefenoxam (Apron XL), fludioxonil (Maxim) and azoxystrobin. This combination of fungicides is marketed under the trade name Dynasty".

*Viruses*

Dr Rob Briddon (John Innes Centre) described the diversity of gemini viruses that infect cotton, all of which are whitefly-transmitted (begomoviruses). The diversity of these viruses is greater in Africa and Asia than in the Americas. Cotton leaf curl virus (**CLCuV**) can infect cotton but requires a single-stranded DNA molecule (DNA_) to cause symptoms. Diversity within this molecule is low across India, indicating that variation in pathogenicity is governed by diversity within the CLCuV molecule. The begomoviruses infecting cotton in Africa have not been fully characterised but they probably also require the DNA_ molecule. DNA sequencing suggests that the begomoviruses associated with cotton have developed independently. Dr Briddon suggested that CLCuV was more likely to move to cotton in Australia from native populations than by way of introduction from the subcontinent.

Dr Eric Natwick (University of California) discussed host-plant resistance against cotton leaf crumple virus (**CLCrV**). The disease has occurs annually in the USA and the Bahai region of Mexico although symptoms appear late in the season and usually don t cause major losses. CLCrV can be found in symptomless hosts. CLCrV is a begomovirus. However, the differences in the severity of symptoms are not related to incidence of the whitefly vector. A number of cotton varieties with resistance against CLCrV have been identified.

Dr O. M. Royo (INTA EEA) discussed screening of cotton germplasm for resistance against blue disease in Argentina. The disease is assumed to be caused by a virus that is supposed to be transmitted by *Aphis gossypii*. Heavy infestations were reported in the 1993/94 season. Under natural infestation, Stoneville crosses tended to be susceptible to the disease whereas many INTA varieties were resistant. Some of the lines screened may not have not been exposed to uniform disease pressure and further screening is required.

Dr C.J. Kapoor (Rajasthan Agricultural University) discussed the role of early maturing and CLCuV-resistant varieties in India. An integrated disease management approach is being promoted including: cropping only with *Gossypium arboreum* or varieties and hybrids of *Gossypium hirsutum* that have resistance; early-season roguing of diseased plants; whitefly control. Resistance to CLCuV is polygenic.

Dr Jeanne-Phillipe Dequine reviewed aphid and whitefly management and commented on red cotton disease in Cameroon. The spread of this disease is associated with whitefly but the cause has not yet been explained. Changing the bio-ecological balance was suggested as a novel approach to control. This strategy involves giving priority to preventive measures combined with an ecological approach.

*Vascular wilts*

Dr Gao Yugian (?) described the progress of Fusarium wilt and Verticillium wilt in China. Fusarium wilt was first reported in 1931 and now occurs across 300 million ha of cotton production area. Race 8 of *Fusarium oxysporum* f.sp. *vasinfectum* (*Fov*) occurs in the north west and at Nanjing. Race 7 occurs in the yellow river region and in the south. Verticillium wilt was reported to cause average losses of 22% in China and each year an extra 2.7 million ha of cotton crops are affected. Breeding programs for resistance against both pathogens have been implemented. Varieties with resistance against strains of *Fov* in the United States had little value against strains in China. Some lines of *Gossypium arboreum* were resistant against Race 8 but not Race 7.

*Witch s broom*

Dr A.E. Arujo (Brazilian Agricultural Research Corporation) described the progress of witch s broom, caused by *Colletotrichum gossypii* var. *cephalosporioides* (***Cgc***), in Brazil. The symptoms of this disease were most severe 30 days after high rainfall accompanied by conditions with relative humidity above 90% and temperatures between 18 and 20 ...C.The pathogen causes necrosis on leaves and distorted growth (witch s broom). Yield losses can be as high as 80%, making *Cgc* one of the most important cotton pathogens in the Matto Grosso State.

*Disease surveys*

Dr Annette Swanepoel (ARC Institute for Industrial Crops) gave and account of disease surveys in cotton in Africa. Bacterial blight, Verticillium wilt and Fusarium wilt appear to be the most important diseases in the southern and eastern African cotton producing countries. South Africa and, to a lesser extent, Uganda were the only countries with data complete enough to estimate yield loss. Verticillium wilt was the most serious disease in South Africa, causing losses of up to 30% and affecting 40% of the cotton area, followed by bacterial blight and boll rot (both causing up to 20% losses) and false mildew (caused by *Ramularia areola*, with an incidence of 25% but little impact on yield). On average, the most important diseases in South Africa cause 18% yield loss. The lack of consistent and reliable survey data prevented comparative analysis of disease issues among different countries in Africa.

*Disease management*

Mr Greg Salmond (Queensland DPI) presented a summary of the extensive collaborative effort to stem the spread of Fusarium wilt in cotton in Australia and to

develop and deploy an integrated disease management strategy. In particular, the essential role of the Fusarium wilt Coordination Committee in facilitating this response was described.

Dr David Nehl presented a paper outlining the relative importance of cotton diseases in Australia and issues associated with development of integrated disease management practices (see abstract below).

*Disease resistance*

Dr O. N. Konan (Gembloux University of Agricultural Science) indicated that a trispecific hybrid of *Gossypium hirsutum* _ *G. longicalyx* _ *G. thurberi* (HLT) was a good candidate for introgression of resistance to reniform nematode (*Rotylenchulus reniformis*) into tetraploid cotton. Egg production by R. reniformis was reduced by 98% in the HLT hybrid.

Dr James McD. Stewart (University of Arkansas) discussed the potential for introgression of exotic germplasm into upland cotton. Hybrid material produced at the University of Arkansas is being screened for resistance against and against the hypervirulent strains of bacterial blight in Sudan, to which some were immune, and against cotton leaf curl virus in Pakistan. Sources of resistance against reniform nematode have also been obtained in this manner.

**Conclusions and recommendations**

Delegates described the impact of various pathogens that are not present in Australia, even though related strains may already be present (Table 1). These pathogens pose a risk to cotton in Australia and should be listed as quarantinable and included in the Biosecurity Plan for the Australian Cotton Industry.

**Table 1. Diseases of cotton, caused by pathogens or strains of pathogens not present in Australia, that were highlighted at the World Cotton Research Conference III.**

| Disease | Pathogen | Location | Potential severity |
|---|---|---|---|
| Root-knot nematode | *Meloidogyne incognita* | South Africa | High |
| Reniform nematode | *Rotylenchulus reniformis* | USA | High |
| Cotton leaf curl | Cotton leaf curl virus | Asia | High |
| Fusarium wilt | *Fusarium oxysporum* f.sp. *vasinfectum* race 7, 8 | China | High |
| Fusarium wilt | *Fusarium oxysporum* f.sp. *vasinfectum* | Sudan | High |
| Witch s broom | *Colletotrichum gossypii* var. *cephalosporioides* | Brazil | High |
| Root lesion nematode | Pratylenchus spp. | South Africa | Medium |
| Stubby root nematode | *Paratrichodorus* spp. | South Africa | Medium |
| Blue disease | ? (aphid transmitted) | South America | Medium |
| Red disease | ? (whitefly transmitted) | Cameroon | Medium |
| Cotton leaf crumple | Cotton leaf crumple virus | USA | Low |

Cotton leaf curl virus has potential to be very debilitating to cotton production in Australia if it occurs. However, the risk of introduction from Asia is probably less likely than the risk of movement into cotton from native Australian populations of gemini viruses. A risk assessment for this disease should be included in Biosecurity Plan.

Wild species of cotton are potential sources for genes for resistance and good progress has been made in creating resistant hybrid cottons, although their agronomic traits require improvement.

The value of comparable, regular disease surveys was highlighted. Disease surveys enable monitoring of disease progress, identification of disease outbreaks, and verification of disease status for export purposes. Ongoing disease surveys will be highly beneficial in Australia and should be encouraged in other cotton growing countries.

***Oral papers presented***

## Soilborne diseases of cotton in Australia: meeting the challenge

David B. Nehl

*NSW Agriculture, Australian Cotton Cooperative Research Centre, Narrabri Australia.*

The most important pathogens of cotton in Australia are soilborne. Black root rot, caused by *Thielaviopsis basicola*, is widespread and Fusarium wilt, caused by *Fusarium oxysporum* f.sp. *vasinfectum*, is becoming widespread. Effective host-resistance is not yet available for these pathogens and control strategies have relied upon exclusion and cultural methods. Fungicides are generally ineffective against either pathogen. Seed treatment with acibenzolar-S-methyl is proving to be an effective method for inducing a degree of systemic acquired resistance to both black root rot and Fusarium wilt. However, devising integrated strategies for the control of multiple pathogens is problematic. Biofumigation, using plants such as hairy vetch (*Vicia villosa*) and *Brassica* spp. as green-manure crops, reduced the severity of black root rot by up to 50% but increased the severity of Fusarium wilt. Rotation with cereals for more than a single year can reduce the severity of black root rot. In contrast, a single rotation with cereals can increase the severity of Fusarium wilt, even though cereals are not susceptible. A plethora of biological treatments are currently being marketed to farmers for disease control, on the assumption that they have ruined the health of their soil in some way. Yet cereals, grain legumes and canola grow very well in cotton fields infested with *T. basicola* or *F. oxysporum vasinfectum*, or other pathogens of cotton. It is, therefore, important to distinguish issues of plant health from soil health. In reality, the build-up of soilborne pathogens can be viewed as a sign that a healthy soil ecosystem is responding to the unnatural imposition of repetitive monocultures of cotton.

revised

# TRAVEL REPORT

## WORLD COTTON RESEARCH CONFERENCE — 3
## CAPETOWN, SOUTH AFRICA
## March 9 — 13, 2003.

**Bruce Pyke, Program Manager,**
**CRDC, Narrabri.**

**Geoff McIntyre, Principal Extension Officer,**
**Department of Primary Industries Qld, Dalby.**

**Greg Salmond, Senior Extension Officer,**
**Department of Primary Industries Qld, Dalby.**

**Mark Hickman, Industry Development Officer and IPM Training Coordinator**
**NSW Agriculture, Toowoomba.**

### Purpose of Travel

The purpose of the trip was to attend and participate in the World Cotton Research Conference 3 in South Africa as a member of the Australian delegation representing the Australian cotton industry and its RD&E programs and to:

- Enhance the development of extension services in cotton industry RD&E by building on and expanding the networks established at the World Cotton Research Conference 2 in Athens in 1998 and during other study trips to USA and during visits of international extension personnel to Australia;

- Present papers related to extension programs in the Australian cotton industry:

  - B.A.Pyke - *The performance of Bt transgenic (INGAR) cotton in Australia over six seasons;*
  - G.T.McIntyre, D.Gibb, A.J.Shaw, I.H.Christiansen and B.A.Pyke - *Extension in the Australian cotton industry - a team approach*;
  - G.T.McIntyre and P.J.Goyne - *Water use efficiency extension in the Queensland cotton and grains industries — an industry partnership*
  - B.Dalton, G.McIntyre, D.Gibb, M.Hickman and G.Kauter - *Australian Cotton Cooperative Research Centre IPM short courses — An industry learning together;*
  - G.R.Salmond and J.K.Kochman - *Disease management information within the Australian cotton industry — an ongoing research, extension and industry collaboration;*
  - D.Gibb, M.Hickman and I.McPherson — *Monitoring fruiting factors as a tool in insect management.*
  - M.Hickman, A.Storrie and T.Cook — *Yield impacts and extension activities with simulated herbicide drift on a commercial cotton field.*

### The Extension Perspective Report

Extension services were not featured in the first two World Cotton Research Conferences although several extension officers from a number of nations have participated in each conference primarily with a research perspective. Nevertheless, informal interactions and linkages were established.

At WCRC II in Athens in 1998, Geoff McIntyre and others initiated and coordinated a workshop session for extension officers with some 31 participants representing six nations. The main issues discussed related to the application and role of field trials and demonstrations in the regional adaptation and adoption of research and technology rather than the processes and methodologies of extension itself.

The main outcome of the workshop was a letter to the organising committee seeking the inclusion of extension in future conferences. Extension services have been included in the WCRC-3 program.

The other outcome was that a network of extension participants was established and there have been a number of contact visits amongst some extension officers since that conference.

Extension, albeit with very broad content, was included in the WCRC — 3program with nine papers including a keynote plenary session paper specifically related to extension — four presented by Australian delegates. In addition several other papers referred to extension with respect to the training, adoption and transfer of technology outcomes from the research program being reviewed.

The keynote paper was delivered by Dr Peter Ooi, the Chief Technical Adviser for the FAO-EU IPM Programme for Cotton in Asia, was entitled *Realities of educating resource poor farmers: experience in IPM implementation in Asia.* Peter s paper was very well presented and, whilst substantially academic, nevertheless provided a broad overview of the concepts of grower participation and experiential learning and its application in agricultural extension based on the Farmer Field School (FFS) approach of educating farmers used in Asia.

Similar themes and processes were addressed in papers presented by:

- K.R. Kranthi *et al* from India — *New vistas in IRM based cotton IPM in India*
- M.B.Sekamatte from Uganda - *Gaining Confidence in farmer-participatory integrated pest management in Uganda: NARO s experience in improving uptake of crop protection technologies for cotton*;
- A.J.Treen and H.Burgstaller from Egypt — *Cotton IPM: research success and field dissapointment — Why are implementation projects not succeeding?*;
- D.A.Russell *et al* from India — *Area-wide insecticide resistance management in Indian cotton.*

Two posters that described the role of demonstration trials in extension were:

- Elizabeth L.Masemola *et al* from South Africa — *Poverty relief and rural development: Promoting cotton as a stepping stone.*
- David Luseesa *et al — Advances in extension of Ugandan cotton management.*

Australian papers related to extension were:

- L.J.Wilson, R.K.Mensah and G.P.Fitt —*Implementing IPM in Australia;*
- S.A.Deutscher and M.P.Bange —*Advancements in computerised decision support for Australian cotton systems;*
- J.N.Stanley, G.W.Roth, D.Gibb and R.S.Jessop — *Schooling our cotton industry in Australia: Sharing the knowledge;*

The critical differences in extension between Australia and the programs in other countries reviewed in the papers include:

- The extraordinarily large numbers of cotton growers in those countries especially in India, Egypt and China;
- Smaller areas of production by each grower;
- Very low levels of knowledge, understanding and literacy of the growers;
- Relatively small numbers of extension officers to deliver programs in those countries.

However, the capacity and efficacy of participatory and experiential learning is well demonstrated but the application of the model varies. The farmer school approach requires more teaching and leading of large numbers of small growers by the extension officers compared with the facilitary approach with much smaller numbers in grower groups in which growers provide a much greater contribution to the provision of knowledge, experience and learning.

IPM and area wide management were key subject areas for the extension papers. Lewis Wilson s keynote paper presentation Implementing IPM in Australia provided a good review of the role of IPM and AWM groups and an excellent introduction to the Crop Protection and IPM Session 2. That session included our IPM Training short course paper, Robert Mensah s IPM paper and the Kranthi *et al* paper on IRMS based IPM in India. It resulted in an extensive discussion session related to IPM training for cotton growers under the chairmanship of Derek Russell who presented a paper on AWM in India later in the conference. The Australian IPM Short Course training program attracted significant interest.

Dr C.D.Mayee from India provided the conference highlights on Transfer Technology. This summary paper is not yet available.

Plans for a more formal workshop for extension officers at the conference were not realised because of the tight agenda to which all conference delegates were well committed. However, many informal and personal contacts were established throughout the conference providing for an enhancement of the extension network as follow up contact is established. A significant number of extension personnel particularly from USA were unable to attend the conference.

The list of extension personnel developed at the previous WCRC will be extended and will include the whole Australian extension team as we strive to maintain contact and share experience world wide at least electronically.

This conference and the development of an enhanced extension network provides a good base for further development of extension as a key subject area for future conferences.

# World Cotton Conference 3 - South Africa

Farming Systems report by Grant Roberts

There were no specific sections dedicated to farming systems research, however there were a range of topics that could be considered under this broad heading. These often were specific presentations presented under other headings such as nutrition, growth regulators and biochemistry, water stress and irrigation, crop protection management and monitoring and breeding.
Many of the speakers in these sections failed to show and present in the farming systems area which was a genuine disappointment. Often entire blocks of presentations were cancelled. As there were few specific farming systems topics covered I will make mention of general overviews.

There was a large difference between the views expressed and research conducted from the1st world countries compared to the 2nd and 3rd world countries. There were many examples of this and some of the differences were obvious and are understandable however many of the views and opinions were not. There was a definite distrust and resentment by the Europeans and 3rd world countries about biotechnology and the companies that owned the technology. As a result *Bt* and herbicide tolerance technology were often missing from their systems. Many of these countries were still conducting basic research on nutrition, varieties and simple IPM systems. Australia and to a lesser degree the USA, had evolved far greater complex systems with sophisticated research and extension programs. This was clearly highlighted with Australia leading the way in developing excellent IPM strategies involving insecticide resistant management, area wide management, intense scouting for both beneficial and damaging insects and support at a range of levels from computer decision support programs through to on farm consultants. No other country appeared to be close to this level of intense management. The same could be said for nutrition management with Australia and the USA leading the way in this research but more so in the delivery of the outcomes to growers. So from this point many of the speakers presented nitrogen experiments specific to a region of the country they were working in rather than concepts.
In the case of growth regulators some American work on the defoliation times of Pima was presented.
There were very few presentations that mentioned Bollgard II or Roundup Ready or Roundup Ready Flex. One poster presentation was on the new insecticidal protein VIP however these technologies and discussion of them were clearly missing from the conference which I found surprising.
Overall I found the gap between the western researchers and the others to be quite large with much of what we had to offer as a dissemination to them with little feed back to us. Although the concept of an overall arching world cotton conference is good as it allows everybody to put in perspective their areas of research.