Cotton Catchment Communities CRC

FINAL REPORT

Part 1 - Summary Details

Cotton CRC Project Number: **1.05.09**

Project Title: Behaviour modifying plant extracts for managing cotton pests: Coordinating the Establishment of Centre for Biopesticides and Semiochemicals in ACRI

Project Commencement Date: 1/7/2011 **Project Completion Date:** 30/6/2012

Cotton CRC Program: **The Farm**

Part 2 – Contact Details

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Part 3 – Final Report Guide (due at 31st May 2012)

Background

1. Outline the background to the project.

The global synthetic insecticide market was valued $26.7 billion in 2005 but declined by 1.1% to $25.3 billion in 2010 (AgroNews 2011). The development of transgenic crops, insecticide resistance, public awareness about environment, pollution and health hazards have seen a continual decline in synthetic insecticide use and production (AgroNews 2011).

In contrast demand for natural biopesticides and semiochemicals is growing steadily worldwide increasing from $672 million in 2005 to $1 billion in 2010 (AgroNews 2011). The use of these pesticides is increasing because they are environmentally friendly.

In Australian agro-ecosystems pest dynamics are changing, synthetic insecticides production are declining and there is evidence of increasing pest resistance or tolerance to transgenic plants. Thus, a total collapse of agricultural industries in Australia is possible if pest control alternatives such as biopesticides, semiochemicals etc are not produced and made available to farmers to manage pests. Subsequently, the development of biopesticides and semiochemicals to support integrated pest management (IPM) in cotton, grains, pulses and horticultural crops is crucial. But the development of biopesticides and semiochemicals *per se* will be ineffective unless these products are registered and available in Australia. Hence, the need to develop a commercialization platform to facilitate generation of toxicological and environmental data and to assist commercial partners in registation of these products .

The aim of the project is to seek and attract highly recognized scientists with achievements in production and commercialization of biopesticides and semiochemicals to develop a proposal for CRDC and other industry funding to establish a Centre for Biopesticides and Semiochemicals.

Objectives

2. List the project objectives and the extent to which these have been achieved.

The proposed Centre for Biopesticides and Semiochemicals (CBS) aims to

- Enhance development, funding, registration and commercialization of biopesticide and semiochemical products to sustain profitable agriculture in Australia
- Complement IPM in Australian agricultural crops to reduce reliance on synthetic pesticides
- Build on the existing research portfolio of its members through facilitating collaboration in research and development and with commercial partners to deliver rapid commercialization of biopesticide products
- Investigate new models to reduce development risks and associated costs and to increase the rate of successfulcommercialization of biopesticides and semiochemicals for the agricultural industries
- Enhance training and science capacity building in biopesticide and semiochemical research and development in Australia and the Asia-Pacific.

Methods

3. Detail the methodology and justify the methodology used. Include any discoveries in methods that may benefit other related research.

Dr Robert Mensah organized and facilitated a series of teleconferences and face meetings in the University of Western Sydney (Hawkesbury campus); School of Plant Science, Southern

Cross University in Lismore and at the Australian Cotton Research Institute (ACRI) in Narrabri to discuss and gain commitment of the various universities and senior researchers to be part of the Centre for Biopesticides and Semiochemicals. A series of meetings were held between Dr Robert Mensah and the CRDC Research Managers (Bruce Pyke and Tracey Leven); CRDC Executive Director (Mr Bruce Finney), CRDC IP consultant (Mr Dallas Gibb) and some of the Board members to enable them gain detail understanding of the proposed Centre's role, aim and the key activities of the proposed Centre.

The participants of the Centre agreed that the Centre will function as an integrated network of highly recognized scientists from research provider organizations and universities. The research provider organizations are (1) NSW Dept of Primary Industries; University of Western Sydney (UWS); Centre for Phytochemistry & Pharmacology – Southern Cross University (CPP-SCU); University of New England (UNE) and Cotton Research & Development Corporation (CRDC).

- NSWDPI, UWS, SCU, UNE and CRDC all contribute to a strong research team with recognized achievements in production and commercialization of biopesticides and semiochemicals.
- There is a history of strong collaboration of Centre's researchers with commercial partners: viz: Dr Robert Mensah (NSWDPI), Prof. Robert Spooner-Hart (UWS), Prof. Peter Gregg (UNE), Prof. David Leach and Dr Myrna Deseo, Mr Aaron Pollack and Prof. Graham King (SCU) to realize asset potential
- The Centre currently has existing bioactive agents for managing arthropod pests in cotton, grains, pulses and horticultural crops, with more in various stages of development

CBS infrastructure

- CPP-SCU has fully equipped laboratories at its Centre for Phytochemistry and Pharmacology (CPP) to characterise, screen and identify actives of natural products..
- NSWDPI has recently installed HPLC and GC/MS equipment at ACRI at a cost of $250,000 to be used for the development of bioactive natural products. The institute is located in regional NSW where broadacre crops such as canola, lucerne, chickpeas, sorghum, mungbeans, faba beans, soybeans etc are grown and can be used for experimental trials
- UWS has a specialised entomology bioassay laboratory and associated facilities for evaluating natural products, including Electroantennagram and EPG equipment., as well as a range of horticultural field trial plots
- UNE .has well equipped semio chemical laboratory for the development of long range attractants

Results.

The key activities of the Centre will be to

- Screen biopesticides, semiochemicals and synergists for their activity against key pests and beneficial species in cotton, grain/pulse and horticultural crops.
- Elucidate mode (s) of action, and for plant extracts to identify active components
- Undertake preliminary toxicological safety of identified chemical actives and fungal isolates and prepare provisional patents, where appropriate,
- establish mammalian and environmental toxicity profile for the chemical actives and fungal isolates,
- formulate chemical actives and extracts into a semiochemical product and fungal spores into biopesticide product and lodge a full patent application,

- undertake field assessment of the new semiochemical and biopesticide products for insecticidal and behaviour modifying activities against key pests and beneficial insects of cotton, grains and horticultural crops,
- seek commercial partners and undertake residual screening of phytochemicals and chronic toxicity in food crops,) prepare and submit a registration package to registration authorities, in collaboration with the commercial partners,
- train PhD and postdoctoral scientists in chemical ecology, phytochemistry, conservational biocontrol (entomopathogens) to build research capacity for the CBS stakeholders.

Outcomes

4. Describe how the project's outputs will contribute to the planned outcomes identified in the project application. Describe the planned outcomes achieved to date.

A proposal to establish the Centre for Biopesticides and Semiochemicals was submitted to the CRDC Board for funding in December 2011. The CRDC Board has given preliminary approval to the project. A meeting was held between the Centre participants and CRDC in Sydney (Cotton Australia) on 23 April 2012. The meeting agreed to prepare a Business plan for the centre and develop business cases for the projects to be undertaken in the centre for submission to the CRDC Board for consideration. This process is in progress.

5. Please describe any:-

a) technical advances achieved (eg commercially significant developments, patents applied for or granted licenses, etc.);

Not applicable

b) other information developed from research (eg discoveries in methodology, equipment design, etc.); and

Not applicable

c) required changes to the Intellectual Property register.

The CRC has no background IP in the Centre when it is established

Conclusion

6. Provide an assessment of the likely impact of the results and conclusions of the research project for the cotton industry. What are the take home messages?

The CBS will research and develop biopesticide and semiochemical products for pest management, and, in collaboration with industry partners, make these available to farmers . The development of biopesticide and semiochemical products will support the further development of IPM in cotton, grains, pulses and horticultural crops. The development of biopesticides and semiochemicals *per se* will be ineffective unless these products are registered and available in Australia. Hence, the CBS will develop a commercialization platform to facilitate generation of toxicological and environmental data and to assist

commercial partners in registration of these products in the cotton and other agricultural industries.

Extension Opportunities

7. Detail a plan for the activities or other steps that may be taken:

The products to be developed in the Centre will have commercial partners with immense experience in the commercialization of biopesticides and semiochemicals. The plan for the release of the products will be developed by the commercial partners in collaboration with extension teams from the respective industries co-investing in the project.

The researchers will also communicate the outcome of their research to industry through the myBMP.

Publications

8. A. Publications relevant to this project.

Peer reviewed articles / books

1. MENSAH, R. K. and MOORE, C. (2011). Exploitation of Semiochemicals for insect pest management with special emphasis on cotton: A Review. *Journal of Biological control* 25 (4), 253 - 264

Non-peered reviewed articles

Conference articles and Bulletins

1. MENSAH, R. K., WATTS, N., Young, A. and Pitt, A. (2012). Discovery, development and commercialization of a new behaviour modifying plant extract for managing Helicoverpa spp. and sucking pests on cotton and other crops, Proceedings of the Cotton Catchments and Communities Co-operative Research Centre Science Forum, 19 – 21 March 2012, Crossing Theatre, Narrabri, NSW; pp 145-147
2. MENSAH, R. K. and WATTS, N (2012). Development and Use of a natural plant extract (semiochemical) for the management of pests and beneficial insects on cotton cropping systems in Australia, Proceedings International Congress of Entomology, 19-25 August 2012, Daegu, South Korea, (in press).
3. MENSAH, R. K., YOUNG, A and WATTS, N. (2010). Use of a new Plant extract (Plant X) for the control of silverleaf whiteflies on cotton crops in Australia. Proceedings 15 Australian Cotton Conference 10-12 August 2010.
4. MENSAH, R. K., AUSTIN, L. and WATTS, N. (2008). Development of a New Semiochemical (Plant X extract) for the management of cotton pests. Proceedings of the 14th Australian Cotton Conference, Broadbeach, Gold Coast, Australia.

B. All other publications by project team during this period.

Grower Advisory Articles

1. MENSAH, R. K., WATTS, N and WATTS, K. (2010). Natural insecticide on the way: Commercialization of a new Plant extract in Australia. Merchandise Magazine , Nov/Dec edition, page 25.

2. Mensah, R. K. and Austin, L. (2008). Kicking cotton pests naturally. The Land Newspaper, 27 November 2008, page 5.
3. MENSAH, R. K. (2008). New environmentally-friendly solution to major cotton pests http://www.dpi.nsw.gov.au/aboutus/news/recent-news/agriculture-news-releases/cotton-pests-solution
4. Mensah, R. K. (2008). Development of Plant X: Formulation and Efficacy trials. Power point Presentation to Cortton CRC and Growth Agriculture Pty ltd, CRC Conference Room, 14 April 2008.
5. Mensah, R. K. and Pitt, A. (2008). X-factor may be biological breakthrough. Media Release Country Leader, Tamworth, 26 May 2008.
6. Mensah, R. K. and Pitt, A. (2008). Bio-control: new weapon in pest war. Media release Rural Weekly, Toowoomba, Qld, 23 May 2008.
7. MENSAH, R. K. (2007). Bio-warfare on sucking pests. Cotton Spotlight Spring 2007, page 21.

Final Reports

1. MENSAH, R. K. and Young, A. (2011). Behaviour modifying plant extracts for managing cotton pests. A Final report presented to the Cotton Catchment Communities CRC, Narrabri, January 2011; 192 pp.
2. May, Kylie and Mensah, R. K. (2008). IPM in Bollgard: Managing Creontiades dilutus and Helicoverpa spp. using plant extracts and crude cotton seed oil. Final Report submitted to the Cotton Catchment Communities CRC and Native Fire Actives Pty Ltd, 81pp.
3. Pollock, A., Leach, D. and Mensah, R. K. (2008). Extraction and LCMS Profiling of Plant X. Final Report submitted to the Cotton Catchment Communities CRC, 35pp.
4. Singleton, A., Rasikari, A.., Mensah, R. K. and Leach, D. (2007). Managing *Helicoverpa* spp. and sucking pests on cotton using semiochemicals, Final Report submitted to the Cotton Catchment Communities CRC, 45pp.

Part 4 – Final Report Executive Summary

In Australian agro-ecosystems pest dynamics are changing, synthetic insecticides production are declining and there is evidence of increasing pest resistance or tolerance to transgenic plants. Thus, a total collapse of agricultural industries in Australia is possible if pest control alternatives such as biopesticides, semiochemicals etc are not produced and made available to farmers to manage pests. Subsequently, the development of biopesticides and semiochemicals to support integrated pest management (IPM) in cotton, grains, pulses and horticultural crops is crucial. But the development of biopesticides and semiochemicals *per se* will be ineffective unless these products are registered and available in Australia. Hence, the need to develop a commercialization platform to facilitate generation of toxicological and environmental data and to assist commercial partners in registation of these products . The proposed Centre for Biopesticides and Semiochemicals (CBS) aims to fulfil both of these roles.

The Centre will function as an integrated network of highly recognized scientists from research provider organizations and universities. The research provider organizations are (1) NSW Dept of Primary Industries; University of Western Sydney (UWS); Centre for Phytochemistry & Pharmacology – Southern Cross University (CPP-SCU); University of New England (UNE); and Cotton Research & Development Corporation (CRDC).

Overall the CBS will research and develop biopesticide and semiochemical products for pest management, and, in collaboration with industry partners, make these available to farmers . The development of biopesticide and semiochemical products will support the further development of IPM in cotton, grains, pulses and horticultural crops. The development of biopesticides and semiochemicals *per se* will be ineffective unless these products are registered and available in Australia. Hence, the CBS will develop a commercialization platform to facilitate generation of toxicological and environmental data and to assist commercial partners in registration of these products in the cotton and other agricultural industries. These biological products will provide economic, environmental and social benefits to agricultural industries.