

Report Cover Sheet for Annual & Final Reports

The following Reporting Requirements MUST BE MET

All Projects

You must submit an **ANNUAL PROGRESS REPORT** by the first Friday in February 1999, detailing the progress of your research. NOTE: IF you are seeking continuation of funding for 2000–2001 for the project, this report will form the basis for CRDC's consideration of ongoing funding. Please complete the budgetary requirements if this is a continuing project.

Terminating Projects

A **FINAL REPORT** must be submitted within three months of completion of the project. This applies in **ALL** cases including research projects, travel, conference attendances, postgraduate, postdoctoral and funded capital items.

Tick Report Purpose

Annual Progress Report (Due 1st Fri Feb. to determine continuation of funding)

X

Final Report (Due 30 September or 3 months after completion of project)

Actual start date:

Anticipated completion date:

OFFICE USE ONLY:

Date of receipt:

Project title (as per original application)

Machinery Development – Cotton Industry

CRDC Project Code **USQ7C**

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Final Report

What was the background of the project?

Prior to the start of this project, there had been many calls for ongoing engineering resources to be provided to the cotton industry. These have been documented in the following publications or meetings:

- a) Equipping the Future Report
- b) Meeting notes CRDC Soils Forum 1994, 1995, 1996, 1997, 1998
- c) Australian Cotton Conference 1996, 1998

From these meetings and reviews, and from regular comments by industry personnel, farmers and other researchers, it is clear that ongoing engineering support is needed by an increasing number of CRDC funded projects. It is anticipated that the need will only increase and the resource will be well used and become wider in scope.

Requests during USQ7C and previous projects have been many and varied, ranging from simple information on available equipment, to more complex designs and configurations of tillage equipment, planter arrangements, farming system management advice, technological assistance, tillage control methods for over wintering heliothis pupae, controlled traffic, compaction issues, stubble handling in both cotton and rotation crops, legal opinion of equipment performance and general help in the field during different parts of the season. As a result of this level of interaction in all growing areas, extension of ongoing developments is assured, and provides a positive outlook for the future.

Commercialisation of developments during USQ7C and its predecessors have been successful, and many lessons have been learned. Contacts with a range of companies have been established and developed, ensuring that any new developments that result from this project flow quickly back to the farming community.

The main benefits to flow from this project were based on information generation and extension of ideas developed to the farming community. A main aim of this project was and is to give farmers a farm based resource to call on for help and to enable researchers to access a technical and practical knowledge base.

What were the project objectives and to what extent were these achieved?

The focus of this project included several aims. These included:

- a) To continue and develop work on residue handling in back to back cotton and rotation crops
- b) To help in the completion of evolving guidelines for the control of diapausing heliothis pupae in back to back cotton, cotton to fallow and in the direct drilling of rotation crops in standing stubble
- c) To extend ideas and concepts above into growing areas and leading grower operations to help industry adoption
- d) To offer and implement suggestions for mechanical improvements and new technological developments across the industry, including manufacturers and developers
- e) To ensure the guidance systems developed in previous projects are commercialised and fully released to the farming community
- f) To produce a MACHINE-pak that details existing and new techniques and equipment for the Australian cotton industry.

These goals and aims were flexible to allow for changes in focus as required by the industry. Below is a summary of progress against the aims listed above and project completion.

- a) Stubble handling equipment and techniques in the cotton industry will be a continuing development while ever the industry exists. Somewhat of a steady state has been reached in that there are a few clearly defined methods and equipment groups to achieve the end results required under different tillage regimes. These machines, techniques and end results were developed over the course of this project and are defined in MACHINE-pak. Various equipment that is capable of handling stubble for the direct drilling of rotation crops into standing stubble and for the direct drilling of cotton into standing winter cereal stubble is also detailed. The planting equipment is one area that still requires further work.
- b) The development of guidelines to assist growers in decisions regarding adequate levels of tillage to achieve maximum control of over-wintering heliothis pupae have progressed well. A document detailing current recommendations has been produced and approximately 2000 copies were distributed during the 1999 post harvest season. Extension of these ideas has continued during this time, with shed meetings, conferences and individual grower visits undertaken as often as required to spread the message throughout the industry. Coordination of information given to farmer groups on the Darling Downs has been achieved through interaction with Dave Murray and Julie Boddington. As much as possible, industry liaison personnel are used to increase the spread of the information throughout all growing areas.
- c) As mentioned in b) above, extension was a major part of this project and will continue to be a part of all subsequent work.
- d) As farmers request help in areas across the machinery range used in cotton, suggestions are made that can be implemented on farm, or are taken back to the manufacturer for inclusion. This has led to some excellent farmer initiated changes to currently manufactured equipment. Gessner industries have been especially helpful and keen in the uptake of new suggestions and requested changes. Case and John Deere have been helpful in providing equipment details required for the integration of new technology to their ranges. Good relationships have been fostered throughout the manufacturing community and communication is continuing. Excel Agriculture have also

requested and been given advice and direction for the development of their equipment line. Other new technology links have been formed with Trimble and Micro Trak America to speedily return the cotton yield monitoring system to the market. Other variable rate technologies will soon be released also.

- e) Guidance systems are now readily available in a variety of forms from different manufacturers. Due to the length of time taken to have the VGS System released through Case, there is now some market resistance to its adoption, but this year should see some adequate sales results. Case have had to be careful releasing an automated steering controller that fits to a major equipment line, but it now has their endorsement and needs to be supported by the industry. Agri-dry Rimik have also released the new furrow based Auto-Trak system that is suitable for fitting to new John Deere and Case equipment. It is a low cost, flexible guidance solution, and provides accurate positioning of the tractor in a furrow for all ground-based operations. It is advised that the industry supports this development as well as providing much needed feedback to the manufacturers. A cotton picker guidance system is also complete, and should be visible in reasonable numbers this coming season. Work has progressed well with the development of steering integration devices for a large range of tractors. Ag Systems and Trimble are advised regularly as to the best steering integration options for their controllers.
- f) MACHINE-pak has been completed and distributed throughout the industry. It is structured to include three chapters on the main rotation options and a series of appendices that detail equipment and techniques currently in use across the industry. Legal opinion from the USQ legal department and CRDC lawyers has been constructive and allowed the document to be modified to comply with Australian law.

Further, the project has achieved the following:

- a) Provision of engineering support to the wider industry and specific support to various CRDC funded projects including US30C with the development of the salinity test rig, DAQ85C Regional Heliothis Management, DNR1C Runoff Control, NEC3C Cotton Ginning Research, CSD InGard audit assessments, UNR machinery development, Monsanto's InGard management and others as requested.
- b) Monitoring of picker efficiency using the cotton yield monitor and visual observations.
- c) Development and transfer of steering system information to Ag Systems for inclusion and development of the Bee-Line GPS based guidance system. Interaction with Ag Systems has progressed well, and has allowed the information gathered during earlier CRDC funded guidance projects to be used for the benefit of the industry. Interaction has also begun with Trimble in the development of a new GPS guidance system.

Detailed results including statistical analysis of results?

The main benefits to flow from this project are more based on information generation and extension of ideas developed back to the farming community. A main aim of this project is to give farmers a farm-based resource to call on for help and researchers access to a technical and practical knowledge base.

An assessment of the likely impact of the results and conclusions of the Research project for the Cotton industry, and where possible a statement of the costs and potential benefits to the Australian Cotton Industry and future research needs?

The impacts on the industry as a result of this project are detailed below.

a) Farmers have had ready access to advice on machinery and its development during the course of the project and have been able to develop specific equipment for their requirements.

b) Two guidance systems have been commercialised for tractors, which have allowed the inclusion of higher accuracy in a variety of field operations. The CRDC receives a small royalty for each unit sold.

c) A cotton picker guidance system has been developed that will increase the volume of cotton harvested and increase the level of picker performance. Compaction caused by the picker is also controlled with this system.

d) MACHINE-pak has been completed and distributed throughout the industry.

e) Guidelines for the destruction of over wintering heliothis pupae have been developed, printed and widely distributed during the project. Adoption of the guidelines has been high and will continue to be encouraged as a major part of the heliothis resistance management strategy.

f) The integration of GPS steering systems to tractors has been encouraged through the development of a relationship with Ag Systems. This has included the gathering of information from manufacturers and hydraulic companies to provide the most up to date advice to customers and clients across all industries.

g) A volume sensor for measuring flow rates of seed cotton in chutes on mobile harvesters was developed, tested and commercialised. The CRDC receives a small royalty for each unit sold.

A description of the project technology (eg commercially significant developments, patents applied for or granted, licences, etc)

The project technologies developed during the course of this project are detailed below.

a) Steering slave controllers and tractor interfacing as described in the attached document. This technology has allowed us to then use alternative sensor inputs to control different equipment.

b) The Picker Tracker uses tactile feelers shown below to detect plant stems. Using sensors to detect a number of rows, this information is then used as an input into the steering controller system as described in a).

c) The Auto-Trak system uses an automatically controlled set of sleds to detect the side of the beds and to steer the tractor relative to the central position. A description of the system is also attached. The output from the sled located between the front wheels is then used as an input into the steering controller as described in a).

d) The Cotton Yield Monitor system developed was the first commercial unit to be released. The unit is patented and is manufactured by MicroTrak. It is for sale through different outlets both in Australia and the USA. For each unit sold, both the NCEA and CRDC receive a royalty payment.

e) MACHINE-pak has been fully developed, revised and printed during the course of this project. A full colour version is attached. The document was printed and widely distributed in black and white to an excellent reception.

f) The 1999 guidelines for over wintering Heliothis control were printed in colour and distributed throughout the industry by consultants, grower bodies and a large mail out. Again, the information was well received and allowed many new contacts and a higher level of compliance to be achieved. A copy of the guidelines is also included in this report.

Recommendations on the activities or the steps that may be taken to further develop, disseminate, or exploit the project technology

To encourage the adoption of project developments by the industry as a whole, it is advised that:

a) the engineering assistance position in the industry is funded on an ongoing basis to ensure farmer access to the resources developed during the last three years. This will also allow ongoing development in the areas undergoing technological advancement at the present time, including GPS application, yield monitoring solutions, and variable rate application technology.

b) MACHINE-pak development and expansion be continued to cover more machinery requirements in the industry.

c) the industry accepts, support and provide feedback on all guidance solutions provided to the industry.

d) pupae destruction guidelines be refined and checked yearly to ensure the publication and distribution of the information to the wider industry

A list of publications arising from the research project

Publications released during the project are listed below.

1. Schoenfisch, M. 1996. Machinery Development in the Cotton Industry. Australian Cotton Conference, Gold Coast.
2. Schoenfisch, M. 1999. Pupae Management Guidelines 1999. Cotton Insight.
3. Schoenfisch, M. 1999. Pupae Management Guidelines 1999. Rural Weekly.
4. Schoenfisch, M. 1999. Pupae Management Guidelines 1998, 1999.
5. Schoenfisch, M. 1999. MACHINE-pak: A machinery Manual for the Australian Cotton Industry.

Other articles were also published in the Cotton Insight paper, Australia Cotton Grower and periodicals. Other productions included a variety of handouts directed at field days and farmer visits.

Plain English Summary

Introduction

The aims and relevant achievements of this project are summarised below. The project was wide in scope and successful in industry interaction as farmers were provided with detailed and relevant information on machinery needs and current developments. Information was provided as possible, and if it didn't exist, was created and distributed to assist the industry in a number of areas. These included stubble handling equipment and techniques, planting and cultivation equipment, and pupae destruction guidelines. MACHINE-pak was developed to allow this information to be readily supplied back to the industry as a whole. There has always been a some flow of information between the extremities of the industry, and it was an important aim of this project to develop this and to spread new developments quickly through MACHINE-pak and personal visits. Technology developments continued and were enhanced. Guidance continued to be a focus, and as much interaction as possible was attempted with other companies including John Deere, Case, Agri-dry Rimik and Ag Systems. A centre of knowledge and technological development has been established at the USQ as a part of the NCEA, and has provided assistance on many levels to researchers, developers, commercial entities and the end user. The base level of the technology is continually being expanded to cover as many areas as possible, but is focussing on guidance and the development of guidelines for the interaction on intelligent steering control systems with physical tractor steering dynamics and the associated safety issues.

Summary of Aims and Achievements

The focus of this project included several aims. These included:

Aim a) To continue and develop work on residue handling in back to back cotton and rotation crops

Result a) Stubble handling and equipment in the cotton industry will be a continuing development while ever the industry exists. Somewhat of a steady state has been reached in that there are a few clearly defined methods and equipment groups to achieve the end results required under different tillage regimes. These machines, techniques and end results were developed over the course of this project and are defined in MACHINE-pak. Various equipment that is capable of handling stubble for the direct drilling of rotation crops into standing stubble and for the direct drilling of cotton into standing winter cereal stubble is also detailed. The planting equipment is one area that still requires further work.

Aim b) To help in the completion of evolving guidelines for the control of diapausing heliothis pupae in back to back cotton, cotton to fallow and in the direct drilling of rotation crops in standing stubble

Result b) The development of guidelines to assist growers in decisions regarding adequate levels of tillage to achieve maximum control of over-wintering heliothis pupae has progressed well. A document detailing current recommendations has been produced and approximately 2000 copies were distributed during the 1999 post harvest season. Extension of these ideas has continued during this time, with shed meetings, conferences and individual grower visits undertaken as often as required to spread the message throughout the industry. Coordination of information given to farmer groups on the Darling Downs has been achieved through interaction with Dave Murray and Julie Boddington. As much as possible, industry liaison personnel are used to increase the spread of the information throughout all growing areas.

Aim c) To extend ideas and concepts above into growing areas and leading growers operations to help industry adoption

Result c) As mentioned in b) above, extension was a major part of this project and will continue to be a part of all subsequent work.

Aim d) To offer and implement suggestions for mechanical improvements and new technological developments across the industry, including manufacturers and developers

Result d) As farmers request help in areas across the machinery range used in cotton, suggestions are made that can be implemented on farm, or are taken back to the manufacturer for inclusion. This has led to some excellent farmer initiated changes to currently manufactured equipment. Gessner industries have been especially helpful and keen in the uptake of new suggestions and requested changes. Case and John Deere have been helpful in providing equipment details required for the integration of new technology to their ranges. Good relationships have been fostered throughout the manufacturing community and communication is continuing. Excel Agriculture have also requested and been given advice and direction for the development of their equipment line. Other new technology links have been formed with Trimble and Micro Trak America to

speedily return the cotton yield monitoring system to the market. Other variable rate technologies will soon be released also.

Aim e) To ensure the guidance systems developed in previous projects are commercialised and fully released to the farming community

Result e) Guidance systems are now readily available in a variety of forms from different manufacturers. Due to the length of time taken to have the VGS System released through Case, there is now some market resistance to its adoption, but this year should see some adequate sales results. Case have had to be careful releasing an automated steering controller that fits to a major equipment line, but it now has their endorsement and needs to be supported by the industry. Agri-dry Rimik have also released the new furrow based Auto-Trak system that is suitable for fitting to new John Deere and Case equipment. It is a low cost, flexible guidance solution, and should provide accurate positioning of the tractor in a furrow for all ground-based operations. It is advised that the industry supports this development as well as providing much needed feedback to the manufacturers. A cotton picker guidance system is also complete, and should be visible in reasonable numbers this coming season. Work has progressed well with the development of steering integration devices for a large range of tractors. Ag Systems and Trimble are advised regularly as to the best steering integration options for their controllers.

Aim f) To produce a MACHINE-pak that details existing and new techniques and equipment for the Australian cotton industry.

Result f) MACHINE-pak has been completed and distributed throughout the industry. It is structured to include three chapters on the main rotation options and a series of appendices that detail equipment and techniques currently in use across the industry. Legal opinion from the USQ legal department and CRDC lawyers has been constructive and allowed the document to be modified so it complies with Australian law.

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