January, August & Final Reports

Part 1 - Summary Details **REPORTS**

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

CRDC Project Number: DAQ98

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

Project Title: Improving pesticide application performance.

Project Commencement Date: 01/07/99 **Project Completion Date:** 30/06/02

Research Program: Insect Management

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Signature of Research Provider Representative: David Hamilton

14/10/02

Part 3 – Final Report Format

The points below are to be used as a guideline when completing your final report.

1. Outline the background to the project.

Inefficient spray application continues to pose a problem area for both the cotton and grains industries. For cotton, **poor application** can:- mean poor efficacy against pests; increase the quantity and frequency of pesticide use (often leading to the use of the "heavier" less selective chemistry); and increase off target drift onto sensitive areas. **Poor application** resulting in off-target effects impacts on surrounding rural and urban communities and industries. Failure to reduce the off target impact will result in;

- damage to the "clean green " image of Australian Agriculture such as that caused by the recent rejection of beef by Korea,
- increased tension between the cotton industry and other primary producers and community members,
- further hamper the industry's attempt to maintain use of all available pesticides and,
- bring further adverse publicity to the industry.

Poor application still occurs because growers and operators lack an understanding of current spray application technology and / or are failing to apply this technology.
Improving application performance depends on growers and operators;

- understanding the environmental conditions that reduce spray application efficacy using "standard equipment",
- understanding the impact of sprayer set up on the efficiency and effectiveness of spray application,
- understanding why there is such a range in performance between users of similar equipment under similar conditions (or determine if the anecdotal range is real),
- having confidence that the application of BMP guidelines to minimise drift will maintain pesticide efficacy and,
- having the capacity to decide when conditions are not favourable for pesticide application. (ie understanding the limitations of the equipment under certain conditions) and implementing appropriate remedial action.

Considerable research information exists on the issues of pesticide application efficiency and off-target movement. This work which has been funded by statutory bodies and agribusiness is not readily accessible. The Best Management Practice manual provides a good framework for the analysis of pesticide related problems (Parkin 1999). Collation of existing research information, identification of definitive benchmarks and packaging it into an action learning format will assist growers and operators to benchmark existing practice, identify areas for improvement, allow access to learning activities and information products to implement improvement and achieve implementation of Best Management Practices for insecticide and herbicide application.

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

Improve efficacy of pesticides by increasing the amount of spray reaching the target by reducing the losses due to evaporation of spray before it reaches the target.
Reduce incidences of off target impact by reducing spray application under adverse environmental conditions.
Improve the pesticide application skills and knowledge of growers and operators.
Increase the number of and use of ground rigs that are properly set up.

Provide users and operators with information products detailing current research information. Examine and support information flows to aerial operators.

3. How has your research addressed the Corporations three outputs: Sustainability, profitability and international competitiveness, and/or people and community?

Sustainability

Improved application of pesticides by ground rigs is crucial for effective operation of industry priorities such as IPM, AWM, IWM and BMP. Ground application of pesticides, using techniques developed and applied in this project will reduce the amount of pesticides used and minimize the off-target impacts of those pesticide applications. A sustainable cotton industry is one that minimizes its reliance on chemical measures for the control of pests and that when utilising a chemical control measure, does so in a way that minimizes the amount being used and minimizes the off target effects.

Profitability and International Competitiveness

Efficient ground application of pesticides reduces the input costs of cotton production and hence improves profitability. In the Cotton Benchmark survey 2001 the most frequent response for using ground application was for "cost" reasons.

People and Community

This project equipped cotton industry personnel with skills acquired through the training provided via workshops and the CRC Cotton Production course and the intensive workshops for CRC Extension Team.

4. Detail the methodology and justify the methodology used.

The major method used in the project was "hands-on action learning" workshops. This extension methodology is well documented in extension literature as a very effective extension process. The focus in the first year of the project was to overcome the off target detections of endosulfan. The workshops had to change the thinking of the whole industry in relation to the droplet size being used for insecticide application. For years the push had been to use small droplets but overnight the industry had to embrace the concept of "medium" spray quality as determined by the NRA on the endosulfan label. This change was made at the start of the season leaving no time to validate the effectiveness of the label requirements on efficacy. Through the hands on workshops participants were able to determine for themselves how well the setup would work before they had applied any product.

The cotton benchmark survey 2001 identified workshops on spray application as on of the top three sources of information on spray setup.

Workshop on endosulfan setup and banding at Warren

Written sources also ranked in the top three in the sources used for changing sprayrig setup. The major focus for the project in this area was the rewrite for SPRAYpak and the "Spray Application Guide – Groundrig Operators".

The other "top three" source of information was the consultant group. Consultants were key participants at all workshops and in many cases were pivotal in the organisation of the workshops.

Current spray technology was field tested in setup-efficiency trials carried out in collaboration with other researchers and projects. Theses trials characterised the performance of a range of products with different sprayer setups.

Extension Team Workshop 1999

5. Detail results including the statistical analysis of results.

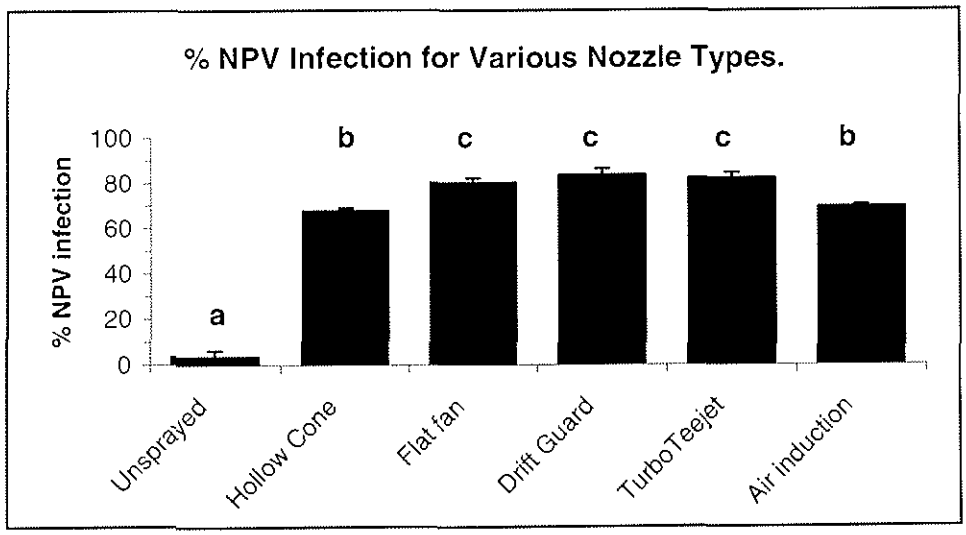
Two examples of the trials conducted are included:

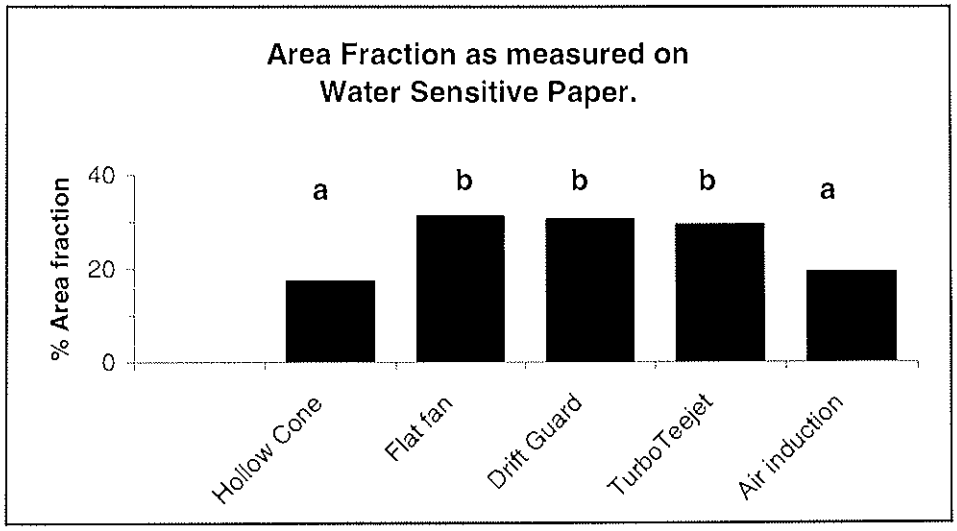
Trial 1 Percentage NPV infection of larval collections 4 DAT with Gemstar at 375 mL/ha using different nozzle types and their corresponding droplet densities and area fraction.

Treatment	% NPV Infection	Droplet Density (droplets/cm^2)	Area Fraction (%)
Unsprayed	3.5 ± 2.9 a	Na	Na
Hollow cone Spraying Systems TXVK4 @ 4 bar and approx 4km/hr. (Approx rate 100 L/ha) *Spray Quality : FINE	67.8 ± 1.3 b	176.6 d	17.3 a
110 Flat Fan Teejet XR 110^0 015 @ 4 bar & approx 8 km/hr. (Approx rate 105 L/ha) *Spray Quality : FINE	80.4 ± 2.0 c	127.0 c	31.2 b
110 Drift Guard Teejet DG 110^0 015 @ 4 bar & approx 8 km/hr. (Approx rate 105 L/ha) *Spray Quality : MEDIUM	83.9 ± 2.8 c	81.9 b	30.6 b
110 Anvil Turbo Teejet 110^0 015 @ 4 bar & approx 8 km/hr. (Approx rate 105 L/ha) *Spray Quality : MEDIUM	82.4 ± 2.5 c	100.0 b	29.3 b
Air Induction Albuz TurboDrop 110^0 015 @ 4 bar & approx 8 km/hr. (Approx rate 105 L/ha) *Spray Quality: COARSE	69.5 ± 1.0 b	25.9 a	19.2 a
	$F_{(5,15)}$ 209.8 $LSD_{(0.05)}$ 6.4	$F_{(4,12)}$ 94.18 $LSD_{(0.05)}$ 21.1	$F_{(4,12)}$ 149.11 $LSD_{(0.05)}$ 3.1

Means in a column followed by the same letter are not significantly different (P>0.05)

* according to manufacturers guidelines



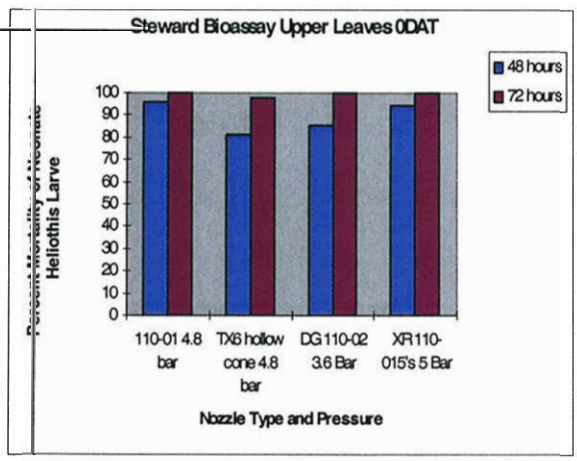


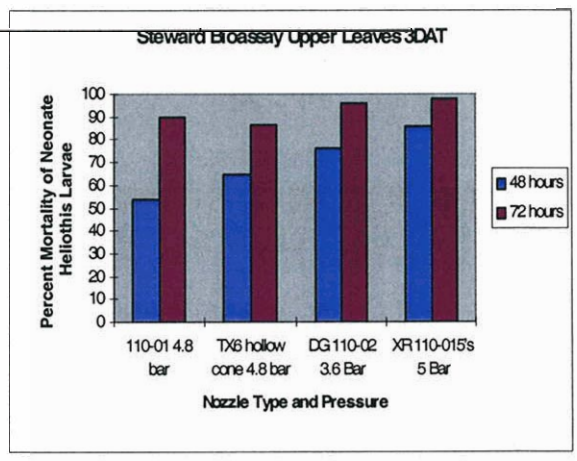
Trial Implications

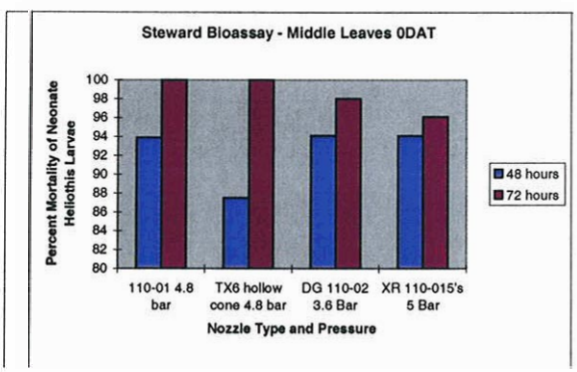
- Fan type nozzles used in this trial provided significantly higher levels of infection than a hollow cone nozzle applied at the same application rates and volumes (80% to 84% infection for fans verses 68% for the cone).
- No significant differences in the level of infection were seen between any of the fan type nozzles used in this trial (fine and previously medium spectrums).
- With Gemstar® the percentage of the target covered with spray appeared to effect efficacy (infection) more than the number of droplets per square centimetre.

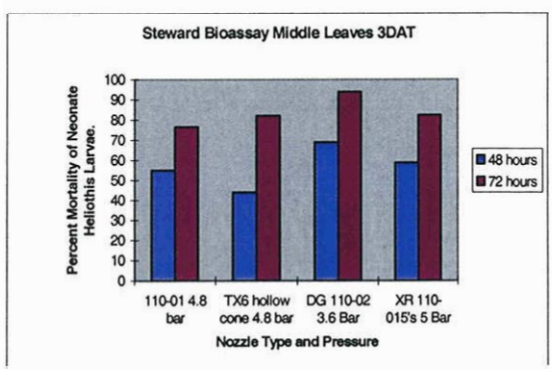
Trial 5 Application parameters for Steward® conducted in conjunction with B. Gordon (DPI/NHT funding)

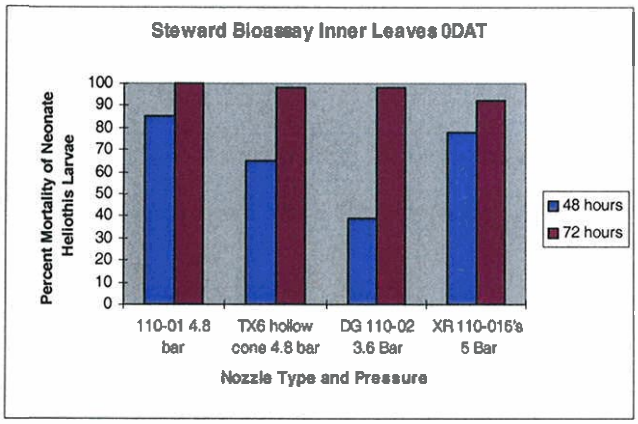
Treatment Number	Nozzle Type	Pressure (Bar)	BCPC spray classification	Travelling Speed Kph	Output (L/ha)
1	Hardi 110-01 Flat Fan	4.8	Very Fine	15.0	100 L/ha
2	TX6 Hollow Cone	4.8	Fine / very fine	15.0	100 L/ha
3	Teejet DG 110-02 Drift Guard Flat Fan	3.6	Medium	22.0	100 L/ha
4	Teejet XR 80°-015's Flat Fan	5.0	Fine	22.0	100 L/ha

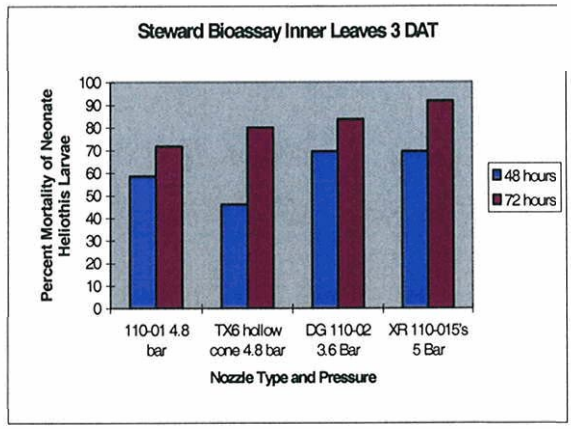












Trial Implications

•Field mortalities were not significantly different with different nozzle setups.

••Bioassay results indicated no significant differences in mortality after 72 hours on leaves collected immediately after spraying, however higher levels of mortality were observed within the first 48 hours on leaves sprayed with a fine droplet spectrum as compared with a medium droplet spectrum.

••Bioassays conducted on leaves collected 3 days after spraying showed higher levels of mortality on leaves sprayed with a medium droplet spectrum than those sprayed with a fine or very fine droplet spectrum.

6. Discuss the results, and include an analysis of research outcomes compared with objectives.

Provide users and operators with information products detailing current research information.

Improve efficacy of pesticides by increasing the amount of spray reaching the target by reducing the losses due to evaporation of spray before it reaches the target.
Reduce incidences of off target impact by reducing spray application under adverse environmental conditions.

The project had a significant effect on minimizing the off target movement of pesticides.

- Since the start of the project there has only been 8 samples with endosulfan concentrations above the export tolerance for beef (down from 229 in 1998/99) (National Residue Survey 1995-2002)
- In addition the incidence of samples with reportable endosulfan residues has dropped from 21% in 1998/9 to 1-2% for the last three years.

Improve efficacy of pesticides by increasing the amount of spray reaching the target by reducing the losses due to evaporation of spray before it reaches the target.

The project confirmed the continued superior performance of flat fan nozzles (in relation to newer ingestion active insecticides). These nozzles help to overcome some of the off target losses associated with drift and evaporation compared to hollow cone nozzles.

- Use of flat fan nozzles for insecticide application is becoming the norm. More than 85% of ground applications are carried out using flat fan nozzles. (Cotton benchmark Survey 2001)

- Sales of hollow cone nozzles have decreased with an increase of flat fan types featured during the workshops including drift reducing types (as proscribed on the endosulfan label), conventional flat fan s and twin jet types.
- Flat fan nozzles continue to outperform Hollow cone nozzles
- Medium spray quality produces equivalent control to fine quality
- Trends suggest that medium quality may be giving greater residual whilst fine quality results in higher initial knockdown.
- Traditional methods of coverage measurement such as number of droplets per square centimetre may be less important then the area of the leaf covered by droplets.

Improve efficacy of pesticides by increasing the amount of spray reaching the target by reducing the losses due to evaporation of spray before it reaches the target.
Provide users and operators with information products detailing current research information.

The issue of weather conditions and spraying was a focus at most workshops. Growers and applicators are more aware of the issues and monitoring conditions as part of all spray operations.

- Records are kept for 100% of spray applications. With 75% of respondents using the SprayLog. (Cotton benchmark Survey 2001)
- More than 4000 copies of the SprayLog record book have been distributed in the last three years.

Improve the pesticide application skills and knowledge of growers and operators.
Provide users and operators with information products detailing current research information.
More than 2000 cotton industry personnel (including growers, spray operators, consultants and spray contractors) participated in spray application workshops conducted throughout all cotton growing areas. The workshops were organised at a local level and dealt with a range of topics including setup for endosulfan; nozzle selection and setup; drift management; weather conditions and spray targeting.

Most CRC Extension Team members attended one of the 2-3 day spray application workshops to build there skills in this area and to allow them to deal with some spray issues in their own local areas. The Extension Team is a primary contact source at the local district level and a number of IDO's subsequently conducted their spray application workshops.

Workshop effectiveness was evaluated using exit surveys. The evaluation of the workshops indicated that most people were very satisified with the workshops and how they were conducted. The following points were compiled from the evaluation of the three one day workshops conducted in the Warren district and are indicative of the general responses received.

What did you like about the workshop?

Informal and informative x 10
Nozzle types, selection, pro's and con's discussed x 5
Small group size x 4
Relaxed atmosphere, allowing everybody some input/good communication both ways x 3

Seeing different nozzle setups x 3
Broad range of subjects/covered all topics well x 2
Very useful info from a bloke that knows, useful practical info
Well presented
Good audience participation
Interesting inter- discussion
Able to discuss whatever we liked
Grass roots level
Demo with sprayers on water sensitive paper
Options for conditions
Good review of water rates and drift management
Well informed on all issues
Efficacy work interesting

What suggestions do you have for improvement in the future?

No Rain x 2
Shorter
Keep the up to date trial work maybe in the handout notes x 2
Follow with night check with fluoro dye
Continue running these workshops with updates on new technology
Trial data on twinjet 015
Don't invite Tucky
Too many field days happening (3 this week), suggested amalgamation

What other information or exercise would you like to have see/undertaken in this workshop?

Night show with UV dye in small groups x 2
More broadacre advice for ground rig not just cotton
Spray rig set-up (Accepting that this was unable to happen due to weather conditions)
Manual more related to workshop topics- helps in note taking
More information, from maybe different contractors on different spray application and nozzle setups for band spraying etc
Have a look at patterns for different nozzles

Increase the number of and use of ground rigs that are properly set up.

The use of ground application to apply insecticides to cotton is increasing rapidly. One major supplier of self propelled sprayers has delivered more than 75 new machines to cotton areas over the last three years. This equates to an increase in capacity of 30,000 ha of spraying per day using conservative calculations. There are more than ten brand names of sprayers found in cotton production.

7. **Provide an assessment of the likely impact of the results and conclusions of the research project for the cotton industry. Where possible include a statement of the costs and potential benefits to the Australian cotton industry and future research needs.**

This project has helped the cotton industry retain endosulfan and as result forestalled further restrictions on other products used by the industry. The reduction in the incidences of off-target impacts of pesticides has improved the standing of the industry within the community.

The training provided to the industry personnel will help to minimise future because they have the skills to slove their own problems.

8. **Describe the project technology (eg. commercially significant developments, patents applied for or granted licenses etc).**

NA

9. **Provide a technical summary of any other information developed as part of the research project. Include discoveries in methodology, equipment design, etc.**

NA

10. **Detail a plan for the activities or other steps that may be taken;**

(a) to further develop or to exploit the project technology.

The publication SPRAYpak will be a continuing resource for the industry.

(b) for the future presentation and dissemination of the project outcomes.

Most outcomes of the project reside in the public domain and as such are available for future dessimination

11. **List the publications arising from the research project.**

Spray Application Guide – Groundrig Operators

Spray record keeping book :"SprayLog"

SPRAYpak Cotton Growers' Spray Application Handbook 2nd Edition

"Spray Rig Performance in Targeting Pests under Dense Canopies" in Narrow Row Cotton Conference Griffith.

"Spraying Agricultural Chemicals" - in Australian Dryland Cotton Production Guide

"Pesticide Application Guidelines" Workshop Proceedings

12. **Are changes to the Intellectual Property register required?**

NO

Part 4 – Final Report Plain English Summary

More than 2000 cotton industry personnel (including growers, spray operators, consultants and spray contractors) participated in spray application workshops conducted throughout all cotton growing areas. The workshops were organised at a local level and dealt with a range of topics including setup for endosulfan; nozzle selection and setup; drift management; weather conditions and spray targeting.

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Key indicators of the success of the project include:

The workshops dealing with setup for endosulfan had to change the thinking of the whole industry in relation to the droplet size being used for insecticide application. For years the push had been to use small droplets but overnight the industry had to embrace the concept of "medium" spray quality.

- Since the start of the project there has only been 8 samples with endosulfan concentrations above the export tolerance for beef (down from 229 in 1998/99) (National Residue Survey 1995-2002)
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- More than 6000 copies of the SprayLog record book have been distributed in the last three years.