ENTERED 25/07/02

January, August & Final Reports

Part 1 - Summary Details **REPORTS**

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

CRDC Project Number: CRDC 133C

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

Project Title: The development of guidelines for ground based spray equipment and the testing of suggested improvements for the Australian cotton industry.

Project Commencement Date: 01/07/00 **Project Completion Date:** 30/06/01

Research Program: ~~Farming Systems Agronomy~~ E

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Part 3 – Final Report

1. Outline the background to the project.

Increasing pressure from industry and environmental sectors has begun to force the Australian cotton industry to rethink its approach to chemical application. This has led to an increase in ground-based applicators this current year to a record number. While this is a positive step, it in effect deregulates the industry, moving from a highly accurate controlled rate applicative technique by a small number of highly trained operators to a large number of relatively unskilled applicators. As a result the application of a given chemical in a field and growing area may vary widely with little or no control.

Ground based application of insecticides does allow for banding of costly or limited products, timely application when conditions are more conducive to maximum efficacy, and for optimum target efficiencies. New spraying units offer wide booms, high load capacity, high clearance, air assist nozzles, four wheel drive and speed that combined are able to compete with aerial based application.

However there are still some limitations. These include target efficiencies as low as 50%, variability in rate application compared to aerially applied mixtures, lack of understanding of conditional effects, drift management and shield technologies most suited to row crop application and target maximisation and more.

Most new insecticide technology relies on ingestion of the product for control. As a result the product must reach protected feeding zones and parts of the plants inaccessible by low rate aerial application or existing ground application technology and limited by ever increasing speeds. Work is required to examine the effects of varied set up parameters, speed, end of row issues and to develop solutions that may enhance the operation, such as minimum energy input systems that will allow excellent targeting of all plant components in all conditions in a repeatable fashion. This may include wind shields/deflectors, plant encapsulation techniques, air assist technology and optimum jet selection. This is to join with the detailed work of the QDPI (Bill Gordon, Peter Hughes) and CPAS (Gary Dorr, Nicholas Woods) to the field application methods currently used and the beginning of guideline development for large ground based application rigs. The effect on evenness of application versus aerially applied products and the influence of adjuvants (CPAS, QDPI) on increased efficacy, economy of application and drift reduction also needs investigation. This in combination with end of row considerations and field conditions will give users some assistance to maximise the efficiency and life of their machines.

As an industry, we need to be ready for the possible elimination of aerial application technology and to pre-empt the need for greater applicative efficiency from the ground. Increasing target efficiency also has the potential to lengthen the life of existing chemicals currently in use.

This project will survey existing farmers who use ground based application rigs, the development of an extension support package for their use, training tools, and develop performance measurement techniques that will allow operators to quantify and qualify performance.

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

Introduction

This project was designed to consider the issues involved in the spraying task and aimed to coordinate efforts with other researchers to achieve the following:

1. Benchmarking of current operational parameters of ground based spray application equipment and techniques. This included the recognition of grower questions and concerns regarding their current practice.
2. Summarising the results from the survey and define the areas of concern that can be readily addressed. These may include but are not limited to the effect of speed on application, use of shields, end of row problems, and nozzle configuration (angle of incidence, number, position). This will be done in the wind tunnel (if practical) and the field.
3. Develop documentation of project outcomes and report back to the industry. This will include testing protocols, a listing of datum settings for ground based application rigs and recommendations of changes with increasing bush size.

BenchMarking and Survey Results

Survey Results

NB: Machines and characteristics observed are attached later in the report.

The survey sought to determine the characteristics of the equipment a farmer has, including make, model, boom width and type, speed of operation and configuration during seasonal plant variations. It determined the nozzle configurations used, banding techniques, dropper use, and attitudes to air assist technology. It also gave the owner an opportunity to express thoughts and perceptions of work and improvements needed.

The results obtained are summarised below. The survey has targeted a variety of owners in irrigated and dry land applications and has considered both owner operators and contractors. Major spray equipment brands have been covered including Willmar, Spray Coupe, John Deere, Nitro and Hardi. Within these groupings are a number of different boom types including wind sheer, air assist and standard hydraulic equipment.

Boom Types

Most booms are either 18 or 24m in width and use a variety of suspension and stabilisation systems to maintain stable boom height. A larger proportion of booms are rear mounted with the exception being the Nitro style equipment. Rear mounted booms cause difficulty in visual monitoring of spray nozzle operation, and struggled to adequately light the extremities during darkness. Some benefits of the front mounting included high visibility of nozzle performance, easy lighting with forward directivity of beams assisting navigation through fields, and boom height control.

A few systems were linkage mounted on the tractor, but the major proportion were dedicated spray units.

Speeds of operation ranged from 18-30kph, the higher speed the dominant territory of contractors and larger operators. Lower speeds were used by owners wishing to achieve a precise application or in rougher country.

Nozzle configurations varied as follows.
Stage 1 (small plants to 40% band)
Two (or a maximum of three) nozzles directed over the row to cover the complete plant.
Some operators use droppers to improve performance even at this stage in an attempt to keep boom as high as possible for damage limitation and to get the nozzles close to the small plant for banding efficiency and drift/wind control.

Stage 2 (medium plants to 60-75%% band)
Three nozzles directed from the top and sides of the plants to give complete coverage into all feeding zones. Some begin to increase pressure and nozzle capacity to improve volumes into the plants. A single dropper either side of the plant is usually employed at this stage.

Stage 3 (large canopy plants to 100% coverage)
Generally by this stage five nozzles are in operation to cover the complete plant. These are located over and down the side of the plant to maximise directivity into the canopy. Droppers around the plant give the opportunity to direct product up into the plants from the side and to target feeding extremities over the complete plant. Pressure and volumes are at a maximum by this stage.

In all cases, conditions dictate the application efficiency. All surveyed owners had no difficulty in the calculations of volumes, pressures and generic set up parameters, but struggled to know the most beneficial nozzles for different situations. Many chose the nozzles that happened to be supplied with the machine or those that were the cheapest. Some were more concerned with drift and used larger droplet sizes, lower pressures or low drift nozzles to minimise drift. Most operators and owners were aware of the importance of nozzles and aware of the choice required to maximise efficiencies at different growth stages. Contractors were more aware of issues associated with nozzle wear and droplet spectrum, whereas farmers were more focussed on efficacy and measured effect on inter-spray time periods.
Those operators using air assist technology had different configurations, but generally used the same bands and varied the air width and nozzle number to suit.

Other Issues

Electrostatic technology is in its infancy and performance characteristics are still really being defined. Other than direct contact with the manufacturer, one user on the Darling Downs feels that it works better than standard booms, especially in windy conditions, but really has no quantitative data to support the view. He is very

specific about the operational parameters of the machine to ensure effective operation, but due to the weight and complexity of the boom is concerned with maintaining the best even boom height.
There is one ongoing debate with regard to the electrostatic technology: there is no direct contact with the ground to provide a reference voltage level to force the oppositely charged spray droplets to be attracted to the plant. This technology is still to be proven and requires significant testing in the field.

Boom height and stabilisation concerns.
If the boom can be actively controlled in a variety of conditions, it is then possible to decrease the boom height to optimum levels. Lower boom height increases the potential for damage and it is therefore necessary it have either active sensors or boom end protection measures in place. This would be of great assistance to contour farmers and during night operation.
There are some boom height control systems on the market, but they are a copy of older header height control systems and unproven at speed.

Penetration into canopy.
Consistent questioning targeted the methods different operators used to ensure canopy penetration. In the case of air-assisted technology, increased air volumes and the angling of the air stream depending on the direction of travel achieved this. Those that could varied the direction of the air stream against the dominant or resultant flow. This was observed to increase canopy penetration and efficacy.
Those using standard hydraulic booms ceased operating under heavier wind conditions as would be expected, but few gave little importance as to the effect of wind direction or speed on the application efficiency.
Standard hydraulic booms used more nozzles and droppers to get the canopy coverage required during later growth stages.

Shields vs air assist
Following on from the questions regarding canopy penetration, questions were asked to gauge interest levels in air assist technology or the use of cheap shields to direct air down into the canopy.
Everyone that uses a standard hydraulic boom was very interested in the attachment of simple cheap device to improve effectiveness, but those that use lighter booms were concerned that the extra drag and higher speeds would affect the boom.
Most felt that air assist technology was over priced for what was delivered and felt that it was the domain of those that had the funds to spare. Those that have air technology feel that it is vital and would never be without it. Most of those that have air technology previously or still do have hydraulic booms. No owners of standard booms felt that the addition of fans (electric or hydraulic) were an option purely for weight and functionality reasons. Most felt that their machines were already underpowered and that the addition of weight or drag would adversely affect performance.

The use of shields in the industry is limited. Some pictures of shields and the effects achieved are attached to this document.

Tests and Developments Undertaken to Further Survey Points

Of all the issues raised, it was apparent that most interest was focussed on the potential for small shields to increase the effectiveness of a particular spray unit. Most survey participants thought that the commercially available air assist units were advantageous, but cost prohibitive. All other concerns were being addressed particularly well by industry suppost officers and commercial entities.

To further this opportunity and areas of interest raised in the survey and field visits, it was clear that there was a need to investigate the effects small shields had on the operation of booms and nozzles in the field. To this end, existing shield usage was documented, and a variety of alternatives that could be readily attached to existing booms were tried.

Shield designs tested included direct angle, aerodynamic ducting, and simple 45/90 degree PVC pipe bends.

To a large degree, anything that effectively redirected air downwards into the canopy has to advantage the target efficiency of droplets. However, there are a lot of confusing interactions with edge effects, eddy currents from boom structures, and an extreme performance limitation based on the low forward speeds in use.

More details will be given shortly, but the best possible advantage will be gained by a consistent boom-wide application of a 90 degree aerofoil of the most forward section of the structure, similar to a formula one racing wing. This will provide maximum consistent downforce across the complete width of the boom, limiting edge effects to those similar to aerial applicators. While this may not be completely practical in its application to existing booms because of the large drag increase, it should be considered in the purchase of new booms.

This will be the most effective way to take all possible air velocity generated by forward motion and to direct it downward into the crop canopy. The exact dimensions will be a function of each machine.

Controller issues including flexibility, rate control, guidance etc

While most operators were extremely pleased with the development and addition of controllers to spray equipment during the last five years, there are still some outstanding issues. These include compatibility between models and makes, inclusion of all required features, ease of use, adjustability and flexibility, and the inclusion of new guidance technology. One company really trying to do this is John Deere with the inclusion and imminent release of the Starfire system. Most see that these issues will be dealt with in time, and are happy to consider how they can best work within the parameters of existing equipment.

Larger machine issues

The larger and wider machines have had to cope with a variety of extra issues. For example, the track width of the John Deere equipment does not suit standard one-metre rows without significant additions to the adjustable track width. This also complicates the use of controlled traffic systems, as the wheel tracks are either two or four metres apart.

In wetter conditions, machines struggle with weight and compaction issues. Often a reduction in water volume carried is required to navigate the fields. Some John

Deere machines have been modified to a four-metre wheel track to fit into controlled traffic systems.
The wider the boom, the more impact variable guess rows have on the effective operation of banding techniques. If there is too much variability, coverage on consecutive sets of eight is compromised and areas often missed.
A general comment was a lack of power to cope with heavy loads in softer conditions as well as normal machine operating conditions.

Emerging Trends and Areas of Focus

Most farmers are happy with existing nozzle technology, and are only seeking assistance in the best nozzles to choose in certain conditions. Out of the multitude of available nozzles, there must be a sub set of those most suited to application of specific chemicals in cotton. Several growers requested a short list of the best nozzles as could be compiled by Peter Hughes.

Boom height control was a lesser issue, but still needs further investigation into those types of equipment available. Some systems such as those from KEE are available, but the best protection still remains a wheel or skid on the extremities.

Shield technology sparked the greatest level of interest, especially in the concept that small low cost additions to the boom could greatly increase performance in certain if not all conditions. This is the area of major work and shields have been built and tried to see what effect they have on droplet movement.

Controller design and development has caused some concern, but will be a secondary area of interest.

Some other issues of how the different equipment fits into cropping systems is being considered, but will be an area of information gathering and advice rather than development.

The basic survey outcome showed that most users are happy with existing equipment, but see it as a jigsaw – they have all the parts but sometimes it is hard to put them together in the right sequence.

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

The project sought and is seeking to improve the application and target efficiency of insecticides to reduce the off target effects and losses. This will increase the effectiveness and lower the use of environmentally unfriendly products.
Lowering the use and improving the efficiency of product will increase profitability through cost reduction and higher yields. This in turn increases the competitiveness of farmers that adopt the improvements and recommendations resulting from the research.

The community as a whole wants to see the reduction of chemical usage across the industry, and this research offers the potential for great gains in this area. Particularly, reduction of drift and the effects that result offer significant benefits to the community and those that live close to farming operations.

4. Detail the methodology and justify the methodology used.

To achieve the aims and objectives of the project in the time available, most of the project time was focussed on determining the needs of the spray application industry, and then on finding solutions to the identified needs. To achieve this end, the following steps were taken.

a) Several pre-project meetings were held to analyse of issues and project content determination. This allowed the project to begin on the right footing.
b) Peter Hughes (QDPI), Gary Door, Nicholas Woods, and the CRDC were contacted regarding issues and background to ensure no duplication of effort and to coordinate possible collaboration. Meetings were held regularly with Peter Hughes to keep a user focus. This was especially useful in the early testing of some shield designs to ensure directivity.
c) Surveys of equipment owners on the Darling Downs and surrounding areas were done to define current equipment set up parameters in use. This survey included details on current settings used, and gave the user an opportunity to raise issues and concerns regarding the operation and function of his equipment. It was necessary to follow this process as far as possible to find out as much detail as possible.
d) Coordination with Peter Hughes (DPI) and Nicholas Woods (CPAS) was employed to :
- Analyse the current use of deflector shield technology in Australia and around the world and consider possible test regimes in the wind tunnel and field. Fields in Australia and overseas were visited to maximise the exposure to new equipment designs. Manufacturers were also targeted to finf out where new developments were headed.
- Observe and assist in tests undertaken by Peter Hughes and provide assistance and integration as required.
- Determine any small additional tests to try alternative nozzle position changes, deflector shields etc.

e) The Groundrig Operators Association was approached for assistance, coordination and support. This ensured as little duplication as possible.
f) Testing new developments began, but the season had progressed to far to complete all tests. As much as possible was done on small test sites using natural and artificial wind sources.
g) Develop any results into a suitable form and extend to the industry through industry development officers and field personnel. Review findings and prepare any reports required to outline further research that may be needed.

This system and process was chosen to maintain strong grower inputs and to keep the focus on the developmentr of the most suitable equipment and guidelines.

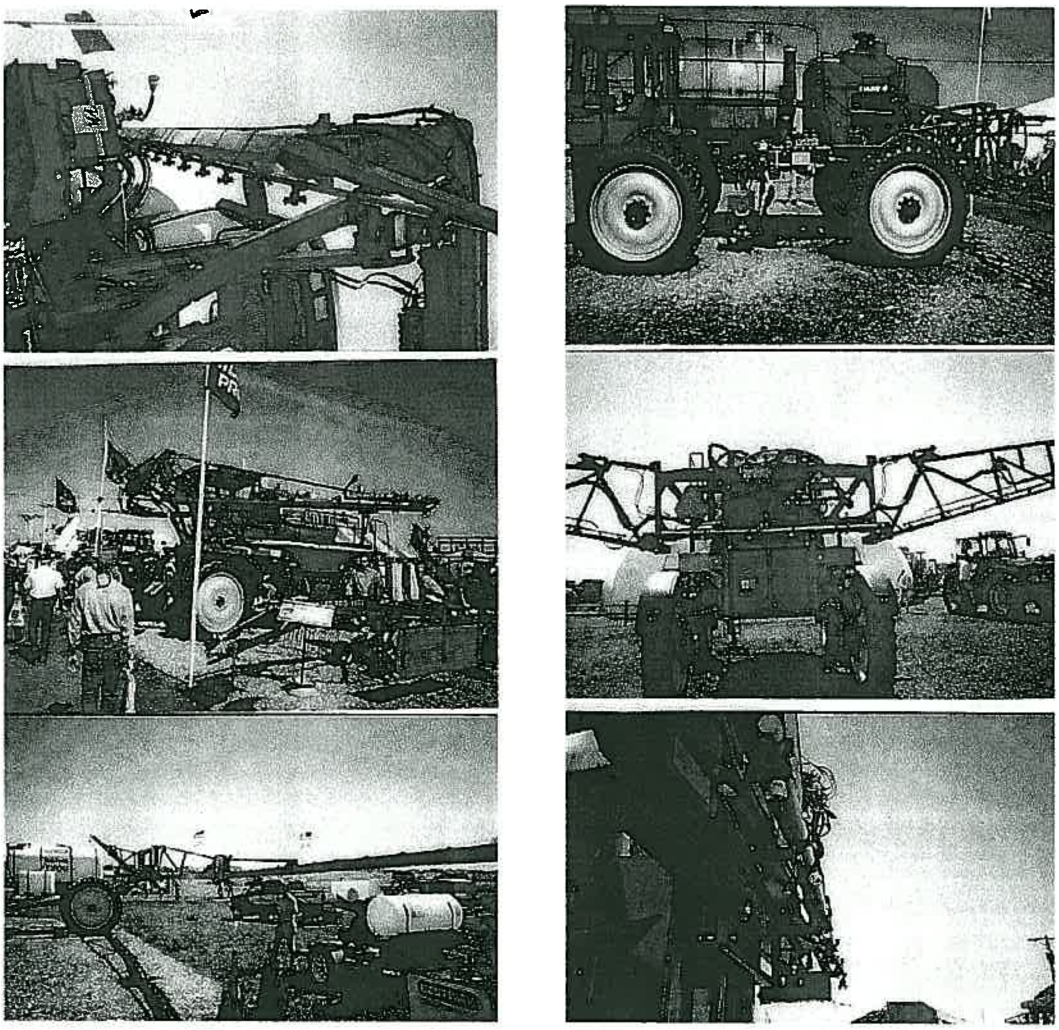
5. Detail results including the statistical analysis of results.

Not applicable.

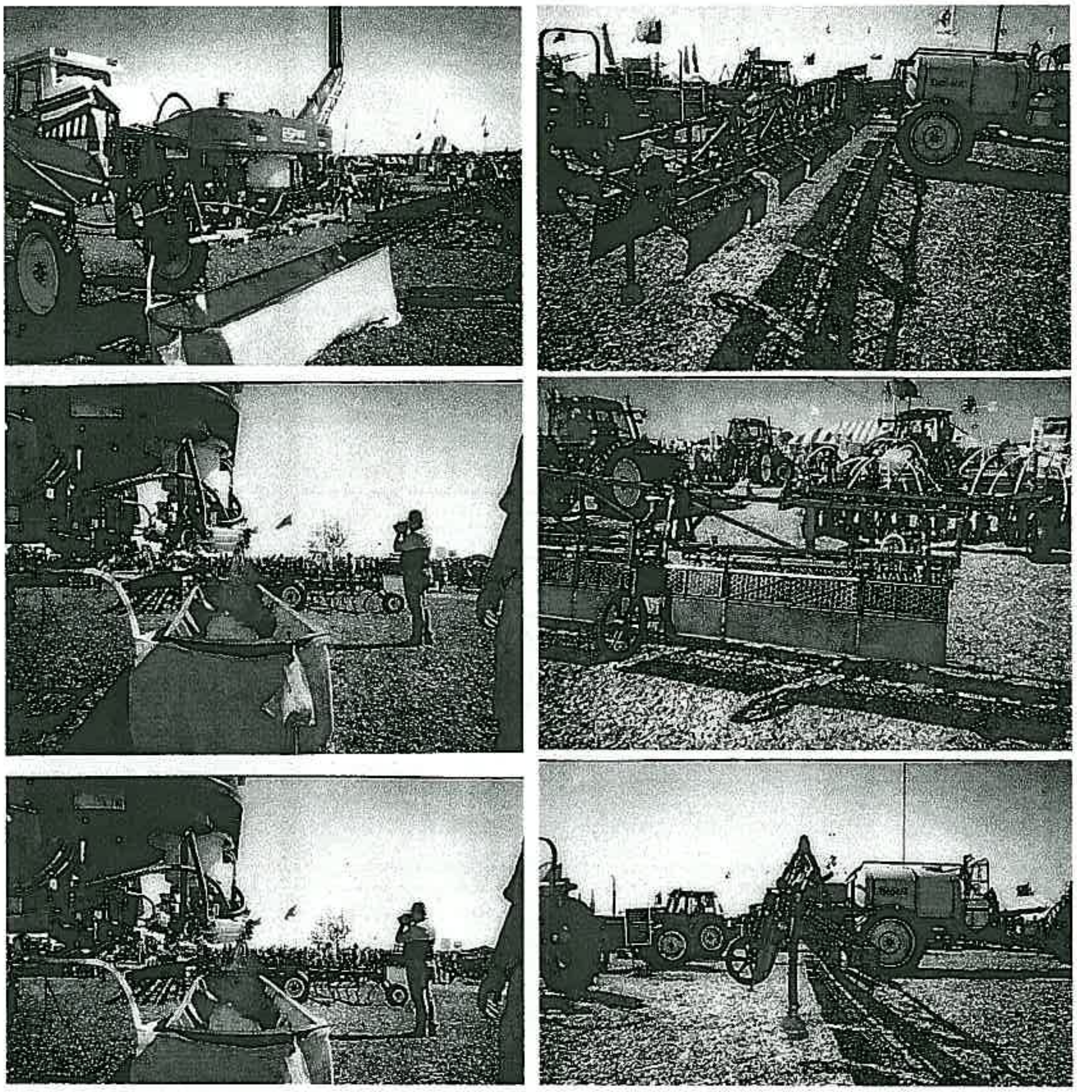
6. Discuss the results, and include an analysis of research outcomes compared with objectives.

The results of the survey showed clearly that the majority of users were well aquainted with their equipment. The initial project concerns with regard to setup parameters were quickly allayed. Farmers were unconcerned about the difficulty of calibration, speed of operation. Most interest was focussed on the potential for the development of simple air assisted designs, alternative application technology such as static assistance and ways to increase application efficiency.

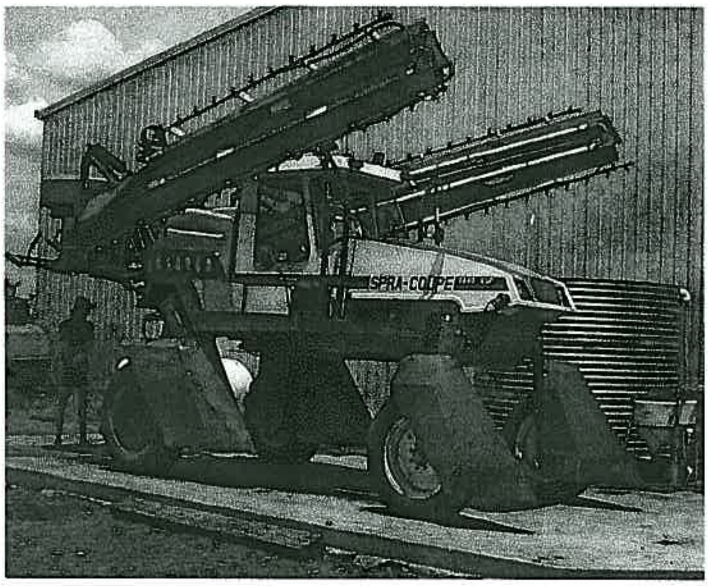
Visits to domestic and international field days showed the following highlights and developments.



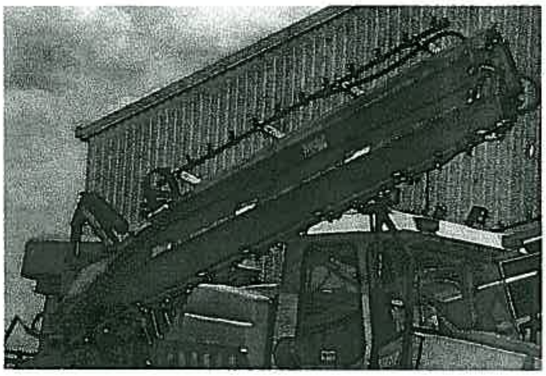
New equipment and boom options observed in Iowa, USA.

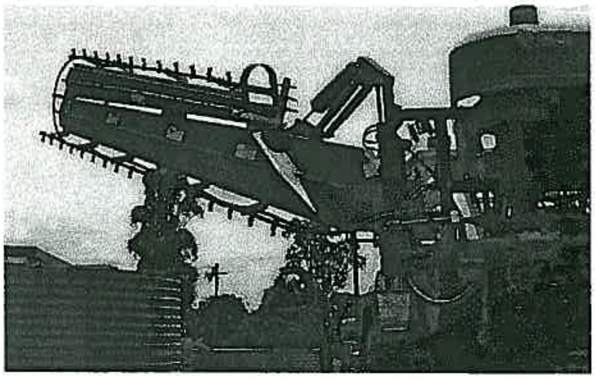


New equipment, including ESP, from Agco.

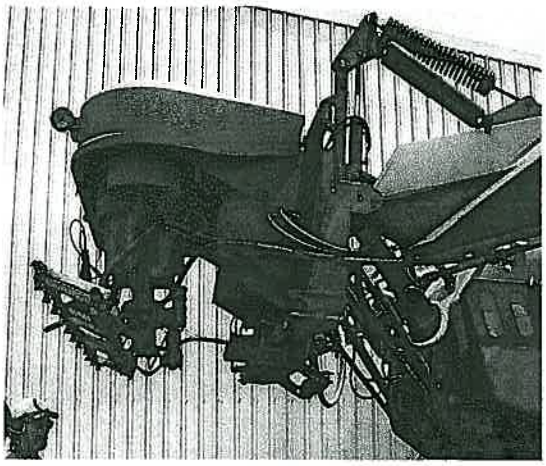


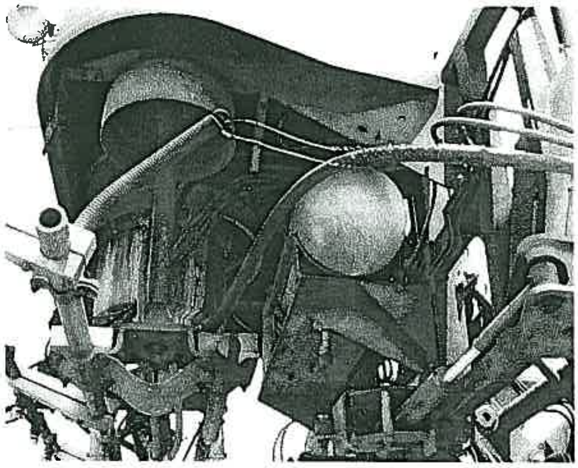
Agco – ESP unit.



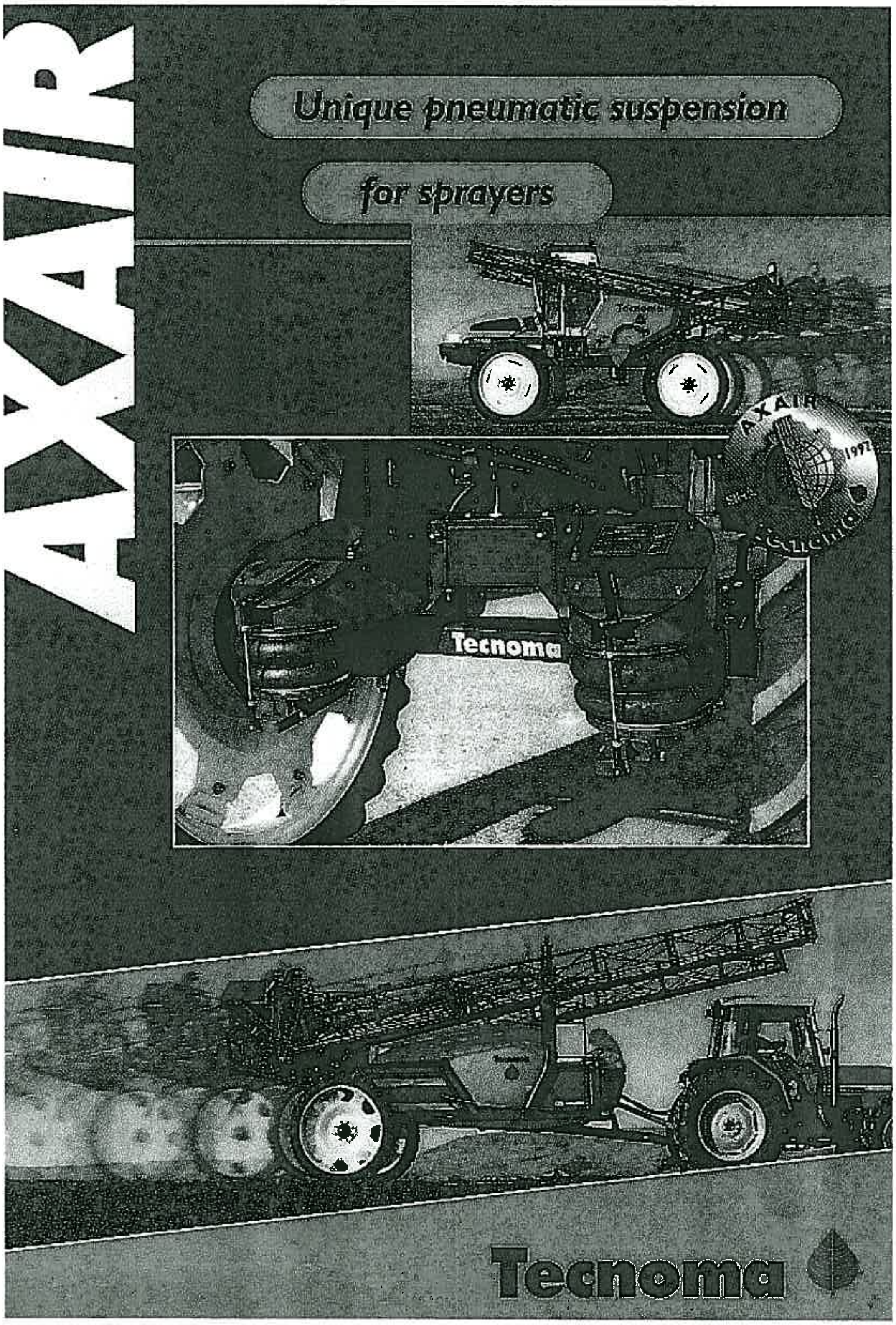


ESP Boom – Brookstead.

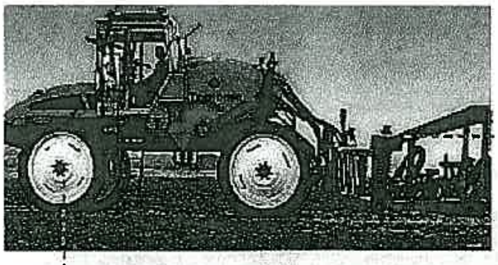




ESP static generation device and components.



The Tecnoma advanced system. One of Europe's most advanced dedicated spray devices that must be considered for wider application in Australia.



laser 3000

BOOMS

HLE 20/12, 21/12, 24/12 & 28/14 m dual width booms : Perfectly matched to the LASER 3000.

Strong but light :
- Tri-box lattice construction for optimum strength and minimum weight.
- Robot-welded for precision.
- Finished by shotblasting and electrostatically powder painted before being baked through TECNOMA's continuous oven.

Ideally suspended :
- Parallelogram mounting with range of working height from 0.65 m to 2.05 m.
- Vertical pneumatic suspension by nitrogen cylinder, active in work and transport.
- Lateral Albatross suspension.
- Torsional rubber bushes control Yaw.

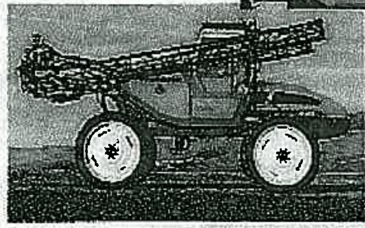
Safety in the field :
- Boom ends breakaway horizontally and vertically in both directions.
- Suspension lock to make folding safe and accurate on side-slopes.
- Accoustic warning while folding/unfolding booms.
- Safety valve for locking lifted boom.

Full electro-hydraulic control :
- Dual control of most in-field adjustments from both the Variotec command centre and the transmission joystick.
- Simultaneous lateral folding of the arms from full width to 12 m spraying (14 m for 28 m), and from 12 m to transport.
- Remote suspension lock.
- Hillside tilt correction.
- Variable geometry allowing individual angling of each boom.

Accurate application :
- Pentajet 5 position nozzle holders with integral antidrips (DVC's).
- Kwix one-piece ceramic nozzles.

OPTIONS

To suit your needs :
- Iveco 155 hp (114 Kw) 6 cylinder, Turbo-charged 5.9 l., supplied in combination with oversize Poclain wheel motors, for maximum output, particularly on steep terrain.
- 4 wheel steering for turning radius of 4 m, ideal for rowcrops.
- 2 optional adjustable axles :
  - 1.80 to 2.25 m (standard UK spec).
  - 2.00 to 2.50 m.
- Wheels : see relevant section.
- AGP pneumatically operated DCV's c/w continuous flow (HLE 28/14 only). In combination with CF 700 centrifugal spraying pump.



Weight and dimensions of LASER 3000 (HLE 28/14, 4 wheel steer and adjustable axle).

Weight distribution	Empty tank				Full tank			
LASER 3000	Boom folded	%	Boom unfolded	%	Boom folded	%	Boom unfolded	%
Front axle	3500 kg	53	3000 kg	47	4320 kg	45	3920 kg	40
Rear axle	3100 kg	47	3500 kg	53	5500 kg	56	5900 kg	60
Total weight	6600 kg	102	6500 kg	100	9820 kg	100	9820 kg	100

- Total width with booms : 2.85 m.
- Total height : 3.93 m.
- Total lengh with booms : 7.55 m.
- Ground Clearance : 1.30 m.
- Wheel base : 3.80 m.
- 2 wheel steer radius : 7.50 m.
- 4 wheel steer radius : 4.00 m.

Specifications and options may vary according to country. 06.97

Tecnoma technologies
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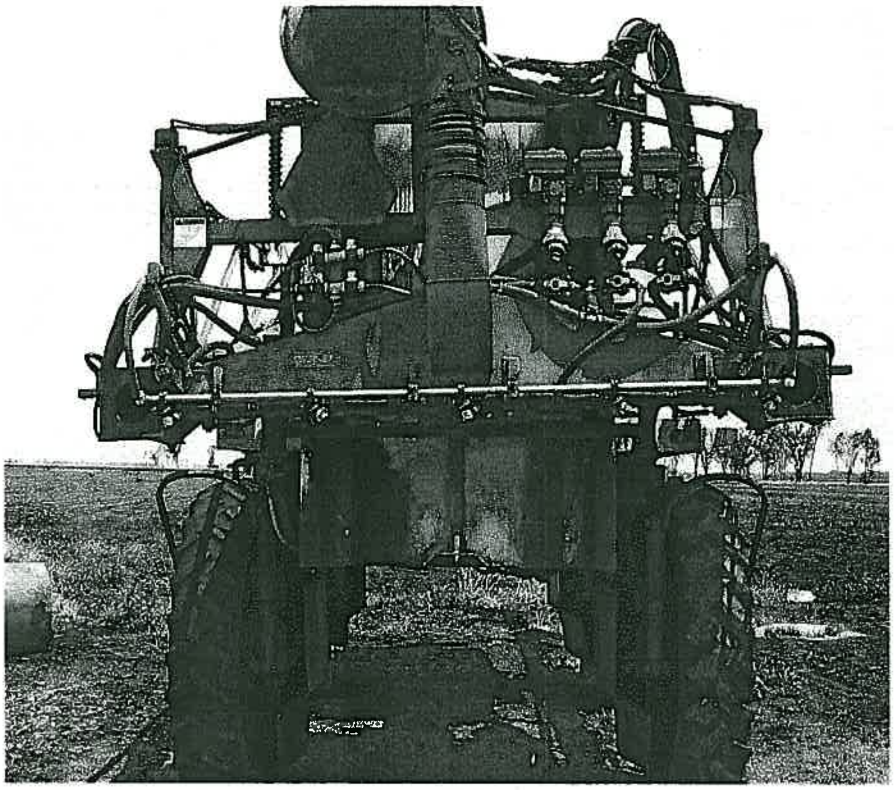
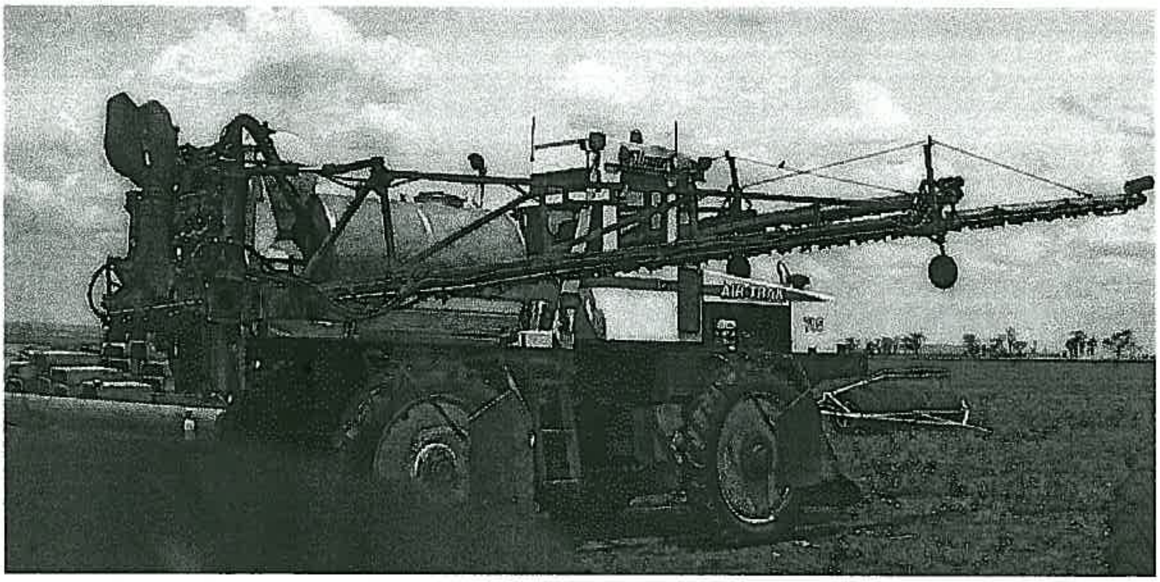
Technoma technical information.

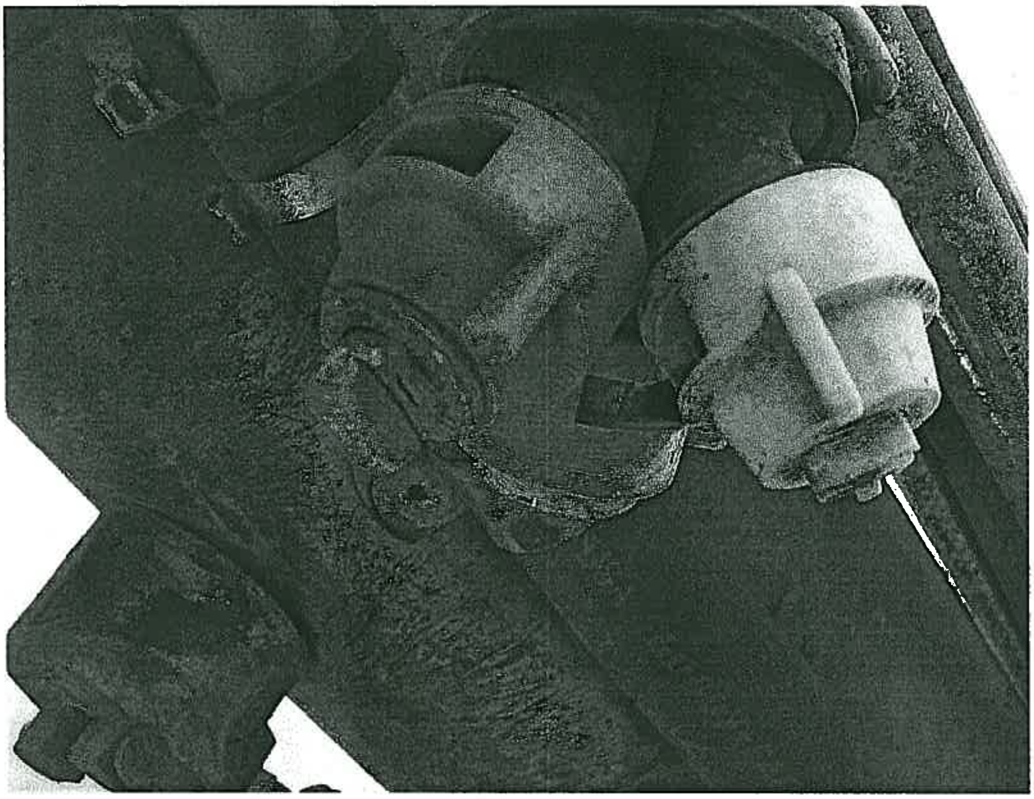
Willmar Air Shear System.



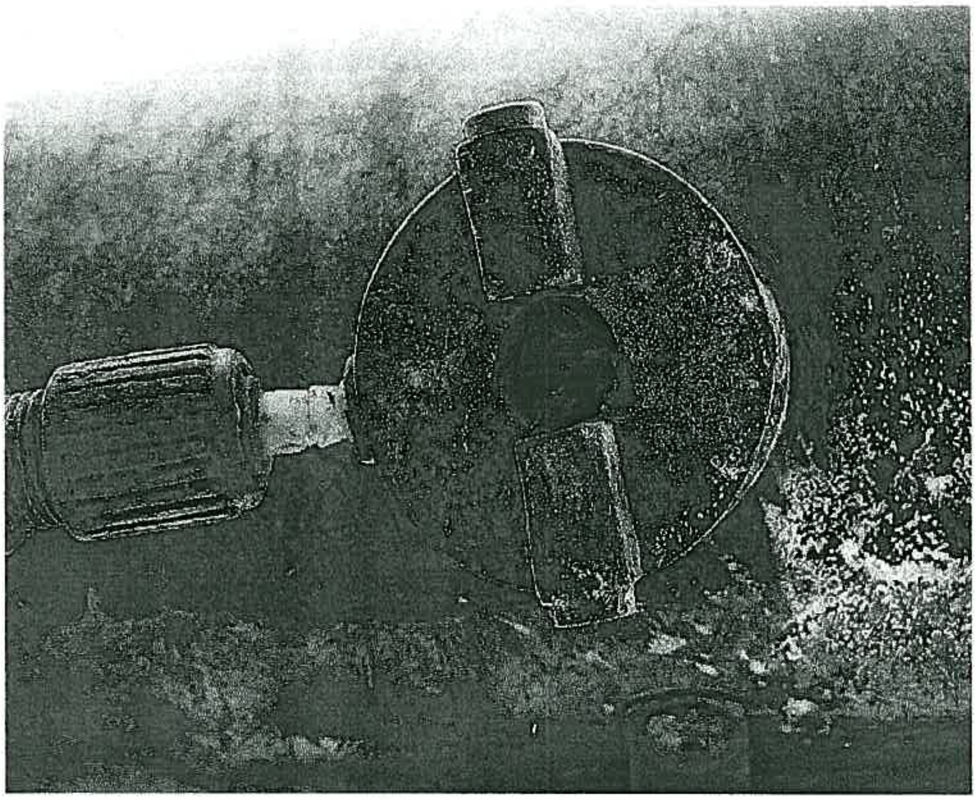
Rear view of Willmar system, showing fan, spray volume control equipment and rear boom sections.



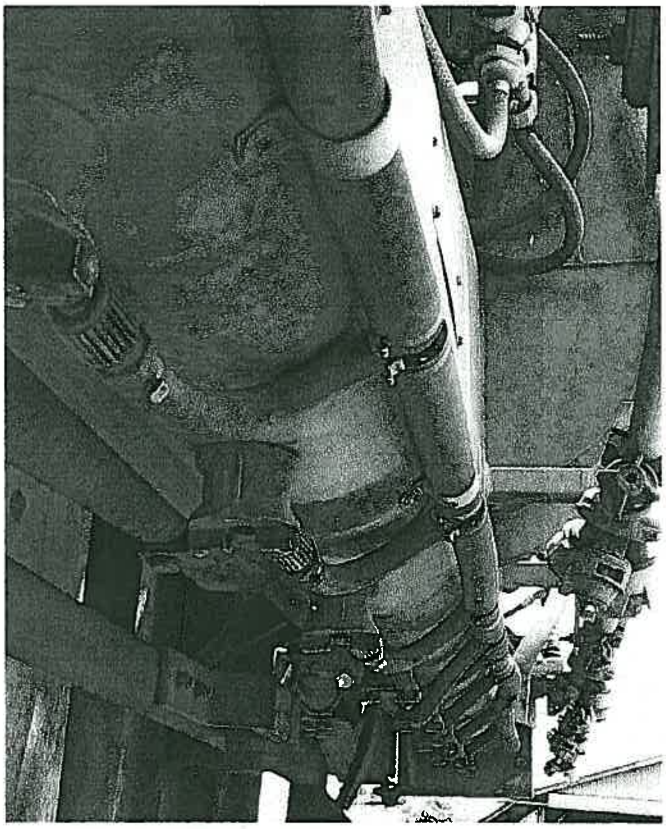
Willmar system that is used right through the season, including defoliation. Only extremely wet rows prevents its use.



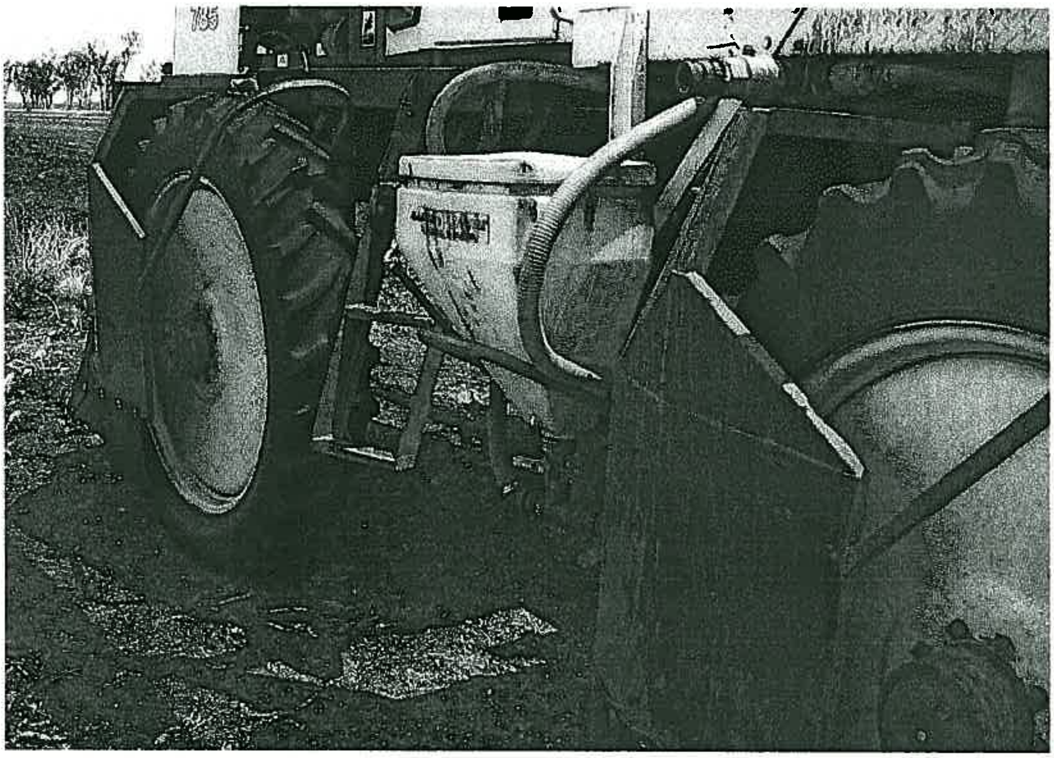
Air shear nozzle and standard hydraulic nozzles.



Air shear nozzle. Creates larger droplets as air pressure introduced from the left reduces, and finer droplets as pressure increases. This reduces drift at row ends and during turning.



Air shear and hydraulic booms as located front to rear. This allows different settings to be used with alternative chemicals, and in an ideal world apply two rates of two herbicides at one time.



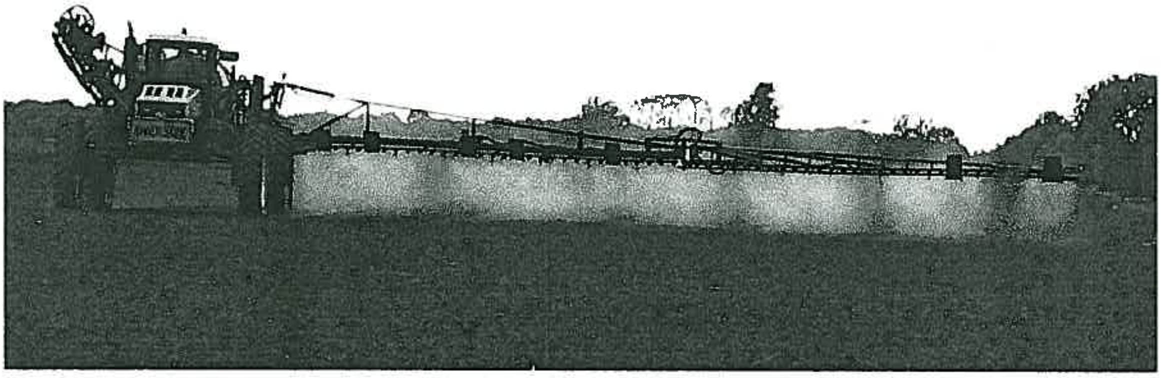
Crop shields and chemical addition/drum washer module.

Ideas and Focus Points

It became clear that the majority of manufacturers are continuing to address the areas of boom stability and general usability of the complete systems. From the contact with growers though, most interest was in the addition of cheap, light shields to increase the ability of their units to 'target' the plants more effectively.

To this end, deflectors were considered from simple to more complicated designs.

Currently, Jeff Bidstrup has been trying some shield designs on his Willmar, and feels that there is an advantage. The effects are visualised below.

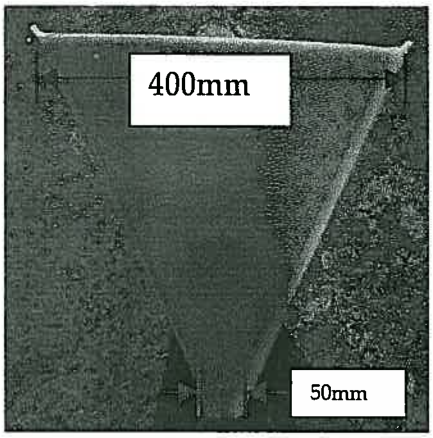


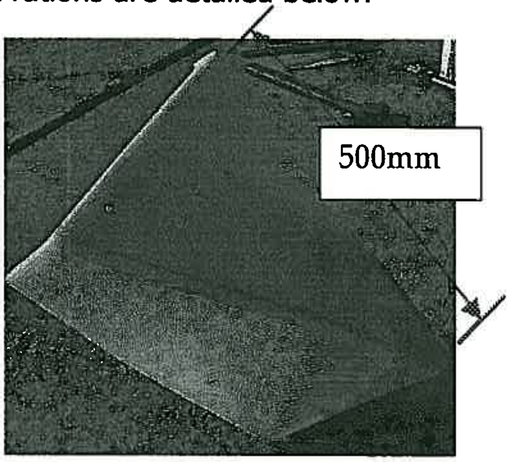
Shields across a boom and the effect. It appears that the shields on the outside have some effect, but the actual sepurstructure of the boom seems to have a significant impact on the inner shields. This is a particular example where a complete boom shield system would evenly direct air from forward motion down into the canopy, regardless of whether full plant or skip row was in use.

The turbulence seems greater where there are shields. The boom obviously effects the operation as well. Measurements in the field did show a small increase in target acquisition, but was inconclusive.

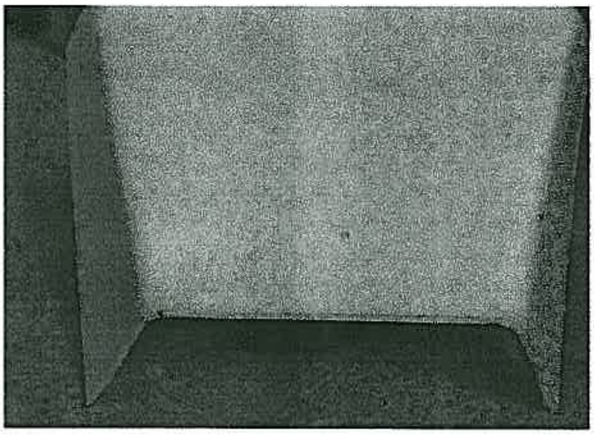
After watching the effect of these in the field, effort was directed towards trying more forms to create ideas on the best opportunities for the future.

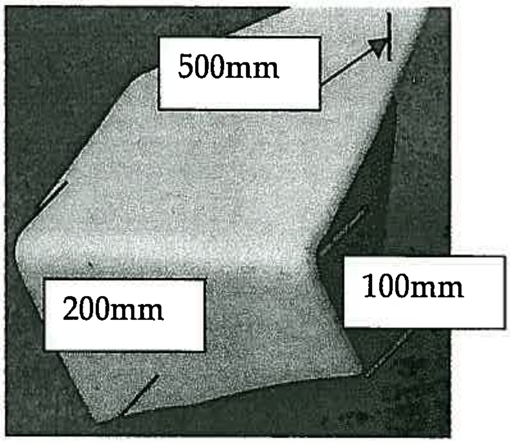
These shapes and associated observations are detailed below.



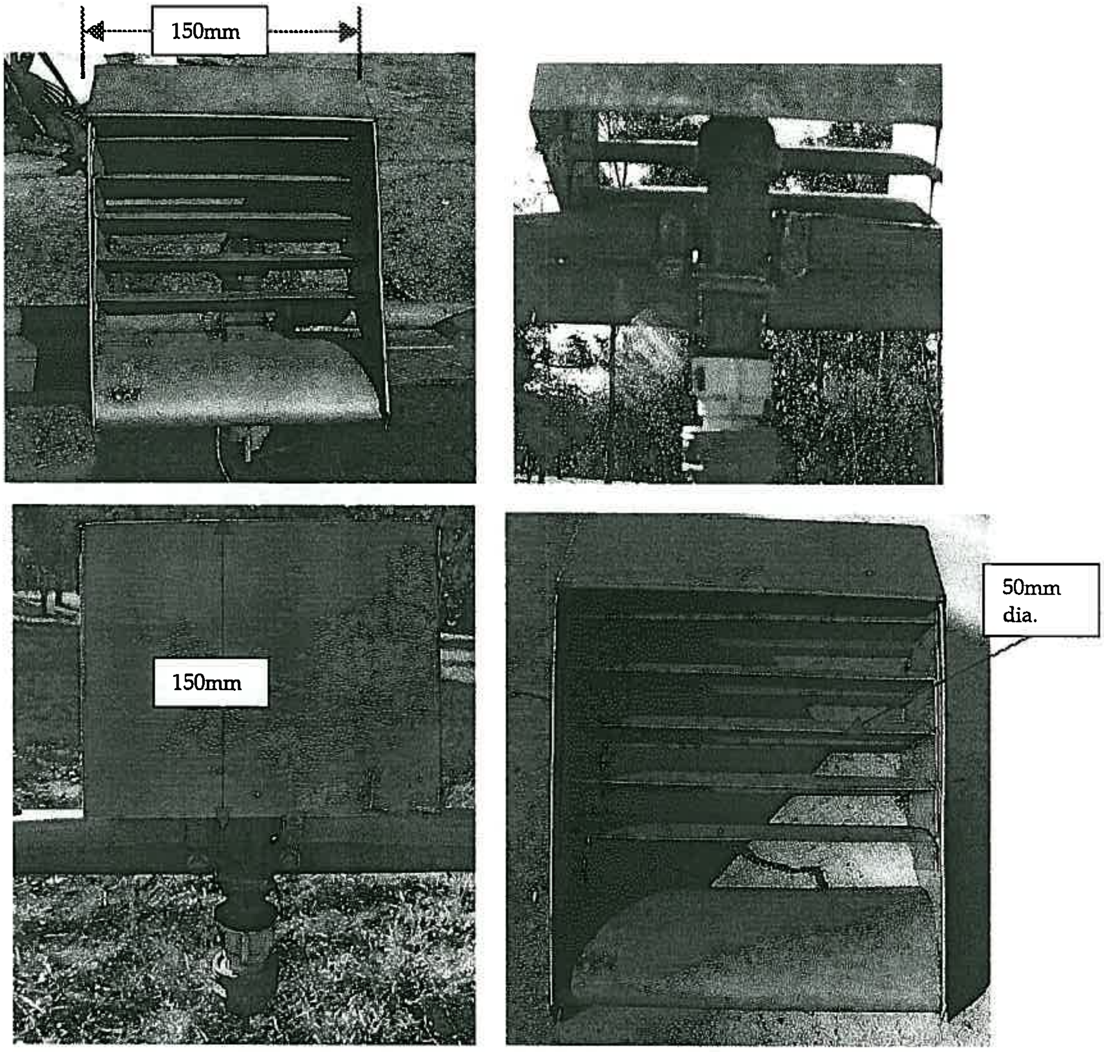


This shield aimed to collect air and compress in gently as it moves to the outlet. Edge effects were a problem, but the unit offered some potential when directed at 45 degrees.

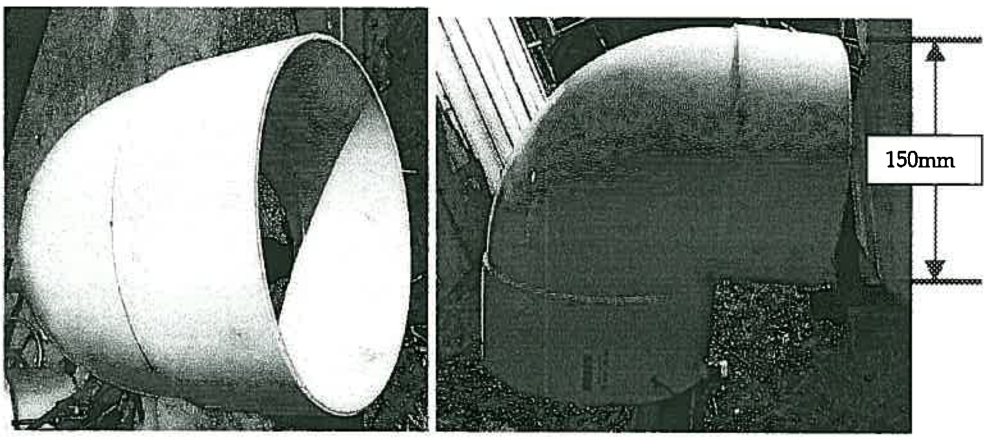




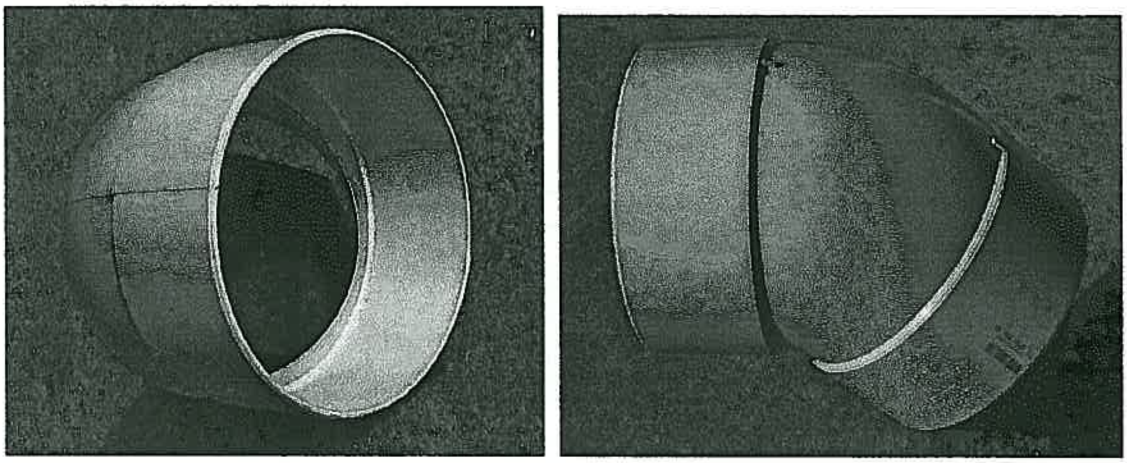
Similar to the shield above, but with less compression. Edge effects created a lot of turbulence, with no even redirection of air.



The most complicated, but most effective shield design. This unit readily accepted turbulent air, segmented the flow and redirected laminar flows directly down towards the crop. Edge effects were minimal. Weight of the unit could prevent it progressing further.



Simple 90 degree pipe bend. This easily and readily redirected all air collected vertically into the canopy. This option is extremely exciting and light weight.



Simple 45 degree pipe bend. This easily and readily redirected all air collected, releasing it at a rear facing 45 degrees. It creates less turbulence and has less effect.

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.

As a result of the research surveys undertaken and the series of tests completed on a variety of shield shapes, there is potential for the concepts to be adopted or tested by end users of spray units.

It is suggested that the ideas developed be simply adapted for use by spray operators and be taken to the level they require.

In the simplest form, individual shields may be tested with a minimal effort, while the more complicated developments require a lot more time, effort and financial commitment. The smaller shields are easily duplicated using thin aluminium sheet or heat mouldable plastic.

In an ideal world, a complete shield across the complete boom or a shield included as a part of the boom would be tested. In the future, the effect of the actual boom on the deflection of air during forward motion needs to be a part of equipment development.

More work in the field on different test equipment would help. Wind tunnel tests may assist but are not really a part of real life in the field. Duplicating boundary layers, plant interaction, land forms and turbulent air is difficult.

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

Not applicable.

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

In Section 6, a series of photographs of the equipment used is provided.

Simple dimensions are added and supplied below.

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

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

If this work is deemed to be of further interest, more work will be required to strictly analyse the test devices in the field. This will include testing in a variety of crops on a variety of equipment in differeing consitions.

Feedback from end users will then need to be included to see if the technology and concepts is worthy of being passed to manufacturers of spray equipment.

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

If possible, and findings may be presented in magazines through the industry and at conferences if requested.

11. List the publications arising from the research project.

No articles have been published.

12. Are changes to the Intellectual Property register required?

No.

Part 4 – Final Report Plain English Summary

Introduction

This project is designed to consider the issues involved in the spraying task and aims to coordinate efforts with QDPI and CPAS to achieve the following:

1. Benchmarking of current operational parameters of ground based spray application equipment and techniques.
2. Summarise the results from the survey and define the areas of concern that can be readily addressed in the time available.
3. Develop documentation of project outcomes and report back to the industry.

Progress and Update

Survey Results

In all cases, conditions dictate the application efficiency. All surveyed owners had no difficulty in the calculations of volumes; pressures and generic set up parameters, but struggled to know the most beneficial nozzles for different situations. Many chose the nozzles that happened to be supplied with the machine or those that were the cheapest. Some were more concerned with drift and used larger droplet sizes, lower pressures or low drift nozzles to minimise drift. Most operators and owners were aware of the importance of nozzles and aware of the choice required to maximise efficiencies at different growth stages. Contractors were more aware of issues associated with nozzle wear and droplet spectrum, whereas farmers were more focussed on efficacy and measured effect on inter-spray time periods.
Those operators using air assist technology had different configurations, but generally used the same bands and varied the air width and nozzle number to suit.

Emerging Trends and Areas of Focus

Most farmers are happy with existing nozzle technology, and are only seeking assistance in the best nozzles to choose in certain conditions. Out of the multitude of available nozzles, there must be a sub set of those most suited to application of specific chemicals in cotton. Several growers requested a short list of the best nozzles as could be compiled by Peter Hughes.

Boom height control was a lesser issue, but still needs further investigation into those types of equipment available.

Shield technology sparked the greatest level of interest, especially in the concept that small low cost additions to the boom could greatly increase performance in certain if not all conditions. This is the area of major work and shields are currently being built and tried to see what effect they have on droplet movement.

Controller design and development has caused some concern, but will be a secondary area of interest.

Other areas of interest or concern included much larger issues such as late season chemistry and control options, nozzle potential and the effects of spray application on neighbouring farms and environmental reserves.