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Part 1 - Summary Details

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Part 1 – Final Report Executive Summary

This project examined the costs and benefits of defoliation strategies used in the defoliation of high input irrigated cotton crops. The project comprised of a field trial and a survey of irrigated cotton enterprises.

The field trial evaluated defoliation efficacy through ground rig and aerial application and measured crop damage from ground rig application.

Similar defoliation efficacy was achieved using ground rig and aerial defoliation for the first pass in this project.

Crop damage sustained through ground rig application must be considered in calculating the costs and benefits of application method. Based on a price of $12/ha for ground rig application and $16/ha for aerial application, cost per application by ground rig is lower than aerial application when damage is taken into account.

The benefits of ground rig application are lower drift risk and smaller down wind buffer zones than occur with aerial application. Area to be defoliated is a limiting factor for ground rig application. Arial application is an important method of defoliant application in large scale enterprises.

Efficiency drivers for both ground and aerial application were identified. These were boom width and speed of travel for ground rig application and volume for aerial application

The survey identified current defoliation practices used and the decision making drivers behind the practices used. From the current practices used by growers, a set of best practices for defoliation was identified. These practices achieve good defoliation efficacy while minimising spray drift risk and effects on the environment.

Best practices currently used by growers were identified as:

- Canopy management with plant growth regulator to enhance evenness and defoliant penetration.
- Sprayer set up which maintains efficacy while minimising environmental impact by using a coarser spray quality for example Turbo TwinJet®twinjet nozzles (standard or the air inducted version) for ground rigs and CP nozzles for aircraft.
- Droplet size – using bigger droplets (medium to coarse spray qualities) which maintain efficacy but minimise drift risk and the down wind no spray zone distances required.
- Using ground rigs to defoliate next to sensitive areas.
- Using a pesticide application management plan to manage spray drift risk in accordance with mandatory down wind no spray zones in accordance with new label guidelines.
- Defoliating as much are as possible when wind conditions are appropriate.
- Defoliating the crop in the least number of passes which reduces the drift risk and potential impact on the environment.

Decision making drivers for defoliation were identified

Timing of the first pass is primarily driven by crop maturity (top boll maturity and openness) with the timing of subsequent passes is more influenced by weather forecast (rain or a cold snap) and picking schedule

Application method (ground or air) is predominantly decided on by the area to be defoliated. Canopy density, weather forecast and soil moisture also play a part in the decision making process.

Sprayer setup is primarily driven by canopy density, label requirements and downwind buffer zones

Canopy density is the main decider for application volume, with products used and weather conditions as the other contributing factors.

Introduction

The Australian cotton industry does not have a current or complete data set which it can use to demonstrate to industry, researchers, regulators and the community what defoliation practices are used by growers, hence we are not able to define or demonstrate what best practice for defoliation currently is, or that we are implementing those practices across the industry. This is the case for both ground and aerial application, both of which are widely used for defoliation.

The Review of the Operating Principles of Spray Drift Risk that has been underway since 2010 has resulted in new label requirements that specify mandatory downwind buffer distances for particular spray qualities. The smallest spray quality that can be used to apply the product must now be specified on the label. It is beneficial for growers if they can demonstrate they are using best practice as this may provide some of the evidence required to reduce these buffer zones.

Background

For cotton defoliation, both ground and aerial application have their own strengths and weaknesses. From an environmental stewardship perspective, ground application is more likely to demonstrate best practice than aerial application. However, there is a widely held perception within many parts of the Australian Cotton Industry that the use of ground application for the defoliation of the crop is not efficient, causes unacceptable damage, can create problems with leaf freeze and reduces lint yield and, or lint quality. This view may not take into consideration recent improvements in sprayer design such as increased boom width and novel application systems, where efficiency can be increased and the proportion of crop that may be damaged by the spray rig is likely to have been reduced when compared to defoliation practices of five to ten years ago.

The cotton industry also needs to consider the changes in regulation to crop protection products that occurred during the same period, with a general reduction in the number products being registered with approval for aerial application, along with restrictions such as no spray zones onto exiting products as the APVMA completes reviews. It would be prudent to investigate the costs and benefits of ground application versus aerial application the defoliation of the cotton crop, or a combination of the two to ensure continued access to products and environmental stewardship.

Objectives

This project aims, through a trial and a survey, to compare the relative efficiencies (leaf drop), crop damage and lint yield of aerial and ground application (or a combination of two) for the defoliation of irrigated cotton identified as having high or excessive nitrogen status.

Aims of the Trial Component

- To compare the relative efficiency and cost/benefit of defoliation of cotton by either ground application or aerial application (or a combination of the two).
- To measure damage to the crop due to ground application (relative to aerial application) during the first and second passes of the defoliation process
- To determine the potential impact to yield and the cost of the cotton harvested.

Aims of the Survey Component

- To establish a bench mark of the current application parameters and practices used to defoliate cotton crops for a limited sample of growers (12 enterprises)
- To determine if relationships exist between application parameters, defoliation timing and lint quality (leaf and colour grades)
- To establish if relationships exist between nitrogen status prior to defoliation, defoliation timing, number of passes and lint quality (leaf and colour grades).
- To compare the potential costs and benefits (financial and timing) of current defoliation practices in relation to application method and nitrogen management strategies

Methods

This project consisted of a large scale field trial which measured the efficacy of ground and aerial defoliation as well as crop damage from ground rig application, and a survey of irrigated cotton enterprises to gauge defoliation practices currently used. A separate report is included for the field trial and the survey both of which detail the methodology used in each component.

Results

Results of the field trial for defoliation efficacy and crop damage are included in the trial report titled BGC1501 Trial Report. Results of the survey are included in the survey report BGC1501 Survey Report.

Outcomes

Trial

Efficacy

Similar defoliation efficacy was achieved using ground rig and aerial defoliation for the first pass in this project. A fine spray quality was used for both methods of application.

Some crop damage is sustained through ground rig application and this must be considered in calculating the costs and benefits of each method. In the interests of minimising damage, the same set of wheel tracks should be used for subsequent passes when travelling in the same direction.

Defoliating with a ground rig with crop guards and a 36 m boom resulted in average damage costs of $2.33/ha on the first pass and $2.94/ha on the second pass giving a total of $5.27 for two passes based on a turnout of 43% and a price of $500 per bale. Based on a price of $12/ha for ground rig application and $16/ha for aerial application, cost per application by ground rig is lower than aerial application when damage is taken into account.

The benefits of ground rig application are lower drift risk and smaller down wind buffer zones than occur with aerial application.

Efficiency

Boom width determines efficiency and the area where ground rig defoliation becomes inefficient. A machine fitted with a 36 m boom defoliating 375 ha per day with 7 days between passes, can defoliate up to 2500 ha. This is reduced to 1800 ha for a 24 m boom and increased to 3600 ha for a 48 m boom. For ground rig defoliation, increased efficiency measured in ha sprayed per day, is achieved by increasing boom width. These figures indicate enterprises up to this size can be successfully defoliated with ground rigs. For larger scale enterprises, wider booms and more rigs are needed, or

aerial application is required, hence aerial application is an important method of application for defoliation.

For aerial application, volume is a major contributor to efficiency and further investigation warranted into the relationship between efficacy achieved, application volumes with various spray qualities and canopy density

Survey

Decision Making Drivers

Drivers for Defoliation Timing

Timing of the first pass is primarily driven by crop maturity with the most influential factors being maturity of top bolls, NACB (nodes above cracked boll) and percent open bolls.

The timing of subsequent passes is more influenced by weather forecast (rain or a cold snap) and picking schedule, especially on large-scale enterprises which defoliate management units together.

Drivers for Application Method (Air or Ground)

Application method (ground or air) is predominantly decided on by the area to be defoliated. Canopy density, weather forecast and soil moisture also play a part in the decision making process. Canopy density, wetness of the field and weather forecast are all contributing factors that may favour aerial defoliation over ground rig.

Drivers for Sprayer Setup and Application Volume

Sprayer setup is primarily driven by canopy density, label requirements and downwind buffer zones demonstrating that growers are endeavouring to use what has been identified as best practice above, for defoliant application and which adhere to label guidelines. This is becoming of increasing importance with the downwind no spray zone distances now included on new labels.

Canopy density is the main decider for application volume, with products used and weather conditions as the other contributing factors.

Defoliation Practices Currently Used Identified as Best Practice

Enterprises achieving excellent defoliation in two passes, using either ground or aerial defoliation or a combination of the two to get the crop defoliated and picked in a timely manner and who use drift management plans could be regarded as using best practice for defoliation. Those practices identified as best practice for irrigated cotton defoliation in high input crops are presented below:

- Canopy management with plant growth regulator, which enhances crop evenness and defoliant penetration.
- Sprayer set up which maintains efficacy while minimising environmental impact (e.g. drift on sensitive areas, native vegetation). Examples are using Turbo TwinJet®twinjet nozzles (standard or the air inducted version) for ground rigs and CP nozzles for aircraft.
- Droplet size – using bigger droplets (medium to coarse spray qualities) for both ground and aerial defoliation which maintain efficacy but minimises drift risk and the down wind no spray zone distances required.
- Using ground rigs to defoliate next to sensitive areas.
- Using a pesticide application management plan to manage spray drift risk in accordance with mandatory down wind no spray zones in accordance with new label guidelines.
- Defoliating as much are as possible when wind conditions are appropriate.
- Defoliating the crop in the least number of passes which reduces the drift risk and potential impact on the environment.

There are a range of methods in use giving effective crop defoliation by both air and ground or using a combination of the two.

Conclusion

Ground rigs and planes are both effective methods of applying defoliants and boll openers. Efficiency drivers for application method are boom width for ground rigs and application volume for planes.

Good defoliation efficacy can be achieved in many ways with a range of equipment and droplet sizes. Current defoliation practices used identified above as "best practice" can provide evidence for other growers to be able to modify regulatory buffer zones if larger droplets (coarse spray qualities or larger), or other drift management tactics are used.

Practice change towards using a coarser spray quality for defoliant application to reduce drift risk and comply with label regulations and operating principles of spray drift risk APVMA is feasible based on the results of practices used in the survey.

Extension Opportunities

There is scope for improved decision making tools for sprayer setups (droplet size, volume, nozzle configuration, nozzle type to match canopy size. In conjunction with canopy management with plant growth regulators

Future research is required to confirm equivalent defoliation efficacy with different sprayer setups, boom widths, spray qualities, application volumes. This would help to define what best practice is and help reduce buffers and off target effects if medium or coarse droplets do not compromise efficacy or time to picking

Research into predictors of efficacy –

- Can deposition in the canopy be measured with a setup to tell growers what the expected level of efficacy will be?
- Can the canopy density be used to predict how many passes will be required for budgeting purposes?