Cotton pesticide application research at Gatton

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At a glance...

The CRDC (in conjunction with the Land & Water R&D Corporation) funded a number of research projects in application technology at the University of Queensland, Gatton Campus from 1993 to 2003.

This brief article examines a few of the many findings from this research and identifies some of the broader outcomes or changes in the industry that have developed directly or indirectly as a result of this research focus.

With the benefit of being able to look back over CRDC funded research programs conducted over a 10 year period, against a range of background political and technical issues, a significant number of positive outcomes can be identified.

Insecticide application (endosulfan) and spray quality

During the mid to late 1990s endosulfan contamination of pasture and beef caused significant disruption of the meat export industry and resulted in the temporary closure of some overseas markets. As a consequence of research already being conducted on aerial transport of pesticides (commissioned by the Land & Water Resources R&D Corporation), the Centre for Pesticide Application and Safety (CPAS) was able to rapidly develop downwind deposition curves based on actual data, supported by modelling. These data and models were used to establish guidelines for future application and develop a new label for the continued use of endosulfan.

In subsequent work, the concept of large droplet placement (LDP) spraying was introduced to reduce the downwind impact of spraying using droplet sizes in excess of 250 micron (Volume Median Diameter — VMD). The success of this approach was later demonstrated with the release of LDP deposition curves. Recent research has shown that 100 metres downwind of the field edge, LDP application generates significantly less spray drift than LV or ULV application. The use of LDP application has now become widely adopted in the cotton industry.

In developing the LDP concept, CPAS was also able to promote the establishment of the British Crop Protection Council, (BCPC) and later the American Society of Agricultural Engineers, (ASAE 572) spray quality classification scheme as a mechanism to describe the performance of hydraulic nozzles and as a tool to limit the production of fine droplets and associated spray drift.

These suggestions were also incorporated into the endosulfan label (boom application) and helped to prolong the usefulness of this compound as an insecticide against Helicoverpa. Similarly, CPAS was able to propose exact nozzle settings for use on agricultural aircraft that would deliver droplet sizes with a VMD greater than 250 micron.

Accurate droplet spectra determination

During 2000, CRDC sponsored the successful design, construction and commissioning of a world class pesticide wind tunnel laboratory at the Gatton Campus of the University of Queensland. Over the past three years, this unique facility has enabled the rapid characterisation of many nozzle systems used on agricultural aircraft and boom sprayers in Australia. It has enabled the development of new nozzle systems and better ways to describe nozzle performance.

The wind tunnel has allowed the influence of many pesticide formulations used by the Australian cotton industry to be characterised. Many companies have used the facility to evaluate the effectiveness of new formulations, adjuvants and pesticide mixes. In generating accurate droplet sizing information (and input data for international models such as AgDRIFT), the wind tunnel has enabled manufacturers to fine tune labels and develop instructions that can reduce spray drift.

Importantly for the Australian cotton industry, the

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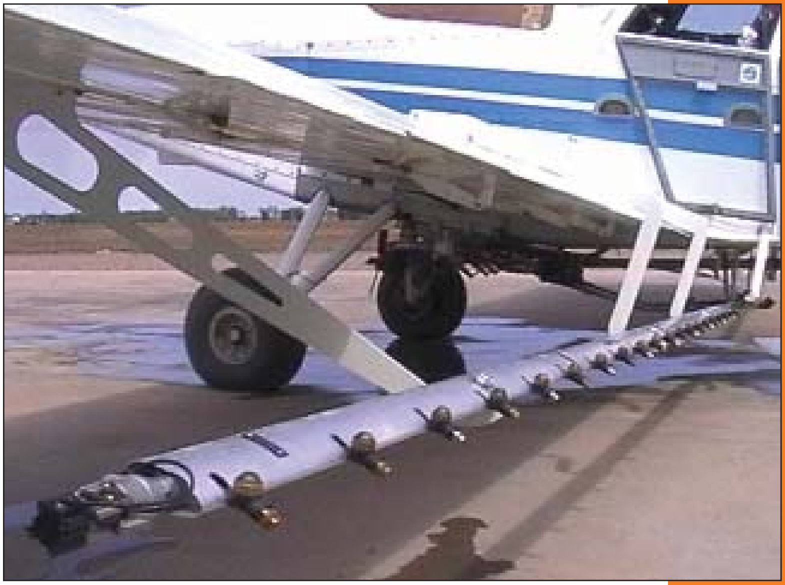

The JARBA Boom showing the capacity of the nozzles to be rotated in flight for droplet size control. (Photo courtesy Jones Air)

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wind tunnel facility has helped predict the performance of nozzles when fitted to agricultural aircraft. For example, specific droplet size calculators have been developed for Micronair rotary atomisers, the Unimizer and the JARBA boom. These models enable users to accurately predict droplet size as a function of flight parameters and nozzle characteristics. They have been used to provide information for pilots and applicators via the internet or developed to drive onboard application computers.

FIGURE 1: Model fitting of downwind deposits (dashed lines) against the US regulatory model AgDRIFT (full lines) from ULV, LDP, LV and ground downwind drift assessments 1994-2003

Information from CPAS wind tunnel studies lies at the heart of the JARBA boom control processor. In this system, the angle of the hydraulic nozzles on the boom is automatically changed in flight to maintain a pre-specified droplet size (see photo page 35). In this way the droplet size can be controlled in flight by the pilot or a nominated droplet size maintained as the airspeed of the aircraft changes. This is an advanced system and has the potential to significantly influence the precision of aerial application technology in Australia and overseas.

Downwind spray drift determination

A comprehensive database of downwind deposition profiles has been compiled and a statistical model developed to predict and compare average deposition downwind from ULV, LDP and LV aerial application. This can be used to predict down wind spray drift and may provide assistance to both regulators and industry involved in environmental management (see Figure 1).

Publications

The research funded by the CRDC has also indirectly supported the publication of a number of key documents that have been used to raise application standards and reduce spray drift in the Australian cotton industry. The Pilots and Operators Manual was revised in 1998 to support the Spraysafe accreditation system devised and

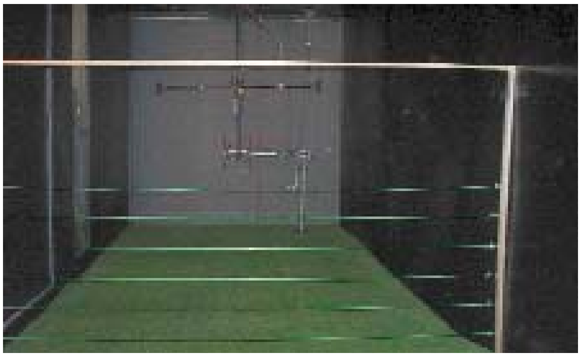

Figure 2 (a) The inside of the low speed working section showing string collectors set up to determine the vertical spray drift profile downwind of a static hydraulic nozzle; (b) Virtual representation of working section allowing the model simulation (L-Studio) of the downwind vertical and horizontal spray drift profile from a hydraulic nozzle.

developed by the Aerial Agricultural Association of Australia. Although this manual is used to encourage the adoption of good application practices across the whole aerial application industry, it is particularly relevant to operators supporting the cotton industry.

More directly relevant to growers, the CRDC research program also supported the production of SprayPak II, a technical manual highly focussed on the specific needs of cotton producers. Released in 2003, this document aims to raise the standards of growers and commercial applicators applying pesticides using ground and aerial application equipment.

In addition, CPAS compiled a new document in 2002 designed to foster better environmental management of pesticides. *Drift Management: Principles, Strategies & Supporting Information* was produced on behalf of the federal Primary Industries Standing Committee (PISC). This important publication is designed to assist producers, communities and applicators develop and design efficient spray drift management plans across a wide range of scenarios.

Recent research developments

During 2003 the wind tunnel was expanded and re-equipped to undertake innovative research on spray droplet movement and canopy interaction. A low speed wind tunnel working section was constructed enabling crop canopies such as cotton to be sprayed with a remotely controlled boom in wind speeds up to 20 km per hour.

The simulation of a spray boom moving across a virtual cotton canopy.

The facility can also be used to precisely determine spray drift from single hydraulic nozzles up to 10 metres downwind of the release point (Figure 2). The velocity and size of droplets can be tracked around canopies at an equivalent film speed of 50,000 frames a second.

The generic research work is being sponsored by

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Bayer CropScience, NuFarm and Syngenta and this work will have relevance and worth to Australian cotton growers over the next few years.

Currently research work is underway not only to simulate the downwind trajectory of spray droplets from a hydraulic nozzle, but also measure and predict droplet interaction and capture by simple and complex canopy surfaces (see picture page 37). The modelling work is being linked to virtual plant models already developed for a cotton canopy with the objective of modelling and predicting droplet distribution in complex plant canopies. If successful, such models will enable more accurate assessments of spray drift risk.

Precision application, the future of aerial and ground application technology

Boom sprayers and agricultural aircraft provide viable and efficient means of pesticide delivery in a wide range of environments and situations, but work should continue to optimise pesticide application and reduce the potential for off-target damage and spray drift.

There has been a rapid development in Differential GPS capable of receiving differential signals from space over wide geographical areas. This, together with the rise in confidence that has occurred with advances in spray drift modelling, is leading to the feasibility of computer assisted spray drift management decisions being made in the tractor cab and aircraft cockpit.

Such technology requires real time measurement of meteorological parameters from on-board sensors or radio links to ground based portable meteorological stations. But it could be possible for ground and aerial applicators to undertake spray operations with full reference to environmental parameters.

Integrating GIS with DGPS and suitable spray drift models would enable a computer to position an aircraft or ground rig with reference to the prevailing wind direction and nozzle settings (droplet size). Allowing for buffer zones and pre-mapped off target areas, real time positioning of the aircraft or boom sprayer could be possible.

Such systems could be developed to alert pilots and applicators to the likelihood and magnitude of off-target drift and even automatically prevent the inadvertent release of pesticide from an aircraft sprayer when incorrectly positioned in or over a crop. As demonstrated above, systems could also be developed to change the rotational rate of rotary atomisers or the angle of the hydraulic nozzles in flight to reduce the potential for spray drift.

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