Best practices for aerial and ground spray applications to cotton

Bill Gordon, Bill Gordon Consulting Pty Ltd.
Adapted from earlier versions by
Andrew Hewitt, Centre for Pesticide Application and Safety,
University of Queensland
Peter Hughes, formerly DAFF Qld
Tracey Leven, CRDC

A lot of time, effort and money are spent on spray application. To achieve the best value from that effort requires that the application technique is matched to the target, the product and the weather conditions. Movement of spray away from the target area wastes product and increases the risk of damage or residues onto non-target crops or sensitive areas.

This chapter provides a summary of factors to be considered in optimising spray application, with an expanded version available in the Cotton Production Manual. New technologies and information are continually becoming available, and readers should consult additional information where available. Recommended additional resources are highlighted and can be found in the myBMP Resources Section www.myBMP.com.au

Spraying?
Be aware – take care

Cotton Map is seasonally available between 1 September and 30 April and can be found at www.cottonmap.com.au

Also remember:
Follow label directions. It’s illegal not to.
Use a “Coarse” spray quality or greater when applying Group I herbicides.
Be particularly vigilant of variable conditions at night.
Notify cotton neighbours of your intention to spray.

Planning

The development of a comprehensive Chemical Handling and Application Management Plan (CHAMP) is an important part of the Best Management Practice (BMP) program in cotton. The CHAMP for farming enterprises should be completed prior to the season and should cover:

- Farm layout;
- Identification of sensitive areas, potential hazards and awareness zones;
- Communications procedures;
- Pesticide Management Guidelines; and,
- Accident and emergency procedures.

Having a CHAMP in place helps to ensure that everyone involved in pesticide application has a clear understanding of their responsibilities.

Legal requirements

Always read and follow the label when handling and applying chemicals. Label conditions may specify spray quality, spray conditions including mandatory wind speed range, and no-spray zones/buffers. Be aware of federal and state regulations for chemical application. Staff responsible for handling and applying pesticides must be qualified according to relevant state and federal requirements.

There may also be workplace health and safety requirements related to storage and use of hazardous chemicals, which require risk assessments to be completed, in addition to maintaining a manifest and Safety Data Sheets for those chemicals deemed to be hazardous.

Users are not absolved from compliance with the directions on the label or the conditions of the permit by reason of any statement made or not made in this publication.

Label Instructions

Many product labels now include a range of Mandatory Statements, some examples include:

Mandatory spray qualities

Labels typically require the use of a coarse spray quality or larger, or a medium spray quality or larger according to the ASABE1 or BCPC2 classification systems. Ensure nozzles are selected from charts that refer to either of these standards and equipment is setup and used appropriately to achieve the required spray quality.

Mandatory wind speed range

Labels state that the wind speed must be above 3 km/h and less than either 15 km/h or 20 km/h (depending on the product) as measured at the site of application. Minimum wind speeds at night should be above 11 km/h to ensure turbulence (mixing of the air) and to minimize the likelihood of a surface temperature inversion being present.

No spray zones

A NO SPRAY ZONE is the downwind distance between the sprayed area and a sensitive area. The NO SPRAY ZONE cannot be sprayed when the wind is towards the sensitive area (which may be a residence, public area, water body, pasture, terrestrial vegetation or another susceptible crop), i.e. a label may include several NO SPRAY ZONE tables. The distance required
for the NO SPRAY ZONE may differ for the various types of sensitive areas. Always check the label to see if a no spray zone is required, and how wide the no spray zone has to be for the product you wish to apply. NO SPRAY ZONES for aerial applications are much larger than those required for ground application.

**Record keeping**

Record Keeping requirements are now included on the label or permit of many products. It is a legal requirement to maintain those records, in addition to any state based requirement for record keeping.

**Communication and neighbour notification**

Prior to spray application and product selection check the proximity of susceptible crops and sensitive areas such as houses, schools, waterways and riverbanks.

It is good practice to notify neighbours and staff of your spray intentions, regardless of label requirements. By doing this, sensitive crops or areas that you may not have been aware of can be accounted for.

Open communications with neighbours is critical when using Roundup Ready or Liberty Link cotton. Herbicide drift onto fields of cotton without the appropriate tolerance traits can result in serious yield losses.

Cotton is extremely sensitive to phenoxy via off target application. To assist with reducing drift it is essential that you identify your cotton fields on the cottonmap website. This map will be used by spray contractors, resellers, agronomist and neighbours to identify crops.

**Monitoring weather conditions**

Weather conditions need to be checked regularly during spray applications (this means continual visual observations and actual measurement at least every 20-30 minutes) and recorded as per label requirements.

Labels contain a legal requirement to measure weather parameters at the site of application. This can be done with handheld equipment (e.g. Kestrel 3000, 3500, 4000 or equivalent) or portable weather stations. Alternatively on-board weather stations that provide live weather information while the sprayer is operating (such as the Watchdog systems) are available.

**my6MP resources: Fact sheet on weather monitoring equipment.**

Growers can also subscribe to websites that provide forecasts of conditions for spraying up to 10 days in advance. These sites evaluate a range of factors to produce tables indicating times that would be suitable for spraying. You can access the websites at either Spraywisedecisions.com.au or Syngenta.com.au for more information.

**Temperature and humidity**

Higher ambient air temperatures and lower relative humidity conditions increase evaporation rates. Since droplet size of water-based sprays decreases rapidly with higher evaporation rates, drift tends to increase.

Water-based sprays should not be applied under conditions of high temperature and low relative humidity (RH). Spraying is best conducted when the delta T (the difference between the wet bulb and dry bulb) is more than 2 and less than 10°C. Refer to Fact Sheet on Tips to Reduce Spray Drift for a Delta T Chart in my6MP resources.

When using coarse sprays at high water volume rates, evaporation may be less significant, which may allow some applications to continue into marginal delta T conditions (where soil moisture exists, and the targets are not in a stressed condition). Never start a spraying operation when the Delta T is below 2 or above 10–12.

**my6MP resources: Tips for reducing drift fact sheet**

**Surface temperature inversions**

Labels state that spraying must not occur during a surface temperature inversion. There is a high risk of surface temperature inversions being present at night. For more information refer to the GRDC factsheets on Surface Temperature Inversions and Tips to reduce spray drift.

**my6MP resources: GRDC Surface temperature inversions and Tips to reduce spray drift**

**Vegetative plantings for buffers**

Effective vegetative buffers can reduce drift by as much as 60 to 90 per cent. A good buffer will be comprised of a mixture of tree and shrub species with foliage all the way to the ground. The planting arrangement and density should allow for air to partly flow through the barrier. Barriers without

<table>
<thead>
<tr>
<th>RELATIVE HERBICIDE VOLATILITY</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Active Ingredient</strong></td>
</tr>
<tr>
<td><strong>HIGH VOLATILITY</strong></td>
</tr>
<tr>
<td>2,4-D ethyl ester</td>
</tr>
<tr>
<td>2,4-D isobutyl ester</td>
</tr>
<tr>
<td>2,4-D n-butyl ester</td>
</tr>
<tr>
<td><strong>SOME VOLATILITY</strong></td>
</tr>
<tr>
<td>MCPA ethylhexyl ester</td>
</tr>
<tr>
<td>MCPA isooctyl ester</td>
</tr>
<tr>
<td>2,4-D isooctyl ester</td>
</tr>
<tr>
<td>triclopyr butoxyethyl ester</td>
</tr>
<tr>
<td>picloram isooctyl ester</td>
</tr>
<tr>
<td><strong>LOW VOLATILITY</strong></td>
</tr>
<tr>
<td>MCPA dimethyl amine salt</td>
</tr>
<tr>
<td>2,4-D dimethyl amine salt</td>
</tr>
<tr>
<td>2,4-D diethanolamine salt</td>
</tr>
<tr>
<td>2,4-D isopropylamine salt</td>
</tr>
<tr>
<td>2,4-D trisopropylamine</td>
</tr>
<tr>
<td>2,4-DB dimethyl amine salt</td>
</tr>
<tr>
<td>dicamba dimethyl amine salt</td>
</tr>
<tr>
<td>triclopyr triethylamine salt</td>
</tr>
<tr>
<td>picloram trisopropylamine</td>
</tr>
<tr>
<td>picloram triethylamine salt</td>
</tr>
</tbody>
</table>

From Mark Scott, Agricultural Chemicals Officer, NSW DPI. *The APVMA has taken the decision to continue to suspend the registration of products containing high volatile ester forms of 2,4-D, namely the ethyl, butyl and isobutyl esters. Refer to page 149 for more information.
Spray Application – sponsored by John Deere

Spray drift can occur as droplets and particles or as vapours.

Droplet and particle drift

Droplet and particle drift is a common cause of off-target damage from pesticides. It is particularly obvious where herbicides drift onto susceptible crops. Water in the spray droplets evaporates resulting in finer droplets and particles of herbicide. Smaller droplets remain airborne longer and hence are susceptible to further evaporation and drift kilometres away from the intended target. Droplet and particle drift is the easiest form of drift to prevent. Under good spraying conditions, droplets are carried down by air turbulence and gravity to collect on the intended plant surfaces.

Vapour drift

Vapour drift is the movement of volatile components of herbicides in air currents during or after application. Volatility refers to the likelihood that the herbicide will turn into a gas. Vapours may arise directly from spray or from the target surface for several hours or even days after application. The risk of vapour drift can be avoided by choosing active ingredients with low volatility. The amine and salt forms of herbicides have a lower volatility than the low volatile ester forms. Even products with low volatility are still susceptible to droplet and particle drift. Some examples of vapour drift risk from some different products are shown in the table on page 138.

Additional considerations for aerial applications

Aircraft setup and operation

Higher airspeeds (above approximately 110–115 knots) can cause air shear, where droplets shatter into smaller sizes. Some faster, larger turbine aircraft have difficulty in producing a Coarse Spray Quality due to their fast airspeed. Reducing air speed (through slower aircraft) and/or reducing nozzle angle or deflection is an effective way to reduce air shear. The lowest air shear occurs when aircraft nozzles are directed straight back on the aircraft (0°) and operated at higher pressure. The boom length on an aircraft should not exceed 65 to 75% of the wingspan, and sprays should only be released when the aircraft is level over the target (never while climbing).

All aerial operators (using hydraulic nozzles or rotary atomizers) should be able to provide a written assurance to the grower that they are complying with the product labels spray quality requirements.

Further information:

2014 Cotton Production Manual
Spraywise – Broadacre Application Guide – Available through Croplands Distributors.
The spray drift model ‘AgDRIFT’, is available for free download from www.agdrift.com
Fact sheets on droplet size classification, and drift management in aerial and ground applications are also available at this website.


Comprehensive information about droplet spectrums of nozzles under aerial application conditions is available from the United States Dept. of Agriculture at http://apmr.usda.gov/downloads/downloads.htm For aerially-applied 2,4-D sprays, from wind tunnel research, see www.aerialag.com.au

Additional resources can be found at www.myBMP.com.au

myBMP resources: DNR planning guidelines.doc

Summary of factors that influence spray drift and best practice

The aim of spray application is to transfer active ingredients through the atmosphere to the target in an effective manner with minimal off-target losses. Application technique needs to be matched to the target and weather conditions. Achieving the best outcome from spray application requires the careful consideration of many factors.

- Setting appropriate spray release height
- Travel speed for ground rigs
- Pressure at the nozzle
- Suitable water volumes and quality
- Nozzle selection
- Maintenance and hygiene

These factors are expanded in the Cotton Production Manual.

Spray Application – sponsored by John Deere

For more information on best practice for aerial and ground spray application go to www.myBMP.com.au.
(Photograph by Cotton Australia – Jack Hawkins)

airflow act like impermeable walls, directing wind containing the spray drift up and over the top of the barrier, increasing how far drift may travel. Do not locate vegetative buffers where airflow will be obstructed by adjacent objects such as turkey’s nests, water storages or large banks.

The optimum height for a vegetative buffer is 1.5 times the release height of the spray. Trees and shrubs are able to act as an effective barrier for ground applied sprays from early in their development. Most guidelines suggest that the optimum width of the barrier is 20 m with a 10 m maintenance strip on either side. It is important that remnant native vegetation is protected from negative impacts such as spray drift. This vegetation should be identified as sensitive areas along with riparian and waterways.

1American Society of Agricultural and Biological Engineers
2British Crop Production Council

140 COTTON PEST MANAGEMENT GUIDE 2014–15
This document is part of a larger publication -

The complete document can be found on the CRDC or myBMP web sites during the 2014-15 Australian cotton season

www.crdc.com.au
or

www.mybmp.com.au

DISCLAIMER
This document has been prepared by the authors for CRDC in good faith on the basis of available information.
While the information contained in the document has been formulated with all due care, the users of the document must obtain their own advice and conduct their own investigations and assessments of any proposals they are considering, in the light of their own individual circumstances.
The document is made available on the understanding that the CRDC, the authors and the publisher, their respective servants and agents accept no representation, statement or information whether expressed or implied in the document, and
disclaim all liability for any loss, damage, cost or expense incurred or arising by reason of any person using or relying on the information claimed in the document or by reason of any error, omission, defect or mis-statement (whether such error, omission or mis-statement is caused by or arises from negligence, lack of care or otherwise).
Whilst the information is considered true and correct as at 31 August 2014, changes in circumstances after the time of publication may impact on the accuracy of the information. The information may change without notice and the CRDC, the authors and the publisher and their respective servants and agents are not in any way liable for the accuracy of any information contained in this document.
Recognising that some of the information is provided by third parties, the CRDC, the authors and the publisher take no responsibility for the accuracy, currency, reliability and correctness of any information included in the document provided by third parties.
The product trade names in this publication are supplied on the understanding that no preference between equivalent products is intended and that the inclusion of a product does not imply endorsement by CRDC over any other equivalent product from another manufacturer.
ISSN 1442-8462
Production by Greenmount Press, 2014

Liberty® and Liberty Link® are Registered Trademarks of Bayer.
Bollgard II®, Roundup Ready Flex® and PLANTSHIELD® are registered trademarks of Monsanto Technology
LLC used under licence by Monsanto Australia Ltd.