

MANAGING SPRAY DRIFT FACT SHEET

CAUTION: RESEARCH ON UNREGISTERED PESTICIDE USE Any research with unregistered pesticides or of unregistered products reported in this document does not constitute a recommendation for that particular use by the authors or the authors' organisations. All pesticide applications must accord with the currently registered label for that particular pesticide, crop, pest and region.

Sprayright – to avoid drift Best management practices

Efficient pesticide application ensures effective spray coverage of the target while minimising off-target effects of the application. Operation managers and spray equipment operators have a moral and legal obligation to ensure that spray applications do not impact on neighbouring situations or landowners.

Good spray application management employs a number of techniques to minimise off-target movement.

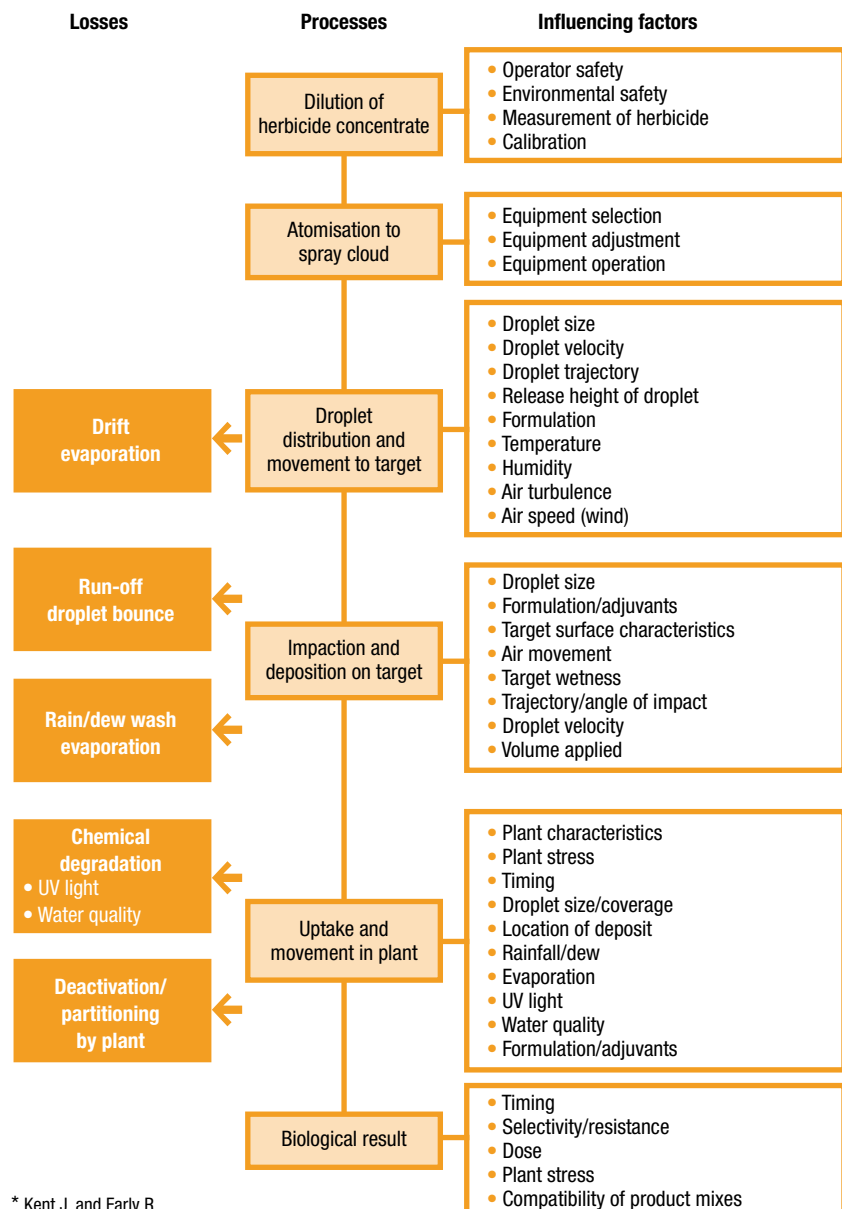
- **Spray under desirable weather conditions including appropriate temperatures and no inversions;**
- **Select the correct droplet size;**
- **Spray when there is a consistent crosswind;**
- **DO NOT spray with the wind direction toward sensitive areas;**
- **DO NOT spray when there is excessive wind speed;**
- **DO NOT operate with a boom height too high;**
- **Avoid spraying with volatile products.**

Assessing the situation

The variables associated with droplet movement and survival interact together in a complex manner. The information in this fact sheet can be used as a guide to help minimise the risk of off-target impacts. However, the most appropriate choice of droplet size, boom height set-up and choice of chemical and additive will vary for each situation; therefore each spray operation must be separately assessed. There will be situations when the risk of off-target movement will be too high even if 'best management practice' were applied.

When conditions are unfavourable the decision not to spray may be the 'best management practice'.

FIGURE 1 THE FACTORS AND PROCESS THAT INFLUENCE SPRAY DROPLET LOSSES*



* Kent J. and Early R.,
Pesticide Application in Vineyards,
2nd edition 1999

1. Communication

Identify any sensitive situation within a 3km radius. Make sure the operator knows the location of any susceptible crop or sensitive area near the crop to be sprayed.

To avoid conflict, talk to neighbours to determine if they are growing susceptible crops or have sensitive situations.

If conditions become unsuitable during the spray operation, tell the operator to stop.

Communication is fundamental to 'best management practice'.

2. Chemical selection

All pesticides have potential off-target effects. Select a non-volatile alternative instead of a volatile product. Volatile products may move from the target area hours after spraying.

Select chemicals that have low toxicity or are not toxic to the non-target situation.

Apply products according to the label directions. The droplet size produced by a nozzle may be changed by the product, its formulation and any additives (adjuvant) used. Do not apply more additive than indicated on the

label. A number of spray additives such as spray oils increase droplet size, where others such as wetting agents decrease the droplet size.

Use products for low volume or high volume application rather than ultra low volume (ULV) products. Low volume or high volume products can be applied using larger droplets.

3. Equipment selection

Equipment type

Well set-up air-assisted sprayers reduce the amount of drift by controlling the movement of any small droplets produced.

Shielded sprayers reduce drift by shielding any small droplets from prevailing wind.

Nozzle selection (see Table 1)

Larger droplets are at less risk of drifting.

When spraying close to sensitive areas, increase the droplet size to decrease the downwind movement of droplets. However, the droplet size selected must be able to control the pest. As droplet size is increased, a greater spray volume may be required to maintain coverage.

Operate nozzles within manufacturer's specifications to



ensure that patterns and overlaps are suitable. When buying nozzles obtain the relevant manufacturer's product specifications guide for nozzle use and equipment set-up.

An example of nozzle selection

Assumptions for this example:

- Spray liquid – a herbicide that has potential to cause off-target damage. The label indicates a coarse or very coarse droplet size, and spray volume in the range of 30 to 120L/ha.
- Travel speed 15 to 20 km/h.
- Application volume 70L/ha.

Coarse droplets are less susceptible to drift but may not produce adequate results in all situations.

Step 1: Determine the droplet size required by answering the following questions.

- What is the target: large flat target, small vertical, underneath a leaf?
- What is the product type: herbicide, insecticide, fungicide and systemic or contact?
- What does the label require?
- Are there any special drift considerations such as nearby sensitive situations?

TABLE 1 NOZZLE SELECTION

| Drift risk | High | Medium | Minimal |
|---|--|--|---|
| | Susceptible situation <1km downwind | Susceptible situation 1-30km downwind | Susceptible situation >30km downwind |
| Droplet size using BCPC & ASAE Standard | Coarse Droplets eg: venturi or air induction-type nozzles | Medium Droplets eg: pre-orifice nozzles | Fine Droplets eg: conventional fan |
| Nozzle pressure | Use minimum pressure. Refer to manufacturers' specifications for the appropriate pressure, as changes in pressure will change the droplet size, spray pattern and overlap. | | |
| Boom height | Minimise boom height. Refer to nozzle specifications. Lower heights are possible with 110° nozzles or by angling nozzle away from vertical. | | |
| Caution | Potential problems with grass contact and coverage. May not be suitable for insecticides and fungicides. Can require higher water volume. | Suitable for grass control at recommended pressures. Suitable for insecticides and fungicides. Nozzles still produce some fine droplets. | Most susceptible to changes in temperature and humidity – monitor conditions regularly. |
| Wind | 3-10km/h | 3-15km/h | 3-15km/h |
| Maximum temperature | 28°C at > 50% humidity | 28°C at > 50% humidity | 28°C at > 50% humidity |

NOTE: The above information is only to be used as a guide. The risk distances depend on the products being used and the nature of the sensitive situation. There are times when spraying cannot occur until conditions change.

Having the spray boom set too high increases the risk of drift and can negate the benefits of low-drift nozzles.



Step 2: Using Table 2, find the application volumes that are close to 70L/ha in the travel speed columns you have selected (15 – 20km/h)

- A number of speed, nozzle size and pressure combinations are possible. Five close combinations are highlighted: 110025 at 300kPa and 16km/h, 110025 at 400kPa and 18km/h, 11003 at 200kPa and 16km/h, 11003 at 250kPa and 18km/h, 11003 at 400kPa and 20km/h.

- When selecting larger orifice nozzles or higher pressures ensure that the sprayer pump and plumbing will operate satisfactorily.

Step 3: Use Table 3 to determine which combinations of nozzle size and pressure produce coarse or very coarse droplets.

- All options produce coarse or very coarse if selected as an air induction nozzle. A pre-orifice

nozzle 11003 at 200kPa will also produce a coarse droplet size.

Summary

Select the option that best suits your sprayer taking into account the sprayer pump capabilities and the operation speeds of the sprayer. In this example, the 11003 nozzle in a pre-orifice type offers a range of speed and pressure combinations to meet the label and drift mitigation requirements.

TABLE 2 NOZZLE CHARTS GIVING APPLICATION VOLUME FOR COMBINATIONS OF NOZZLE SIZE, NOZZLE PRESSURE AND TRAVEL SPEED. (NOTE THESE ARE EXAMPLES ONLY. Refer to charts supplied by manufacturers.)

| Nozzle Size | Pressure kPa | Nozzle Flow rate L/min | Application Volume L/ha (for 50cm nozzle spacing) | | | | | | | |
|-------------|--------------|------------------------|---|---------|---------|---------|---------|---------|---------|---------|
| | | | 10 km/h | 12 km/h | 14 km/h | 16 km/h | 18 km/h | 20 km/h | 22 km/h | 24 km/h |
| 11001 | 150 | 0.28 | 33.6 | 28.0 | 24.0 | 21.0 | 18.7 | 16.8 | 15.3 | 14.0 |
| | 200 | 0.32 | 38.8 | 32.3 | 27.7 | 24.2 | 21.6 | 19.4 | 17.6 | 16.2 |
| | 250 | 0.36 | 43.4 | 36.1 | 31.0 | 27.1 | 24.1 | 21.7 | 19.7 | 18.1 |
| | 300 | 0.40 | 47.5 | 39.6 | 33.9 | 29.7 | 26.4 | 23.8 | 21.6 | 19.8 |
| | 400 | 0.46 | 54.9 | 45.7 | 39.2 | 34.3 | 30.5 | 27.4 | 24.9 | 22.9 |
| 110015 | 150 | 0.42 | 50.4 | 42.0 | 36.0 | 31.5 | 28.0 | 25.2 | 22.9 | 21.0 |
| | 200 | 0.48 | 58.2 | 48.5 | 41.6 | 36.4 | 32.3 | 29.1 | 26.5 | 24.2 |
| | 250 | 0.54 | 65.1 | 54.2 | 46.5 | 40.7 | 36.1 | 32.5 | 29.6 | 27.1 |
| | 300 | 0.59 | 71.3 | 59.4 | 50.9 | 44.5 | 39.6 | 35.6 | 32.4 | 29.7 |
| | 400 | 0.69 | 82.3 | 68.6 | 58.8 | 51.4 | 45.7 | 41.2 | 37.4 | 34.3 |
| 11002 | 150 | 0.56 | 67.2 | 56.0 | 48.0 | 42.0 | 37.3 | 33.6 | 30.5 | 28.0 |
| | 200 | 0.65 | 77.6 | 64.7 | 55.4 | 48.5 | 43.1 | 38.8 | 35.3 | 32.3 |
| | 250 | 0.72 | 86.8 | 72.3 | 62.0 | 54.2 | 48.2 | 43.4 | 39.4 | 36.1 |
| | 300 | 0.79 | 95.0 | 79.2 | 67.9 | 59.4 | 52.8 | 47.5 | 43.2 | 39.6 |
| | 400 | 0.91 | 109.7 | 91.4 | 78.4 | 68.6 | 61.0 | 54.9 | 49.9 | 45.7 |
| 110025 | 150 | 0.70 | 84.0 | 70.0 | 60.0 | 52.5 | 46.7 | 42.0 | 38.2 | 35.0 |
| | 200 | 0.81 | 97.0 | 80.8 | 69.3 | 60.6 | 53.9 | 48.5 | 44.1 | 40.4 |
| | 250 | 0.90 | 108.4 | 90.4 | 77.5 | 67.8 | 60.2 | 54.2 | 49.3 | 45.2 |
| | 300 | 0.99 | 118.8 | 99.0 | 84.9 | 74.2 | 66.0 | 59.4 | 54.0 | 49.5 |
| | 400 | 1.14 | 137.2 | 114.3 | 98.0 | 85.7 | 76.2 | 68.6 | 62.4 | 57.2 |
| 11003 | 150 | 0.83 | 99.6 | 83.0 | 71.1 | 62.3 | 55.3 | 49.8 | 45.3 | 41.5 |
| | 200 | 0.96 | 115.0 | 95.8 | 82.1 | 71.9 | 63.9 | 57.5 | 52.3 | 47.9 |
| | 250 | 1.07 | 128.6 | 107.2 | 91.8 | 80.4 | 71.4 | 64.3 | 58.4 | 53.6 |
| | 300 | 1.17 | 140.9 | 117.4 | 100.6 | 88.0 | 78.3 | 70.4 | 64.0 | 58.7 |
| | 400 | 1.36 | 162.6 | 135.5 | 116.2 | 101.7 | 90.4 | 81.3 | 73.9 | 67.8 |

4. Equipment set-up

Minimise droplet release height

Under the same weather conditions, reducing the droplet release height significantly reduces the drift distance. Raising the boom height from 500mm to 750mm increases the drift potential by four times.

With ground rigs select 110° nozzles to minimise boom height. Minimise the amount of boom bounce and movement.

Ensure aerial operators stop spraying before climbing and do not start until the plane has levelled out. It may take two or more runs to treat the headlands.

Spray controllers

Set appropriate limits and alarms on controllers to ensure that if speed is increased the resulting nozzle pressure still produces the desired droplet size.

Speed

Travel speed selection requires considerable compromise. Increased travel speeds maximise the area covered while spraying conditions are suitable. However increased speed results in increased drift potential due to excessive boom movement, droplet shear



Water-sensitive paper is a useful tool for checking spray quality and the deposition of spray in the paddock.

resulting in smaller droplets and entrainment of fine droplets in eddies caused by the higher speeds.

5. Avoid undesirable weather conditions

Spray in neutral conditions (Figure 2). Do not spray when thermal (unstable) or inversion (stable) conditions exist. Significant off-target movement

results in these conditions. Check for these conditions using smoke or by observing the movement of spray droplets.

Use hand-held weather monitoring equipment or on-property weather stations to monitor conditions.

Keep accurate records of spraying conditions at the start, during and end of operations.

TABLE 3 EXAMPLE OF DROPLET SIZE CHARTS (Note these examples only. Refer to charts supplied by manufacturers.)
 VF = Very fine; F = Fine; M = Medium; VC = Very Coarse; C = Coarse; XC = Extremely Coarse

| Standard Nozzle | Pressure kPa | | | | |
|-----------------|--------------|-----|-----|-----|-----|
| | 150 | 200 | 250 | 300 | 400 |
| 11001 | F | F | F | F | VF |
| 110015 | F | F | F | F | F |
| 11002 | F | F | F | F | F |
| 110025 | M | F | F | F | F |
| 11003 | M | F | F | F | F |

| Pre-Orifice Nozzle | Pressure kPa | | | |
|--------------------|--------------|-----|-----|-----|
| | 200 | 250 | 300 | 400 |
| 110015 | F | F | F | F |
| 11002 | M | M | M | M |
| 11003 | C | M | M | M |

| Air Induction Nozzle | Pressure kPa | | | | |
|----------------------|--------------|-----|-----|-----|-----|
| | 200 | 250 | 300 | 400 | 450 |
| 110015 | VC | VC | VC | C | C |
| 11002 | VC | VC | VC | VC | C |
| 110025 | XC | VC | VC | VC | VC |
| 11003 | XC | XC | VC | VC | VC |



Tractor-mounted weather stations can help growers monitor spray conditions on-the-go.

6. Spray with a crosswind between 3-15 km/h

Direction is often variable under light wind conditions and may result in unpredictable off-target movement. With no wind, there is a risk that off-target movement will occur if a wind springs up.

With constant crosswind, the spray swath will be predictable. Susceptible crops in the upwind direction will not be contaminated.

High wind speeds have the potential to increase the distance droplets travel downwind. High wind speed coupled with high travel speeds may increase drift from air induction nozzles due to shear of the droplets.

7. Spray at temperatures of less than 28°C and high humidity

When using water-based products, evaporation of the spray droplets increases off-target movement. Spray when temperatures are less than 28°C and the relative humidity is high, that is, when Delta T (ΔT , the difference between wet and dry bulb temperatures) is less than 8°C (see Table 4 and Figures 3 and 4).

8. Buffer zone

Small droplets travel in the wind currents until they are caught by a target. All spray application is characterised by a peak

deposit close to the centre line of application and a downwind tail. The amount of pesticide in the downwind tail is affected by factors such as wind speed, release height, droplet size, and catching efficiency of the surface.

Downwind 'buffer' areas have the capability to catch droplets that move off-target. The type of buffer determines the ability to trap small droplets. An unsprayed strip on the downwind side of a crop to be treated can be used.

For ground spraying, a 50m strip is suggested and for aerial spraying 500m.

Other buffers can be specifically vegetated strips.

Bare fallows have much lower catching efficiency than a growing crop such as wheat or cotton. The downwind buffer distance for bare fallow condition may be much higher than 500m.

9. Training and accreditation

Ensure spray equipment operators receive appropriate training: for example Chemcert® or SMARTtrain®.

10. Records

Keeping records satisfies legal requirements, for example state pesticide application and Workplace Health & Safety legislation, as well as providing important information to manage future spray applications. These requirements vary from state to state and growers should make themselves aware of these requirements.

11. Engaging contractors

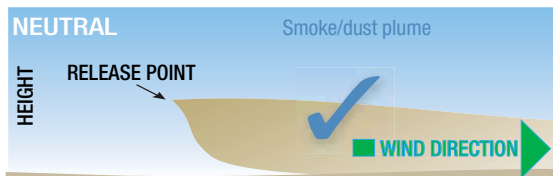
Use licensed contractors who have appropriate insurance cover and industry accreditation, such as Spraysafe® for aerial operators.

Confirm all application requests with written spray orders. When engaging a contractor you still have a duty of care to supervise that operation.

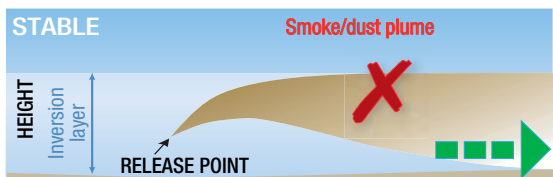
TABLE 4 MINIMUM HUMIDITY FOR VARIOUS TEMPERATURES TO ACHIEVE ΔT OF LESS THAN 8°C.

| Temperature | Minimum humidity |
|-------------|------------------|
| 30°C | 50% |
| 25°C | 45% |
| 20°C | 40% |

FIGURE 2 SMOKE OR DUST BEHAVIOUR INDICATES ATMOSPHERIC STABILITY: NEUTRAL CONDITIONS ARE IDEAL FOR SPRAY APPLICATION



NEUTRAL CONDITIONS are most likely in the early morning and early evening. Smoke or dust will spread out in an even pattern a short distance from the release point, and fall to the ground under gravity.



STABLE CONDITIONS are most likely in the early evening or overnight. Smoke/dust may initially rise, but will spread out at the inversion level and may slowly descend, undispersed, at a distance from the release point. Smoke/dust will move towards lower points in the landscape, even in the absence of wind.



UNSTABLE CONDITIONS are most likely mid-morning to late afternoon. Smoke or dust will rise vertically and disperse.

SOURCE: Based on information from the Australian Government Bureau of Meteorology leaflet *Weather for Pesticide Spraying*

FIGURE 3 SELECTING THE RIGHT DELTA ΔT CONDITIONS FOR SPRAYING

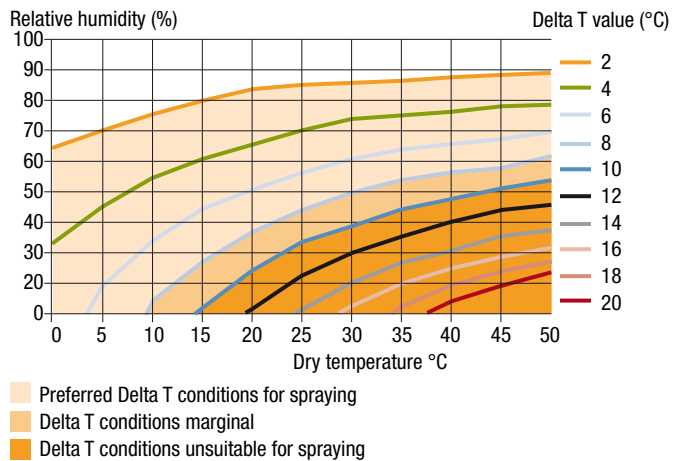
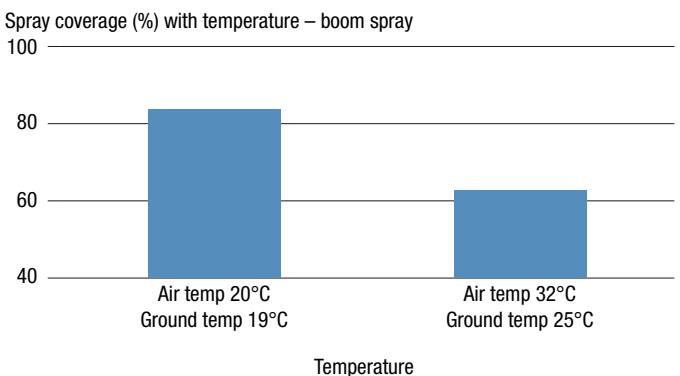


FIGURE 4 EFFECT OF TEMPERATURE ON SPRAY COVERAGE OF FINE DROPLETS



Useful resources

- SprayLog is available from QDPI&F (07) 4688 1200
- Australian Pesticides and Veterinary Medicine Authority www.apvma.gov.au
- Chemcert® – search the web for your state-based organisation
- SMARTtrain® www.smartrain-publications.com
- Spraysafe® www.aerialag.com.au
- *Adjuvants: Oils, Surfactants & other Additives for Farm Chemicals*, published by Conservation Farmers Inc., available from Ground Cover Direct www.grdc.com.au/director/events/bookshop
- *SPRAYpak Cotton Growers' Spray Application Handbook, 2nd Edition*, Cotton Research and Development Corporation
- State Departments of Primary Industries
- *Spray Drift Management, Principles, Strategies and Supporting Information*, Primary Industries Standing Committee (SCARM) Report 82 www.publish.csiro.au
- Nozzle manufacturers' websites
- Visit the GRDC website www.grdc.com.au/weedlinks, www.grdc.com.au/pestlinks, www.grdc.com.au/rustlinks

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