

Avoiding spray drift in blueberries

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Introduction

An effective spray application will deliver the right amount of product to the desired area. However, if any part of the spray equipment is not set up or calibrated appropriately, the target could be missed, or spray might drift to non-target areas. This Primefact will briefly describe the main points you should consider before going out to spray your blueberries.

Type of sprayer used

The three main types of sprayers used in blueberries are the ducted air sprayer (Figure 1), the multi-head sprayer (Figure 2) and the axial fan air-blast sprayer (Figure 3). The axial fan air-blast sprayer is more prone to missing the target than the multi-head and ducted sprayers, but by carefully following the instructions included herein, many of the off-target risks can be reduced.



Figure 1. A ducted air sprayer. Photo: Melinda Simpson.

As much as 60% of the applied spray can end up either on the ground or drifting away if spray equipment is not set up properly.



Figure 2. A multi-head sprayer. Photo: Dave Farmer, Croplands.



Figure 3. An axial air-blast sprayer. Photo: Melinda Simpson.

Adjust spray water volume to match the canopy size

Chemical application rate is dependent on spray water volume (when using the per 100 L water rate) and spray water volume is dependent on crop canopy volume. An industry standard for spray water volumes in blueberries is

shown in Figure 4. If spray water volumes are not matched to crop canopy volumes (i.e. less water than industry standard), chemical application rates should be adjusted (i.e. using a concentration factor) to achieve the same dose per plant. Using these water volumes and the per 100 L label rate will achieve the most desirable amount of chemical per leaf area.

Dilute spray volume is required to calculate the correct amount of chemical to be applied to cover the canopy. Water-sensitive paper should be used to verify these volumes provide adequate coverage.

Nozzle selection

Coarser droplets are preferable when spraying near sensitive areas (always follow the label recommendations). Combining coarse spray quality and an appropriate surfactant will significantly reduce the risk of off-target drift. Some product labels state the size of the spray droplets required and/or nominated no-spray zones; both must be followed.

Over time, all nozzles suffer from wear and tear, causing their orifices to get bigger, increasing the desired or calibrated output. When nozzles are producing up to a 10% increase in the flow rate at a given pressure compared to a new nozzle or manufacturer's guide, they should be replaced. A reduction in flow may indicate blockages or restriction to a particular nozzle. Uneven wear can cause poor spray patterns

and poor control; both potentially causing crop damage. Regularly cleaning nozzles will improve delivery rates by removing debris build-up (Figure 5).

Rules of thumb with nozzles:

- hollow cone nozzles produce finer sprays than solid cone nozzles
- wide-angle nozzles produce finer sprays than narrow-angle nozzles
- smaller orifice nozzles produce finer sprays than higher output nozzles at equivalent pressures.



Figure 5. Regularly cleaning nozzles will improve delivery rates by removing debris build-up. Photo: Melinda Simpson.

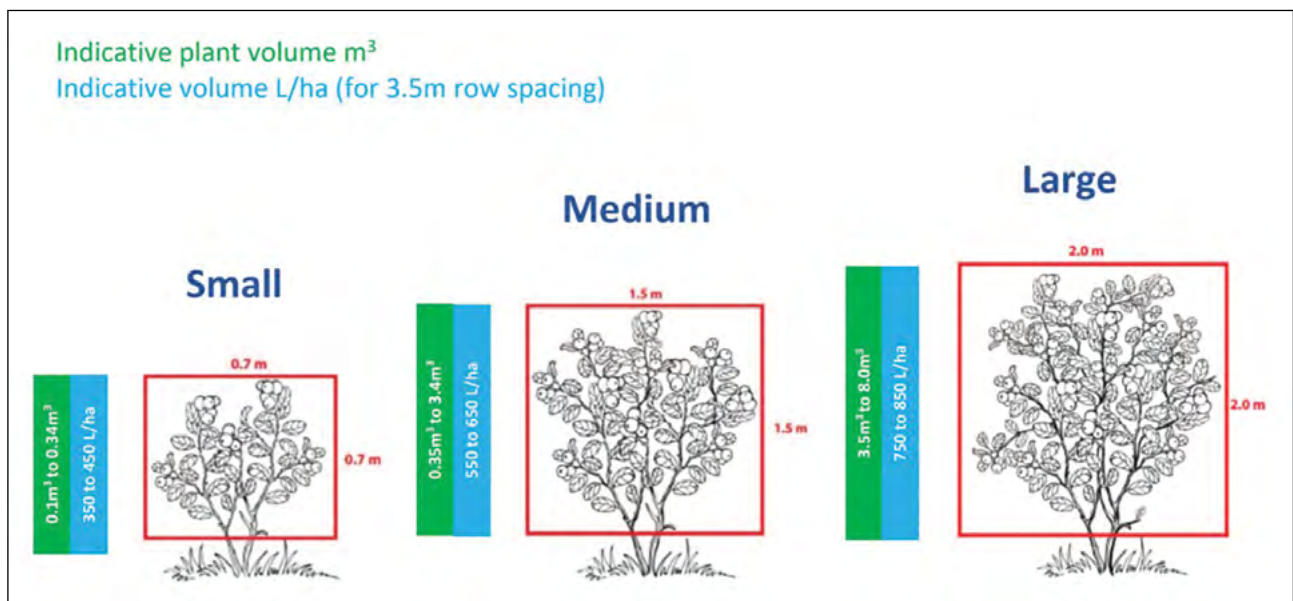


Figure 4. Industry standards for water volumes for dilute spraying in blueberries.

Direct the sprayer output towards the target canopy

The main risk in spraying is failing to hit the target. To assess your spray output, park the sprayer in a block to be treated. Look at which nozzles should be turned on and what proportion of the output is directed to the different bush zones (Figure 6). Adjust nozzles as required for better coverage and use water-sensitive paper (Page 6) or fluorescent tracer dyes and ultraviolet lights to help you assess the coverage. An observer should monitor leaf movement to ensure sprayer-generated air is displacing the air within the canopy.

Make sure you turn off the sprayer at the ends of rows when turning. When spraying outside rows of a block, use single-sided spraying i.e. turn off nozzles not directed at the crop row.

Manage travel speed

Travel speed is a compromise between getting the job completed in good time and achieving thorough coverage. Research has shown that by increasing travel speeds from 2.1 km/h to 7.7 km/h while keeping all other settings the same, the deposition rate of chemical halves in axial air-blast sprayers (Celen et al. 2008). Sprayer speeds can have a significant effect on spray deposits distribution i.e. increasing sprayer speed can increase drift.

Sprayer speed and the effect on spray drift is a very complex subject, therefore many factors need to be taken into consideration including weather conditions, droplet size, type of sprayer, air speed and tree canopy density and height.



Figure 6. Assessing the sprayer output is towards the canopy. Photo: Melinda Simpson.

Use deflectors

When using axial air-blast sprayers, deflectors can be used to channel the air into the target rather than over or under the target (Figure 7). Deflectors help to compress the air from sprayers into a tighter stream that easily reaches and penetrates the canopy.

To check where the air is going from your sprayer, attach 25 cm lengths of strong ribbon to each active nozzle position. Turn the sprayer on and the direction that the ribbons move will show you where the air (and spray) is being directed (Figure 8). Adjust the nozzles and deflectors so that the air stream is directed into the canopy. Note, most manufacturers can supply aftermarket deflectors.



Figure 7. Deflectors on an air-blast sprayer. Photo: Sprayers 101.



Figure 8. Using ribbons to work out where the air is being directed from the sprayer. Photo: Airblast101 Handbook.

Consider fan speed

Throughout the season it is important to adjust fan settings to produce the most effective air speed. This is important because the air carries the chemical and if the air speed is too fast or too slow, the chemical will end up in the next

row, on the ground or drifting away.

To estimate the required air speed, tie 25 cm lengths of ribbon to the top, middle and lower parts of the plant on the opposite side of the canopy. Drive past the canopy and note where the ribbons are being directed as this will tell you if you have the correct air speed for spraying (Figure 9).

How to reduce air speed

Many sprayers have gearboxes that allow you to change your fan speed. Consider using 'gear up throttle down' (GUTD) to do this. If you go to a higher gear and reduce your throttle speed to around 1500 rpm, you will slow your fan speed. It will also give you the added benefit of reducing fuel use by approximately 40%. Note, GUTD will only work if you have piston, diaphragm or roller pumps; it will not work with centrifugal pumps.

Increasing ground speed will reduce air penetration.

Note, if you increase the air speed, the sprayer volume will need to be recalibrated.

How to increase air speed

- change fan gear
- reduce speed but remember the sprayer volume will need to be recalibrated
- if the canopy is too dense, it may need thinning.

Natural and artificial barriers for spray drift mitigation

An artificial or natural barrier may be effective at intercepting some airborne droplets and deflecting the airflow to reduce spray drift potential by 60–90%. Wind slows and distorts as it travels through porous barriers such as a windbreak. Windbreaks protect for approximately 10 times their height. If the windbreak is 20 m high, the area 200 m beyond it will receive reduced pesticide. The windbreak should have 50% porosity (i.e. you can see through it) as solid windbreaks that allow little or no wind through cause turbulence on the side it is meant to protect.

Artificial barriers

Artificial barriers can be made of a variety of materials such as shade cloth with 50% porosity (Figure 10). The advantage of artificial barriers is little or no waiting time for establishment. However, they are generally not as high as natural windbreaks, so the distance of protection is less. [Dr Andrew Hewitt](#), Senior Research Fellow School of Agriculture and Food Sciences, University of Queensland, is about to undertake wind tunnel experiments to improve the efficacy of artificial windbreaks. Updates on this research will be communicated to the industry.

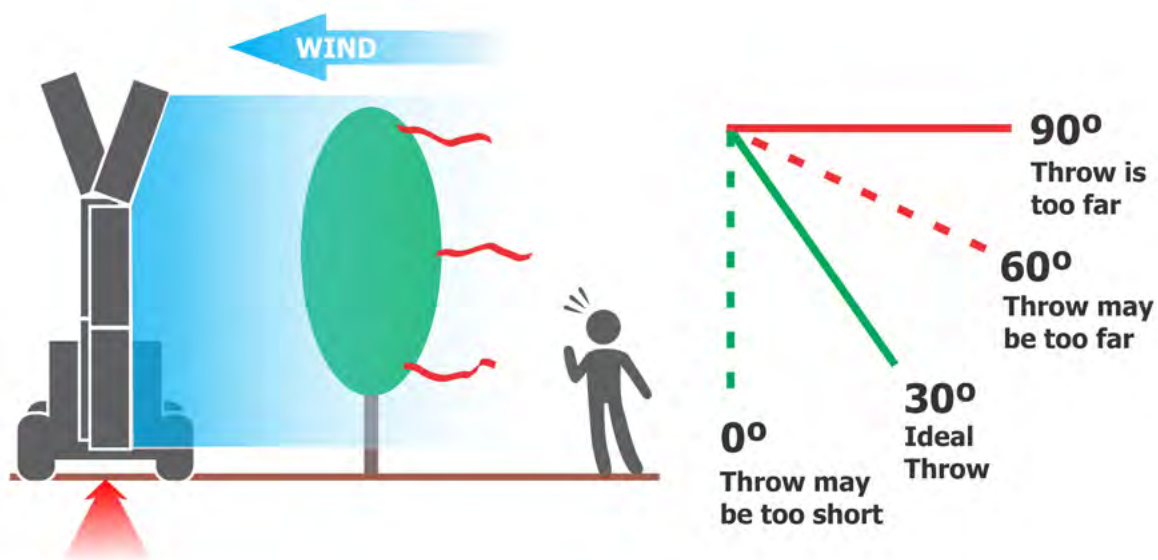


Figure 9. Using ribbons to determine adequate air speed for spraying. Source: Airblast 101 Handbook.

Vegetative buffers

Vegetation barriers may be planted and maintained on downwind edges of fields and properties adjacent to susceptible areas. Trees and shrubs planted to form buffer zones should be a narrow leaf type, i.e. *Casuarina* (Figure 11) as these are much more effective at capturing droplets than larger leaved species.



Figure 10. An artificial barrier made of shade cloth with 50% porosity. Photo: Andrew Hewitt.



Figure 11. *Casuarina* as a vegetative buffer. These are evergreen and have fine greyish needle-like foliage down to ground level. *Casuarina* requires hedging to be effective.

Weather conditions affecting spraying

Wind

Avoid spraying when the wind is blowing towards a non-target sensitive area and during calm or still conditions as this is when droplets are more likely to remain suspended in the

air. The ideal safe wind speed is 7–10 km/h. Leaves and twigs are in constant motion (a light breeze). Wind speeds of 11–14 km/h (moderate breeze) are suitable for spraying if you are using low drift nozzles or higher volume application (80–120 L/ha per nozzle).

Avoid spraying when wind speed is too low (<4-5 km/h) or too high (>15 km/h) and wind direction is towards sensitive areas. Also avoid spraying when wind speed is < 10 km/h when the wind direction is towards the coast and the sun is less than 20 degrees above the horizon.

Be aware that drainage winds and morning land breezes do not mix the air the way that synoptic winds (BOM predicted direction). Drainage winds and land breezes can transport droplets far from the application site.

High temperatures

Avoid spraying when temperatures exceed 28 °C.

Humidity

Avoid spraying when relative humidity is low i.e. when Delta T (the difference between wet and dry thermometers; Figure 12) exceeds 10 °C. Avoid spraying when the delta T is above 8–10 °C with a medium spray quality or finer. High humidity extends droplet life and can greatly increase the drift hazard from fine droplets under local surface temperature. This results from an increased life of droplets smaller than 100 microns.

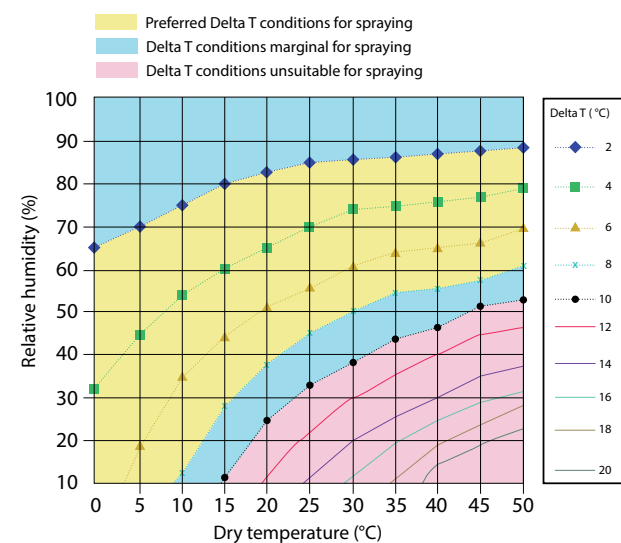


Figure 12. Delta T chart indicating appropriate conditions for spraying.

Methods to assess coverage

Water-sensitive paper

Water-sensitive paper (Figure 13) is an effective and economical way to monitor spray distribution. To test your coverage, place six pieces of water-sensitive paper per plant, locating them on the top, middle and bottom and on the underside and top of the leaf surface, for multiple plants along a row. Generally, 85 fine-medium-sized droplets per square centimetre, with about 15% total surface coverage, should be adequate for most foliar applications. Be prepared to make changes to your sprayer set-up and calibration to compensate for plant height, canopy density and weather conditions throughout the season. Using water-sensitive paper takes some time and effort but is far more accurate than looking over your shoulder and/or leaf residue.

Folding the water sensitive paper in half before placing in the canopy can provide an opportunity to look at upper and lower leaf coverage.

Take photos of the setup you use for future reference to see if changes have improved deposition and coverage. With your smartphone, you can use the SnapCard App to quantify spray coverage from a water sensitive spray card.

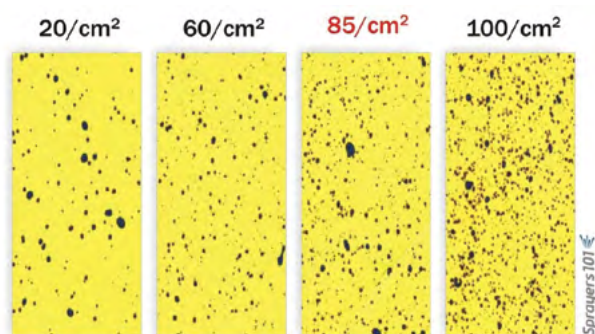


Figure 13. 85 droplets per square centimetre provides the appropriate coverage. Photo: Sprayers 101.

Clay markers

Spraying with clay markers such as kaolin clay shows coverage over the entire canopy as well as in detail. Clay markers are also effective at picking up uneven banding or shading in the canopy as well as excessive run-off (Figure 14).

The clay droplets need to dry to become visible and it is advisable to wait 20 minutes after applying them before carrying out the assessment. If using clay markers, make sure you clean your tank and nozzles afterwards as

it can clog up nozzles and may deactivate some products in future tanks.

UV dyes

There are commercially available, water-soluble, non-toxic fluorescent dyes that can be used to assess where sprays have deposited. The dyes highlight where individual droplets have landed within the crop, or onto the inter-row. To be able to see the individual droplets requires the use of a black light ultraviolet (UV-A) torch or hand-held UV-A lamp that causes the individual droplets to glow in the dark (Figure 15).



Figure 14. Using clay markers to demonstrate coverage. Photo: Jeremy Bright.



Figure 15. Using fluorescent dyes to demonstrate coverage. Photo: Jeremy Bright.

Summary

Ensuring your spraying equipment is set up correctly will help reduce the risk of spray drift. Always adjust the spray water volume to match the canopy size and select the right nozzle for the job. Use ribbons to assess sprayer output and adjust the nozzles until the output is directed towards the target area.

If necessary, use a deflector (if using an axial air-blast sprayer) to channel the air into the target rather than over or under the target.

Make sure you travel at the most appropriate speed to get the desired coverage. Fan speed must also be adjusted to produce the most effective air speed so that the chemical is carried to the target. Using the 'ribbon method' is an easy way to assess this. Remember though, any changes made to the travel or fan speed might require recalibration of the sprayer volume. Physical barriers can be used to help prevent spray drift and these can be either natural (e.g. a tree line) or artificial (e.g. shade cloth).

Only apply sprays in suitable weather conditions such as when the wind is between 7–10 km/h and away from sensitive areas, the temperature is below 28 °C and Delta T is within the preferred range. Finally, you should assess the coverage using either water-sensitive paper, clay markers or UV dyes.



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