NEED TO KNOW

GLOBAL EXTENSION TEAM

UNDERSTANDING SPRAY DRIFT

NK54

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AT A GLANCE

SPRAY DRIFT

Agrichemical losses from orchard spraying mostly come from drift of spray droplets that move downwind at the time of application.

Losses from airblast spraying are usually 1%-2% of the applied spray and virtually all will deposit within 30 metres downwind of the treated area (less if effective shelter is present). Highest deposits occur closest to the treated area.

PREVENTING SPRAY DRIFT

Minimising the quantity of spray that is projected too high into the air, or towards downwind block edges, will greatly reduce off target losses.

Sprayer operating practices will largely determine how much spray is lost as drift.

Effective spraying risk assessments, with appropriate operator responses to these will greatly help reduce risks of spray drift.

Off-target movement of agrichemcials beyond the target application area is highly undesirable and needs to be managed and minimised – especially where there is risk of losses onto sensitive areas, where people, animals, crops or waterways may be at risk of harm or contamination. Off-target movement can occur in two main ways:

1) as drift, which is the movement of spray as droplets beyond the target application area during or soon after spray application (primary losses); and
2) through movement of spray-contaminated dust or soil particles, or movement of spray as a vapour following volatilisation from treated surfaces (secondary losses).

In kiwifruit we are most concerned with primary losses caused by drift at the time of spraying.

Drift is influenced by a suite of risk factors that can be assessed and managed. Off target drift comes from the portion of the spray plume that is directed above and/or beyond the target canopy. The key factors that will determine how much of the spray plume is available to drift are;

- droplet size (smaller = higher risk)
- spray release height (higher = higher risk)
- wind speed and turbulence (higher = higher risk).

Drift losses can be divided into two types "true drift" versus "overspray";

"True drift"= losses of very small (smaller than 70-100 micron) spray droplets that escape into the air above the canopy and can potentially be carried long distances. Deposits from these reduce massively through dilution with increasing distance. Usually only a tiny fraction of the spray plume, this is more a contamination issue rather than a significant risk of harm. However, deposits might still be detected in residue tests and it is still important that these losses are minimised.

The quantity of true drift will increase with increasing height of spray plume projection, and with increasing wind speeds and turbulence. These tiny droplets have no energy of their own and move with the air mass they're released into. If it's windy, they move downwind. If the air is turbulent, they move up and down. They have the potential to evaporate, and so become smaller and to move further off target.

"*Overspray*" = losses in larger droplets (bigger than about 70-100 microns) that have been projected beyond the treated area by the sprayer. These typically deposit within about 10-30 m of the downwind edge of the treated area. Because they contain most of the off target spray volume they can be deposited in concentrations that could potentially cause harm.

Overspray losses are largely preventable and are often caused by bad sprayer operator decisions, poor turning practices and too much air assistance.

If the atmosphere is stable and an inversion layer forms where a mass of warm air sits on top of cooler air near ground level, the buoyant fraction will stay aloft and concentrated and can deposit long distances away from where they were produced – for this reason we aim to **always avoid spraying under inversion conditions**. Inversion conditions usually only occur on still clear nights and can continue into the morning until mixing winds occur.

With good spraying practices, the driftable proportion of even a fine droplet spray plume in kiwifruit will be a very small proportion (less than about 1%) of the total spray volume. Losses when spraying dormant and developing spring canopies can be higher, but should still be only a small proportion (less than about 2-5%) of the total applied volume.

The downwind deposit curves for apple spraying in Figure 1 provide a good example of the ranges of downwind deposits seen from airblast orchard spraying with fine droplets. This highlights the higher losses in dormant and developing canopies and the potential to use downwind buffer zones to allow overspray to safely deposit.

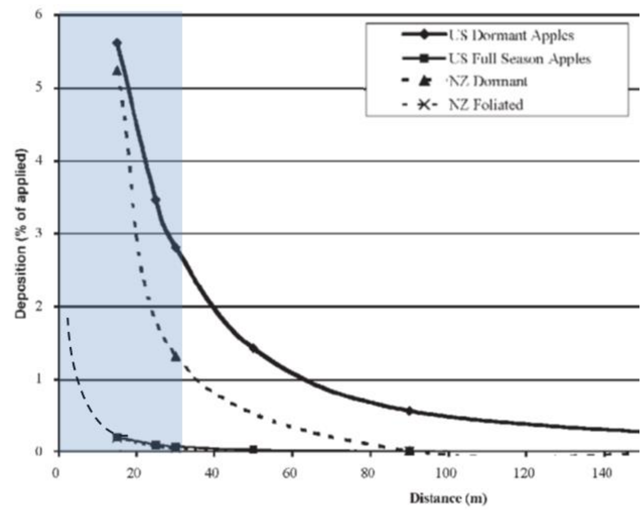

Figure 1 – Downwind spray deposits from dormant and foliated apple canopies expressed as a percentage of the applied product rate.

The applicator is responsible for primary drift because it occurs at the time of spraying and the way the sprayer is operated will determine how much occurs. Factors related to the application equipment (for example, droplet size, height of release of the spray) can be adjusted at the time of spraying, when judgements about the weather (especially, wind speed, wind direction) can be made.

SPRAY RETENTION EFFICIENCY

When spraying dormant kiwifruit canopies only about 5% of the applied spray volume deposits on the target canes and wood, with about another 5% landing on structures and wires. That leaves a lot of the applied spray volume that could potentially be lost as drift (in practice most is deposited on the ground within the treated area). For this reason we use large droplet, low drift sprays in the dormant and early season.

Unfortunately, large droplet sprays give slightly worse coverage and deposits than can be achieved with fine droplet sprays. The good news is that fully developed kiwifruit canopies are very efficient collectors of the spray plume and 80-90% of the applied spray volume should deposit on regular canopies from about flowering and beyond. This allows fine droplet sprays to be safely used on fully foliated canopies without much risk of spray drift – provided operators are careful on downwind edge rows and do not allow excessive spray projection above the target canopy.

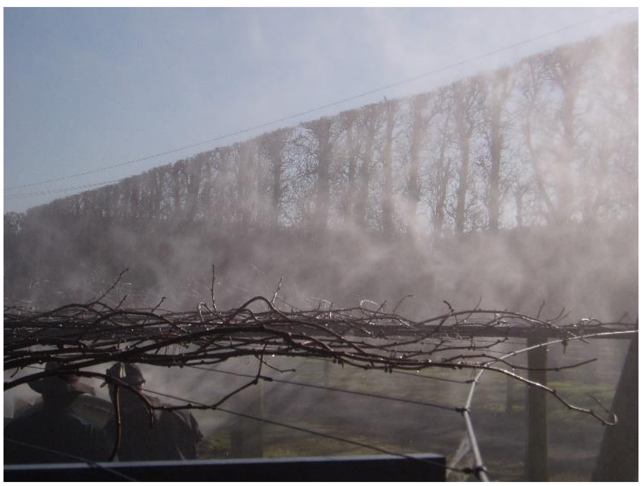

Figure 2 – spray plume being pushed too high above and beyond the target canopy

PROJECTED SPRAY DRIFT (OVERSPRAY)

Sprayer operators should be able to completely manage projected spray drift issues and can do so if they are aware of them and have sensible management options in place.

Projected drift is largely a result of poor spraying practices on edge- and end-rows, when the operator has allowed spray to be projected towards and beyond the downwind edge of the block. Overspray usually occurs through some combination of;

- poor row end turning practices (leaving sprayer on after it has exited the row)
- leaks or bad taps that leave the sprayer projecting spray towards block boundaries
- use of too much air assistance driving the spray plume to more than ca.1m beyond the furthest foliage (and potentially drawing spray back into fans and outwards on edge rows)
- by failing to recognise that spray in the first 1-3 downwind edge rows can be actively projected beyond the treated area.

Projected drift can involve significant quantities of chemical and this type of off-target movement is something that is totally in the control of the operator and is the wetting type of drift that will seriously annoy passing drivers, cyclists, walkers, neighbours etc. It is highly visible and simply should not occur.

MANAGING SPRAY DRIFT

The key spray drift risk factors that sprayer operators can directly control are;

Droplet size

- use large droplet AI nozzles + appropriate adjuvants in high risk situations.

Height and distance of spray projection

- there should be no need to project the spray plume more than about 1-2m above and beyond the target canopy.
- find travel speed and fan speed combinations that deliver controlled spray projection (consider reducing PTO speed and/or fan pitch and/or layers of shelter cloth over the fan intake to adjust air outputs).
- Turning off sprayer air assistance on edge rows may also be an option to help minimise potential losses.

Spraying patterns on edge rows

- it is practical to look to just treat the first, second and possibly even the third rows on a downwind block edge with the spray plume projected only into the block (ie no projection towards the downwind edge).
- Two approaches to maintaining application rates on these edge row sprays are 1) to double pass these rows (an up and back pass in the same row with just one side of the sprayer operating) or 2) to halve travel

speed with a single pass down the row with just one side of the sprayer operating.

- Yes, both the practices above will deliver more uneven edge row deposits, but this might be a necessary compromise.

Timing application to take advantage of favourable wind conditions

- A decision not to treat edge rows under unfavourable wind conditions is a real option. Yes, this complicates spraying operations, but sprayer operators need to be empowered to consistently make these types of decisions.

Developing practical rules for sprayer management to prevent spray drift requires that operators are confident as to how far spray is being projected under different setups and conditions. Visualising how high and far a spray plume is projected requires someone to observe the plume interaction with the canopy from outside the sprayer – the driver often simply cannot see exactly what the plume is doing.

Monitoring and responding to wind conditions on sensitive boundaries is a really important risk management tool. The best tool to facilitate this is a visual wind direction and speed indicator that is placed near sensitive boundaries. Inexpensive windsocks are readily available (eg https://pilotshop.co.nz/collections/windsocks) and tools like this should be used as part of spraying risk assessment and management decisions.

SHELTER AND DRIFT

Effective boundary shelter can provide both a visual screen and act as a significant collector of spray drift. The presence of an effective shelter can allow downwind buffer zone distances to sensitive areas to be reduced to about a third of the 30 metres recommended for orchard spraying without shelter.

To be effective shelter needs to be;

- higher than the observed height that the spray plume reaches
- continuous (large gaps greater than about 1m will tend to funnel and increase wind speeds)
- porous to allow wind to move through it and deposit droplets
- three dimensional: the greater the width the better the drift reduction. Two layers of artificial 50% shelter cloth can perform almost as well as a good natural shelter belt, while the drift reduction from a single layer of shelter cloth is quite limited.

Figure 3 – too windy to spray? Windsocks on senstivie boundaries are key operator risk assessment tools.

FURTHER READING

- KiwiTech Bulletin N39 – Best Practice Guide – Spraying https://canopy.zespri.com/EN/industry/pubs/kiwitech/Documents/N39.pdf
- KiwiTech Bulletin N98 – Dormant and Early Spring Spray Application https://canopy.zespri.com/EN/industry/pubs/kiwitech/Documents/N98.pdf
- Support for Safe Spraying Booklet https://canopy.zespri.com/EN/grow/GET/GET-webinar-series/Documents/Guide-to-safe-spraying.pdf

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