Optimising Sprays in Berry Crops

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This article was written using information presented at the Berry Spray Optimisation webinar on 12 February 2025 by Scott Mathew, Product Lead Viticulture & Fruit at Syngenta. You can watch the Webinar at bit.ly/4ljHLmV or scan the QR code.

A berry industry webinar was held on 12 February 2025 focused on understanding and optimising sprays in berry crops. Scott Mathew, Product Lead in Viticulture & Fruit from Syngenta presented on a range of topics, including how crop protection products work, factors that affect their performance and how to get the dose right. The webinar was well attended with 53 growers, researchers and industry representatives tuning in, and it was great to see keen interest from berry growers who made up 81% of attendees. This article includes a summary of the topics covered in the webinar.

Limiting success factors for sprays

There are four main limiting success factors for sprays:

1. **Right product:** this requires a sound knowledge of the target pest or disease and enables us to better understand how it can be controlled
2. **Right dose:** check the product label and understand the required rates for the product, including understanding the difference between a 'per 100L' rate and a 'per hectare' rate
3. **Right coverage:** optimising the spraying setup, including spray volume, nozzle size, pressure and droplet size. Products require different levels of coverage in terms of water volumes and droplet distribution
4. **Right timing:** requires good observation of the crop stage, pest lifecycle and weather conditions. Good planning around weather conditions helps ensure the product is applied at the appropriate time

Types of fungicides

Preventative fungicides prevent spore germination or penetration of the pathogen into the plant. Preventative fungicides should be applied *before* disease development.

Curative fungicides are designed to be applied when the disease is present but before symptoms are visible.

Eradicant fungicides can be applied to the plant *after* symptoms are visible, but there are limited fungicide products available with eradicant activity and none currently available for berry crops in Australia.

Contact vs systemic fungicides

A **contact fungicide** is a type of fungicide that remains on the surface of a plant and doesn't penetrate into the plant tissue. It protects the plant by creating a barrier against fungal pathogens when sprayed, essentially acting as a shield on the leaf surface.

A **systemic fungicide** is a type of fungicide that is absorbed into the plant and then moves throughout its tissues, effectively protecting the plant from fungal infections and potentially even controlling existing ones. Unlike contact fungicides which only protect the areas they are sprayed, systemic fungicides offer a more comprehensive and long-lasting protection.

How products work in the plant

Protectant or contact products spread out on the surface where the product is deposited but do not move inside the plant. As a general rule, contact pesticides require more coverage than systemic pesticides as they are not mobile within the plant and only control the area where they are applied.

Examples: copper, mancozeb, chlorothalonil

Volatile (vapour activity) products are compounds that can volatilise after being applied to the plant and redistribute to other areas within the canopy, however good coverage is still essential to maximise performance.

Examples: sulphur, cyflufenamid (Flute®)

Translaminar products can only move short distances from one side of the leaf to the other, and do not move through the plant. Scott explained that many translaminar products are labelled as 'systemic', which can be misleading as they do not move throughout the plant as a systemic product would.

Examples: emamectin (Proclaim®), cyflufenamid (Flute®)

Xylem mobile products are mobile in the plant but can only move upwards and outwards in the direction of the xylem stream from the point of application.

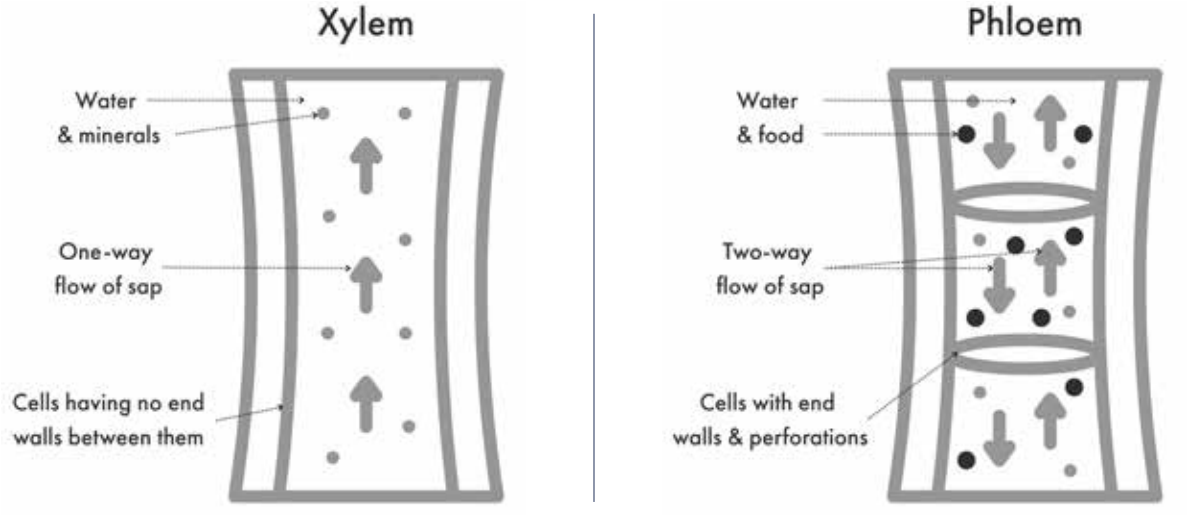
Examples: Switch®, propiconazole (Tilt®)

The attributes of different active ingredients can be combined into dual active products which provide complementing modes of activity to better target the pest or disease. For example, Miravis Prime® (pydiflumetofen & fludioxonil) incorporates two actives which provide translaminar and xylem translocation as well as contact/protectant activity.

Phloem mobile or 'truly systemic' products can move down through the phloem stream and upwards through the xylem, reaching all parts of the plant.

FUNGICIDE FACTS — TEST YOUR KNOWLEDGE:

Excluding herbicides, there are only two phloem mobile or 'truly systemic' products registered for use on berries in Australia. What are they?



The **xylem** is the plant vascular tissue which transports water and nutrients upwards from the roots to the canopy.

The **phloem** is the plant vascular tissue that transports sugars and other products from the canopy to other parts of the plant. Unlike the xylem, the phloem can move products both upward and downward through the plant.

Spray coverage and air movement within the canopy

The aim of spraying is to have good coverage with equally distributed product throughout the canopy, however it is not always possible to achieve this. Equal coverage is a challenge and there will be areas through the plant where coverage is higher or lower despite best efforts.

Spray nozzles will generally produce a range of droplet sizes, with smaller droplets generally travelling further than larger ones. Smaller droplets are important as they can be dragged by turbulence in and around the canopy to the underside of leaves or fruit for better coverage.

In broadleaf crops such as berry crops, it can be difficult for the droplets to get past the outer leaf layer and into the canopy. Some turbulence is needed to move smaller droplets around and through the canopy and to avoid the outer leaves from 'shingling' and creating a barrier of foliage that spray cannot penetrate. Angled nozzles can also be used to increase turbulence and improve spray coverage in the canopy.

Air displacement is important to move out the existing air in the canopy and replace it with air containing the crop protection product. The aim is to move the volume of air containing the crop protection product through the canopy so that it reaches the outside edge, but not past it. A useful method to determine if the air is being displaced is by placing flagging tape on the outer side of the plant, and observing movement or fluttering indicates air is being displaced through the canopy.

Tip: yellow water sensitive paper is an easy and effective way to measure spray distribution and can be placed through the canopy to measure spray coverage through the plant.

Scott explained that even with a perfect sprayer setup there will be some areas where there can be higher or lower coverage, however the aim is to maximise the amount of canopy receiving even effective application.

Factors affecting product performance

Many factors can affect spray performance and reduce the final amount of product reaching the plant and target pest or disease. Despite aiming to apply 100% of our dose, application losses can occur throughout the process due to atomisation losses, poor retention of the product on the plant, slow product uptake and inefficient translocation in the plant. Application losses at each of these points can compound and result in very little product reaching and being taken up by the plant for effective pest or disease control.

A trial in New Zealand showed that in one example, only 2% of the initial application dose was available for uptake due to significant losses throughout the process.

Temperature and humidity

Xylem mobile, translaminar or phloem mobile products can only enter the plant when the active ingredient is wet in solution, and once the droplet dries on the plant surface, there is no further uptake in the plant.

Temperature can significantly impact the extent of product uptake, with higher temperatures resulting in faster evaporation and less product uptake. Similarly, humidity can affect the time it takes for droplets to dry and therefore enter the plant.

Low humidity increases evaporation and droplet drying, reducing the time for plant uptake. Temperature and humidity can fluctuate significantly through the day, and in high Delta T conditions (hot and dry), larger droplets can be more suitable due to the faster evaporation. However, while increasing droplet size will increase the survival time of the droplet, it also reduces the number of droplets covering the plant, compromising coverage.

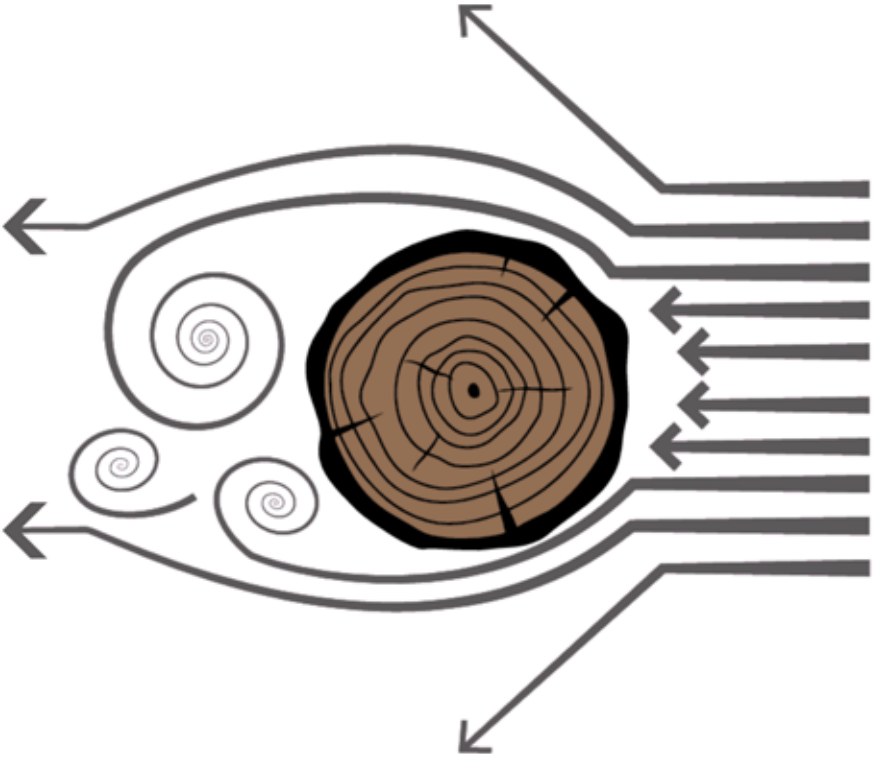
Scott explained that everything we do can be a compromise in trying to get the maximum efficiency out of crop protection products.

Growth dilution

As the leaf grows and expands in spring, the area to which it is applied does not expand out with it, resulting in a dilution effect. This means that when the leaves grow, the area covered by the product relative to its size decreases, and there is reduced coverage and crop protection. This is a reason why spray intervals are recommended, to provide continual plant protection against growth dilution.

As spray air moves toward twigs, branches, or leaves, part of it will bounce off while the rest wraps around the surface

The amount of spray that sticks to these surfaces depends on how big the droplets are and how fast they're travelling



Source: Deveau et al. 2021

EFFECTIVE ALTERNATE-ROW STRATEGY

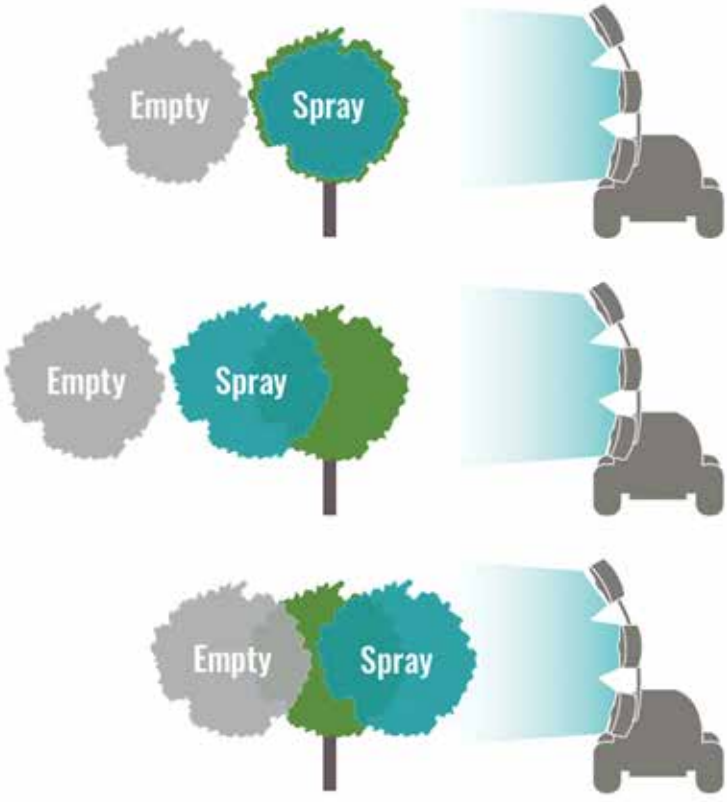
Droplet-laden air displaces empty canopy air

INEFFECTIVE STRATEGY

Droplet-laden air pushed past the canopy

EFFECTIVE EVERY-ROW STRATEGY

Droplet-laden air pushed just beyond half-way into canopy



Source: Deveau et al. 2021

Weather

Rain, wind and ultraviolet light from the sun can degrade or wear off crop protection products, reducing their efficacy. Rain can wash off applied products, particularly if the product has not yet dried or become rainfast. The rainfast period is the time after application during which the product needs to remain undisturbed by rain to be effective. Scott explains that if the rainfast period is unavailable on the product label or from your product supplier, a rule of thumb is that when the product dries, it can often be considered rainfast.

Spray drift

Spray drift can be a major challenge and is something that all growers should know how to manage if they are undertaking sprays. Spray drift can be prevented by having a suitable sprayer and nozzle setup, such as appropriate droplet size for the conditions. Larger droplets are at less risk of drift than smaller droplets, which can be carried by wind or air currents to non-target crops and areas. While spray drift is exacerbated by windy conditions, it can also occur on calm days, such as due to excessive air assistance from air blast sprayers.

Adjuvants

Spray adjuvants aim to improve the effectiveness of pesticides and should be applied according to label directions. If a label recommends a particular adjuvant to be applied with that product, then that adjuvant should be used. Conversely, if a label does not have a requirement to have an adjuvant, then it is not required for the product to be effective.

Adjuvants have various functions:

Oils improve spread and reduce droplet evaporation rate and will generally be recommended when a product needs additional time on the leaf for plant uptake.

Non-ionic surfactants help to break the surface tension of a water droplet to provide better spread and coverage across the leaf surface.

Modified organic silicone surfactants break the surface tension to a greater extent than non-ionic surfactants with greater spread across the leaf, however they also dry faster and are not recommended for certain products.

Keeping to the recommended adjuvant rate is also important, as dose can impact how the droplet behaves. A dose higher than the recommended rate can result in too much spread and faster evaporation, preventing effective uptake of the crop protection product.

Applying sprays in berry crops

Different crops and canopies require different management strategies. Water volumes can change significantly between applications even within the same berry crop as plants grow through spring and require higher water volumes. Spraying requires close monitoring of the crop as it develops, and water rates should be adjusted accordingly.

(A) Early crop just after planting and (B) a more mature strawberry crop with thicker canopy which requires different spray volumes for ideal coverage.
Photo credit: Syngenta

Product labels vary in terms of required rates, which can be stated either as a rate per hectare or as a rate per 100L of water. This is an important distinction to be aware of as both require a different calculation for the crop application.

Dilute spraying

Dilute spraying is where a sprayer is set up to apply water volumes up to the point of runoff and can be adjusted to the type and stage of crop being sprayed. The point of runoff is the amount of water required to wet the plant to the point where some spray droplets join together and run off the plant. Determining the point of runoff should be done using test volumes numerous times during the season as the required spray volume will change and sprayer set up may need to be adjusted as the crop grows and develops through the season.

Example dilute spraying calculation using Switch®:

Water volume determined to reach point of runoff: **800L/ha**
Label application rate for Switch®: **80g/ 100L**
800 / 100 = **8**
80g x 8 = **640g/ha**

Concentrate spraying

Concentrate spraying is where a sprayer is set up to apply water volumes less than that required to reach the point of runoff, however it is rarely used in berry crops.

Example concentrate spraying calculation using Switch®:

Water volume determined to reach point of runoff: **800L/ha**
Chosen spray volume: **400L/ha**
Concentration factor: dilute volume/ chosen volume = **800/400 = 2**
Label application rate for Switch®: **80g/ 100L**
Application rate for concentrate spraying: 80g x 2 = **160g/ 100L**
Application rate/ha: 400/ 100 = **4**
160 x 4 = **640g/ha**

Useful resources and links

Berries Australia factsheet on tank mixing chemicals: bit.ly/3FZiqP6

Deveau, J, Ledebuhr, M & Manketelow, D (2021) Airblast 101: Your Guide to Effective and Efficient Spraying, Available at: https://sprayers101.com/airblast101/

Simpson, M. & Browne, B. (2020) Avoiding spray drift in blueberries. (Primefact 1786). NSW Department of Primary Industries, NSW Government. https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/1255976/Avoiding-spray-drift-in-blueberries.pdf

Fungicide Facts Answers for phloem-mobile products:
Spirotetramat (Movento®) and phosphorous acid (eg. Phos Acid®) – well done if you got both right!

FGT Fruit Growers Tasmania