Kiwifruit Spraying Factsheet 1:

Spraying issues and terminology

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KEY POINTS

- This factsheet defines the common terminology used in spray application and discusses some key issues in spray application.
- The different terms used in spray application are often used too loosely and are often misinterpreted. It is important that everyone in the industry understands what is implied by the terminology used.

Spraying issues

1) What is needed to achieve effective pest and disease control?

*Application of an appropriate chemical at an appropriate time and **rate,** with the sprayer setup to achieve even **coverage** of fruit, leaves and/or wood with at least the minimum effective **dose** of agrichemical.*

While even coverage is the goal, it is impossible to fully and evenly cover, wood, leaves or fruit with spray. Uneven coverage of kiwifruit vines may limit pest or disease control and the efficiency of chemical use. Improved coverage is an achievable goal that all growers can work towards. Specific guidelines for setting up sprayers to improve coverage and methods for coverage assessment using water sensitive papers are given in ZESPRI KiwiTech Bulletins on spraying.

2) What is needed to minimise pesticide contamination of the environment?

Application of approved agrichemicals in a way that gives the highest possible spray retention on the target.

To avoid spray losses either as drift, or to the ground within sprayed blocks, you need to maximise **spray retention** on the target canopy. Spray retention is a measure of spraying efficiency and is the amount of spray liquid retained on target leaves, fruit and/or wood. This can be expressed as a percentage of the spray volume applied to a block.

Spray retention can vary greatly between different sprayer setups (especially nozzle arrangement and sprayer air output volumes) for different canopy training systems. Factors that affect spray retention are listed below:

- **Canopy growth stage** - the greatest variation in spray retention occurs between different canopy growth stages. When spraying dormant wood, approximately only 5-10% of the applied spray volume will be retained on the target canopy (as most of the spray is lost through the gaps). Potential spray retention increases dramatically as the canopy leafs up and in fully developed canopies retention from a well setup sprayer can be as high as 90% of the applied spray volume.

- **Spray application volume** – any spray application that produces runoff will reduce spray retention (some spray drips to the ground). Typically a spray applied dilute to the point of runoff will retain 10-20% less chemical than the same spray applied at 2X or greater concentrate (i.e. using half, or less, of the dilute spray volume). Expressed another way, a typical concentrate spray application will deposit 10-20% more chemical on average per square centimetre of leaf or fruit surface area than a typical dilute spray application.

Figure 1. *An open green pergola trained canopy about three weeks prior to bloom – estimated application volume required to reach the point of runoff was about 1200 l/ha.*

Figure 2. *A relatively dense pergola trained canopy at full bloom – estimated application volume required to reach the point of runoff was in excess of 1500 l/ha.*

- **Canopy training system** – airblast spray applications to highly structured and contained canopies like trimmed and wire tucked grape vine trellis systems can have much lower retention (ca. 50%) than is achieved with canopies that are free to arrange themselves in space. Retention on typical kiwifruit canopies can be expected to fall somewhere between that of free-standing trees and constrained grape trellis systems. Care will need to be taken in kiwifruit canopies to confirm spray deposits in dense canopies are penetrating and not tending to channel through holes and gaps (i.e. is not just being forced around the outside of the canopy).

Spray drift is a topical issue that needs to be put into perspective. The ability to detect chemical residues down to parts per billion means that some measurable off-target losses will occur from virtually any spray application. However it is possible to setup and operate sprayers so as to minimise this problem. By far the greatest proportion of the spray that does not get deposited on the target canopy will be lost to the ground within the sprayed block rather than lost beyond the block as drift. Where drift could be a problem (especially when spraying dormant vines or boundary shelter belts) it is recommended that low drift air inclusion nozzles are used on the sprayer. This technology is now well proven for use with hydrogen cyanamide applications to kiwifruit and is recommended for dormant and very early season application of other products. The use of large low drift risk spray droplets is currently **not** recommended for use in foliated canopies as poor and uneven coverage is expected in this situation.

Once a canopy is fully developed it should be possible to retain over 90% of the sprayer output on the target leaves and fruit. At this stage spray drift is only likely to be an issue on outside rows, or where there are large gaps in the canopy cover.

While spray drift should not be a problem on fully developed canopies (post bloom), spray coverage certainly can be and the sprayer operator can do a great deal to improve potential pest and disease control by managing the canopy and the sprayer setup. Basically anything that improves light penetration and fruit exposure will improve potential spray coverage on fruit.

3) Spraying terminology

An important part of achieving consistency in interpretation of agrichemical rates is to make sure that everyone involved in the industry uses a consistent language around spraying. The following are some definitions of different spraying terminology:

High volume or "dilute" spraying
The application of agrichemicals using the rate per 100 litres found on chemical labels. The application volume in this case should result in some visible dripping from the outer canopy, with the majority of the inner canopy wetted by spray droplets (about 50% of total surface area evenly wetted with droplets). The volumes needed to achieve this will vary with canopy size and density, to achieve coverage in the inner part of a dense canopy more volume will be required, and more runoff will be seen in the outer canopy than will be seen in a more open canopy.

Low volume, "concentrate" spraying
Uses the chemical application rate established for dilute spraying and applies this in a lower volume. The concentrate spray volume selected is usually 2X or 3X lower than the dilute volume and the chemical mixing rate per 100 litres of spray mix is increased by the same factor.

For example, if a particular canopy is sprayed dilute to the point of runoff using say 100 grams of chemical per 100 litres and a sprayer emission of 30 litres per minute at 7 km/hr, a 2X concentrate spray application will apply 15 litres per minute at 7 km/hr using 200 grams of chemical per 100 litres.

Expressed in terms of chemical application rates per hectare, both dilute and concentrate should be the same. However, reduced runoff losses from concentrate applications can, in some cases, allow concentrate chemical application rates per hectare to be reduced by 10-20% of the dilute application rate without reducing average deposits.

Semi-concentrate spraying
This is a term that appears on the KeyStrepto™ product label. It is not an generally accepted term in international spray application. However, it appears to relate to the concept of applying active ingredients such as hydrogen cyanamide or streptomycin at volumes slightly below the volume required to achieve runoff. This would be expected to minimise the number of drip points in the canopy and hence reduce the potential risks of phytotoxicity.

Figure 3*. High volume spraying (on young kiwifruit fruitlet) showing poor surface wetting and coverage.*

Application rate
Ideally refers to the amount of chemical sprayed per 100 litres of spray mix. However application rates are often used to describe the quantity of chemical applied per planted hectare. Rates per hectare are useful in budgets but variations in canopy size and spacings mean that rates per hectare can be an extremely unreliable indicator of chemical doses achieved on different canopies.

Coverage
Refers to the percentage of target surface covered by droplets and may be further described in terms of deposit distribution on the target surface. Usually it is only necessary to determine whether deposits are evenly or unevenly distributed. Uneven distributions (as are usually seen in dense areas such as where fruit overlap) are likely to lead to control problems. Coverage is determined by the way the sprayer outputs (air and spray liquid) interact with the canopy being sprayed and how the spray droplets behave on the surface of the plant.

Dosage
Refers to the amount of chemical deposited per unit weight or area of plant tissue.

Chemical residue tests on fruit express residue data as parts per million (ppm), which is the equivalent of milligrams of chemical per kilogram of sample weight (mg/kg). An alternative way of expressing dosage is as micrograms (millionths of a gram) per square centimetre ($\mu g/cm^2$) of leaf or fruit surface area.

Dosages achieved are a function of the interaction between application rate, coverage and the canopy being sprayed.

It is important to recognise that both dose and coverage have to be right; good coverage with a sub-lethal dose, or poor coverage with a high dose, can both fail to provide control.

Dosage is the primary consideration when applying crop protection chemicals. The amount of chemical should be adequate to control pests and diseases over the surface area of the canopy. Maximising spray retention on the target will maximise average dose. Achieving even coverage will ensure that the chemicals come into contact with the disease or pest. Spray application timing is a separate issue, but improving dosage may allow reductions in the frequency with which applications need to be made.

The application of 1 kg of chemical product per hectare to most fully developed fruit crop canopies can be expected to deliver a dose in the order of 2 $\mu g/cm^2$. Usually, deposits on leaves are higher than on fruit (leaves can move in the sprayer air stream and are more efficient collectors of spray droplets than fruit). Typical leaf deposits will range from around 1 to 4 $\mu g/cm^2$, while fruit deposits are often half of that seen on leaves. Any parts of the outer canopy, which are directly exposed to the sprayer output, will typically receive approximately twice as much as inner canopy regions.

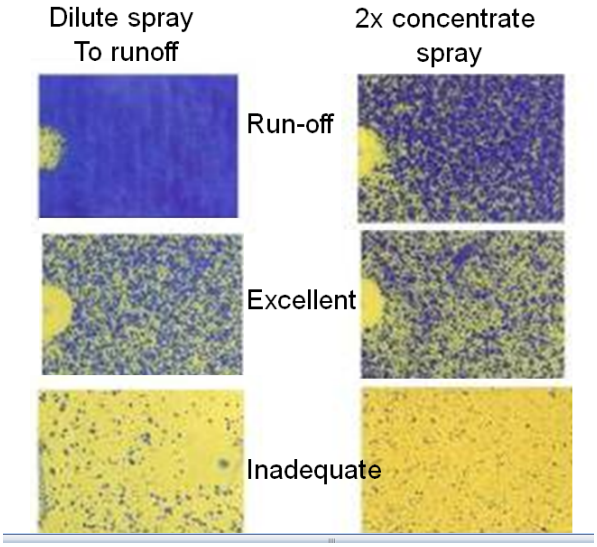

Figure 4.*Examples of spray coverage seen on water sensitive paper at dilute and 2X concentrate spray application volumes.*