FACTSHEET 2: Interpreting chemical labels

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Key Points

- How are recommendations for concentrations of pesticide sprays developed ?
- Why is 'spray to runoff' the universal benchmark for high volume applications ?
- What variables might affect the volume that I might apply in any given orchard ?

Developing recommendations for spray concentrations

The agrichemical industry uses long established and widely accepted protocols for developing, screening and testing new materials for pest and disease control. When an agrichemical shows promise in laboratory screening for potential efficacy, it then progresses to small plot field trials (usually using single tree replicates):

- The trial material is applied to different trees at a range of concentrations, each as high volume <<glossary>> ("dilute") sprays, using high-pressure, hand-held spray-guns, or backpack mist-blowers
- All target surfaces are thoroughly wetted to the point where some excess spray liquid just begins to drip to the ground (the point of "runoff" <<glossary>>) so that:
    - all parts of the plant receive an even amount of chemical, minimising variations in dosage between treatments or experiments.
    - all plant targets, regardless of differences in size, shape or growth stage, can be treated equally in these types of field tests
    - the level of control achieved in any treatment is directly related to the concentration of chemical applied.

This type of testing provides the basis for the dilute chemical "mixing rates" (<<glossary: quantity of chemical in 100 litres of dilute spray mix>>) that appear on labels found on containers of agrichemicals used on fruit and vine crops in New Zealand. The protocols used to develop these mixing rates serve to identify useful agrichemicals and to define application rates that can reasonably be expected to work in commercial practice. Actual spray deposits produced in tests used for registration of agrichemicals are seldom quantified. The focus of chemical testing work is quite appropriately on pest or disease control outcomes and chemical residues at harvest. However, this misses the opportunity to provide dosage <<glossary>> levels that could be used to benchmark the performance of subsequent commercial spray applications.

Translation of recommendations for spray concentrations

There is a simple piece of logic behind the recommendations for spray concentrations found on labels on agrichemical containers. This is that growers will secure similar performance to that achieved by the recommended rate in the testing protocol, in terms of efficacy and safety, by applying sprays that deposit a uniform and similar dosage. Growers can be most confident of this by using spraying conditions that mimic the registration tests: high volume sprays that wet the entire target canopy to the point of runoff. Since the canopies of commercial trees differ in size, form and density from those present in experimental orchards, the goal in commercial spraying is usually: "spray to the point of runoff for the

outer canopy and to provide good wetting and coverage in the inner canopy". This generally still works well because some spreading of spray deposits occurs in dew or rainfall after application; some chemicals are also moved inside plant tissues. The only sprays that really require virtually full coverage of fruit or wood targets are contact oil sprays because they work by smothering target pests.

In practice, there is a host of ways in which variation in commercial spraying practice can increase variability in dosage relative to small plot field trials:

- spray applicators differ in their perception of the volume of spray required to reach the point of runoff
- applying chemicals in volumes below those that cause uniform runoff can produce slightly (10-20%) greater levels of on-target deposits from a given quantity of chemical (per row length or per hectare) but these deposits are more variable than when the point of runoff is achieved
- canopy size, form and density associated with cultivar features, training systems and seasonal growth changes can have large effects on ease of penetration of the canopy
- different nozzles, air fan speeds, and wetting / spreading agents can lead to variability in absolute levels, and variability, of dosage.

The sprayer operator has to work out the application volumes required to treat different canopies to the point of runoff (this defines the chemical application rate required for that canopy) and how to most efficiently deliver the spray to the target (Figure 2). All fruit industries can define indicative spray application protocols for high volume ('to runoff') treatments (and hence chemical application rates) for different training systems and seasonal growth stages. These recommendations continue to evolve slowly as crop planting and training systems change.

<<Apple snippet:

Dwarf trees have been found to require lower application volumes than larger trees because they are generally easier to target with spray and typically have a lower total leaf surface area per hectare than larger trees. Thus, two typical scenarios to achieve wetting to the point of runoff with spray applications to apple trees are:

- Trees 4.5 to 5.5 metres tall on 4.5 to 5.5 metre row spacings are expected to require around 2000 litres per hectare (100 litres applied per 100 metres of sprayed row length)

- Dwarf trees around 3.5 metres tall on 3.5 metre row spacings are expected to require around 1000 litres per hectare (35 litres per 100 metres of sprayed row).

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<<Grape snippet:

<<Kiwi snippet:

<< Avo snippet:

It is important to note that these accepted dilute application volumes do not guarantee 100% coverage of fruit, leaf or wood in the target canopy. Large fruit and limbs create "shadow" areas that spray may not reach. It is not uncommon to see 30% or more of a fruit surface completely unwetted (Figure 1). This problem increases with increasing fruit size and is often made worse when the fruit have leaves in close proximity. Poor fruit coverage is most commonly seen on the sides of fruit that were facing away from the sprayer and is caused largely by the sprayer output air and droplets separating around the fruit and leaving a "dead spot" in behind. Simply increasing spray application volumes is not a solution to this type of problem – even doubling or even trebling applied volumes would not necessarily resolve the problem. Instead, attention needs to be given to sprayer setup to maximise spray retention and coverage potential. Optimising a sprayer to maximise retention and coverage can

increase deposits by 15-30% for a given volume of application. A range of tools is available to assist sprayer operators with continually refining and improving spraying practice based on observation, reflection and action (see below).

Next steps

Now that you understand the rationale that underpins the high volume recommendations for spray mixture concentrations found on labels on agrichemical containers, you will probably want to:

- Check out guidelines on how to set up sprayers for best performance (see HIP factsheet <<REF Fact Sheet 3>>)
- Look at tools you can use to assess coverage by your spray operations (see HIP factsheet <<REF Fact Sheet 4>>)
- Learn how to calibrate spray operations for safe, effective and economical spray practice (see HIP factsheets <<REF Fact Sheet ??>>).

Figure 1: Examples of spray coverage on dwarf apple fruit sprayed with a blue dye.

Top - *1000 l/ha dilute to runoff*
Bottom - *330 l/ha 3X concentrate*
Note poorly covered areas.

***Figure 2**: Mist-blower application to the point of runoff in single tree plots for trial work that tests the efficacy of chemicals.*