

# CRC for Viticulture

## Pesticide application fact sheet 2

### Maintaining pesticide performance in spray mixes

The selection and, safe and effective use of agrochemicals is a complex area, with many products registered as pesticides for use in vineyards, and many factors influencing their effectiveness in the field.

Spray tank mixes can contain a variety of chemicals and adjuvants that may interact and change the effectiveness of one or more of the pesticides. Incompatibility, poor water quality and insufficient tank agitation can lead to reduced effectiveness of sprays, phytotoxicity and can affect equipment performance eg. clogging of nozzles and filters in sprayers.

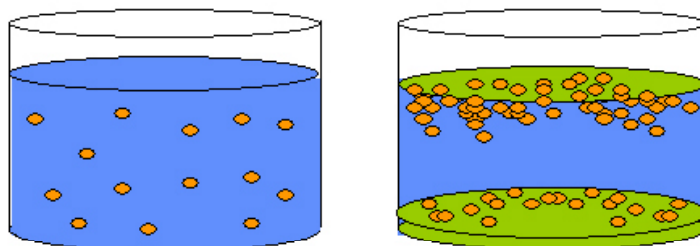
The main issues when mixing pesticides in the spray tank are briefly outlined below including pesticide compatibility problems, tank agitation and mixing, and water quality effects on pesticides. Further information is available from the references listed at the end of the fact sheet. Selection and use of chemical additives such as adjuvants is discussed in *Pesticide application fact sheet 3*.

#### Pesticide compatibility

Two or more pesticides are frequently combined to control different pests and diseases with a single application. This reduces application costs (labour, fuel and equipment) and time spent spraying in the vineyard. Ideally pesticide mixtures should be avoided but this is usually not practical on a commercial vineyard due to time and cost constraints. When combining two pesticides the following application and efficacy problems can occur:

- ❑ Effectiveness of one or both pesticides may be reduced ie. biological incompatibility
- ❑ Physical incompatibility resulting in precipitation or clumping ie. physical incompatibility
- ❑ Grapevine phytotoxicity (plant injury)
- ❑ Excessive run-off due to a high concentration of wetters in the tank mix
- ❑ Excessive residues

#### Physical incompatibility



Source: *Research to Practice (CRCV)*

A pesticide label will indicate if two products can be mixed together and provide guidance as to the proper order in which they need to be mixed. Generally, only compatibilities between pesticides produced by that manufacturer are listed. Some labels will also contain directions for mixing the product with certain other pesticide formulations. The safest method of assessing compatibility is to ask the manufacturer.

If possible don't use pesticide mixtures unless the chemical label allows their use, the manufacturers recommend the combination, or the mixture has been shown to be compatible through extended use over a range of conditions. Always check the chemical label carefully for incompatibility warnings from the manufacturer.

A pesticide can be tank mixed if the label does not prohibit its application with other products, and if the pesticides in the mix must be registered individually for grapes. **But under this situation the user assumes all responsibility for the application.**

The following issues should be considered when mixing pesticides in the spray tank:

- ❑ When concentrating more than two pesticide formulations in the spray tank ie. 3X, 4X etc., consider that the compatibility of the mix may change at these higher concentrations.
- ❑ Labels usually give little information on the compatibility of inert ingredients such as emulsifiers and wetting agents. In addition factors such as vine growth stage, weather and water chemistry (especially pH) may be important in whether incompatibility becomes an issue.
- ❑ Wettable powder formulations are usually not compatible with emulsions (particularly for herbicides) and can result in sedimentation when mixed.
- ❑ Care should be taken when mixing pesticides and liquid fertilisers as these tend to acidify the spray solution and highly acidic mixes can be phytotoxic to grapevines.
- ❑ Increasing the number of pesticides mixed together in the spray tank will increase the chance of incompatibility problems occurring. Don't mix more than three products unless prior experience or technical advice indicates that a particular mixture will not have reduced efficacy or cause crop damage.

### **Agitation and mixing of spray mixtures**

Tank agitation is required when mixing chemicals to aid in even distribution of active ingredients in a spray solution and to prevent settling of particulate products. Once a chemical is settled out, it is difficult to resuspend. If a pesticide in a tank mix does settle out during spraying then there is a possibility that the application will be too concentrated at the beginning of spraying and too diluted at the end of spraying. This can result in over dosing vines in one part of the vineyard and under dosing in other sections. To ensure a uniform spray mixture at all times:

- ❑ Agitate during loading and mixing
- ❑ Keep the mixture agitated during application
- ❑ Turn PTO and pump on when driving to the vineyard or stopping for a break
- ❑ Make sure that agitator is designed to move water in one direction and 'sweep' the bottom of the tank
- ❑ Do not allow the mixture to stand overnight without agitation - if possible apply all of a tank mixture in one day

When combining chemicals carefully follow mixing instructions on the label. It often describes the mixing order and gives other important mixing or agitation instructions. In general, if more than one pesticide is going to be added to a tank then they should be added in the WALES sequence:

- ❑ **W**ettable powders then dry flowables
- ❑ **A**gitate then add adjuvants such as buffers
- ❑ **L**iquid and soluble products
- ❑ **E**mulsifiable concentrates
- ❑ **S**urfactants

### **Water quality**

The quality of water available for spraying will depend on the source of the water on the vineyard such as a bore, dam or channel. Climatic conditions during the season such as heavy rains or drought can also affect the available water quality. Poor quality water can seriously affect pesticide efficacy and compatibility in the spray tank before application. Use the cleanest water available on a vineyard in spray tanks. Generally the water should not be used unless it is suitable for irrigation.

#### *Suspended solids*

Dirt or clay particles and organic matter that make water sources cloudy or brown can react with some pesticides. Glyphosate, paraquat and diquat are examples of non-residual herbicides that bind to clay in dirty water. The active ingredient is inactivated and is no longer free to work on target weeds. Dirt and clay can also block nozzles, lines and filters on sprayers and can increase the rate of equipment wear. Additives such as alum (aluminium sulphate) can be used to flocculate suspended solids in dirty water.

### Hard water

High levels of soluble salts such as magnesium and calcium are the cause of 'hard' water. These salts can cause some chemicals to precipitate out of the spray solution, significantly reducing the effectiveness of the pesticide. However many susceptible pesticides often have adjuvants added to their formulation to overcome this problem. Hardness is measured as a concentration of salts per volume of water sampled (parts per million - ppm).

As a rule of thumb, water is usually classified as hard once the calcium carbonate concentration rises above 150 ppm CaCO<sub>3</sub>. Soluble salts are often found at high levels in bore water. Hard water can also affect surfactants in the spray solution and properties such as wetting and dispersion. Very hard water can be treated with an adjuvant but in many cases the problem can be minimised if sprays are applied straight after mixing in the spray tank.

### pH

pH is a measure of acidity and alkalinity scaled on a range between 1 and 14. A pH of 7 is neutral, less than 7 acid and more than 7 alkaline. Most natural waters have a pH of between 6.5 and 8. Very acid water can affect the stability and physical properties of some pesticide formulations. Many bores produce alkaline water of pH 8 to 8.5 and water stored for a long period in concrete tanks may also become highly alkaline.

In highly alkaline water (pH>8) many pesticides, particularly organophosphates and carbamates undergo a chemical reaction known as alkaline hydrolysis (interaction with water). This process causes the breakdown of active ingredient into other compounds and reduces the pesticide's effectiveness. Pesticide breakdown increases with increasing alkalinity and water temperature, and with the length of time the spray mix is left in the tank. Examples of the stability with respect to pH of some common pesticides used in grape production are provided below:

- ❑ Glyphosate - performs best at pH 3.5 - 5.0
- ❑ Iprodione (eg. Rovral) - undergoes rapid alkaline hydrolysis at pH>8 (ph 7 is optimal)
- ❑ Captan - incompatible with highly alkaline mixes
- ❑ Bt (eg. Delfin, Dipel) - incompatible with highly alkaline mixes
- ❑ Chlorpyrifos (eg. Lorsban) - stable in neutral and weakly acidic solutions
- ❑ Chlorothalonil (eg. Bravo) - stable below pH 7
- ❑ Benomyl (eg. Benlate) - stable below pH 7

The pH of alkaline solutions can be adjusted by adding the recommended rate of a buffering agent or acidifier. To determine the dose rates to add to the spray solution the pH needs to be measured accurately. Also check that buffering agents are compatible with pesticides and formulations being used.

**Water quality effects on the performance of selected herbicides used in viticulture**

Herbicide	Water quality				
	Muddy	Saline	Hard	Alkaline (pH >8)	Acidic (pH<5)
Diuron®	✓	Test	✓	✓	
Fusilade®	✓	✓	✓	Not recommended	✗
Glyphosate	✗	✓	✗	✗	✓
Simazine®	✓	✗	✓	Not recommended	
Spray Seed®	✗	✓	✓	Not recommended	✓
Trifluralin	✓	✓	✓	✓	✓
Verdict®	✓	✓	✓	Not recommended	✓

*Adapted from Weed control in winter crops, Mullen & Dellow (1997).*

### **Read the label as it is a LEGAL document**

The first step when considering pesticide use is to read the complete chemical label including:

- ❑ Safety directions and first aid instructions
- ❑ Pests which the chemical is registered to control and Crops on which the chemical may be used
- ❑ Application rate and Method and timing of application
- ❑ Storage and disposal instructions
- ❑ Withholding periods and Warnings and restrictions

Chemical registrations vary between states. Check the product label for appropriate use in your vineyard. Also check the specific chemical and spray program requirements of the winery or customers you supply.

#### **Further information**

- *Spray Application Viticulture: Research to Practice*<sup>®</sup> is a training package that can be fine-tuned to suit regional requirements and includes workshops, short courses and a comprehensive manual.
- *Pest Genie web site*. Australian plant protection information including chemical labels and material safety data sheets – [www.pestgenie.com.au](http://www.pestgenie.com.au).
- *Pesticide technical guides*. Detailed information on specific pesticides and formulations available from chemical manufacturers or resellers.

#### *Disclaimer*

The advice provided in this publication is intended as a source of information only. Always read the chemical label before using any of the products mentioned. CRCV and DPI Victoria do not necessarily endorse any company or brand mentioned.