viti-notes

[Effective chemical use]

Research to Practice

Maintaining product performance in spray mixes

Viti-note Summary:

- Product compatibility
- Agitation and mixing of spray mixture
- Water quality
- Suspended solids
- Hard water
- pH

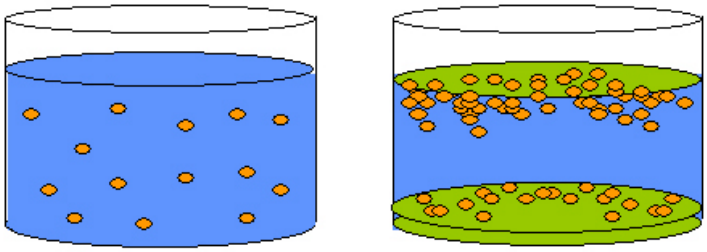

Figure 1. Example of satisfactory (left) and poor chemical mix (right).

There are many products registered as pesticides, fungicides and herbicides for use in vineyards and there are many factors that can affect how well they work.

Incompatibility of chemicals mixed in the same vat, poor water quality and insufficient tank agitation can all lead to reduced effectiveness.

The main issues to consider when mixing products in the spray tank are outlined below, including compatibility problems, tank agitation and mixing, and water quality effects on the active ingredients in compounds.

Product compatibility

Two or more products 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 such mixtures should be avoided but this is usually not practical due to time and cost constraints. When combining two products the following application and efficacy problems can occur:

- Effectiveness of one or both products may be reduced (biological incompatibility);
- Different chemical compounds may interact resulting in precipitation or clumping (physical incompatibility);
- Combinations of chemicals may damage vine tissues (phytotoxicity);
- Chemicals may not 'stick' to vines resulting in excessive run-off, e.g. due to a high concentration of wetters in the tank mix;
- Excessive residues may occur in vine tissue or soils.

The product labels will indicate if two products can be mixed together and show the order in which they need to be mixed. Generally, only compatibilities between products produced by that manufacturer are listed. Some labels may give directions for mixing the product with certain other formulations. Manufacturers provide advice directly or through agents when there is uncertainty about compatibility.

Always check the chemical label carefully for incompatibility warnings from the manufacturer.

Products can be mixed in the spray tank if the label does not prohibit its application with other products, and if all products in the mix are registered individually for grapes, but under this situation the user assumes all responsibility for the application.

Other topics in this Viti-Notes series include:

- Targeting sprays for vineyard pests and diseases
- *Maintaining product performance in spray mixes*
- Selecting and using spray adjuvants
- Understanding chemical 'modes of action'
- Managing chemical resistance in the vineyard
- Equipment adjustment and evaluation to maximise spray coverage
- A single rate per hectare – why it shouldn't be used
- Determining chemical rates for dilute and concentrate spraying
- Determining dilute water volumes for spraying
- Calculating chemical rates for vines

The following issues should be considered when mixing products:

- When using more than two formulations consider that the compatibility of the mix may change at 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 influence product performance and compatibility;
- Wettable powder formulations are usually not compatible with emulsions (particularly for herbicides) as they can result in sedimentation when mixed;
- Care should be taken when mixing pest or disease control products with liquid fertilisers, as fertilisers tend to acidify the spray solution and highly acidic mixes can be phytotoxic to grapevines;
- Increasing the number of products mixed together in the spray tank will increase the chance of incompatibility 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 product 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 product is going to be added to a tank then they should be added in the 'WALES' sequence:

W	Wettable powders then dry flowables
A	Agitate then add adjuvants such as buffers
L	Liquid and soluble products
E	Emulsifiable concentrates
S	Surfactants.

Water quality

The quality of water available for spraying will depend on the source of the water used, e.g. 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 the performance of active ingredients and compatibility in the spray tank before application. Use the cleanest water available in spray tanks. Generally the water should not be used for spraying unless it is also suitable for irrigation.

Suspended solids

Dirt or clay particles and organic matter that make water sources cloudy or brown can react with some products. The active ingredients glyphosate, paraquat and diquat found in many non-residual herbicides are an example of compounds 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 active ingredient. However, many susceptible products often have adjuvants added to their formulation to overcome this problem.

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.

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 ($CaCO_3$) concentration rises above 150ppm.

pH

pH is a measure of acidity and alkalinity scaled 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 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.

Many pesticides, particularly organophosphates and carbamates, undergo a chemical reaction known as alkaline hydrolysis (interaction with water) if highly alkaline water (pH>8) is used. This process causes the breakdown of the active ingredients into other compounds and reduces the mixture's effectiveness. Breakdown of spray compounds increases with increasing alkalinity and water temperature, and with the length of time the spray mix is left in the tank.

Table 1. Examples of the stability of some common active ingredients in chemicals used in grape production with respect to pH

Active ingredient	Product	pH cautions/limitations
Glyphosate	Roundup®	performs best at pH 3.5 - 5.0
Iprodione	Rovral®	undergoes rapid alkaline hydrolysis at pH>8 (ph 7 is optimal)
Captan	Captan®	incompatible with highly alkaline mixes
Bt	Delfin®, Dipel®	incompatible with highly alkaline mixes
Chlorpyrifos	Lorsban®	stable in neutral and weakly acidic solutions
Chlorothalonil	Bravo®	stable below pH 7
Benomyl	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 the products and formulations being used.

Table 2. Effects of water quality on some herbicides

Herbicide	Muddy	Saline	Hard	Alkaline (pH>8)	Acidic (pH<5)
Diuron	OK	Test	OK	OK	-
Fusilade®	OK	OK	OK	NR	No
Glyphosate	No	OK	No	-	OK
Simazine	OK	No	OK	NR	-
Spray Seed®, paraquat/diquat	No	OK	OK	OK	OK
Trifluralin	-	OK	OK	OK	OK
Verdict®	OK	OK	OK	NR	OK

Key to table
OK = OK to use
No = DO NOT USE
NR =Not recommended but use quickly if no alternative
Test=Mix herbicides and water in proportion and observe for instability.

Adapted from Weed Control in Winter Crops 2009, a NSW Department of Agriculture publication.

The first step when considering product use is to read the complete chemical label noting:

- 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, method and timing.
- Storage and disposal instructions.
- Withholding periods, warnings and restrictions.

REMEMBER: Always read the product label as it is a LEGAL document

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.

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9. Determining dilute water volumes for spraying
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Further information

Innovator network factsheets

Spray application by Alison MacGregor

http://www.gwrdc.com.au/webdata/resources/files/GWR_070_Spray_Application_Fact_Sheet_FINAL_WEB.pdf

Training
For regional specific training in pest and disease control, the AWRI is running Research to Practice: Integrated Pest Management for changing viticultural environments.

Contact
Marcel Essling: rtp@awri.com.au for more information.

Agrochemical information

Agrochemicals registered for use in Australian Viticulture - updated annually.

Visit www.awri.com.au for the latest version.

Useful references

Nicholas, P., Magarey, P.A. and Wachtel, M. (Eds.) 1994 Diseases and pests, Grape Production Series 1, Hyde Park Press, Adelaide (a glove box edition of this book is also available).

For images of grapevine symptoms visit www.winetitles.com/diagnosis/index.asp.

Product or service information is provided to inform the viticulture sector about available resources and should not be interpreted as an endorsement.

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