Optimising chemical efficacy for spray application in berries

Gaius Leong, Berry Industry Development Officer, NSW Department of Primary Industry

The application of agrichemicals to control pest and disease incursion is used as part of an integrated management approach which also includes cultural and biological control. It is important that users of agrichemicals optimise the efficacy of the chemicals applied as the cost and time associated with application often makes up a substantial portion of total production costs.

To ensure optimal efficacy, there are a few components that growers should focus on. Firstly, it is important to achieve adequate coverage of product and reduce spray drift. For more information about these aspects, please refer to the Berry Plant Protection Guide available on the DPI website.

Secondly, attention needs to be given to water quality and the appropriate chemical mixing order when more than one chemical is used during an application. This article covers these two components.

Water Quality

Water quality is variable and dependent on the source (e.g. rainwater, dams, river, bore, town). Quality can also vary throughout the year after periods of high rainfall or drought. The quality of water used to mix agrichemicals can:

- Reduce the activity or efficacy of chemicals
- Block nozzles, reducing application uniformity
- Increase wear on nozzle and spray rigs, also reducing application uniformity

Clean rainwater is the best option, however, where unavailable the following guidelines can be used to determine suitability.

> It is recommended that water be tested regularly to ensure it is suitable for use.

Turbidity

This is the term used to measure water cleanliness and essentially tells us the amount of solids in the water. Suspended particles of clay, silt and organic matter are often found in dam or river water, which gives it a cloudy appearance. Wind, increased water temperature, excessive run-off, breakdown of aquatic plant material or heavy rainfall may increase turbidity.

The effectiveness of some herbicides, such as glyphosate, is reduced when mixed with turbid water as the chemicals are readily adsorbed to soil particles. Turbid water can also block nozzles and pre-filters which reduces spray pressure, limits coverage, and causes additional wear on spray rigs.

Filtering turbid water into a settling tank allows heavier particles to sink. Application of a flocculent or coagulant such as aluminium sulphate or aluminium chlorohydrate helps reduced turbidity.

> This should be done before adding to a spray tank.

Hardness

Water hardness refers to the positively charged mineral content within the water. As water moves through various substrates, it accumulates dissolved solids such as calcium and magnesium carbonates/bicarbonates, sodium, and iron. Water hardness is expressed in milligrams per litre (mg/L) or parts per million (ppm).

It is suggested that water with a hardness level of 300 mg/L can cause problems for chemical sprays.

The solubility of chemicals with amine formulations, such as glyphosate, is reduced by hard water, which leads to less absorption by weeds. Hard water can also cause some chemicals to precipitate and can affect properties of surfactants, emulsifiers, and wetting agents. Precipitates can block nozzles and pre-filters thus affecting pressure, coverage and cause additional wear to the spray rig.

Where water is found to exceed 300 mg/L, the use of ammonium sulphate at 1 – 2 % w/v* to total spray volume solves most hard water issues. The sulphate ion binds with hard water cations to prevent the antagonistic cations from binding to, and inhibiting, activity while the ammonium ion improves cellular uptake of the chemical. This should be completed prior to the addition of any agricultural chemicals.

**Weight/volume percentage (w/v percent or %w/v) is a measure of the concentration of a solid in a solution. It is expressed as the ratio of the weight or mass of the solute to the total volume of the solution multiplied by 100.*

pH

This parameter is linked to pesticide solubility, hard water antagonism and pesticide degradation. Alkaline water (>pH 8) can break down some chemicals through a process called alkali hydrolysis. The half-life of chemicals such as Dimethoate can be drastically reduced with increasing pH.

For example, Dimethoate at pH 9 = 1 hour; pH 6 = 19 hours; pH 4 = 21 hours. Very acidic water (<pH 4) can affect the stability and physical properties of some chemical formulations.

pH values between 4 and 7 are considered acceptable.

The length of time at which the chemical is exposed to non-ideal pH levels increases the level of breakdown, therefore it is not recommended to leave spray mixes for extended periods of time prior to application.

You should check the pH of your water regularly. If you find you need to lower your pH, this can be done by adding adjuvants such as Agri-Buffa or LI700m while the addition of an alkaline substance such as potassium hydroxide will increase pH. The amount of chemical required can be calculated by measuring the pH of your water and then adjusting the pH in a 5-10L jug with a known amount of buffer and then using that to determine the required rates for a larger spray tank volume. The pH must be adjusted prior to the addition of chemicals, which will be covered in the following segment on tank mixing procedure.

It is best to carry out water testing to ensure you are aware of any potential problems. Before you add any products to modify your spray water quality, seek professional advice on the best options for your situation.

Types of Chemical Formulations

Pesticides come in different formulations. The solubility of an active ingredient (AI) and its intended use determines the product formulation. There are some active ingredients (AI) that come in different formulations such as Mancozeb that can be found in both dry flowable and water dispersible granule form.

The following are a few of the registered chemicals used in berries to provide examples. Regardless of the product used, you must always refer to the label for comments on mixing and compatibility. If you are unsure, please contact a crop protection representative, agronomy consultant or reseller.

Tank Mixing Procedure

When adding multiple products to the spray tank, always check for the label for compatibility.

These products must also be added in a specific order to ensure they are adequately mixed.

The order relates to the solubility and formulation type.

If products are added in the incorrect order, it increases the risk of reducing chemical efficacy and affecting the stability in the tank mix.

Key	Equals	Examples
WP	Wettable Powder	Serenade® Opti, Mimic®
WDG	Water Dispersible Granule	Pristine®, Switch®, Captan, Interven®, Dragon, Ridomil® Gold MZ, Avatar®, Proclaim®
DF	Dry Flowable	Mancozeb, Kocide® Blue Xtra™, DiPel®
SC	Suspension Concentrate	Miravis® Prime, Infinito®, Bravo® WeatherSti®, Teldor®, Amistar®, Scala®, Kenja®, Movento®, Coragen®, Confidor®, Success™, Prodigy®
SE	Suspension Emulsion	Fyfanon®
EC	Emulsifiable Concentrate	Tilt®, Triadimenol, Dimethoate, Bifenthrin, PyGanic®
SL	Soluble Liquids	Agri Fos® 600

Tank Mixing Procedure Steps

Step 1	**Fill tank to 70% and commence agitation**
Step 2	**Add water conditioner if required (e.g. LI 700, Agri Buffa®, Liase)**
Step 3	**Add DRY products in following order:** 1. Wettable Powders (WP) 2. Water-dispersable granules (WDG/WG) 3. Dry Flowables (DF) / Water Soluble granules (SG)
Step 4	**Agitate tank for a minimum of 3-5 minutes between products**
Step 5	**Add WET products in the following order:** 1. Suspension Concentrate (SC) 2. Suspension Emulsion (SE) 3. Emulsifiable Concentrate (EC) 4. Soluble Liquid (SL)
Step 6	**Fill tank to 90%**
Step 7	**Add adjuvants if required (e.g. Designer®, Expand®, Bond®, Hasten™, Agral®)**
Step 8	**Finish filling tank**

Reminders

- Always wear appropriate PPE when mixing chemicals
- Avoid adding oil-based products, EC formulations and/or adjuvants before dry products, as the oils and adjuvants in the mix can coat the dry formulation and reduce its ability to disperse properly. Undispersed products will clog nozzles and filters.
- Allow 3-5 minutes of agitation in between products
- If using foliar fertiliser with chemical application, consult the manufacturer to ensure suitability
- Do not reduce the pH of the tank mix when using copper products

Acknowledgements

This Water Quality segment was adapted from the NSW DPI fact sheet 'Water quality for chemical spraying' written by Sandra McDougall. The Tank mixing procedure and types of formulations segment was adapted from the article found in the Macadamia Plant Protection Guide 2023 written by Mark Whitten.

NSW GOVERNMENT | Department of Primary Industries