How to get the most out of copper sprays

After well over a century of use in viticulture to control diseases, copper sprays are still an important tool for protection against downy mildew. They do, however, need to be used judiciously to avoid accumulation of copper in soil to levels that have a negative effect on soil health. In this column, AWRI Senior Viticulturist, **Marcel Essling** and Technical Officer - Viticulture, **Christa Schwarz** address some common questions received by the AWRI helpdesk about copper use in the vineyard.

After applying copper to my vines I got downy mildew anyway. What can I do better?

Copper compounds are protectant fungicides that must be applied prior to the development of disease because copper has no curative or systemic activity. When applied correctly, a protective barrier of the copper compound coats the plant tissue. The copper compound releases copper ions in the presence of moisture which are passively taken up by the fungal spore of the downy mildew pathogen to the point that they stop germination and infection.

Coverage is very important with copper sprays, especially on the underside of the leaf. This is because germinating downy mildew spores enter the leaf through stomata, which are located on the underside. Copper sprays also need to be reapplied across the season to account for tissue growth and losses caused by weather, so if it has not been possible to get sprays out due to wet weather, this may account for the downy mildew infection.

There are a lot of copper active constituents and products available. How do I know which one to use?

Copper sprays are available in a variety of formulations, with the most common active constituents used in viticulture being copper hydroxide and copper sulfate tribasic, although other options include copper ammonium complexes, copper cuprous oxide, copper octanoate and copper oxychloride. All these active constituents are effective (or they would not be registered); however, not all products are equal. A discussion with your chemical supplier about the attributes of the products available will probably centre on particle size, how well the product mixes in the tank and with other products, and the capacity of the product to release copper ions when wet.

Why is particle size important?

Just as the same volume of water in small droplets provides better coverage than large droplets, for the same weight of copper, small particles provide better coverage than large particles. Particles should be no larger than around 3 microns or they are very prone to being lost from the leaf surface after wind or rain.

Various manufacturers will highlight their particle size distribution as being more retentive/persistent or providing better protection (by smaller particles) than others. A key positive outcome from the work done on particle size, aside from improvements in coverage, is an overall reduction in the amount of copper that is required. In some products, the label rate is as low as 24 g of copper per 100 L, which is about one-third the amount of copper that is required for some other products.

Why do the copper ions matter and what role does the active constituent play?

It is the copper ions released when a copper compound comes into contact with water that provide the fungicidal activity of copper. For example, when copper hydroxide ($Cu(OH)_2$) comes into contact with water, copper ions and hydroxy ions dissociate. To have a fungicidal effect, the copper ions need to be in solution and in high enough concentration that when they are absorbed into a germinating spore they disrupt various cellular functions and prevent infection from occurring.

There is some conjecture about the speed and extent of the dissociation to copper ions of different copper active constituents. Some sources claim that copper hydroxide readily releases copper ions, whereas the copper sulfate component in copper sulfate tribasic may be slower to dissolve and release copper ions. The European Food Safety Authority in a risk assessment of copper fungicides determined that it was unclear if the oxidative state (i.e. if the copper is in the Cu^{+} or Cu^{++} form) has any bearing on its biological activity.

Are there other factors to consider?

Copper products are packaged in a range of physical forms including wettable powders, water-dispersible granules and liquid flowable suspensions. The product that is best for a certain situation may depend on a range of attributes aside from copper content and formulation. How compatible it is with other products, the ease with which it dissolves or stays in solution in the spray tank or its propensity to foam when mixed should also be taken into consideration.

How does water pH impact copper?

Copper chemistry dictates that as the pH of the solution decreases, copper ions are more available. In high concentration, these ions can be toxic to plants. For copper products, the recommended water pH will be detailed on the label, and this is typically around pH 7. This will prevent excessive amounts of copper ions being released which might otherwise cause damage to fruit and foliage.

What are they key tips for best-practice copper use?

- If copper is an important tool in your disease program, recognise that not all copper products are the same. Investigate the options to find what works best for you.
- Spray before any infection is present, as copper is a protective fungicide not a treatment.
- Follow product label directions regarding compatibility with other products and mixing rates.
- Re-apply sprays to account for tissue growth and the impact of weather.
- In seasons where downy mildew pressure is low, consider if a copper protectant is required.

Can organic growers use copper?

Some copper products are permitted for use in organic production. Check with the organic certification body before application because some products may contain other ingredients such as solvents that are not allowed. There may also be limits imposed on organic growers for the total amount of copper that can be applied per hectare per year.

For further information on copper and spraying, contact the AWRI helpdesk on helpdesk@awri.com.au or 08 8313 6600.

References and further reading

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