

# Technical note- copper

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## Introduction

Copper based fungicides are used to control fungal disease such as body rots and stem end rots in avocados.

Unsound fruit in export markets comes at a cost to growers' pool returns, directly impacting on orchard gate returns (OGR).

The key cause of outturn failures for New Zealand avocados is the expression of rots postharvest.

Postharvest rot prevention begins on orchard and requires copper applications to protect the fruit and tree from infection.

The following information has been compiled to enable growers to achieve improved out-turn quality in all export markets.



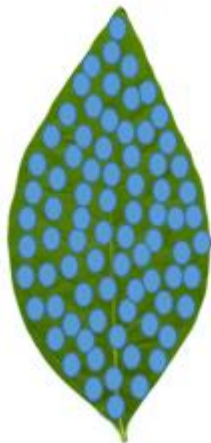
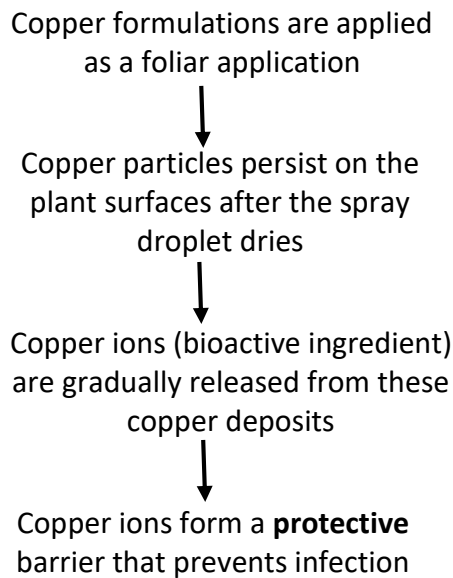
## Best Practise

***Apply copper every four weeks with a minimum of 10 applications per year to maintain an adequate cover.***

- Copper sprays are protectant fungicides and need to be applied before disease infection.
- Apply to just before the point of run off for even coverage of copper to the plant and fruit surfaces.
- The protective layer of copper diminishes over time and offers only short-term protection. If infection is likely over longer periods, re-application is recommended.
- Smaller particle size results in better rain fastness and retention of the copper product on the surface of fruit and leaves.
- Apply copper sprays only as per the manufacturers' recommendations.
- The pH of the water used to apply copper should be in the 6.8 – 7.4 range.
- Frequent applications using the lower label rate is less toxic to plants, than infrequent applications at higher rates.
- Don't apply copper when fruit or leaf temperatures are high, humidity is high or the fruit is wet.

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## How Copper Works



## Copper Formulations

There are a variety of copper compounds used as active ingredients in fungicide formulations:

- Cuprous oxides – red copper
- Copper oxychlorides
- Copper hydroxides
- Tri-basic copper sulphates – green and blue coppers
- Copper ammonium complexes – dark blue copper

Formulations contain from 8% to 75% copper as an active ingredient and application rates vary accordingly. Products are formulated as wettable powders, water-dispersible granules, liquid flowable suspensions or aqueous liquids.

Please refer to your spray diary for a comprehensive list of copper formulations that are registered for use on avocados.

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## Considerations

The most important factor affecting product effectiveness is the **particle size** of the formulation and its **retention** (i.e. How well it sticks to the plant surface).

### 1. Coverage - Particle size

The smaller the particle size the greater the surface area, the greater number of particles per gram, the better the fungicidal activity.

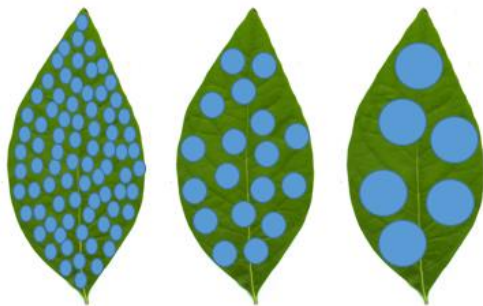


Figure 1. Better coverage with smaller particle size.

### 2. Retention

Factors that influence retention:

1. Particle size
2. Rainfall – from direct rainfall dislodgement or from rain solubilisation.
3. Wind– larger particles can be blown off plant surfaces.
4. Physical dislodgement – rubbing of plant parts against each other
5. Fruit growth and expansion
6. Spray application - excessive volumes resulting in run-off and/or stripping of copper from leaf and fruit surfaces.

### 3. pH - Ion Release/Solubility

Most copper products are formulated to be almost insoluble in water at pH 7.0.

As the pH of water decreases, the solubility of the copper fungicides increases and more copper ions are released.

If the water or spray solution is too acidic (i.e. pH <6.5), excessive amounts of copper ions may be released, causing phytotoxicity.

Solubility	Copper formulation	Persistence
Least	Copper oxychloride	Most
	Cuprous oxide	
	Copper hydroxide	
	Tri-basic copper sulphate	
Most		Least

*Comparison of solubility and persistence of copper formulations.*

Copper formulations vary in their solubility (e.g. copper hydroxide has a fairly high solubility and activity but is not very persistent under wet conditions).

## Rate of Application

The rate of application required to effectively spray an avocado orchard will vary with the density of the target canopy. A well calibrated and targeted spray unit is essential for spray application efficacy and cost efficiency.

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## Summary

The most important factor affecting product effectiveness is the particle size of the formulation and how well it sticks to the plant surface (i.e. its rain-fastness).

- Products with a smaller particle size tend to have better coverage, rain-fastness and longevity.
- Frequent applications of copper at lower rates are more effective than the same amount of copper applied in fewer applications.

## Acknowledgements

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