

# Copper / foliar application of streptomycin I say No! You be the Judge!

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## Copper affects floral bud development

Copper is phototoxic to kiwifruit vines when applied in spring.<sup>21</sup> Copper will affect floral bud development in spring and reduce the crop. Italian scientists report a 20% to 30% reduction in crop load<sup>30</sup>. While you probably will not see any phytotoxic foliage damage, copper damages flower bud development (internal phytotoxicity).

## Psa produces biofilms to protect against copper and streptomycin

When copper or streptomycin is applied on *Pseudomonas syringae*, the first few bacterial cells that die release "effector" molecules which signal to the live *Pseudomonas* to produce biofilms to protect them against the toxic environment. Therefore, the copper or streptomycin becomes ineffective.

There is indirect evidence that PSA produces biofilm. Where Zespri has conducted invitro tests there are several products that were not effective in "plates" but were effective in "broth". This is an indicator that PSA produces biofilm because scientific evidence shows that the biofilm is produced on "plate" but not in "broth"<sup>29</sup>

Japanese scientists, researching the genetic basis for copper resistance in PSA in 2002, identified the plasmid that codes for copper resistance<sup>32</sup>. New Zealand scientists later showed that the gene that coded for streptomycin resistance in apples and stone fruit was similar to the gene that codes resistance to copper in PSA<sup>33</sup>. This means PSA has the genes to resist both copper and streptomycin.

## Copper may allow Psa to spread further

Part of this immune reaction also produces uronic acid which chelates the copper. The copper can then enter the plant cell in toxic amounts to weaken the plants systems and cause death. This allows *Pseudomonas syringae* to invade this dying tissue and move into a more protected environment. At this stage you have lost your battle.

Orchardists who experience poor control of PSA are tempted to use higher rates of copper. This will only accentuate the phytotoxicity problem by continuing to damage the plant cells function and providing food for the bacteria.

## *Pseudomonas syringae* versus *Pseudomonas fluorescence* and other beneficial bacteria

One of the best natural defences the plant kingdom has against *Pseudomonas syringae* is its antagonist *Pseudomonas fluorescence*. *Pseudomonas fluorescence* like *Pseudomonas syringae* grows and is active at low temperatures.

*Pseudomonas fluorescence* will be killed off by copper or streptomycin. The mass destruction of beneficial bacteria will also open the door for invasion by other pests and diseases in orchards and weaken the vine further.

## **Using copper and streptomycin could accelerate the destruction of orchards.**

- **These two products are broad spectrum biocides which will kill off beneficial microbes.**
- **Copper damages flower bud development resulting in decreased crop load**
- **Copper and streptomycin application causes PSA to protect itself with biofilms**

- **Copper can cause toxic death and assist the invasion of PSA**
- **Copper and streptomycin can kill the beneficial enemy of Psa: Pseudomonas fluorescence**

Copper is proven to reduce crops by 20 to 30 %. The argument that it is better to save your orchard than worry about one year's reduced production is flawed. If the crop load is reduced, you will end up with increased summer pruning which will increase the risk of further invasion! The young growth is more prone to disease.

There are recent reports on copper application in Kiwifruit Orchards in New Zealand<sup>31</sup>. The authors claim copper is not phytotoxic. Growers need to objectively consider the options. **You be the judge.**

**Here is an option you can consider. Replace any of the products with ones you choose from the Zespri approved list.**

#### **Hort 16A Integrated PSA Management Plan**

1. Spray 1 litre/ha humates (humic acid + fulvic acid +( if available mugenoic acid + avenic acid) – this is to bioremediate the copper in the soil so that the beneficial bacteria can proliferate and toxic levels of copper do not enter the vine.

2. Inject Kasumin 1ml – 3ml/vine when approved and available. The ai Kasugamycin is systemic antibiotic and the injection technique will prevent environmental contamination. **ONLY IF YOU HAVE INFECTED VINES.**

3. ThemoMax –This is to increase the plant temperature. PSA is a low temperature bacteria and it is capable of making water freeze at temperatures above freezing.

4. Agrizest 4 sprays **PRE** flowering. To strengthen the vines immune system and increase OGR. Some relevant benefits are

- to mediate soil salinity problem,
- as an alternative to girdling,
- to reduce leaf breakdown disorder,
- to overcome frost damage stress,
- to improve productivity and reduce secondary growth (summer pruning).

**I have suggested all 4 sprays are applied PRE blossom to quickly strengthen the plant.**

5. Pseudomonas fluorescence – if approved and available. This bacteria, like PSA, is active in low temperature and is well known antagonist of Pseudomonas syringae.

6. Blow torch - If exudates appear use blow torch to singe the exudates.

Using the example above you may wish to replace humates with liquid worm cast based on availability or your own preference.

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#### **REFERENCES**

21 N. Balasingham 1988. Chemical control of bacterial bud rot. NZ Kiwifruit Feb.1988;30

27. Sang-Jik Lee and Jocelyn KC Rose 2010. Mediation of the transition from biotrophy to necrotrophy in hemibiotrophic plant pathogens by secreted effector proteins. [www.landesbioscience.com/journals/10/article/11778/](http://www.landesbioscience.com/journals/10/article/11778/)
28. Inmaculada Yruela 2005 Copper in Plants , a Review. Braz. J. Plant Physiol., 17(1):145-156, 2005
29. Saranga P. Kidambi, George W. Sundin, David A. Palmer, Anand M. Chakrabarty, and Carol L. Bender 1995. Copper as a Signal for Alginate Synthesis in *Pseudomonas syringae* pv. *syringae*. Applied and Environmental Microbiology, June 1995, p. 2172–2179
30. Scortichini M., Ferrante P., Marcelletti S. 2011. Updates on bacterial canker of gold and green kiwifruit (2009-2010) [http://agricoltura.regione.campania.it/eventi/pdf/convegno-10-11-10\\_rel\\_2.pdf](http://agricoltura.regione.campania.it/eventi/pdf/convegno-10-11-10_rel_2.pdf)
31. Callum Kay 2011. PSA Italy trial update 2011. <http://www.kvh.org.nz/vdb/document/332>
32. Nakajima, M.; Goto, M.; Hibi, T. 2002: Similarity between copper resistance genes from *Pseudomonas syringae* pv. *actinidiae* and *P. syringae* pv. *tomato*. J. Gen. Plant Pathol. 68: 68-74
33. J.L.Vanneste, M.D.Voyle, J.Yu, D.A.Cornish, R.J.Boyd and G.F.Mclaren. 2003. Copper and Streptomycin resistance in *Pseudomonas* strains isolated from pipfruit and stonefruit orchards in New Zealand. M>B>Fatmi et al (eds.) *Pseudomonas syringae* Pathovars and Related Pathogens. Springer Science + Business Media B.V.2008