

Understanding Plants & Protection

Understanding plant responses to our orchard management and agrichemical activities is a vital key to maintaining orchard health and resistance to pests and diseases. As yet scientists have not been able to provide a chemical formulation that works systemically within the plant to protect our vines from Psa attack. That leaves orchardists in the position of applying a range of protectants and elicitors to arrest or slow down bacterial attack. I refer to protectants as those chemicals which have proven efficacy external to the plant and elicitors as those products which are designed to elicit an internal plant response and improve the ability of the plant to resist attack by stimulation of defence pathways. Neither of these approaches is fool-proof against the Psa-V strain as has been demonstrated by the continued orchard infection that has occurred since first detection in November 2010.

Plant physiology is a complex field (and it is over twenty years since my university studies) but is useful to understand some of the basics to assist in guiding adequate intervention to reduce risk of infection and when deciding on the choice of protectants and/or elicitors that are available.

Plants have separate defence systems to deal with biotic stress such as pathogenic (e.g. bacterial and viral) or wounding (e.g. insect attack or pruning cuts). These plant responses result in the production of compounds such as salicylic acid, jasmonic acid, auxins, abscisic acid, cytokinins and amino acids which act as signalling agents and plants defence mechanisms.

Pathogenic infections such as Psa are repelled by the plant sensing the introduction of elicitors produced by the pathogen and designed to assist the entry of the pathogen into the plant. The plant response is the stimulation of production of salicylic acid (SA), and necrosis of plant tissue to inhibit the pathogen invasion. In the case of Psa this can be observed as the halo around leaf spots where the plant is actively shutting down cells as a defence against infection. The success of resistance to attack is due to the ability of the plant to turn these defence systems on and differences in the impact of Psa on H16A and Hayward varieties is thought to be due, in part, to the reduced ability of Hort 16A to activate this mechanism.

This knowledge enables orchardists to consider the use of products that elicit or assist the vine to produce salicylic acid the beef up the defence mechanism, which are broadly referred to as elicitors. Elicitor products need a period of active plant photosynthesis to assimilate the products before they are effective, usually this is in the order of several days to a week so again judicious planning of application prior to planned orchard activities which either expose the vascular system (e.g. pruning cuts) or weather events needs to be considered. Elicitors are not a replacement rather they are additional to the use of protectants.

Growers should also consider that the confounding impacts of using an elicitor to stimulate the SA pathway and the corresponding impact that pruning or girdling wounds have in causing the plant to respond to the perceived attack that these cuts induce. Wounding causes the stimulation of a separate biological pathway and the production of jasmonic acid (JA) and ethylene which aids the formation of callousing and in the case of ethylene repels insects. We are in new territory using elicitors and plant responses to other impacts are unknown territory so caution and diligence in

regard to monitoring and control for insects especially leaf roller and passion vine hopper is advisable. There are some new biological products on the market which may be worthy of your consideration if you need to control cicada or passion vine hopper.

Of course for the plant to function effectively it needs to be in good health with adequate supply of nutrients and water and without mechanical impediments such as compact or saturated soils or wind exposure. Consideration of these issues are a broader context which I will not attempt to address here apart from the comment that we have found the use of seaweed derived products to assist plant health where phytotoxic symptoms or wind damage has occurred within the canopy have proved useful.

The bacteriologists advise that the risk of Psa infection is at its greatest when the canopy is anticipated to remain with high leaf moisture for periods of greater than 48 hours. Keeping a keen eye on the weather or using the NIWA service provided via the KVH website is a useful tool available to the grower to anticipate weather events that protection is required to cover.

Delivery of protectants to the leaf surface with the best possible coverage that can be achieved, so as to provide an adequate source of chemical protectant on the leaf surface is crucial. If you have not already checked your sprayer delivery then using water sensitive paper to monitor the coverage you are achieving is a quick approach. Timing protectant applications prior to significant rain events rather than on a calendar basis will provide most effective protection and reduce overall agrichemical usage and the risk of phyto-toxicity through over use.

The Zespri CPP has a list of protectants that have been evaluated *in vivo* (in glasshouse) and *in vitro* (using agar plates) and recommended for use against Psa bacterial infections.

The cheapest most basic and widely used and effective fungicides are products derived from copper in the form of oxides, hydroxides, and acetates. However, they need to be used in horticultural systems with the understanding the kiwifruit are particularly sensitive to copper toxicity, especially juvenile leaves. We are using Kocide Opti at rates of between 40- 80g /100ml at 1000-1500 L/ha for summer foliar application. When using copper products phytotoxicity is exacerbated under acidic conditions (i.e. when pH is greater than 6) and slow drying conditions exist. Whilst recommendations have been to add adjuvants to improve the coverage of copper products, with the premise that coverage is essential for good protection against airborne bacterial infections, our experiences this spring indicate that additions of adjuvants and spreaders can cause adverse plant reactions, especially in Hort 16A canopies. Copper products also have a deleterious effect on soil biota and overuse or over dosing can be antagonistic to maintaining good soil health. My soils professor always advised against disturbing the balance of soil biota by abiotic inputs, and the rule of thumb being all things in moderation.

Sterilants such as oxine can provide effective knock down of bacterial populations, and therefore short term protection, which may be useful prior to pruning operations, but efficacy of longer-term protection from these types of products is likely to be unreliable.

In short the judicious use of copper is the most cost effective and reliable tool available to orchardists, yet it comes with the complications of phytotoxicity and effects on the soil biotic flora and fauna. Use different formulations to reduce bacteria resistance. Additionally, overuse of copper

is likely to have long term impacts on fruit production. Consider using other forms of protectants and sterilants in conjunction with orchard activities to reduce these impacts.

Finally, avoiding cuts which expose the vascular system of the plant which are known to be high risk infection sites is another consideration that needs to be in the mix. The simple solution is to undertake these activities only in dry conditions, however this may not always be possible and the risks need to be weighed up. For example, using sealants which prevent the movement of water (and potentially pathogens) to the vascular system of the plant exposed by pruning or girdling operations is a simple and effective solution where activities need to be carried out under less than ideal conditions. We have applied Nordox via hand-held sprayer to protect our girdling wounds with no observed reduction in the callous formation.

If you have any questions regarding our approach please do not hesitate to contact Matt Nelson 027 511 4420 (Field Technical Manager) or Margaret Miller 027 576 3899 (Horticulture Technical Manager).

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