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VI1284 - Short-term risk assessment of spring pruning techniques

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Executive summary

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Pruning wounds probably provide multiple infection points for Psa-V (*Pseudomonas syringae* pv. *actinidiae*) and it is possible that some pruning methods pose greater risk of infection and canker development than others. The objective of this project was to confirm the degree of risk associated with a range of shoot pruning techniques normally applied in spring to 'Hort16A' and 'Hayward' vines in the Bay of Plenty.

Pruning treatments were applied to whole canes. These included: tip-squeezing; zero-leaf pruning; ripping; flush cutting – untreated; flush cutting with protectant paint; NAA-gel pruning and a "no prune" control. All treatments were applied in spring 2011 and assessments continued until June 2012. Some treatments were repeated in autumn 2012.

'Hort16A' symptom development

Secondary symptoms of Psa-V infection on 'Hort16A' vines/canes developed slowly following application of shoot pruning treatments in spring 2011. By March 2012, up to 15% of canes had symptoms compared with 5% on the "no prune" control canes. We did not regard this degree of infection to be sufficient to indicate significant treatment effects, as these figures represent the difference between six and two canes per treatment (out of a total of 40 canes per treatment) showing symptoms of infection. When pruning treatments were repeated in April 2012, we found between 0 and 21% of treated canes with symptoms of Psa-V infection, compared with 16% on the "no prune" control canes.

'Hayward' symptom development

No primary leaf-spotting or secondary symptoms of Psa-V infection were recorded on the 'Hayward' vines used in this trial. These treatments were applied during a relatively low risk period following several days without rain.

Conclusion and future work

Although new symptom development was recorded on 'Hort16A' vines from November 2011 until June 2012, none of the shoot pruning treatments appeared to change the rate of symptom development compared with the "no prune" control treatments.

Future experiments investigating risks associated with pruning should consider applying whole-vine treatments comparing perceived "high risk" vines pruned vigorously in spring to generate significant new shoot development, with perceived "low risk" vines that receive no or minimal pruning until early summer to avoid creating pruning wounds and stimulating new shoot growth during periods of higher rainfall in spring.

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1 Introduction

A key question for kiwifruit growers following the recent incursion of Psa-V (*Pseudomonas syringae* pv. *actinidiae*) into New Zealand has been, "What is the relative risk of different pruning techniques increasing Psa-V infection of my vines?"

Current recommendations on "pruning risk" are often vague and based on anecdotal information and perceived "common sense" rather than sound scientific data. Some of these recommendations have suggested that:

- Tip squeezing will result in a smaller wound than pruning, so should have a reduced risk of infection.
- Vine management activities applied immediately before planned application of protectant sprays should ensure all cuts/wounds are covered.
- Psa-V infections on individual vines can often be traced back to "zero leaf" cuts so these wounds should be protected as soon as possible.
- Leader ripping is effective in managing vine vigour. The 'ragged' wounds left after ripping were at first thought to take longer to heal than wounds from the use of secateurs and thus potentially posed greater risk. However, now the feeling is that wounds from secateur cuts are more likely to lead to infection than wounds from ripping and so many growers are continuing to use ripping as the preferred method to remove leader growth.
- Early blind shoot management should aid spray coverage. Depending on fruitfulness, canopy density and vine vigour, these could be dealt with by either tip squeezing or removal, but earlier than usual.
- Performing these activities immediately before or after rain will most likely increase infection, so should be avoided.

This project was established to examine these observations/recommendations in field trials. The project complemented inoculation trials using: 1) potted plants in a containment glasshouse to compare infection risk of shoot pruning and tip-squeezing (Shirley Miller et al, Plant & Food Research); 2) comparison of methods for applying protectants to pruning wounds (Shirley Miller et al, Plant & Food Research) and 3) trunk girdling (Bill Snelgar et al, Plant & Food Research). The relevant reports are:

Miller S. 2012. Psa Epidemiology – susceptibility of summer pruning wounds. Research note prepared for ZESPRI Group Limited, Ref. VI1276: 7pp.

Miller S, Barnett A, Blattmann M, Longman K, Ward B, Boyd L, Davy M, Yu J, Thorp G. 2012. On-orchard management of Psa-V infection and symptom expression: Part A. Wound protection and application technologies. A confidential report prepared for ZESPRI Group Limited, Ref. VI1254 (Part A): 16pp.

Snelgar B, Blattmann P, Tyson J, Manning M, Curtis C. 2012.On-orchard management of *Pseudomonas syringae* pv. *actinidiae* infection and symptom expression: Part C. Girdling - possible positive and negative effects on Psa. A confidential report prepared for ZESPRI Group Limited, Ref. VI1254 (Part C): 45pp.

2 Materials and methods

Nine pruning treatments were applied to 'Hort16A' and Hayward vines in Te Puke (Table 1), in orchard blocks currently not expressing secondary symptoms of Psa-V infection but adjacent to blocks where there was known infection by Psa-V. This approach was used to ensure a source of inoculum for infection but to try to mitigate the risk of the vines already being infected and thus confounding the results. Canes from each of the treated vines were polymerase chain reaction (PCR)-tested by Hill Laboratories Limited during set-up of the block, with the intention that the trials would be abandoned if infection by Psa-V was already very high.

The selected pruning treatments were designed to represent standard orchard activities (Table 1, Figure 1). Treatments were applied to individual canes to maximise the number of treatments that could be compared while ensuring there was sufficient replication to obtain meaningful comparisons. Each treatment was applied to five shoots per cane. Most treatments were applied when there was a high risk of infection following rain, and wounds were not protected, to assist with passive infection. The intention here was to ensure that treatment effects would appear as soon as possible, in order for results to be quickly passed onto growers. Two "control" treatments, one with no pruning and one with protectant paint (Greenseal ULTRA™) applied to the pruning wounds, were also included. In addition, some treatments were repeated during a prolonged dry period when infection risk was regarded to be low. Rainfall data were collected from the Te Puke Research Centre weather station.

Table 1. Pruning treatments applied to individual canes on 'Hort16A' and 'Hayward' kiwifruit vines to assess the relative risk of each pruning treatment increasing *Pseudomonas syringae* pv. *actinidiae* (Psa-V) infections. Treatments were applied in spring 2011 to five shoots on each of 40 canes per cultivar. Treatments were re-applied in April 2012 to 20 of these original 40 canes/vines on 'Hort16A' vines only.

		'Hort16A'		'Hayward'
	Treatment	Spring 2011	April 2012	Spring 2011
1	Zero-leaf pruning during a dry period	25-Oct	18-Apr	18-Nov
2	Zero-leaf pruning immediately after rain	3-Nov	11-Apr	23-Nov
3	Tip-squeezing immediately after rain	3-Nov	11-Apr	23-Nov
4	NAA-gel pruning immediately after rain	3-Nov	11-Apr	23-Nov
5	Ripping immediately after rain	3-Nov	11-Apr	23-Nov
6	Flush cut immediately after rain	3-Nov	11-Apr	23-Nov
7	Flush cut immediately after rain with protectant paint applied to wound	3-Nov	11-Apr	23-Nov
8	Flush cut during a dry period	25-Oct	18-Apr	18-Nov
9	No-prune control	Na	na	na
	No. of cane replicates:	*40*	*20*	*40*

Pruning treatments were replicated on 40 canes per treatment, with each treatment repeated once on each of 40 vines (nine canes per vine) and with five shoots on each cane receiving the same treatment. All vines continued to receive a protectant spray programme as recommended by KVH.

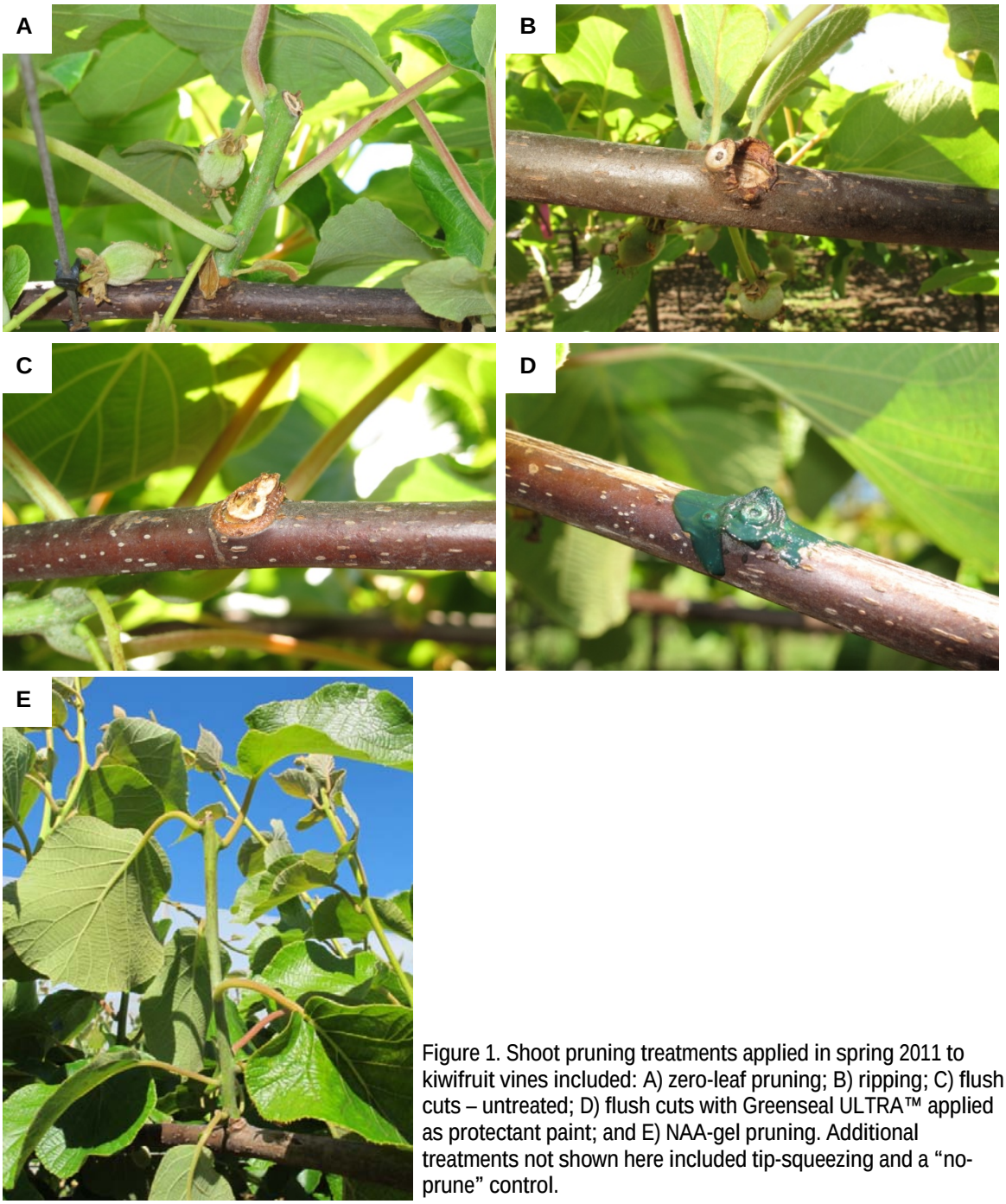

Figure 1. Shoot pruning treatments applied in spring 2011 to kiwifruit vines included: A) zero-leaf pruning; B) ripping; C) flush cuts – untreated; D) flush cuts with Greenseal ULTRA™ applied as protectant paint; and E) NAA-gel pruning. Additional treatments not shown here included tip-squeezing and a "no-prune" control.

'Hort16A' vines used in this study were located near Paengaroa; they were grafted in 2005 onto two-year-old 'Bruno' seedling rootstocks. The 'Hayward' vines used were at the Te Puke Research Centre; the vines had been grafted in 1998 onto 'Bruno' seedling rootstocks.

Visual assessment of any Psa-V symptoms was undertaken on a regular basis, on the expectation that with the high infection pressure a result would be obtained within 6-8 weeks. Assessments were made using the following categories: no symptoms, leaf spotting, shoot dieback/death, cane dieback, cankers present.

Following these earlier assessments, it was decided to repeat each of the treatments in April 2012 using 20 of the original 40 'Hort16A' vines. The 20 vines had either no or low symptom development in response to the earlier treatments in spring 2011 (Table 1).

3 Results and discussion

Canes that were PCR-tested during the set-up phase of the trial were not Psa-V-positive and so the project continued as planned, with the first round of cane assessments completed approximately one week after treatments were applied.

With ‘Hort16A’ vines, Treatments 1 and 8 were applied on 25 October 2011, following a period of 6 days without rain, and Treatments 2-7 were applied on 3 November following a period of 8 rain days (Table 1, Figure 2). It was not possible to obtain a similar separation between “wet” and “dry” treatments for the ‘Hayward’ vines. Treatments 1 and 8 were applied to ‘Hayward’ vines on 18 November and Treatments 2-7 were applied on 23 November. Both dates were during a prolonged period of unusually dry weather. We attempted to overcome this by intermittent application of overhead irrigation, sufficient to keep the vines wet during three days following application of Treatments 2-7, without creating water-logged conditions.

In general, there was a relatively low incidence of symptoms of Psa-V infection. This made it difficult to attribute symptoms to specific pruning wounds as more often symptoms were observed on parts of the canes distant from the actual pruning wound. Thus we were not able to determine an average rate of symptom development for the five treated shoots per cane. Data were therefore summarised at the whole-cane level, into two categories: 1) no symptoms; 2) secondary symptoms including shoot dieback, cane dieback and/or cankers (Figure 3). Incidence of leaf spotting (including that present before treatments were applied) was low and so was not included in these data summaries.

Where a cane or shoot had been pruned/removed by the growers, it was confirmed with the grower that this was done because of the presence of a canker(s) or shoot dieback, in which case the cane was recorded as having secondary symptoms.

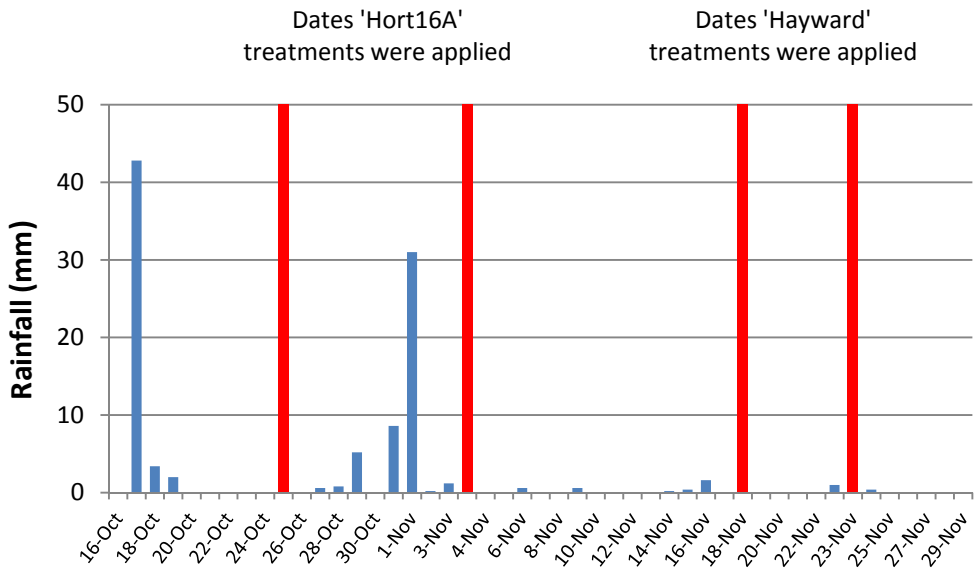

Figure 2. Daily rainfall recorded at Te Puke Research Centre during the period when shoot pruning treatments were applied to 'Hort16A' and 'Hayward' kiwifruit vines in spring 2011.

Figure 3. Secondary symptoms of *Pseudomonas syringae* pv. *actinidiae* (Psa-V) infection were seen as kiwifruit shoot dieback on otherwise "healthy canes" (left) and cankers with orange/red exudate on canes and/or leaders (right).

3.1 'Hort16A' symptom development

For treatments applied in spring 2011, up to 15% of canes had developed symptoms by March 2012, compared with 5% on the "no prune" control canes (Figure 4, Table 2). These figures represent the difference between six and two canes per treatment (out of a total of 40 canes per treatment) showing symptoms of infection, which we did not regard to be sufficient to indicate significant differences between treatments. Development of secondary symptoms of Psa-V infection on 'Hort16A' vines/canes was not rapid during the 5 months following treatment application (Figure 4). There was some indication that the rate of symptom development was slower over summer, which is consistent with industry experience. There was also no indication that date of treatment application in high or low risk conditions increased or decreased the likelihood of infection.

By June 2012, between 20 and 40% of canes on the original 'Hort16A' vines pruned in spring 2011 that were not included in the second round of treatments in autumn 2012 had secondary symptoms of Psa-V infection, compared with just 10% on the "no prune" control canes (Table 2). This may indicate increased infection via pruning wounds but it was not clear from the data if one pruning treatment had higher risk than another. There was no evidence that pruning during perceived low or high risk periods affected the degree of risk, or that application of protectant pruning paints increased or decreased infection risk.

When pruning treatments were repeated in April 2012 on a subset of the original vines treated in spring 2011, we found between 0 and 21% of treated canes with symptoms of Psa-V infection compared with 16% on the "no prune" control canes (Table 2). These vines were selected for repeat treatments in April on the basis that they had either a zero or low incidence of symptoms.

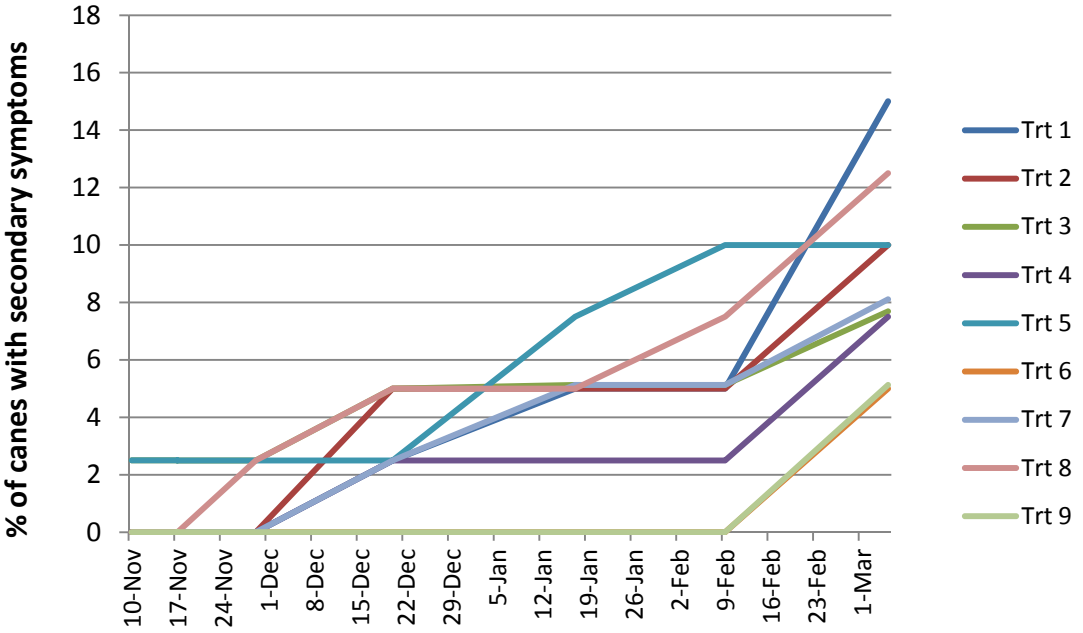

Figure 4. Development of secondary symptoms of *Pseudomonas syringae* pv. *actinidiae* (Psa-V) infection on 'Hort16A' kiwifruit vines following application of pruning treatments in spring 2011. Refer to Table 1 for Treatments.

Table 2. Incidence of secondary symptoms of *Pseudomonas syringae* pv. *actinidiae* (Psa-V) infection on 'Hort16A' kiwifruit canes following application of shoot pruning treatments in spring 2011 and autumn 2012.

Date of treatment application		Spring 2011	Spring 2011	Spring 2011 and Autumn 2012
Assessment date		March 2012	June 2012	June 2012
Treatment		(% of canes with secondary infections)		
1	Zero-leaf when dry	15	40	5
2	Zero-leaf after rain	10	25	16
3	Tip-squeeze after rain	7.5	20	21
4	NAA-gel after rain	7.5	25	0
5	Ripping after rain	10	25	5
6	Flush cut after rain	5	30	0
7	Flush cut with protectant after rain	5	35	11
8	Flush cut when dry	12.5	30	11
9	No-prune treatment	5	10	16
	No. of cane replicates:	*40*	*20*	*20*

3.2 'Hayward' symptom development

No primary leaf-spotting or secondary symptoms of Psa-V infection were recorded on the 'Hayward' vines used in this trial. These treatments were applied during a period of low risk of infection following an unusually prolonged period of dry weather without rain, although we did attempt to increase the risk by applying overhead irrigation following application of the "wet" treatments.

4 Concluding comments

Despite continuing to record new symptom development from November 2011 until June 2012, none of the original shoot pruning treatments appeared to increase the rate of symptom development compared with the “no prune” control treatments. So there was no clear evidence that any of the treatments either increased or decreased the risk of Psa-V infection.

The selected treatments were all applied on a similar calendar date rather than at the standard time when growers would be using each technique. For example, tip-squeezing and ripping are normally applied quite early in the season before flowering, whereas flush cutting and zero-leaf pruning are generally applied after flowering. Future experiments investigating risks associated with pruning should consider applying whole-vine treatments comparing perceived “high risk” vines, pruned vigorously in spring to generate significant new shoot development, with perceived “low risk” vines that receive no or minimal pruning until early summer to avoid creating pruning wounds and stimulating new shoot growth during periods of higher rainfall in spring.

5 Acknowledgements

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