Plant & Food RESEARCH
RANGAHAU AHUMĀRA KAI

PFR SPTS No. 14471

Trunk sprays and lower phosphite injection rates for kauri dieback control

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March 2017

Confidential report for:
Ministry for Primary Industries

PUBLICATION DATA

Horner I, Hough E, Horner M. March 2017. Trunk sprays and lower phosphite injection rates for kauri dieback control. A Plant & Food Research report prepared for: Ministry for Primary Industries. Milestone No. 66672. Contract No. 33523. Job code: P/345160/04. SPTS No. 14471.

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CONTENTS

EXECUTIVE SUMMARY

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Previous trials with phosphite injection of kauri trees with kauri dieback symptoms have shown good control of trunk lesion expansion, but have also revealed problems with phytotoxicity in some cases. In March 2016, new trials were established on three sites (Huia and two Dargaville sites), to investigate injection with lower phosphite concentrations and doses, plus test application of phosphite via a trunk spray. There are a total of 72 trees in the trial, all between 20 and 70 cm trunk diameter, and all showing symptoms of kauri dieback.

Baseline assessments of canopy health plus basal trunk lesion dimension and activity were made before treatment. Re-assessments of these parameters plus phytotoxicity symptoms will be made 6-monthly throughout the trial.

Results from assessments made one year after treatment application indicate that, compared with the untreated controls, all phosphite treatments, including trunk sprays and the lowest injection rate of 4% phosphite injected at 40-cm spacings, reduced basal trunk lesion spread and activity. However, there were still some active lesions present in all treatments, more so in the trunk spray treatment. Future monitoring will determine if these remaining active lesions eventually heal, as was observed in previous forest trials with higher concentrations of phosphite.

No obvious foliar phytotoxicity symptoms were observed. In trunk spray treatments, copious bark peeling was often observed in the sprayed zone, but bark beneath appeared healthy.

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1 INTRODUCTION

Trials evaluating phosphite trunk injection for control of kauri dieback have provided promising results to date, with cessation of lesion expansion in treated trees, and evidence for excellent control of *Phytophthora agathidicida* within trees (Horner et al. 2015, NZ Plant Protection 68: 7–12). However, there have also been some detrimental effects, with foliar phytotoxicity in some treated trees. Application concentrations in the early trials were possibly too high (20% & 7.5% phosphite), and this may have contributed to the observed phytotoxicity. In addition, there were some trunk symptoms such as cracking, which appeared to be associated with injection points.

New trials have been established to investigate the efficacy of lower concentrations and doses of phosphite, to determine if phytotoxicity symptoms can be reduced, while still providing adequate disease control.

Trunk sprays have also been included, to determine if topical application and absorption through the bark could provide disease control while avoiding invasive injection. Such treatments have been tried with other species (such as apple, avocado and oak) and while not always as effective as trunk injection, they still had a positive effect on *Phytophthora* control.

2 METHODS & OBSERVATIONS

2.1 Trial sites and tree selection.

Three sites were selected for the trials: Huia Dam – adjacent to the existing long-term trial, and two farm blocks at Aropohue, near Dargaville. Trees in the trial are mostly at the advanced ricker and mature stage, ranging in size from 20 to 70 cm trunk diameter. All trial trees showed symptoms of kauri dieback at the start of the trial, including basal trunk lesions.

2.2 Treatments

1. Untreated control
2. 7.5% phosphite trunk injection, 20 mL every 20 cm.
3. 4% phosphite trunk injection, 20 mL every 20 cm
4. 4% phosphite trunk injection, 20 mL every 40 cm
5. 10% trunk spray with bark penetrant (Pentrabark™).
6. 10% trunk spray without bark penetrant.

All treatments were applied in March 2016. Trunk sprays were applied to the lower 2 m of the trunk, using a hand mister. Volumes were carefully measured, so that equivalent total volumes of phosphite were applied in injection and spray treatments (based on trunk girth).

The rationale of the treatment selection was to include the lowest concentration from previous trials (7.5%) as the high injection rate for this trial, to include injection with a lower phosphite concentration (4%), plus the 4% concentration at a lower dose (i.e. one 20-mL injection every 40 cm around the trunk, rather than every 20 cm). The trunk sprays were included to test this application method, with or without the bark penetrant recommended by the phosphite suppliers.

2.3 Trial design

There are a total of 72 trees, 24 on each site. The trial is evenly balanced, with four replicates of each treatment on each site. At each site, trees were placed into groupings based on disease parameters such as lesion activity and canopy symptoms, then within each grouping were randomly assigned to the various treatments. This ensured a relatively even distribution of disease symptoms across treatments.

2.4 Initial assessments

Before treatment, baseline assessments were made on various tree growth and health parameters. These included tree girth, canopy health score, canopy colour, plus trunk lesion size and activity. Selected lesion margins were marked for subsequent measurement of expansion, and canopy photographs were taken for later comparison.

2.5 Periodic assessments and observations to date

Approximately every 6 months, tree health and lesion expansion plus activity are measured. Assessments to date have been in August 2016 and February/March 2017. Although it is too early to draw conclusions about treatment efficacy, the following observations were made in the one-year assessment:

- Lesion healing has been better and lesion expansion less in all phosphite treatments than in untreated controls (Figures 1 and 2).
- Healing in the trunk spray treatment was less consistent than in the injection treatments.
- No obvious phytotoxicity symptoms have been observed in the canopy.
- Minor 'stretch marks' have been noted in trunks of some injected trees, one year after treatment (Figure 3). These appear to be in line with injection points. These will be carefully monitored to see if they develop into cracks, as occurred in some trees in earlier trials.
- In the trunk spray treatments, lichen in the sprayed zone went brown.
- In some of the 'trunk spray' trees there was prolific peeling of bark in the sprayed zone (Figure 4). This was not just around lesion margins. In some cases the peeling was of bark that would not normally be expected to peel, although there appeared to be healthy bark below.

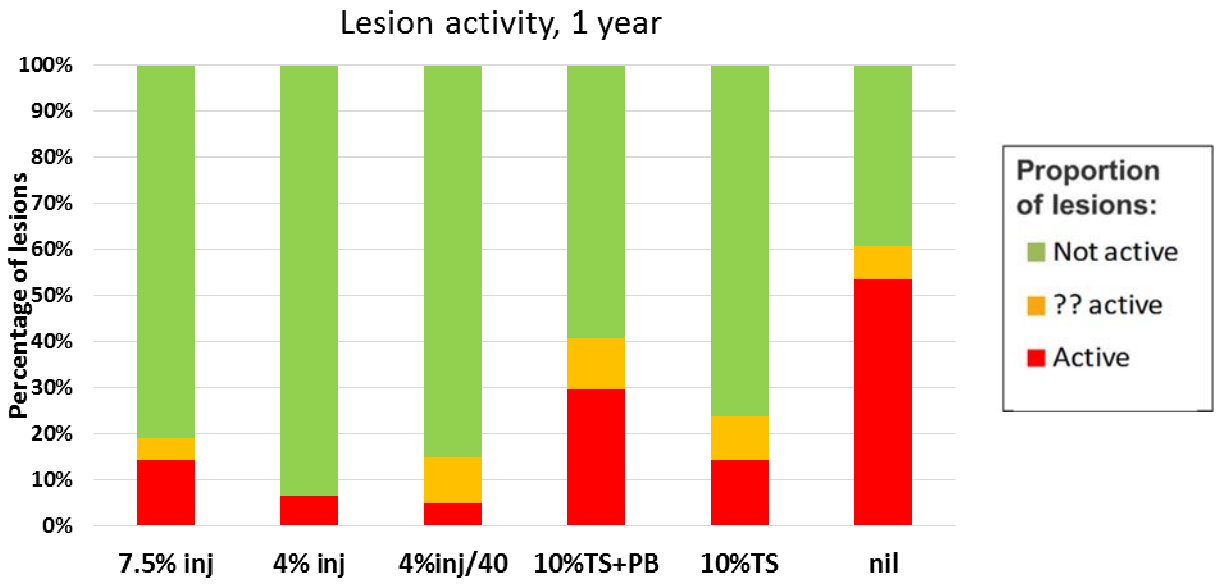

Figure 1. Basal trunk lesion activity on kauri trees, 1 year after application of 7.5% or 4% phosphite by trunk injection (inj) or a 10% phosphite trunk spray (TS) with or without Pentrabark™ (PB). Data are from 72 trees across three sites.

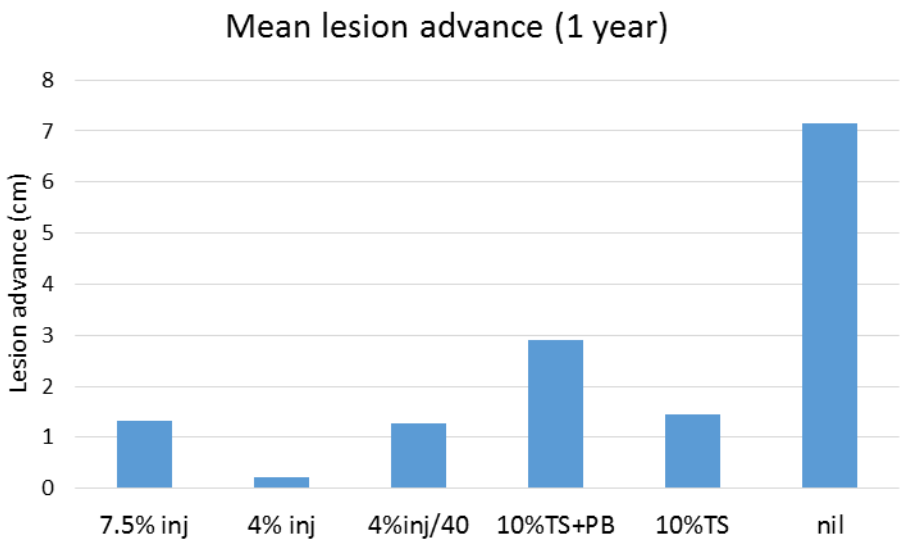

Figure 2. Mean advance of basal trunk lesions on kauri trees in the year following application of 7.5% or 4% phosphite by trunk injection (inj) or a 10% phosphite trunk spray (TS) with or without Pentrabark™ (PB). Data are from 72 trees across three sites.

Figure 3. Faint stretch mark in a kauri trunk, in line with an injection point made one year earlier.

Figure 4. Cracking and peeling of kauri bark, one year after application of phosphite as a trunk spray

2.6 Residue testing

In late April and August 2016, three and eighteen weeks after treatment application, twig and leaf samples for phosphite residue analysis were collected from representative trees of each treatment in the two Dargaville sites, and pooled for analysis. Samples were sent to Hill Laboratories Limited in Hamilton, and analysed for phosphonate content following aqueous extraction and LC-MS/MS. The detection threshold was 0.4 ppm.

Results showed that regardless of application method, phosphite could be detected in tissue remote from the point of application. However, residue concentrations were very low, and were not obviously correlated with concentration or dose applied.

In April 2016, a few root samples were also collected from the 7.5% injection-treated trees. Collection of these samples was difficult without substantially disturbing the site, and because of overlapping root systems there was no certainty that the roots collected were actually from the prescribed tree. Phosphite concentrations in these roots were below the detection threshold of 0.4 ppm.

Table 1. Phosphite residues detected in kauri leaves and shoots collected 3 or 18 weeks after application of phosphite.

Treatment	Mean phosphite residue detected (ppm)	
	3 weeks	18 weeks
nil	<0.4	<0.4
7.5% phosphite injection/20 cm	<0.4	1.2
4% phosphite injection/20 cm	1.2	1.0
4% phosphite injection/40 cm	2.4	0.7
10% phosphite trunk spray plus Pentrabark™	<0.4	0.5
10% phosphite trunk spray	0.6	0.4

3 PLANS

Six-monthly assessments of tree growth, canopy health, lesion activity and spread, and phytotoxicity symptoms will continue for a period of at least 3 years. A brief report will follow each assessment.

One further round of residue testing will be carried out in late March/early April 2017, one year post-treatment.

We will consider re-application of the spray treatment after the next evaluation in July/August 2017, as we suspect the first application was not sufficient to suppress the advance of *P. agathidicida* systemically.

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