PFR SPTS No. 18505

Phosphite large tree treatment trials: brief report August 2019

Horner IJ, Arnet MJ

August 2019

1 INTRODUCTION

Forest trials established in 2012, testing phosphite for kauri dieback (causal agent *Phytophthora agathidicida)* control, provided promising results with demonstration of a curative effect (Horner et al. 2015, 2017). However, these trials were all carried out with trees in the 'ricker' size class, mostly 15–35 cm diameter, with no testing on larger trees. Before any future deployment to treat moderate-sized trees or large iconic trees, and to allow informed decisions to be made, information on safe and effective treatment regimens for large trees is required. Doses based on trunk girth have previously been used to calculate required phosphite volumes. But with giants such as kauri, scaling up from rickers to trees with girths of 5–15 m may be difficult. Earlier trials also indicated some problems with phytotoxicity, particularly with higher phosphite rates, so it is very important that effects on larger trees are assessed before widespread release of the treatment. A balance must be struck between rates sufficient to suppress the disease, yet still safe for the tree.

In 2016, new trials were established on large kauri trees to help to determine appropriate treatment regimens, with emphasis on phosphite rates and doses lower than those used in previous trials. This report summarises recent re-treatment of trees, and results of assessments made on all trial trees in August 2019, and supersedes a similar report in April 2019 (Horner 2019a).

2 METHODS

2.1 Trial sites and tree selection

Three sites were selected for the trials: Puketotara Road, near Kerikeri in Northland; Trounson Park in Northland; and the Cascades in the Waitakere Ranges, Auckland. The Puketotara block is on a private land, and Trounson Park and the Cascades are under Department of Conservation and Auckland Council jurisdiction, respectively.

Trees in the trial are in the mature stage. At Puketotara, trees range in size from 0.4 to 1.1 m trunk diameter. At Trounson, trial trees range from 1.0 to 2.1 m trunk diameter, and trees at the Cascades range from 0.6 to 2.4 m 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. 4% phosphite trunk injection, 20 mL every 40 cm around the trunk circumference.
3. 4% phosphite trunk injection, 20 mL every 80 cm around the trunk circumference.

Treatments were applied at the Puketotara site in March 2016 and at the Trounson and Cascade sites in November 2016. Treatment 3 applications were repeated at the Puketotara site in March 2018, and in the Trounson and Cascade sites in March 2019. Following discussions with the Kauri Dieback Programme Planning & Intelligence team, Treatment 2 was re-applied at all sites in June 2019.

The determination of phosphite concentration and doses for the large trees was difficult. With trunk girth being the main determinant of dose, and with no international experience with treating trees of such size, a very conservative approach was taken. This decision was in part influenced by previous experiences with phytotoxicity. The selected phosphite concentration of 4%, with injector frequency of one every 40 cm, corresponds to the lowest rate and dose used in the concurrent 'Trunk spray and low rate trial' (Horner 2019b). We have also included another treatment with an even lower dose of one injector every 80-cm girth. Although this dose may be too low to provide adequate long-term control, we had the opportunity to observe effects over the first year or two, then make another application if deemed appropriate. This has now been done, as noted above.

2.3 Trial design

There were a total of 42 trial trees (nine at Puketotara, 15 at Trounson and 18 at the Cascades). This is double the number that was proposed in the initial trial outline, but should lead to more robust data. At each site, trees were divided evenly among the three treatments. To ensure a relatively even distribution of disease symptoms across treatments, at each site trees were placed into groupings based on disease parameters such as lesion activity and canopy symptoms, before random assignment of the various treatments within each grouping.

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

Tree health and lesion expansion plus activity has been measured approximately every 6 months. Assessments to date have been in August 2016 for the Puketotara site and February/March 2017, August 2017, March 2018, October 2018, February/March 2019 and August 2019 for all three sites. The later than planned assessment in October 2018 was because of delays in gaining permission to access sites in the Waitakere Ranges with the recent Controlled Area Notice.

3 RESULTS AND DISCUSSION

To date, no phytotoxicity symptoms have been observed in any of the trees. At the Cascade site, two untreated control trees have died, as has one of the six trees in each of the injected treatments. One untreated control tree at Trounson has shown substantial canopy decline, as has one treated (20 mL phosphite/80 cm spacing) tree at Puketotara. Otherwise, there are no major changes in canopy density to date, and no sign of yellowing of leaves in any of the treated trees.

It is now almost 3 years since treatments were first applied at Trounson and the Cascades sites, and 3½ years since the initial Puketotara treatment.

In the previous assessment in February/March 2019, it was noted that there was not complete healing of lesions in either phosphite treatment at any of the sites (Horner 2019a). Since then, phosphite treatments have been re-applied to all trees (except treatment 3 at Puketotara, which was re-treated 1 year earlier). There has since been a noticeable shift in lesion activity in treated trees at all sites. In untreated control trees, lesion activity has remained similar or increased slightly across all sites (Figures 1 and 2). In contrast, there has been a decrease in the number of active lesions in treated trees across all sites (Figure 1), and a reduced mean activity score (Figure 2). This is a rapid response, considering it is only 2 months since the 20 mL/40 cm treatment was reapplied.

To date, this trial has shown that a single application of the low rates chosen is insufficient to adequately suppress *P. agathidicida*-lesion growth in large trees. The conservative and cautious approach with treating these big trees (in order to avoid phytotoxicity) stretched the lower limit too far. The highest rate used in this trial (20 mL of 4% phosphite injected every 40 cm) is substantially lower than the 20 mL of 7.5% phosphite injected every 20 cm in the earlier ricker trials. While phytotoxicity symptoms seem to have been avoided, lesion healing has not been sufficient and a number of trees still have active bleeds. However, results from the August 2019 assessments suggest that a second dose of the same low rates, 2–3 years after the initial treatment, may be effective. The assessment planned in 6 months (February 2020) will determine whether this second round of treatment at low rates leads to complete cessation of lesion activity.

In the concurrent ‘Trunk spray and low rate trial’, a rate of 4% phosphite injected every 40 cm around the trunk was effective at stopping lesion activity in rickers (Horner 2019b). This same dose (based on trunk circumference) in the current large tree trial was not fully effective, suggesting that these large trees need a higher dose to facilitate total lesion healing and a different formula may be required. Given that there have been no obvious phytotoxicity symptoms noted to date, higher dose rates or higher frequency of application should be considered.

4 PLANS

Six-monthly assessments of tree health, lesion activity and spread, and phytotoxicity symptoms will continue for a period of at least 2 years, to evaluate whether the second treatment has been effective. A brief report will follow each assessment.

There should be consideration of new trials evaluating higher doses from the outset. A treatment of one 20-ml injection of 4% phosphite every 20 cm should be included in such trials.

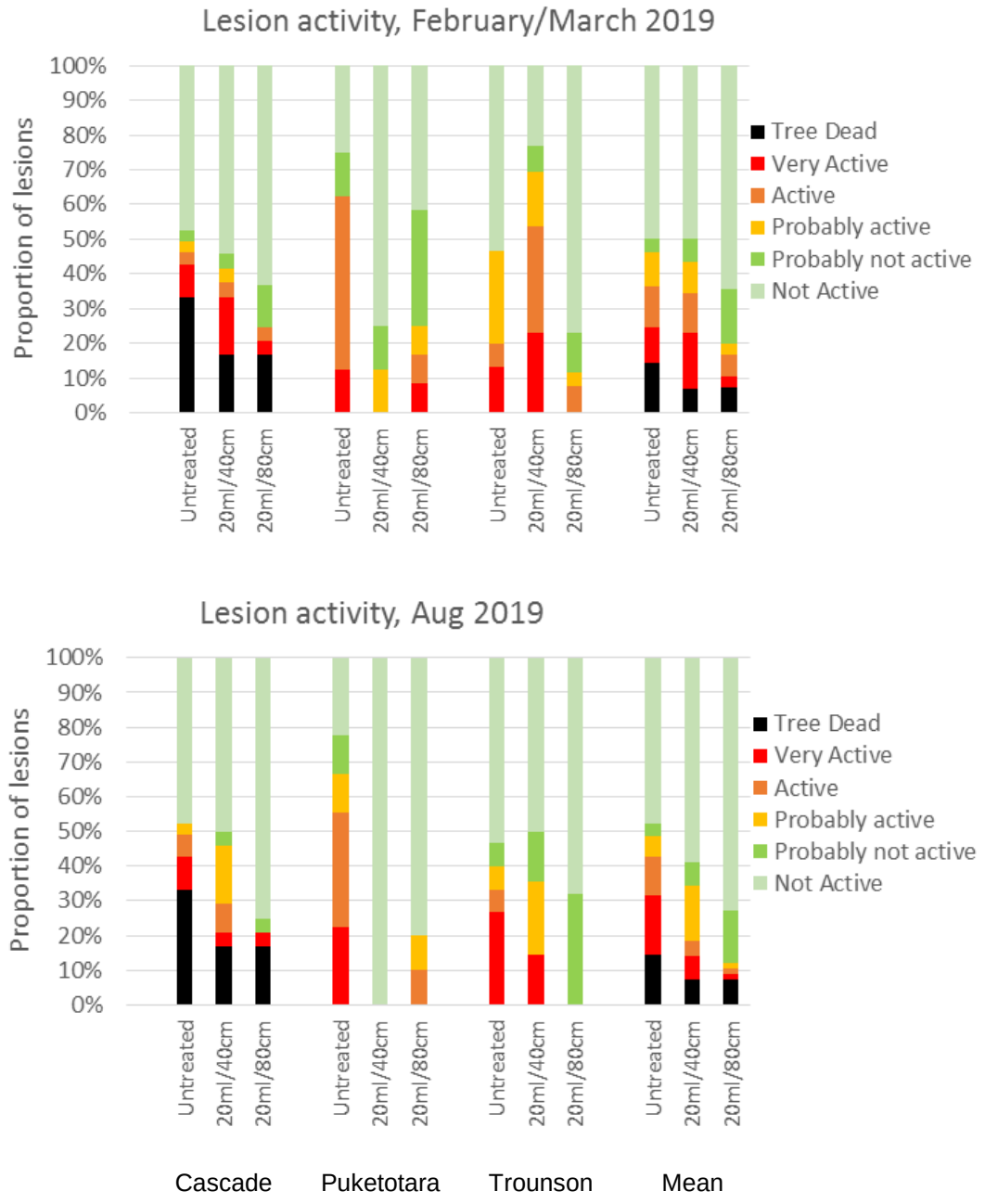

Figure 1. Proportion of lesions in various lesion activity categories, in *Phytophthora agathidicida*-infected kauri trees on three sites, assessed in February/March 2019 (top) and August 2019 (bottom). Phosphite injections were applied in March 2016 (Puketotara site) or November 2016 (Cascade and Trounson sites). A 4% phosphite solution was applied as one 20-mL injection every 40 cm or one injection every 80 cm around the trunk circumference. Phosphite was re-applied to trees in the low dose (4% injection every 80 cm) in the Puketotara site in March 2018 and Cascade plus Trounson sites in February/March 2019. The higher dose phosphite treatment (4% injection every 80 cm) was re-applied on all sites in June 2019.

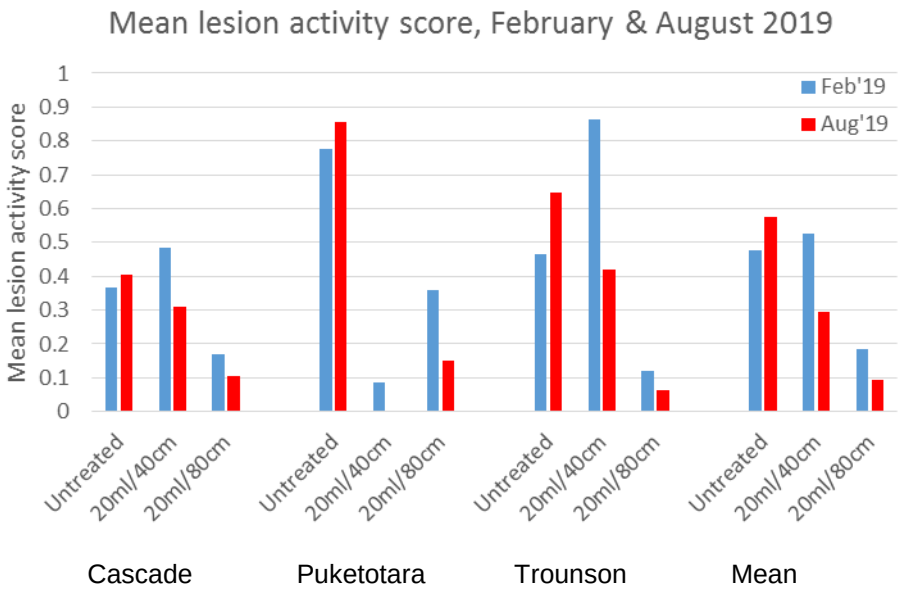

Figure 2. Mean lesion activity score, in *Phytophthora agathidicida*-infected kauri trees on three sites, assessed in February/March 2019 and August 2019. Phosphite injections were applied in March 2016 (Puketotara site) or November 2016 (Cascades and Trounson sites). A 4% phosphite solution was applied as one 20-mL injection every 40 cm or one injection every 80 cm around the trunk circumference. Phosphite was re-applied to trees in the low dose (4% injection every 80 cm) in the Puketotara site in March 2018 and Cascade plus Trounson sites in February/March 2019. The higher dose phosphite treatment (4% injection every 80 cm) was re-applied on all sites in June 2019. Lesion activity scoring: 0=not active, 0.2=probably not active, 0.5=probably active, 1=active, 2=very active.

5 REFERENCES

Horner IJ, Hough EG, Horner MB 2015. Forest efficacy trials on phosphite for control of kauri dieback. New Zealand Plant Protection 68: 7–12.

Horner I, Hough E, Horner M. July 2017. Phosphite for control of kauri dieback: final report. A Plant & Food Research report prepared for: Ministry for Primary Industries. Client project no. 17682. Milestone No. 66652. Contract No. 33430. Job code: P/345160/06. SPTS No. 15425.

Horner I. April 2019a. Phosphite large tree treatment trials: brief report. A Plant & Food Research report prepared for: Ministry for Primary Industries. Milestone No. 66661. Contract No. 33447. Job code: P/345160/05. SPTS No. 17750.

Horner I. April 2019b. Trunk sprays and lower phosphite injection rates for kauri dieback control – brief update April 2019. A Plant & Food Research report prepared for: Ministry for Primary Industries. Client ref: 18062. Milestone No. 66676. Contract No. 33523. Job code: P/345160/04. SPTS No. 17758.

Confidential report for:

Ministry for Primary Industries
Client ref: 18061

PUBLICATION DATA

Horner I, Arnet M. August 2019. Phosphite large tree treatment trials: brief report August 2019. A Plant & Food Research report prepared for: Ministry for Primary Industries. Milestone No. 66662. Contract No. 33447. Job code: P/345160/05. SPTS No. 18505.

Report approved by:

Ian Horner
Team Leader, Pathogen Biology and Ecology
August 2019

Beccy Ganley
Science Group Leader, Plant Pathology
August 2019

For further information please contact:

Ian Horner
Plant & Food Research Hawke's Bay
Private Bag 1401
Havelock North 4157
NEW ZEALAND

Tel: +64 6 975 8880
DDI: +64 6 975 8925
Fax: +64 6 975 8881
Email: Ian.Horner@plantandfood.co.nz

This report has been prepared by The New Zealand Institute for Plant and Food Research Limited (Plant & Food Research).
Head Office: 120 Mt Albert Road, Sandringham, Auckland 1025, New Zealand, Tel: +64 9 925 7000, Fax: +64 9 925 7001.
www.plantandfood.co.nz