Needle disease strategy Research Programme

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Technical Note

Evaluation of the persistence of cuprous oxide (operational dothistroma treatment) to control and manage – RNC 2015/2016

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Summary: We evaluated the operational cuprous oxide treatment (860 g/ha active ingredient) currently used to control *Dothistroma septosporum* in *Pinus radiata* stands for its potential to control *Phytophthora pluvialis*. The operational treatment was applied via helicopter to three different *P. radiata* stands of varying age classes in November 2015. Needles were collected from treated trees before and after spraying and exposed to *P. pluvialis* in detached needle assays. Cuprous oxide suppressed development of *P. pluvialis* lesions in needles collected from all three stands, ranging from 90% to 100 % suppression up to one month after spraying.

Introduction

Red needle cast (RNC) is a foliar disease of *Pinus radiata* caused by *Phytophthora pluvialis*. It has the potential to cause significant (up to 16%) annual growth loss in badly infected plantations. An operational, cost-effective, chemical treatment is required to control outbreaks of RNC. In a fungicide screening trial to identify fungicides with the potential to reduce lesions caused by *P. pluvialis*, the persistence and efficacy of cuprous oxide showed promise and warranted further investigation (Rolando et al. 2014). The aim of the study reported here was to evaluate the efficacy of field-applied cuprous oxide for control of *P. pluvialis* lesion development. The current operational treatment used for control of dothistroma needle blight (860 g/ha applied in 5 L water and oil) was evaluated.

Methods

Two detached needle assays were used to determine the potential of aerially applied cuprous oxide to reduce lesion formation when needles were exposed to *P. pluvialis*. The first detached needle assay was carried out prior to the operational copper treatment and served as a before treatment control. The second assay was carried out one month post-treatment. Treatments were applied by helicopter at the standard operational Dothistroma control treatment (1140 g cuprous oxide (860 g/ha metal equivalent), 2 L dothi spray oil made up to 5 L with water).

Treatments were applied during the last week of November 2015 to three different *P. radiata* stands: Kinleith, age 4, Te Manawa O Tūhoe (TMOT) age 8 and Waiotapu, age 15. Twenty random trees were selected, labelled and sampled from each site. Three branchlet sub-samples were taken from each tree for the detached needle assays. Individual trees served as replicates (n = 10 – 20). In the needle assays, five fascicles per sub-sample (15 total samples per tree) were dipped into either sterilised pond water (control) or solution containing zoospores of *P. pluvialis* after which they were placed in a controlled temperature room for 10 days. Following this, lesion length was measured to the nearest millimetre. Total lesion length for the 3-5 needles per fascicle was calculated and averaged across the five fascicles and sub-samples to yield a mean for each tree replicate.

Data analysis

A generalised least squares model fitted by restricted maximum likelihood was used to analyse the lesion lengths resulting from *P. pluvialis* inoculation (R version 3.3.0, R Development Core Team 2016, Pinheiro et al. 2016, R-package nlme). The model

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comprised site (Kinleith, TMOT and Waiotapu), spray (pre- and post-copper aerial spray) and inoculation treatment (control = sterilised pond water, pathogen = P. pluvialis) and all interactions as explanatory variables.

Graphical model validation tools were used to assess the underlying assumptions of variance homogeneity and normality (plots of the standardised residuals vs. fitted values and against all predictors, quantile-quantile plots).

Results

Prior to copper treatment, *P. radiata* needles treated with sterilised pond water showed minimal lesion development across sites, while exposure of needles to *P. pluvialis* resulted in substantial lesion development (Fig 1). Lesion length, however, differed by site as seen in Figure 1. This shows a likely difference in susceptibility in the genotypes planted at each site (or age or needle physiology). This initial sampling established the baseline susceptibility of these trees to infection with *P. pluvialis*.

Needles collected one month after aerial application of cuprous oxide showed suppressed lesion development relative to the pre-spray samples. This was respectively 100%, 96% and 90% at Kinleith, TMOT, and Waiotapu. Together these findings produced a significant site × spray × inoculation interaction ($L = 14.78$, $df = 2$, $P < 0.001$).

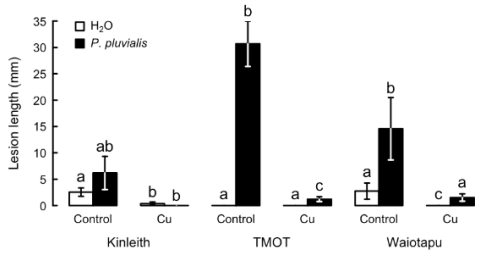

Fig. 1 Average lesion length in *P. radiata* fascicles inoculated with *P. pluvialis* before (Control) and one month after aerial cooper spray application (Cu) at three sites. n = 10 – 20 trees. Different lower case letters indicate statistically significant differences within site (based on a multiple comparison procedure using Tukey contrasts following the significant site × spray × inoculation interaction).

These results confirm the effectiveness of copper to control RNC. At all three sites, comprised of different age classes of radiata pine, there was a very significant suppression of lesion development. It is recommended that the operational dothistroma copper treatment should be further investigated over much longer periods after treatment.

References

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