Needle disease strategy Research Programme

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Phytophthora pluvialis zoospore survival at different relative humidity and temperature

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Report information sheet

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Executive summary

The problem

Phytophthora pluvialis is responsible for a significant needle disease within New Zealand's *Pinus radiata* plantation called red needle cast (RNC). Red needle cast has been associated with inconsistent damage in some areas and the distribution and impact of the RNC have been linked to some environmental conditions, including rainfall. However, it is not accurately known how the disease is impacted by atmospheric characteristics including temperature and humidity.

Little is known about the tolerance of *Phytophthora* zoospores to environmental conditions of relative humidity and temperature and few techniques have been developed to measure their viability. Internationally, most significant foliar *Phytophthora* pathogens have been shown to spread through the aerial dispersal of detached caducous sporangia. In contrast, *P. pluvialis* may be only partially caducous and rely upon freely available rainwater for aerial dispersal. Determining how atmospheric environmental conditions impact the reproductive biology and distribution of *P. pluvialis* will increase our understanding of inoculum spread and disease establishment.

This project

In this study we quantified how *P. pluvialis* zoospore production varied across different isolates that were collected in 2016/17. We optimised and developed techniques to measure the viability of *P. pluvialis* zoospores and determined zoospore viability at 98 and 80% relative humidity and temperatures of 10, 15 and 20 °C over 6 hours.

Key results

Only two of the six isolates tested within this study produced any zoospores. Zoospore production was not associated with isolate age. Zoospore viability was highly variable across all treatment interactions. An average of 14.5% of zoospores were viable at time 0. Zoospore viability decreased across all humidity and temperature interactions over time and decreased more rapidly at the lower relative humidity of 80% and at the lower temperatures.

Implications of results for the client

Variation in zoospore production and reproductive viability across isolates may significantly impact disease establishment and is an important factor to be incorporated into epidemiological models. Results show that zoospore viability decreases rapidly under the conditions tested here with zoospore viability dropping to below 5% after 6 hours for all tested interactions. Under the environmental conditions tested here, if zoospores were unable to infect a suitable host and/or rehydrate with freely available water within a few hours, they may not effectively contribute to disease establishment. Under more the variable environmental conditions that occur within forests, which include exposure to air turbidity and ultraviolet light, zoospore viability may decrease more rapidly.

Further work

The epidemiological models associated with atmospheric and climatic environmental variability could be further refined by measuring zoospore viability across a wider range of temperatures, relative humidity and time frames, and could also be used to measure the impact of other important variables including ultraviolet light and air turbidity. The techniques developed here may also be used to answer questions around how and where *P. pluvialis* survives within the environment during the extended periods when disease does not occur. Further work is also required to determine the impact of temperatures below 20°C on zoospore viability.