THE CONTROL OF *PHYTOPHTHORA* IN NATIVE PLANT COMMUNITIES

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Summary

Phytophthora cinnamomi is a vigorous pathogen that kills a wide range of plant species by attacking their root system. The fungus is widespread in the South-West of Western Australia and it is estimated that 1500 to 2000 species of the estimated 8000 species of vascular plants in the South-West may be susceptible to infection. Many of them are highly endemic and have been brought to the brink of extinction. Therefore, dieback disease currently poses the greatest conservation threat facing Western Australia.

Phosphonate is an aqueous solution of di-potassium phosphonate, held at pH 5.7 to 6.0. The active component of the fungicide is the phosphite ion (PO_3^-).
The chemical has been used to control *P. cinnamomi* in economically significant crops for several years. Phosphonate was also found to be very effective against the infection in jarrah and some species of banksia. It is cheap, biodegradable and non-toxic to people, animals and soil microflora.
The fungicide has been field trialed by CALM in various areas in the South-West on plant communities already infested with *Phytophthora cinnamomi*. The trials have shown that one application of phosphonate gives excellent control of the fungus over several years.
The results from our field experiments indicate that long protection is achieved because of both: direct effect of the chemical on the pathogen and stimulation of the host's defence mechanisms.
Phosphonate offers the only available option in the prevention of further losses of rare and endangered plant species from dieback, in areas where the pathogen is present, in the short to medium term.

1. Assessment of the efficacy of aerial application of phosphonte

In order to control spread of infection effectively over large areas, the chemical must be applied by aircraft. There are three aerial application field trials being conducted in the South-West with the aim to provide information on the appropriate rates of application, the duration

of protection of phosphonate achieved by this method of application and to determine when re-spraying is required. The effectiveness of follow-up application is also being assessed.

Samples for chemical analysis are taken periodically to follow the changes in phosphite tissue concentration. The results show that the concentration of phosphite can be increased significantly by second spraying. Fungicide residues are retained in the plants and experiments are continuing to determine the longevity of the fungicide within plant tissues.

The preliminary results indicate the following:

- Aerial spraying of the chemical is a promising method of application
- This method is the most suitable if long infection fronts were to be treated
- It permits treatment of most remote areas cost-effectively without disturbance to the treated and neighbouring areas
- Phosphonate can be applied to the whole plant canopy effectively
- Phosphonate applied aerially reduces plant death in the treated areas (Fig. 1)
- Phosphonate residues persist in the plants for some time.
- Second application of the fungicide increases plant tissue concentration of phosphonate

2. Bioassay of the *in vitro* activity of phosphonate

The study on the *in vitro* sensitivity of local *P. cinnamomi* has been completed. The paper is currently in a draft form and will be published in the Journal of Phytopathology.

The main conclusions of the study can be summarised as follows:

- Phosphonate must be added to the media after autoclaving. High temperature causes oxidation of phosphonate to phosphate. Therefore ED_{50} concentrations presented in the literature should be revised

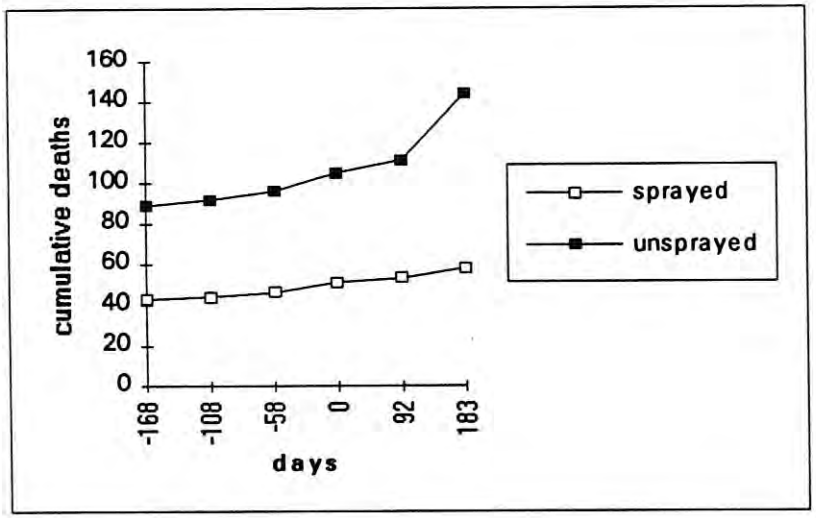
- Optimum phosphate concentrations are variable even within the same species and can be higher tan 20 mM and are much higher than reported levels for other *P. cinnamomi* isolates.

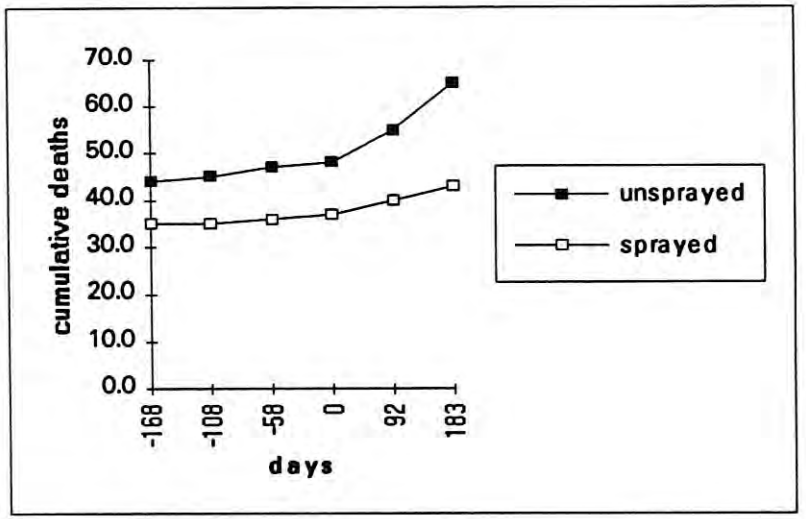
- The toxicity of phoshonate depends on phosphate concentration in the medium and it increases with decreasing phosphate level. This provides some explanation for the long protection that has been achieved when phosphonate is applied to native species which generally are low phosphate plants.

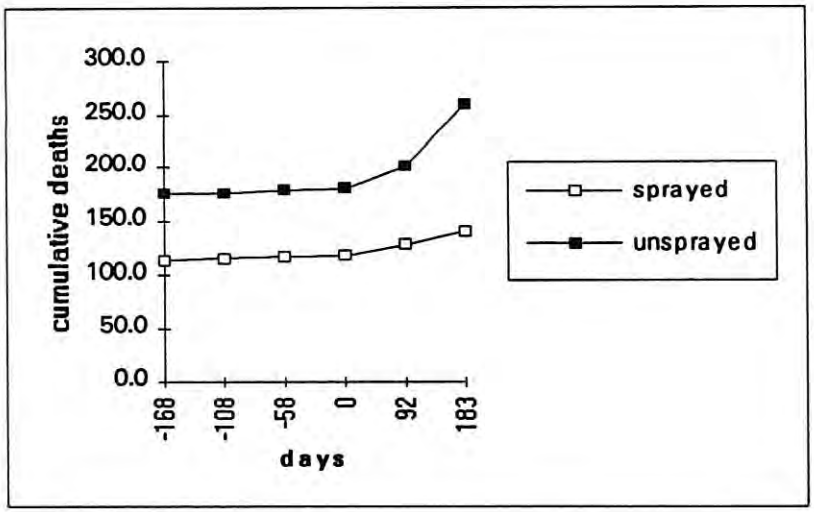
- Our local *P.cinnamomi* isolates are very sensitive to phosphonate.

- Due to the very low ED_{50} levels (Fig. 2) it is likely that phosphonate has a direct effect on the pathogen for a long time.

Fig. 1 Gull Rock aerial application trial - number of dead plants







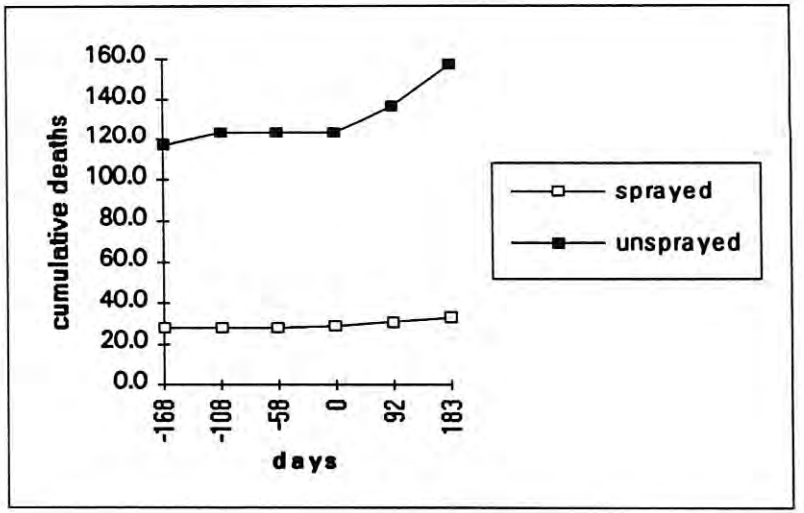


Fig. 2 Summary of ED_{50} phosphonate concentrations for inhibition of radial growth for three isolates of *Phytophthora cinnamomi.*

SPECIES	ISOLATE	ED_{50} ($\mu g\ ml^{-1}$)	PO4 (mM)
P.cinnamomi	mu	4.3	0.1
P.cinnamomi	mu	6.4	1
P.cinnamomi	mu	8.3	5
P.cinnamomi	mu	13.2	10
P.cinnamomi	mu	17.8	20
P.cinnamomi	cin2	2.1	0.1
P.cinnamomi	cin2	3.5	1
P.cinnamomi	cin2	4.8	5
P.cinnamomi	cin2	6.5	10
P.cinnamomi	cin2	10.5	20
P.cinnamomi	dce60	1.7	0.1
P.cinnamomi	dce60	11.2	1
P.cinnamomi	dce60	13	5
P.cinnamomi	dce60	15.7	10
P.cinnamomi	dce60	15.8	20

Future work

As a result of the recent review of the project it has been decided that the work should concentrate mainly on the effective application of phosphonate and its effects on native flora. Therefore additional field experiments will be established before the end of this year.

We will:

- Establish new phosphonate field trials involving different species of banksia
  - measure shoot and root phosphite concentration
  - determine the effect of the spray on plant growth and plant nutrition
  - test different concentration rates
  - establish the longevity of the fungicide in young/older plants
  - determine the effect of 2 vs 1 application

- Conduct additional aerial application field trial (test higher concentration rates)

- Study the effect of phosphonate on flowering, seed set and seed viability
- Determine whether phosphonate is stored in plant tissues as polyphosphonate and acts as a source of phosphite ion
- Continue established trials and in addition examine the effect of the chemical on flowering and seed viability
- Develop a suitable bioassay to be used as a management tool. The biaoassay will be essential in making decision when to re-spray in a situation when phosphite concentration falls below detectible limit but plants are still resistant to infection