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CONTROL OF PHYTOPHTHORA ROOT ROT IN FOREST NURSERIES

Forest nurseries in New Zealand typically operate with a considerable level of chemical intervention in order to manage a range of weeds, insect pests and diseases. Good control of weeds and insect pests is readily achievable but some of the diseases prove more intractable with root diseases in particular often difficult to control effectively. Several micro-organisms are implicated in root-rot problems with the most common and widespread being species of the oomycete genus *Phytophthora.*

Phytophthora cinnamomi is the species most frequently recorded in forest nurseries, infecting a range of host species and responsible for substantial losses on occasions. It has been recorded in nurseries from the far north of the North Island to the south of the South Island. *Phytophthora cactorum* has also been associated with losses in some nurseries.

Waterlogged soils provide a suitable environment for infection as the motile spores produced by species of *Phytophthora* require free water for spore release and dispersal. Levels of mortality can be exacerbated when a wet period, during which some root infection and destruction occurs, is followed by dry conditions. Although no further infection occurs, the necessary regeneration of fine roots is inhibited in the dry soil and the damaged root systems are unable to satisfy the water requirements of the plants. In some nurseries, seedling mortality due to *Phytophthora* infection does not become apparent until root pruning commences in late summer/early autumn, though it is likely that root systems are already infected.

Cultural methods (e.g. good drainage) and chemical control options are important components of the management of *Phytophthora* diseases in nurseries. In particular phenylamides such as metalaxyl and metalaxyl-M (e.g. Ridomil) have been used extensively, often with very good results with a single application per season. However, some nursery growers have reported an apparent loss of efficacy of the chemical in recent years, particularly when a single application was made at seedling emergence. Possible reasons for this failure include the development of pathogen resistance, inappropriate chemical application rate, or degradation of the metalaxyl in the soil in the time between application and root pruning when protection is most needed.

Over the past two years, alternative treatments for *Phytophthora* control of *Pinus radiata* have been investigated in forest nursery trials conducted by Scion and HortResearch (now Plant & Food Research) and with considerable support from nursery staff. The trial area had a history of root disease that had not responded to an early-season single application of metalaxyl. Symptoms of root rot typically developed when seedlings were approximately six months old and shortly after root pruning. In the trials, the effect of metalaxyl rate and application timing was compared with other chemical and biologically-based control options. These treatments included methyl jasmonate (a plant hormone with an important role in the regulation of the plant's natural defence mechanisms), organic and mineral soil amendments, seed coating with the biological control agent *Trichoderma,* and phosphorous acid (a chemical with direct activity against *Phytophthora* and also an ability to promote plant defence mechanisms). The organic compound selected was humate (a mixture of mineral salts of humic and fulvic acids), which may encourage the proliferation of beneficial microbes, applied in combination with calcium in the form of lime, which has been shown to have some capability of suppressing *Phytophthora* root diseases.

Trial 1: In the first year two experimental treatments were applied to seed before sowing. These were: thiram, a fungicide which has been widely used in forest nurseries for many years and a commercially available mix of *Trichoderma* spp.; an untreated control was also included. Seven different foliar or soil, or combination treatments were then applied during the growing season. These were:

1) untreated,
2) metalaxyl-M/mancozeb,
3) metalaxyl-M/mancozeb/phosphorous acid,
4) metalaxyl-M/mancozeb/methyl jasmonate,
5) humate-calcium/phosphorous acid,
6) humate-calcium/methyl jasmonate,
7) phosphorous acid.

The metalaxyl-M/mancozeb or humate plus calcium were applied 20 days after sowing in September; whilst the foliar treatments: phosphorous acid or methyl jasmonate, were each applied seven times at monthly intervals from November.

Mortality due to root rot was recorded at intervals during the growing season and finally counted in July. Seedling height was measured pre-topping in May. Neither of the two seed treatments (*Trichoderma* or Thiram) reduced root rot levels in comparison to the untreated seed control or affected seedling height. Neither the standard nursery management treatment (metalaxyl-M/ mancozeb applied at seedling emergence) nor the methyl-jasmonate

Above: Wilted seedlings - an indication of root destruction

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had any effect on disease incidence compared with that in the untreated control. The humate-calcium reduced root rot levels slightly. Phosphorous acid, whether used alone or in combination with soil-applied treatments, was the only treatment that significantly reduced disease levels.

Trial 2: In the second year phosphorous acid was applied at different frequencies to determine whether root disease levels could be further reduced, and metalaxyl-M/mancozeb was applied at root-pruning for comparison with application at seedling emergence, and at different rates. The treatments were:

1) untreated,
2) metalaxyl-M/mancozeb (15 kg/ha) applied 16 days after sowing,
3) metalaxyl-M/mancozeb (15 kg/ha) applied at root pruning,
4) metalaxyl-M/mancozeb (50 kg/ha) applied at root pruning,
5) phosphorous acid applied six times at monthly intervals from December,
6) phosphorous acid applied at monthly intervals from December plus humate-calcium applied 16 days after sowing,
7) phosphorous acid applied four times at monthly intervals from February,
8) phosphorous acid applied seven times at fortnightly intervals from February.

By the end of June the incidence of root rot in untreated plots was 22.2%. Disease incidence in plots treated with 15 kg/ha of metalaxyl-M/mancozeb at seedling emergence was not significantly different from the untreated control, but significantly suppressed disease when applied one week after root pruning. Disease control with metalaxyl-M/mancozeb was further enhanced when applied at 50 kg/ha one week after root pruning. Phosphorous acid was the most effective treatment with disease incidence at 0.8% or below when applied monthly from December or February. Phosphorous acid almost completely suppressed disease when applied fortnightly from February with no disease until 6 weeks after the final application, when 0.1% was recorded.

Summary
In this study, chemical and biological options were compared over two seasons for their ability to suppress Phytophthora root rot in radiata pine seedlings. The most effective treatment in both trials was phosphorous acid. Four monthly phosphorous acid applications from February reduced mortality to less than 1%, with only 0.1% disease incidence when seven applications were made at fortnightly intervals from February to May. Metalaxyl was more effective when applied at root pruning than at germination but did not provide the same level of control as phosphorous acid. *Trichoderma* seed treatment was not effective possibly because the wet conditions in the trial area that favour pathogen development would be unfavourable to *Trichoderma* spp.

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NEW RECORDS

New host record for New Zealand – Insect: *Calliprason pallidus* (Cerambycidae); **Region:** Auckland; **Host:** *Pinus patula*; **Coll:** C Inglis, 27/03/2009; **Ident:** S Sopow, 31/03/2009; **Comments:** This native beetle infests the dead wood of a wide range of native and exotic softwoods.

New host record for New Zealand – Insect: *Oemona hirta* (Cerambycidae); **Region:** Auckland; **Host:** *Syzygium paniculatum*; **Coll:** C Inglis, 24/03/2009; **Ident:** S Sopow, 31/03/2009; **Comments:** This native borer has an extremely wide host range.

New host record for New Zealand – Insect: *Parlatoria fulleri* (Diaspididae); **Region:** Bay of Plenty; **Host:** *Ceratopetalum gummiferum*; **Coll:** B Rogan, 24/03/2009; **Ident:** R Henderson, 03/04/2009; **Comments:** This Australian scale insect was first recorded in New Zealand in 1956. It has been recorded from Auckland, Bay of Plenty and Hawke's Bay on *Pinus, Eleagenus, Callistemon, Phoenix, Melaleuca* and *Griselinia.* Recorded hosts in Australia are *Acacia* and *Pittosporum.* It has also been recorded from France.

New host record for New Zealand – Insect: *Parasaissetia nigra* (Coccidae)**; Region:** Auckland**; Host:** *Polygala* sp.; **Coll:** C Inglis, 17/03/2009; **Ident:** R Henderson, 03/04/2009; **Comments:** This cosmopolitan scale insect was first recorded in New Zealand in 1879 and is sporadically distributed throughout the North and South Islands. It has a wide host range.

New host record for New Zealand – Insect: *Phloeophagosoma thoracicum* (Curculionidae)**; Region:** Auckland**; Host:** *Araucaria heterophylla*; **Coll:** C Inglis, 31/03/2009; **Ident:** S Sopow, 03/04/2009; **Comments:** This native weevil has been recorded from the dead wood of a variety of genera including *Cupressus, Dacrycarpus, Melicytus, Myoporum, Pinus, Populus, Salix* and *Ulmus.*

New host record for New Zealand – Insect: *Parlatoria fulleri* (Diaspididae)**; Region:** Auckland**; Host:** *Macadamia tetraphylla*; **Coll:** C Inglis, 31/03/2009; **Ident:** R Henderson, 20/04/2008; **Comments:** See above.

New host record for New Zealand – Insect: *Parlatoria fulleri* (Diaspididae)**; Region:** Auckland**; Host:** *Lophostemon confertus*; **Coll:** C Inglis, 16/04/2009; **Ident:** R Henderson, 23/04/2008; **Comments:** See above.

New host record for New Zealand – Insect: *Pseudococcus longispinus* (Pseudococcidae)**; Region:** Auckland**; Host:** *Lophostemon confertus*; **Coll:** C Inglis, 16/04/2009; **Ident:** R Henderson, 23/04/2008; **Comments:** This cosmopolitan mealybug was first recorded in New Zealand in 1890 and has been found on a wide range of hosts.

New host record for New Zealand – Insect: *Hemiberlesia lataniae* (Diaspididae)**; Region:** Wellington**; Host:** *Cycas revoluta*; **Coll:** B Rogan, 11/04/2009; **Ident:** R Henderson, 23/04/2008; **Comments:** This cosmopolitan, polyphagous scale insect was first recorded in New Zealand in 1979 at Kerkeri. It is now found throughout the North Island.

New host record for New Zealand – Insect: *Pseudaulacaspis eugeniae* (Diaspididae)**; Region:** Auckland**; Host:** *Corymbia calophylla*; **Coll:** C Inglis, 17/04/2009; **Ident:** R Henderson, 23/04/2008; **Comments:** This first record of this Australia species in New Zealand is 1922. It is a polyphagous species found mainly in the North Island but there is one record from Invercargill.

New host record for New Zealand – Insect: *Cardiaspina fiscella* (Psyllidae)**; Region:** Wanganui**; Host:** *Eucalyptus propinqua*; **Coll:** B Rogan, 21/04/2009; **Ident:** S Sopow, 24/04/2008; **Comments:** This Australian lerp forming psyllid was first found in 1996 at Auckland and is now found throughout much of the North Island. It is common on *Eucalyptus botryoides* and *E. saligna.*

New host record for New Zealand – Insect: *Trachymela sloanei* (Chrysomelidae)**; Region:** Wanganui**; Host:** *Eucalyptus propinqua*; **Coll:** B Rogan, 21/04/2009; **Ident:** S Sopow, 07/04/2008; **Comments:** This Australian beetle was first found in New Zealand in 1976. It feeds on quite a wide range of *Eucalyptus* spp. and is found throughout most of the North Island and in the Marlborough Sounds, Marlborough and Mid Canterbury.

New host record for New Zealand – Insect: *Bedellia psamminella* (Bedelliidae)**; Region:** Wellington**; Host:** *Muehlenbeckia australis*; **Coll:** B Rogan, 11/02/2009; **Ident:** R Hoare, 24/04/2008; **Comments:** This native leaf miner has been recorded from *Calystegia* spp.

New distribution record for New Zealand – Fungus: *Hysterographium fraxini*; **Region:** Wanganui**; Host:** *Fraxinus angustifolia*; **Coll:** B Rogan, 21/04/2009; **Ident:** J Gardner, 27/04/2008; **Comments:** This fungus was first found in New Zealand in 2004 at Timaru and is now quite widespread. Fruit bodies are found on dead branches and twigs of *Fraxinus* spp. and *Catalpa bignonioides.*

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