Phytophthora cinnamomi 简体中文 正體中文

System: Terrestrial

Kingdom	Phylum	Class	Order	Family
Fungi	Oomycota	Peronosporea	Peronosporales	Peronosporaceae

Common name wildflower dieback (English, Australia), Phytophthora Faeule der Scheinzypresse (German), seedling blight (English), phytophthora root rot (English), cinnamon fungus (English, Australia), phytophthora crown and root rot (English), jarrah dieback (English, Western Australia), green fruit rot (English), heart rot (English), stem canker (English)

Synonym

Similar species *Phytophthora cactorum, Phytophthora cambivora, Phytophthora castaneae, Phytophthora citrophthora, Phytophthora colocasiae, Phytophthora drechsleri, Phytophthora infestans, Phytophthora katsurae, Phytophthora manoana, Phytophthora nicotianae var. parasitica, Phytophthora palmivora, Phytophthora parasitica*

Summary The oomycete, Phytophthora cinnamomi, is a widespread soil-borne pathogen that infects woody plants causing root rot and cankering. It needs moist soil conditions and warm temperatures to thrive, and is particularly damaging to susceptible plants (e.g. drought stressed plants in the summer). P. cinnamomi poses a threat to forestry, ornamental and fruit industries, and infects over 900 woody perennial species. Diagnostic techniques are expensive and require expert identification. Prevention and chemical use are typically used to lessen the impact of P. cinnamomi.

view this species on IUCN Red List

Species Description

Phytophthora cinnamomi is a destructive and widespread soil-borne pathogen that infects woody plant hosts. *P. cinnamomi* spreads both by chlamydospores as well as water-propelled zoospores. The presence of the oomycete is only determinable by soil or root laboratory analysis, although its effects upon the vegetation it destroys are readily evident (Parks and Wildlife, 2004). Infection often results in the death of the plant, with earlier symptoms including wilting, yellowing and retention of dried foliage and darkening of young feeder roots and occasionally the larger roots. The plant is unable to adequately absorb enough water from the soil because its roots are damaged and consequently may die (Botanic Gardens Trust, UNDATED). *P. cinnamomi* causes water deficiency symptoms which can result in tree death, following a slow or abrupt decline. Primary symptoms caused by this pathogen in temperate oaks (*Quercus rubra* and *Q. robur*) include fine root lesions which may extend into larger roots, collar and trunks causing bleeding cankers, but no water deficiency has been described (Moreau & Moreau, 1952; Robin *et al.* 1992; Robin *et al.* 2001). Bergot *et al.* (2004) observe that, \"The initial lesions at root or collar level develop upwards in the trunk and the disease expression is typically a bleeding trunk canker, therefore named 'ink disease'. Since *P. cinnamomi* essentially develops in inner cortical tissues and not in the wood, oaks keep track of past infections in the form of necroses at the cambium level (scars)\".

Notes
Robin *et al.* (2001) state that, \"Waterlogging increased the severity of *Phytophthora cinnamomi* induced diseases in the field (Fagg *et al.* 1986). Under controlled experiments, when waterlogging was imposed at or after the time of inoculation, lengths of lesions caused by *P. cinnamomi* significantly increased (Davison & Tay, 1987). Moreover, waterlogging and associated hypoxia had a direct effect on *P. cinnamomi* by reducing mycelial growth and sporangium production (Davison & Tay, 1986). It is likely that in the field, the combination of heavy rainfalls leading to occasional waterlogging, and summer droughts, may act sequentially and predispose oaks to decline when infected by *P. cinnamomi*.\"
Bergot *et al.* (2004) states that, \"Disease development was shown to be strongly hampered by cold winters (Robin *et al.* 1992b; Marçais *et al.* 1996), in agreement with the known sensitivity of *P. cinnamomi* to frost (Benson, 1982). The hypothesis that lethal frost effects on the pathogen could be a major factor limiting disease range in oaks was put forward by Delatour (1986).\"

Lifecycle Stages
The Australian Department of Conservation and Land Management (2003) states that, \"When conditions are warm and moist the mycelial threads (or hyphae) that form the body of the oomycete in the soil or host-plant tissue vegetatively produce micrscopic spore sacks called sporangia and thick-walled chlamydospores. Mycelium of different mating types may grow together to produce thick walled sexual spores called oospores. Zoospores have flagellae, which allow them to swim very short distances (25-35mm) in standing water or in films of water in soil pores. They can also be carried along in moving water over large distances. Zoospores are short-lived and fragile, but are produced in large numbers and probably are the cause of most new infections. As they move through the soil zoospores are attracted to the tips of plant roots, where they lodge, encyst, and germinate to produce germ tubes which penetrate roots. Mycelium then grow within the roots of susceptible plants and may grow from plant to plant *via* root contact points. This root to root growth is the main cause of spread of a *P. cinnamomi* infestation upslope. Chlamydospores are much larger spores that are tough and long-lived (within dead plants and the soil). They are produced within plant roots in response to drying conditions, and are the resistant, 'resting' phase of the oomycete. They may be transported in root fragments or soil and then germinate to cause a new infection when they encounter warm, moist conditions. Germinated chlamydospores may produce sporangia, more chlamydospores, or mycelium which directly infect roots. After infection, the mycelium grows through the root tissue causing cell breakdown and 'rotting' of the tissue. The pathogen extends into the major roots of susceptible species and may girdle the base of the trunk. Plant death occurs because transport of water from the roots is prevented. Various environmental factors control the rate of growth of mycelium within the root. For instance, there is little growth when the water content of the plant tissue is below 80%. In very susceptible species, such as banksia, death may occur in weeks, while in moderately susceptible species such as jarrah the tree may not die till a year or more after infection. Moderately susceptible and resistant species have the ability to 'wall off' the infection to prevent further spread of the mycelium, with varying degrees of success.\"

Habitat Description
Phytophthora cinnamomi requires moist soil conditions and warm temperatures to be active, but damage caused by the disease most often occurs in summer when plants are drought stressed (Botanic Gardens Trust, Undated). Menge (1998) states that, \"Soil with poor drainage, high clay content, high water tables, hard pans, clay pans or where water pools after irrigation or rainfall, have historically been associated with sites where *P. cinnamomi* infection is severe.
A study (Moreira & Martins, 2005) undertaken during 1995-98, surveyed cork and holm oak stands in four different regions of Portugal (Trás-os-Montes, Alentejo, Ribatejo and Algarve) for the presence of *P. cinnamomi*. Tree decline severity, sudden death and site characteristics were assessed in varied conditions. Analysis of the survey results indicated: that 56% of surveyed flora were infected with the pathogen; the flora belonged mainly to the following families Ericaceae, Cistaceae and Leguminosae; recovery of the pathogen was more frequent in shallow soils; soils with low fertility and low mineral nutrient levels, particularly phosphorus, seemed to favour infection and sites facing south showed higher occurrence of *P. cinnamomi*, which was also more frequent in slopes and valleys than on hilltops.

Reproduction
Botanic Gardens Trust (Undated) states that, \"Small swimming zoospores are released which attach to and infect roots, normally behind the root tip. All spores and structures of *P. cinnamomi* are microscopic and cannot be seen with the naked eye. There is no way of visually telling if the pathogen is present in the soil. *P. cinnamomi* grows through the root destroying the tissue which is then unable to absorb water and nutrients. Further zoospores are produced in sporangia, particularly when the soil is moist and warm, and are released into the soil. Consequently zoospore numbers can build up quite rapidly. Zoospores move in water and may infect neighbouring plants especially those down slope from a site of infection. These spores are easily transported in storm water, drainage water, contaminated soil and on tools, footwear and vehicles. A further two spore types may be produced, a chlamydospore and an oospore, which are survival structures produced when conditions become unfavourable such as when a food source is exhausted or in periods of low temperature or drought. These spores are capable of surviving for extended periods of time, and when conditions become favourable they germinate and renew the life cycle. This allows *P. cinnamomi* to survive in dead plant tissue for a number of years.\"

Nutrition
The food source of *Phytophthora cinnamomi* is the root and basal stem tissue of living plants (Department of Primary Industries, Water and Environment, 2004).

General Impacts
Phytophthora cinnamomi is one among the most destructive species of *Phytophthora* associated to the decline of forestry, ornamental and fruit species, as well as of some 900 other woody perennial plant species (Ferraris *et al*. 2004). Commercial enterprises such as agricultural projects and related plant industries are negatively impacted by the impact of the *P. cinnamomi* infection. In Italy *P. cinnamomi* infections are being reported with increasing frequency: first on chestnut coppices and *Rhododendron* spp. in plant nurseries and more recently on chestnuts (causing ink disease) and Chamaecyparis in nurseries and on avocado, oak, walnut and highbush blueberry (*Vaccinium corymbosum*) in nurseries and the field. The ability of *P. cinnamomi* to infect oaks has led to speculation that *P. cinnamomi* is involved in the severe decline of oaks in the general Mediterranean region (Robin *et al*. 2001). The pathogen also causes significant damage on the African continent and is highlighted as the most damaging disease in South African avocado orchards, where is causes root rot and heavily reduces crop yields (Bezuidenhout *et al*. 1987). \r\n
Just as concerning is the impact that *P. cinnamomi* may have on native species. According to Rudman (Undated) 181 plant species have so far been recorded as hosts for *P. cinnamomi* in Tasmania, Australia. At least 39 of Tasmania's threatened plant species are susceptible to *P. cinnamomi* and it is possible that native species may be rapidly killed and unable to regenerate in infected areas. As is the case in other areas there is considerable variation in response to infection by *P. cinnamomi* amongst host species, some showing resistance and some extreme susceptibility.
P. cinnamomi is causing and has the potential to cause significant ecological damage in native North American biomes from California to the Appalachian mountains, impacting on ecosystems as diverse at the Sierra Nevada desert and the Appalachian forests. A scientific study of the recent mortality of Ione manzanita- a rare, endemic, evergreen shrub restricted to Ione formation soils in the foothills of the Sierra Nevada, California, (*Arctostaphylos myrtifolia*) found that the cause of mortality was due to the *P. cinnamomi* pathogen. The pathogen which causes wilting, foliage desiccation and root necrosis in native plants is believed to have a significant impact on the conservation of the already threatened *A. myrtifolia* (Swiecki and Bernhardt 2003). *P. cinnamomi* is also impacting native Californian species in the woodlands around Lake Hodges, where 27% of coast live oaks (*Quercus agrifolia*), show disease symptoms and are suspected to be infected with the pathogen (Garbelotto, Hüberli and Shaw 2006). All natural oak woodlands in the western United States are potentially at risk of ecological damage from the pathogen and studies such as the one by Garbelotto, Hüberli and Shaw (2006) may contribute to an understanding disease factors (susceptibility, present of other pests) and may ultimately help to minimise the spread of the disease. In eastern North America, in the Appalachian forests, chestnut forests are struggling to regenerate, a situation partly attributable to the impact of *P. cinnamomi*. While chestnut blight disease has historically been linked to chestnut mortality, among the chief obstacles facing chestnut restoration are the oomycete pathogens of the genus *Phytophthora*. Recent plantings of chestnut seedlings in Appalachian forests have experienced high mortality attributable through standard diagnostic practices to *Phytophthora*, principally *P. cinnamomi* (Rhoades *et al*. 2003).

Management Info
Drenth *et al.* 2006 describe the development and \r\nvalidation of a DNA-based diagnostic assay that can detect and identify 27 different *Phytophthora* species.
For details on preventative measures, chemical, physical, biological control options, please see *management information*.

Principal source: Menge, 1998. Strategies to control *Phytophthora cinnamomi* root rot of avocado.
Botanic Gardens Trust, UNDATED *Phytophthora* root rot - fact sheet

Compiler: National Biological Information Infrastructure (NBII) & IUCN/SSC Invasive Species Specialist Group (ISSG)

Review: Cécile Robin, Institut National de la Recherche Agronomique, Bordaeux, France.

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ALIEN RANGE

[14] AUSTRALIA
[1] FRANCE
[1] MEXICO
[1] PORTUGAL
[1] SLOVAKIA
[2] SPAIN
[1] UNITED KINGDOM
[1] CHINA
[1] ITALY
[1] NEW ZEALAND
[1] ROMANIA
[1] SOUTH AFRICA
[1] SWITZERLAND
[4] UNITED STATES

Red List assessed species 4: CR = 2; EN = 1; NT = 1;

Mastacomys fuscus **NT**
Pseudomys fumeus **EN**
Potorous gilbertii **CR**
Sminthopsis aitkeni **CR**

BIBLIOGRAPHY

41 references found for **Phytophthora cinnamomi**

Managment information
Australian Department of Conservation and Land Management. 2003. Lifecycle of *Phytophthora cinnamomi*. Western Australia Department of Conservation and Land Management.
Summary: Information on description, economic importance, distribution, habitat, history, growth, and impacts and management of species.
Available from: http://www.calm.wa.gov.au/projects/dieback_lifecycle.html [Accessed 01 September 2004]
Barker, P.C.J., Wardlaw, T.J., and Brown, M.J. 1996. Selection and design of *Phytophthora* management areas for the conservation of threatened flora in Tasmania. Biological Conservation. 76 (2): 187-193.
Summary: Provides management and observation data based on Tasmania s treatment program of their *Phytophthora cinnammomi* infestation.
Bergot, M., E. Cloppet, V. Perarnaud, M. Deque, B. Marcais, and M.L Desprez-Loustau. 2004. Simulation of potential range expansion of oak disease caused by *Phytophthora cinnammomi* under climate change. Global Change Biology 10: 1-14
Summary: Information on description, economic importance, distribution, habitat, history, growth, and impacts and management of species.
Bezuidenhout, J. J., J. M. Darvas, and J. C. Toerien. 1987. Chemical control of *Phytophthora cinnammomi*. South African Avocado Growers Association Yearbook 10: 106-108, Proceedings of the First World Avocado Congress.
Summary: Information on description, economic importance, distribution, habitat, history, growth, and impacts and management of species.
Available from: http://www.avocadosource.com/wac1/wac1_p106.htm [Accessed 01 September 2004]
Botanic Gardens Trust. UNDATED. *Phytophthora* root rot - fact sheet.
Summary: Information on description, economic importance, distribution, habitat, history, growth, and impacts and management of species.
Available from: http://www.rbgsyd.nsw.gov.au/information_about_plants/pests_diseases/fact_sheets/phytophthora_root_rot [Accessed 01 September 2005]
Department of Environment & Conservation. 2004. Infection of native plants by *Phytophthora cinnammomi* - key threatening process declaration. NSW Department of Environment & Conservation.
Summary: Information on description, economic importance, distribution, habitat, history, growth, and impacts and management of species.
Available from: http://www.nationalparks.nsw.gov.au/npws.nsf/Content/Infection+of+native+plants+by+Phytophthora+cinnamomi+-+key+threatening+process+declaration [Accessed 01 September 2004]
Department of Primary Industries, Water and Environment. 2004. Quarantine, Pests and Diseases.
Summary: This website gives information about the biology, impacts and management of *Phytophthora cinnammomi* in Tasmania.
Available from: http://www.dpiwe.tas.gov.au/inter.nsf/WebPages/EGIL-53Y7MW?open [Accessed 19 November 2004]
Drenth, A, G. Wagels, B. Smith, B. Sendall, C. O'Dwyer, G. Irvine and J. A. G. Irwin., 2006. Development of a DNA-based method for detection and identification of *Phytophthora* species *Australasian Plant Pathology*, 2006, 35, 147–159
Summary: Available from: http://www.publish.csiro.au/?act=view_file&file_id=AP06018.pdf [Accessed 21 March 2006]
Environment Australia. 2001. Threat abatement plan for dieback caused by the root-rot fungus *Phytophthora cinnamomi*.
Summary: Provides an example of management and damage assessment plans in Austraila.
Available from: http://www.deh.gov.au/biodiversity/threatened/publications/tap/phytophthora/pubs/phytophthora.pdf [Accessed 19 November 2004]
Fairbanks, M.M., Hardy, G.E., and McComb, J.A.. 2001. The effect of phosphite on the sexual reproduction of some annual species of the jarrah (*Eucalyptus marginata*) forest of southwest Western Australia. Sexual Plant Reproduction. 13: 315-321.
Summary: This document details a sufficient and cost-effective control for cinnamomi.

Ferraris, L., F. Cardinale, D. Valentino, P. Roggero, and G. Tamietti. 2004. Immunological Discrimination of *Phytophthora cinnammomi* from other *Phytophthorae* Pathogenic on Chestnut. Journal of Phytophathology 152: 193-199.
Summary: Information on description, economic importance, distribution, habitat, history, growth, and impacts and management of species.
Garbelotto, M., H�berli, D. and Shaw, D. 2006. First Report on an Infestation of *Phytophthora cinnamomi* in Natural Oak Woodlands of California and its Differential Impact on Two Native Oak Species, in *Plant Disease 90*(5): 685.
Summary: A study looking at the effect of *P. cinnamom* on native oak stands and the varying susceptibilty of different oak species to the pathogen.l
Glevan Dieback Consultancy Services. Undated.
Summary: This service was established in 1994 in Western Australia, and provides advice about the management of *P. cinnamomi*.
Available from: http://www.glevan.com.au/page3.html [Accessed 19 November 2004]
Hansen, E. 2003. Phytophthora in North American forests. Oregon State University: Sudden Oak Death Online Symposium.
Summary: Information on description, economic importance, distribution, habitat, history, growth, and impacts and management of species.
Available from: http://www.apsnet.org/online/sod/Papers/Hansen/default.htm [Accessed 01 September 2004]
Jackson, T.J., Burgess, T., Colquhoun, I., and Hardy, G.E. StJ. 2000. Action of the fungicide phosphite on *Eucalyptus marginata* inoculated with *Phytophthora cinnamomi*. Plant Pathology. 49: 147�154.
Summary: This article gives information about the use of phosphite in controlling *P. cinnamomi* on *Eucalyptus marginata*.
Kliejunas, J. 2000. Sudden Oak Death: *Phytophthora* sp. Pest Risk Assessment. USDA Forest Service Forest Health Protection.
Summary: Information on description, economic importance, distribution, habitat, history, growth, and impacts and management of species.
Available from: http://camfer.cnr.berkeley.edu/oaks/SODPRA.html [Accessed 01 September 2004]
Lloyd, S. Aliens-L. 5 April 2004.
Summary: Available from: http://indaba.iucn.org/archives/aliens-l/2004-04/00005635.htm [Accessed 19 November 2004]
Menge, J. A.. 1998. Strategies to control *Phytophthora cinnammomi* root rot of avacado. Dr. Gary Bender, Farm Advisor (Avacados specialist).
Summary: Information on description, economic importance, distribution, habitat, history, growth, and impacts and management of species.
Available from: http://commserv.ucdavis.edu/CESanDiego/bender/p%20cinnamomi%20root%20rot.htm [Accessed 01 September 2004]
Moreira, A. C. & J. M. S. Martins., 2005. Influence of site factors on the impact of *Phytophthora cinnamomi* in cork oak stands in Portugal Forest Pathology Volume 35 Issue 3 Page 145
Parks and Wildlife Service, Tasmania. 2004. Plants of Tasmania: Phytophthora Root Rot.
Summary: Australia s Tasmanian Parks and Wildlife information guide on local flora and fauna.
Available from: http://www.parks.tas.gov.au/veg/phytop/ [Accessed 19 November 2004]
Pryce, J., W. Edwards, and P. A. Gadek. 2002. Distribution of *Phytophthora cinnammomi* at different spatial scales: When can a negative result be considered positively?. Austral Ecology 27: 459-462
Summary: Information on description, economic importance, distribution, habitat, history, growth, and impacts and management of species.
Rhoades, C. C., S. L. Brosi, A. J. Dattilo, and P. Vincelli. 2003. Effect of soil compaction and moisture on incidence of phytophthora root rot on American chestnut (*Castanea dentata*) seedlings. Forest Ecology and Management 184: 47-54
Summary: Information on description, economic importance, distribution, habitat, history, growth, and impacts and management of species.
Robin, C., G. Capron, and M. L. Desprez-Loustau. 2001. Root infection by *Phytophthora cinnammomi* in seedlings of three oak species. Plant Pathology 50: 708-716
Summary: Information on description, economic importance, distribution, habitat, history, growth, and impacts and management of species.
Rudman, T. UNDATED. Information & Advice - Phytophthora Root Rot. Tasmania Outdoors.com Pty Ltd.
Summary: Information on description, economic importance, distribution, habitat, history, growth, and impacts and management of species.
Available from: http://www.tasmaniaoutdoors.com/advice/advicedetail.php?AdviceID=00003 [Accessed 01 September 2004]
Shearer, B. L., Fairman, R. G. & Grant, M. J. 2006. Effective concentration of phosphite in controlling *Phytophthora cinnamomi* following stem injection of *Banksia* species and *Eucalyptus marginata*. Forest Pathology 36 (2), 119-135.
Swiecki, T. J. and E. A. Bernhardt, 2003. First Report of Root and Crown Rot Caused by *Phytophthora cinnamomi* Affecting Native Stands of *Arctostaphylos myrtifolia* and *A. viscida* in California, Phytosphere Research, 1027 Davis Street, Vacaville, CA 95687; and M. Garbelotto, Department of Environmental Science, Policy, and Management, University of California, Berkeley 94720. Plant Dis. 87:1395, 2003; published on-line as D-2003-0911-02N, 2003. Accepted for publication 22 August 2003.
Summary: Available from: http://www.apsnet.org/pd/searchnotes/2003/0911-02n.asp [Accessed 12 November 2007]
Swiecki, T.J., Bernhardt, E.A. and Garbelotto, M. 2005. Distribution of *Phytophthora cinnamomi* within the range of Ione manzanita (*Arctostaphylos myrtifolia*). Prepared for California Department of Fish and Game. Vacaville CA: Phytosphere Research and University of California, Berkeley.
Summary: A distributional study investigating the range of *Phytophthora cinnamomi* in native plant (Ione manzanita) mortality centres in Sierra Nevada.
Available from: http://phytosphere.com/publications/Pcinn_Amyrt_2005.htm [Accessed 20 September 2007]
Tasmania Parks & Wildlife Service. 2004. What is *Phytophthora cinnamomi* ? Plants of Tasmania.
Summary: Information on description, economic importance, distribution, habitat, history, growth, and impacts and management of species.
Available from: http://www.parks.tas.gov.au/veg/phytop/whatis.html [Accessed 19 November 2004]

Vannini A. and Vettraino A.M. 2001. Ink disease in chestnuts: impact on the European chestnut. For Snow lands. Res. 76(3), 345-350.
Summary: Information on description, economic importance, distribution, history, and impacts and management of ink disease of chestnut
Vettraino A.M., Morel O., Perlerou C., Robin C., Diamandis S., Vannini A. 2005. Occurrence and distribution of *Phytophthora* species in European chestnut stands, and their association with Ink disease and crown decline. EJPP 111, 169-180.
Summary: Information on description, economic importance, distribution, history, and impacts and management of ink disease of chestnut

General information

Ann, P.J., and Ko, W.H. 1985. Variants of *Phytophthora cinnammomi* extended the known limits of the species. *Mycologia*. 77: 946-950.
Summary: Information about *Phytophthora cinnammomi*
Barnard, E.L. Florida Department of Agriculture and Consumer Services. Forestry Images website.
Summary: The forestry images website provides some pictures of vegetation destroyed by *Phytophthora cinnamomi*.
Available from: http://www.forestryimages.org/browse/detail.cfm?imgnum=4823085 [Accessed 19 November 2004]
Daniel, R., J. Taylor and D. Guest., 2006. Distribution and occurrence of *Phytophthora cinnamomi* at Middle Head and North Head, Sydney Harbour Australasian Plant Pathology, 2006, 35, 569–571
Gonsalves, A.K. and Ferreira, S.A., 1994. *Phytophthora* Primer: General Information Summary .
Summary: This overview is a very helpful list of references of similar *Phytophthora* species and their effects on vegetation.
Available from: http://www.extento.hawaii.edu/kbase/crop/Type/phyt_prim.htm [Accessed 19 November 2004]
Hansen , E.M. 2001. *Phytophthora* diseases in woody plants. From the First International Symposium of SFB 607 Mechanisms of Growth, Competition and Stress Defence in Plants , February 13 - 14, 2001.
Summary: Hansen is an expert on *Phytophthora* and details the life cycle and spread of *Phytophthora cinnamomi*.
Available at: http://www.sfb607.de/english/science/symposium/symposium_2001/phytophthora.html [Accessed 19 November 2004]
Ho, H.H. 2002. *Phytophthora cinnamomi* var. *robiniae* var. *nova* on black locust in Jiangsu Province of China. Mycotaxon. 82:.391-396.
Summary: Details of the variant of *P. cinnamomi* causing damage to black locust populations in China.
Johnston, P.R., Horner, I.J., and Beever, R.E. 2004. *Phytophthora cinnamomi* in New Zealand's indigenous forests. Landcare Research.
Summary: This article gives details on the distribution and impacts of *P. cinnamomi* in New Zealand.
Available from: http://www.landcareresearch.co.nz/research/biodiversity/fungiprog/Phytophthora_cinnamomi.pdf [Accessed 23 November 2004]
Landcare Research. 2004. *Phytophthora cinnamomi.*
Summary: This website gives taxonomic information and distribution records from New Zealand.
Available from: http://nzfungi.landcareresearch.co.nz/html/data.asp?TID=&ID=81-XJD-43&NAMEPKey=8129 [Accessed 19 November 2004]
MAF (Ministry of Agriculture and Forestry)/Biosecurity New Zealand, 2004. Biosecurity Organisms Register for Imported Commodities.
Summary: This website gives details about plant diseases found in New Zealand.
Available from: http://www.maf.govt.nz/biosecurity/pests-diseases/registers-lists/boric/?page=1&scientific=phytophthora [Accessed 19 November 2004]
New South Wales (NSW) National Parks and Wildlife Service, 2004. Infection of native plants by *Phytophthora cinnamomi* - key threatening process declaration.
Summary: This article gives details about the distribution and possible impacts of *P. cinnamomi* on native flora and fauna.
Sanchez, M.E., Caetano, P., Ferraz, J., and Trapero, A. 2002. *Phytophthora* disease of *Quercus ilex* in south-western Spain. Forest Pathology. 32 (1): 5.
Summary: This study details the invasive effects of Phytophthora in Spain, its infected area, manageability, and provides discussion of its infected hosts.