Phytophthora root disease

the plant killer that threatens wildlife habitat

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Phytophthora root disease, also known as cinnamon fungus, is a very serious disease that destroys many of our native plants. The disease is caused by a microscopic pathogen that lives in the soil and in plant roots. It causes symptons similar to drought stress. The following is a description of the disease, how its effects habitat and steps you can take to minimise its spread.

What is Phytophthora root disease?

Phytophthora root disease is *Phytophthora cinnamomi* which belongs to a large group of plant pathogens that cause serious devastation to ecosystems worldwide. This group of pathogens derive their name from the Greek words for "plant destroyer" (Phyto – phthora).

Phytophthora cinnamomi was first described on cinnamon trees in Sumatra in the 1920s (Erwin and Ribeiro 1996). Hence, it is commonly called Cinnamon Fungus. Since then, it has spread throughout the world and now impacts on native forest, horticultural industries, and agricultural crops worldwide. The disease is well known in Western Australia as the cause of jarrah dieback (Shea and Tippett 1989).

Phytophthora cinnamomi causing a mass collapse of Jarrah in Western Australia. Photo: Tonia Griffith-Jones

P. cinnamomi can seriously destroy wildlife habitat. Most levels of habitat such as tree canopy and shrub layers can be altered by this pathogen. In turn this can reduce breeding, feeding and shelter sites for many fauna species. Loss of canopy layer can lead to the loss of bird species that feed in this zone, such as Striated Thornbills, Weebills, lorikeets and honeyeaters. Even if a plant species is not infected by the pathogen, the lost canopy layer may lead to less than favourable conditions for them. For example, fern species may be lost because of the increased exposure. This in turn may lead to the loss of fauna species reliant on shady and moist habitats, such as frogs, worms and other invertebrates.

What does it do?

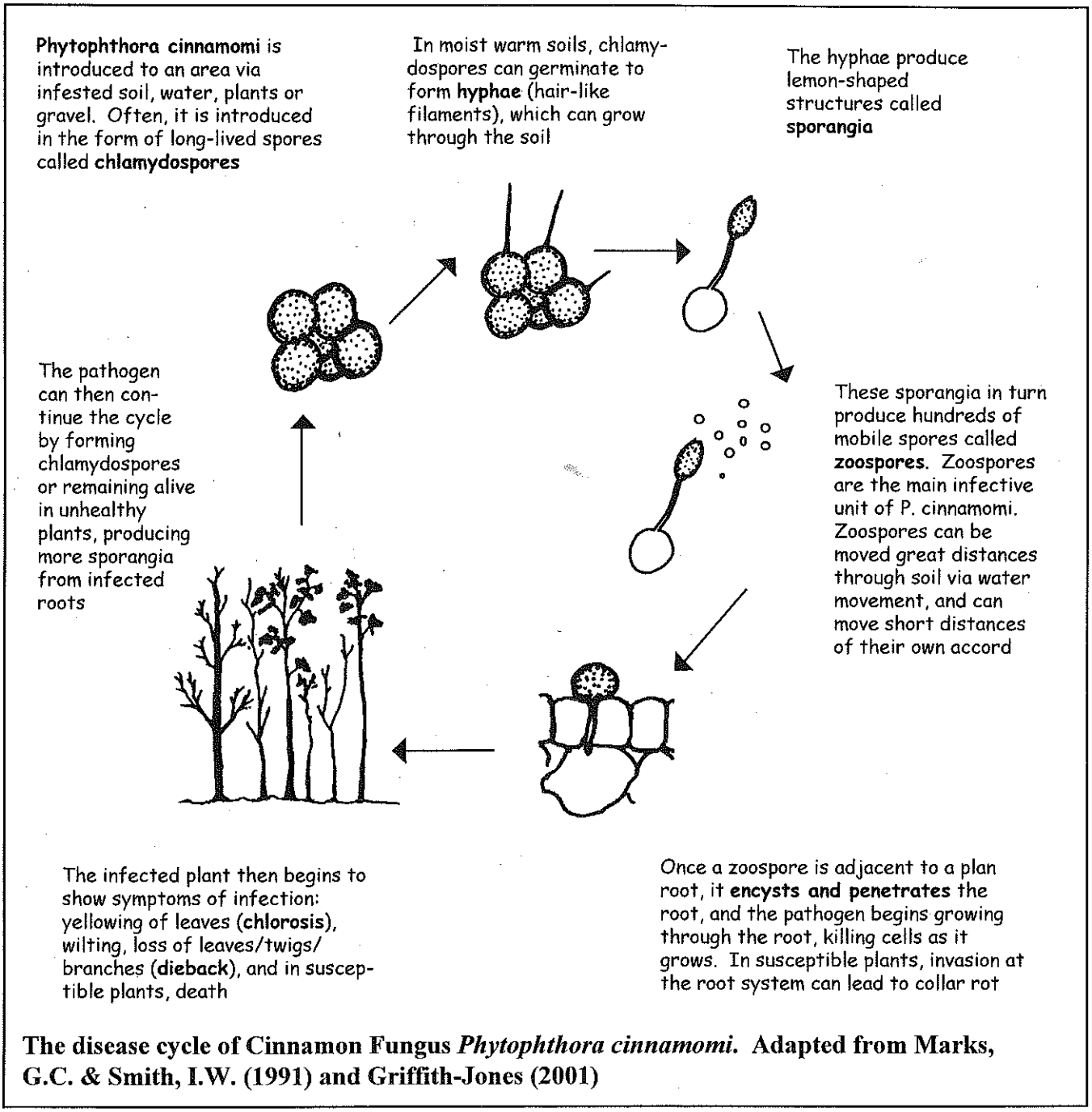
P. cinnamomi is primarily a root and collar rot pathogen. The pathogen penetrates the roots of plants, causing the death of root cells. As root cells are killed by the pathogen, the plant begins to suffer from a reduction in water uptake. As a result, the plant starts to show symptoms similar to those of drought stress. These include yellowing of the leaves and wilting, followed by leaf loss. Leaf loss can often lead to the death of branches, which may be shed by the tree. This leaf loss is usually from outer branches and is generally referred to as "dieback" – the "dying back" of leaves from the branches. Dieback may be followed by death of the plant. In some cases, death is rapid, occurring within six months of the original infection.

The rapidity of death and the extent of disease seen in areas affected by *P. cinnamomi* depends on the interaction of three factors – the pathogen itself, the plant host, and the environment. Each factor will be described further below, but it must be remembered that none of these factors acts in isolation – all factors affect each other to produce disease of varying degrees of severity.

The pathogen

P. cinnamomi has a life cycle that equips it well to cause disease and also makes it difficult to control. The pathogen is often introduced into an area in the form of chlamydospores, either in infested soil, gravel, or infected plants. These chlamydospores are capable of surviving in gravel for up to five years, although their survival depends greatly on how many microbes are present. Chlamydospores can be parasitised by soil microbes, reducing their survival.

When introduced into an area, chlamydospores germinate to produce hyphae, a hair-like growth that can grow through the soil. Under warm, wet conditions, this mycelium can produce a structure called a sporangium, which in turn produces mobile spores



The disease cycle of Cinnamon Fungus *Phytophthora cinnamomi*. Adapted from Marks, G.C. & Smith, I.W. (1991) and Griffith-Jones (2001)

called zoospores. These zoospores are the main infective propagule of the pathogen. Zoospores can move a short distance of their own accord, but usually spread great distances when carried in water moving through soil or drainage channels. This water movement carries the zoospores into new, uninfested areas, where they can cause disease. When the zoospores are carried close to a host root, they are attracted to the root by chemicals produced by the root. The zoospores then infect the root.

Once a plant is infected, the infected root can, under warm, wet conditions, produce more zoospores (spreading disease further) or infect nearby roots if the pathogen grows through the soil. In a susceptible host under favourable environmental conditions, the pathogen can move through the root system and cause collar rot.

The environment

The environment, as mentioned in the previous section, plays a significant role in disease development. The environment affects the activity of the pathogen, the production of spores, the spread of spores, and the response of the infected plant. In some areas of Australia, the pathogen is present in the soil but does not cause significant disease because low soil temperature inhibits activity of the pathogen.

In other areas of Australia, the soil itself suppresses disease (Broadbent and Baker 1974a, b). *P. cinnamomi* can be suppressed by the activity of other soil microbes, such as fungi and bacteria. In areas with high levels of organic matter – such as rainforests – the microbial population in the soil may inhibit activity of *P. cinnamomi* suppressing disease development. Unfortunately, significant areas of Australia have poor soils that are low in organic matter and therefore are able to suppress the disease.

In addition, many areas of Australia have shallow soils that

Compare the healthy stand of Austral Grass Trees (above) with the infected area below. Photos taken in the Brisbane Ranges National Park. Photos: Tonia Griffith-Jones.

are poorly drained. These soils waterlog rapidly in spring, resulting in increased disease as the pathogen produces large numbers of mobile spores. In contrast, well-drained soils generally have lower disease incidence, as the pathogen has less free water available and cannot spread as far.

Because it requires warm, wet conditions, the peak season in Victoria for populations of the pathogen and for disease spread is spring, and to a lesser extent, autumn. In winter, the soil is often too cold for the pathogen to be active. Over summer, soil is usually too dry for the pathogen to spread and infect although the dry summer conditions can lead to the death of infected plants that are already suffering from reduced water uptake.

The plant host

Plant responses, both between species and within species, to infection by *P. cinnamomi* range from resistance to high susceptibility. There are few truly resistant plants – *P. cinnamomi* is capable of infecting roots of most species – but some plants are able to contain the pathogen once it has penetrated the root and prevent it from invading the rest of the root system and plant collar. Other plants, such as grasses and sedges, are able to rapidly produce new roots to replace those infected by the pathogen and so are able to withstand infection.

Moderately susceptible species are species that withstand infection as long as the environment favours the plant and not the pathogen. Many plants tolerate dry conditions well, and as long as the environment remains dry, these plants may withstand infection. When the environment becomes waterlogged, the pathogen is favoured and the plant becomes ill. Many moderately susceptible species can show symptoms when the environment favours the pathogen, but recover when the environment no longer favours the pathogen.

Highly susceptible species are those that have no resistance to the pathogen. These plants are often used as indicator species, as they are generally the first to show symptoms of infection when an area becomes infected with *P. cinnamomi*. An example is the Austral Grass Tree (*Xanthorrhoea australis*), which when infected, rapidly yellows, wilts, and eventually collapses. In areas containing this species, the death of these plants is often spectacular and highly indicative of infection by *P. cinnamomi*.

How do I know if I have *P. cinnamomi*?

The symptoms of infection have been described – yellowing of leaves, wilting, loss of leaves, dying back of branches. In some cases, these symptoms will move through an area in a "front" – there will be a clearly defined line between healthy vegetation and dying vegetation. In other areas, there will be a mosaic pattern, with individual plants becoming infected. Over time, an area infested with the pathogen will change as susceptible plants die out and are replaced by resistant species, especially grasses and sedges.

However, as the symptons resemble the effects of drought stress, it can be difficult to tell if you have an area infested with *P. cinnamomi*. The only way of being certain is having your soil tested for the presence of the pathogen. See page 4 for details on where you can get your soil tested.

How can I protect my land from this threat?

The best protection comes from knowledge and prevention. Understanding the disease is important, as it makes you aware of how the disease can be spread and how it behaves. Understanding what factors affect disease is important in

understanding what can be done to prevent it.
Basically, the pathogen can be spread into a new area by the introduction of infested soil and/or infected plants, or movement of water containing zoospores from nearby infested areas. When purchasing plants from nurseries, select those businesses that have an understanding of the pathogen, and that take steps to prevent the infection of their stock. Ask questions – ask what your nursery does about this pathogen. If the answer is, "Nothing," you know what your response should be. Always buy from a reputable nursery that has a good understanding of plant hygiene.

If you are concerned that soil from nearby areas may be a risk, introduce sanitation methods. When moving from an infected area into an uninfected area, scrub boots with a disinfectant, making sure to remove all soil from the shoe. In Victoria, the disinfectant Phytoclan (AvisChemicals) is registered for this purpose. Be aware of your surroundings – if you find yourself in an infested area, carry a spray bottle with disinfectant in it, and when leaving the area, spray your shoes with it.

Minimise moving stock from infected areas into non infected areas. Soil containing the pathogen may be carried in hooves.

Also, take steps if necessary to clean equipment when moving between infected and uninfected areas – any soil clinging to the underside, wheels, or side of the vehicle could be carrying spores of the pathogen. This may even involve cleaning your tent pegs after camping. Be aware of the movement of soil.

Soil/Gravel to be used in gardens, driveways and roads of pathogen free areas should be tested before introduction to your property. When planning roads/tracks ensure that culverts do not direct water flow into areas containing susceptible species. Similar precautions should be undertaken when constructing dams/lakes etc where water outflows may result in waterlogging.

What if I already have the pathogen on my land?

There is no known way to eradicate *P. cinnamomi* from areas already infested. The best option, if you already have the pathogen, is to be aware of how it spreads, and limit the potential for further spread (see previous section). A program of testing will help delineate the distribution of the pathogen on your land and enable quarantine and hygiene measures to be implemented as appropriate. Where walking tracks are to be constructed through infested areas, consider using tanbark on the tracks to prevent the pick up of soil on shoes. Board walks may be considered in very wet areas.

Other research underway is investigating the use of fungicides to control the disease. Promising results are being obtained with low concentration foliage sprays with phosphonate on native species.

In horticulture and forestry, breeding for resistance to *P. cinnamomi* has produced a number of lines of plants tolerant to the pathogen. Encouraging the regeneration of native plants in infested areas (eg by regeneration burn) may produce some individuals that are tolerant of the disease. Alternatively, planting of known tolerant species, that are locally indigenous, may help provide a vegetation structure for wildlife.

However, it is far better where possible to prevent spread of the pathogen into new areas. In the case of Phytophthora root disease, the old saying "prevention is better than the cure" certainly applies.

References and further reading

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Where can I get my soil tested?

The Department of Natural Resources and Environment (NRE) Laboratories at Crop Health Services, Knoxfield, (03)9210 9356 or 9210 9222

NRE's Forest Science Centre, Heidelberg, (03) 9450 8600.

Both have disease testing services at a fee for service basis.