MYRTLE WILT: A disease of *Myrtle Beech*

September 2005

Background

Myrtle Wilt is a fungal disease of Myrtle Beech (*Nothofagus cunninghamii*) caused by the hyphomycete pathogenic fungus *Chalara australis*. The disease is considered indigenous to Australia and Myrtle Beech is the only known naturally infected host (Kile 1989). The high genetic diversity of isolates of the pathogen support the indigenous hypothesis, as a new introduction to an area would normally have a narrow diversity (Gumley 1993).

Myrtle Wilt is a major cause of mortality of Myrtle Beech trees in Tasmania and Victoria, particularly the Otway Ranges of South-western Victoria. Infection of root and outer stem wood causes conspicuous wilt symptoms in tree crowns leading to death of the whole tree (Figure 1).

The disease was first described in Tasmania in 1973 (Howard 1973) where it has since been shown to be widespread in rainforests. In undisturbed Tasmanian forests an estimate of annual mortality due to Myrtle Wilt was calculated to be 0.61% p.a. (Packham 1994b). Human disturbance has also been found to lead to increased Myrtle Wilt incidence in myrtle-dominated rainforest (Kile *et al* 1989), although there was evidence in some areas that the elevated Myrtle Wilt mortality levels declined to background levels within an average of nine years (Packham 1994b).

In Victoria, it appears that the current disease epidemic has developed after 1973, as there was no evidence of it during a study of Myrtle Beech forests in 1968-72 (Howard & Ashton 1973). However patch deaths of Myrtle Beech trees due to unknown causes were observed in the Central Highlands in the late 1950s and Myrtle Beech was noted as susceptible to the pin-hole borer in 1944 (Hogan 1944) which is now considered an indicator of the disease. By 1980 an aerial survey showed the disease to be well established in the Otway Ranges. Further surveys carried out in 1991 showed the disease is present throughout the range of Myrtle Beech in Cool Temperate Rainforest, although pockets of apparently uninfected stands exist in the Strzelecki Ranges of South Gippsland.

Fungal spread and the Platypus beetle

The fungus spreads by means of air and water-borne spores, and infects trees through wounds in the outer bark. It may then spread through the root system of infected trees to neighbouring trees via root grafts or root contact, thereby creating patches of dead trees (Figure 2).

Figure 1. Red-brown foliage symptoms of Myrtle Wilt disease affecting Myrtle Beech.

Following infection, the trees become susceptible to the tiny pin-hole borer *Platypus subgranosus*, which is the less common of two species of 'ambrosia' beetles known to occur in Victorian eucalypt forests (Neumann and Harris 1974).

It was at first thought that *P. subgranosus* may be a vector for the spread of *C. australis*, but it is now known that the beetle is not directly involved in the cause of the disease. However, trees infected with the fungus are favoured for beetle attack. The beetles therefore have the potential to be of significance in disease spread through liberation of contaminated frass (wood dust generated as the beetles bore into the tree), creation of further wounds (pin-holes) and promotion of spread within trees that are already infected. The presence of the beetles is therefore an early indicator of disease (Figures 2& 3).

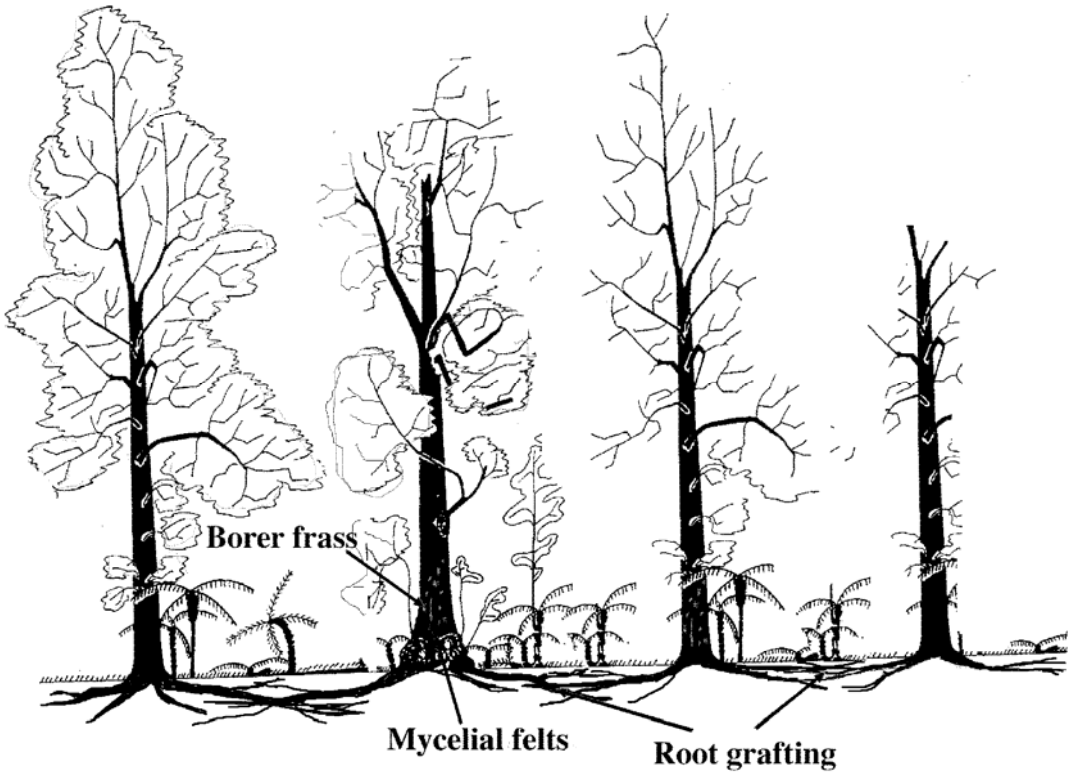

Figure 2. Root grafting as a source of spread of Myrtle Wilt disease in pure stands of Myrtle Beech. (Modified from Howard and Ashton, 1973)

Figure 3. Frass (borer dust) of *Platypus subgranosus* around the openings of borer galleries in the stem of Myrtle Beech affected by Myrtle Wilt disease.

The time from initial wound infection to tree death can be up to three years. In undisturbed forests, falling branches and wind-throw are the most likely source of wounding that would allow entry of spores leading to disease development.

Symptoms and signs of disease

Foliage: Distinctive red-brown coloured leaves of recently killed trees are the most easily recognised symptom of the disease (Figure 1). However, prior to death and browning of the leaves, conspicuous chlorosis (yellowing) of the leaves followed by wilting of the younger shoots and leaves, may be seen.

Wood: The sapwood of affected trees has a distinctive dark brown to light greyish-brown discolouration interspersed within the healthy pink coloured wood (Figure 4). This staining is visible as irregular radial streaks or patches when examined in cross- section. The staining occurs in the buttresses and roots and extends up through the stem, but rarely reaches crown break.

The presence of *P. subgranosus* beetles is indicated by an abundance of frass around the openings of borer galleries in the stem, and around the base of affected trees (Figure 3). Extensive galleries constructed by the borers, practically devoid of frass, can also be seen in cross-section of felled trees.

Figure 4. Sap-staining of Myrtle Beech, caused by *Chalara australis*

Figure 5. Mycelial felts of *Chalara australis* on the trunk of a dying Myrtle Beech

Bark: Black felts made up of mycelium and phialides that hold the spores *of C. australis*, commonly develop on the bark of the lower stem and root buttresses of wilt-affected trees. Felts, vary in size from <5 cm^2 to large irregular patches or streaks 25-50 cm^2 (Figure 5).

Other pathogens of Nothofagus

Other diseases recorded on Myrtle Beech that may be confused with Myrtle Wilt include endemic root pathogens such as *Armillaria* species and the introduced soil-borne pathogen *Phytophthora cinnamomi*. Wood decay fungi are also very aggressive on dead Myrtle Beech and rot the wood rapidly following tree death. Other fungi commonly found on Myrtle Beech include *Cyttaria gunnii* (Beech Orange) and *Hypoxylon* spp that may be confused with the mycelial felts of *Chalara australis*.

Time of year for symptoms

- Chlorosis of the foliage may be seen at any time of the year, although wilting of younger shoots and leaves are most common in spring (Figure 6).
- Death of a tree will occur after four weeks of the onset of foliage symptoms, and is followed by shedding of dead foliage within 6-18 months.
- Pin-hole borer activity in diseased Myrtle Beech trees can be seen during the flight season of the beetle from December to April, although frass expelled from established galleries through entry holes can be seen at any time of the year on the stems.
- Sporulating felts are produced most abundantly during the autumn-winter period (Figure 6).

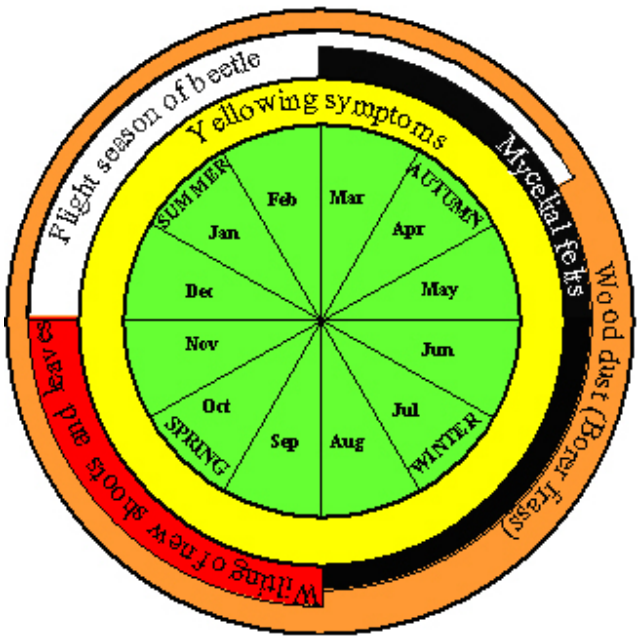

Figure 6. Time line for the appearance of symptoms of Myrtle Wilt on Myrtle Beech

Factors influencing disease incidence and development

In undisturbed forest, disease incidence appears to be related to stem diameter and elevation. Trees under 12 cm dbhob (diameter at breast height over bark) are rarely killed by Myrtle Wilt, possibly reflecting less incidence of suitable wounds and root grafts. As Myrtle Beech seedlings require gaps in the canopy to develop, it is possible that Myrtle Wilt provides a means for gap development by killing the older trees which then allows seedling regeneration and growth to take place. This hypothesis is supported by data in Tasmania showing that the vegetation composition in large, old gaps caused by Myrtle Wilt, was reverting to that of the surrounding forest, and that Myrtle Beech was self replacing in such gaps (Packham 1994a&b).

Disease incidence also declines with increasing elevation of the forest, probably because of an inhibition of fungal activity by lower temperatures. The optimum temperature for growth of the pathogen is 20^{o}C (Kile *et al* 1989).

A reduction in infection of wounds by *Chalara australis* was also observed with wound age, with little infection after 14 - 28 days (Packham, 1994a). In research trials a reduction in infection rates was recorded with decreasing spore concentrations (10^{6}/ml -10^{3}/ml, Packham, 1994a) suggesting that high spore levels are needed for the infection process. Any localised disturbance should therefore not result in landscape scale increases in disease due to the dilution of spores below critical infection levels.

Other factors affecting disease incidence and development relate primarily to the incidence of wounding and extent of root grafting. Rainforest (forest devoid of eucalypts), containing pure stands of tall Myrtle Beech have a higher extent of disease than rainforest composed of a mix of co-dominant rainforest species (Elliott *et al* 1987, Packham 1994a). This observation probably relates to the higher degree of root grafting between individual Myrtle Beech trees within a stand (Figure 2).

It has been hypothesised that the presence of a eucalypt overstorey may increase the incidence of disease as there is a greater chance of wounding of Myrtle Beech through branch shedding by the dominant eucalypts. While this may be so, it would also result in a decrease in severity due to limited underground spread of the pathogen due to reduced root grafting (Figure 7). In Tasmanian mixed forests, an increase in disease incidence has been recorded with increasing Myrtle Beech density peaking in pure stands of Myrtle Beech (Elliott *et al* 1987).

Disease incidence has also been exacerbated through human disturbance that can increase the degree of wounding of root systems and tree stems (Jennings and Hickey 2003). For example, disturbance associated with roads and walking tracks, tourist facilities, land clearance for agriculture, harvesting and wind-throw all have the potential to cause an increase in disease incidence.

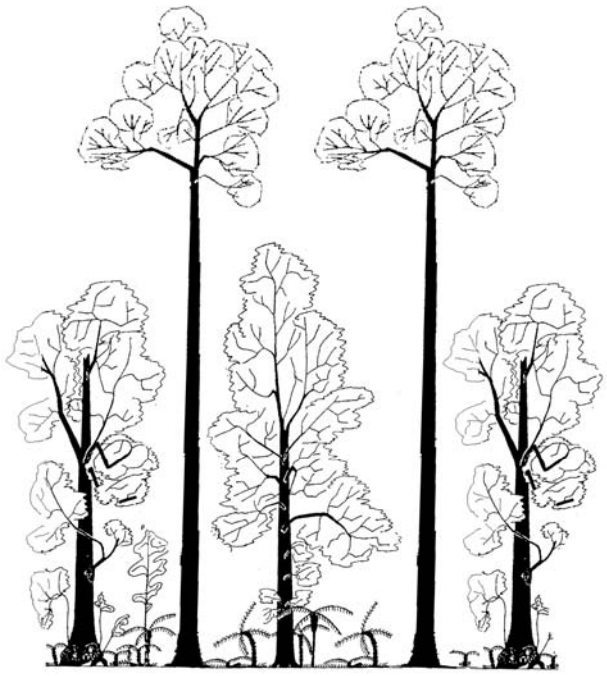

Figure 7. Mixed forest of Mountain Ash (*Eucalyptus regnans*) and Myrtle Beech results in reduced root grafting. (Modified from Howard and Ashton, 1973)

Disease management

Based on current knowledge of the behaviour of the pathogen, disease management options may include:

1) prevention or minimisation of wounding,
2) breaking of root grafts between trees and
3) regeneration of infected stands.

Prevention of wounding of Myrtle Beech is an essential element in any management strategy to minimise fungal infection and needs to focus on:

- providing special prescriptions for the planning, construction and maintenance of roads and tracks through rainforest containing Myrtle Beech and eucalypt forest with a Myrtle Beech understorey.
- minimising damage to trees at the edge of the buffer strips when harvesting eucalypts in forests with a Myrtle Beech understorey. In Victoria, rainforest on public land is excluded from harvesting by the code of forest practice, with buffer vegetation (strips) provided to minimise any impacts.
- minimising impacts of wind-throw that could reduce the efficacy of buffer strips.
- providing education programs for land managers and the general public to ensure up-to-date information is available for disease management prescriptions to be developed, and to prevent vandalism of trees, particularly in areas of high conservation significance and with high visitor attendance.

On high value sites, trenching to break root grafts between infected and uninfected trees may be considered. This has been successful with other similar tree diseases overseas (e.g. Dutch Elm disease and Oak Wilt).

To improve the long-term prognosis, infected stands may require active management to promote seedling regeneration and growth of Myrtle Beech. In Tasmania seed tree systems have produced successful regeneration of Myrtle Beech even in the presence of Myrtle Wilt (Jennings and Hickey, 2003).

The way forward

Packham (1994b) concluded, following her extensive study of the disease, ***"..that, if current levels of Myrtle Wilt continues, it is unlikely that the disease will lead to any permanent change in forest structure."*** **and** ***"In undisturbed forest, Myrtle Wilt acts primarily as a mechanism facilitating stand rejuvenation."***

Research to date has resulted in Myrtle Wilt being understood as a major cause of mortality of Myrtle Beech. Symptoms and signs of disease as well as mechanisms of disease spread have been described. Factors influencing disease incidence and development have also been identified and disease management protocols introduced.

The challenge for the future is to quantify the threat Myrtle Wilt poses to Cool Temperate Rainforest conservation in Victoria, particularly in the light of climate change. To this end Victorian research aims to assess the extent and impact of the disease, the rate of disease development and to establish long-term monitoring plots for studying disease gap dynamics. Monitoring of the disease over time will enable researchers and managers to evaluate this threat and the effectiveness of disease management prescriptions.

Acknowledgments

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Further information

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