

## Root diseases

Due to the similarity of symptoms on the aerial portion of the tree, an accurate diagnosis of root diseases is not easy to achieve. In diseases such as wilts and diebacks, by the time visible symptoms appear most or all of the root system may be involved or destroyed. Furthermore, investigating the development of soil fungi is laborious. Unfavourable soil conditions, such as impenetrable hardpan or abnormally high or low moisture content, can cause death of roots, thus in some cases reducing vigour of the tree and certainly affording an entrance for fungi that could not penetrate living roots directly. Wood-destroying fungi entering through dead roots then can progress into the trunk, causing decay in the hardwood.

Root diseases, especially root rots, are more prevalent in planted stands, in stands on sites to which they are not adapted, and in stands of unnatural composition, so that in the future these diseases are likely to increase in this country. Root diseases are particularly abundant in tropical regions.

## Shoe string root rot

### Hosts

These fungi rot the roots of many different kinds of plants. Most often this disease is found on trees and shrubs such as fir, oak, pine, rhododendron, lilac, and dogwood. However, it is not restricted to woody plants and has been found on raspberry and strawberry. Many woody angiosperms (hardwoods) and gymnosperms (conifers) in native forests, planted forests, orchards, vineyards, and in amenity plantings in urban areas. Some nonwoody plants are also hosts. Plants which are not growing well are more likely to be seriously damaged. Oaks, chestnuts, spruces, and pines seem to be quite susceptible. The reduced vigour trees are more liable to attack. For instance, trees infested by defoliation or bark-boring insects, infected by other fungi, affected by drought, injured by lightning, or weakened in any other way are commonly attacked by *A. mellea*.

## **Symptoms**

The first external symptoms above ground are the decline of the tree vigour such as stunting, yellowing, or browning of leaves or needles, which may drop. Symptoms occur over the whole plant. Foliage may look unhealthy and become more sparse over a period of several years or may show no evidence of any problems but suddenly die. Similar symptoms may be caused by other factors such as general lack of plant care or weather stress.

The damages come from rotting of the bark and wood of the roots and root collar followed by death of the tree.

Armillaria root rot can be distinguished from other problems by examining the lower trunk and roots. If Armillaria is responsible for the problem, a white, generally felt-like fungus growth can be seen between the bark and the wood when the bark is carefully peeled from the wood. At the edge of a diseased area, the white fungus growth normally assumes a characteristic fan-shape. The fungus growth may also be in bark.

In addition, the fungus forms blackish, string-like strands about 1/16 inch in diameter or less which can often be seen between the bark and the wood, and/or on the surface of the roots, and/or in the adjacent soil. These string-like strands, called shoestrings, look similar to roots and may be confused with the roots of the plant, or adjacent plants. However, the shoestrings are darker and grow from areas and in ways which roots would not. Honey-coloured mushrooms may develop around the base of the affected plant, but many times these do not develop.

Mushrooms may be produced in late summer or autumn. Fruiting is erratic; mushrooms may be absent in some years and very abundant in others. Although mushroom morphology varies with the species, they are generally in clusters near or on the base of trees. Caps are honey-brown, usually with small tufts of dark hairs, gills are whitish with notched attachment, spore prints are white, and stems are white to brown, usually with an irregular, mottled appearance. Most species have a partial veil that results in a more or less delicate annulus (ring) on the stem. Other differences among species in mushroom morphology are often subtle and variable. The mushrooms are edible, although you should not eat wild mushrooms unless you are with an experienced collector.

**Pathogen**

Shoestring root rot is caused by a group of fungi known as *Armillaria*. At least 12 species of *Armillaria* have been shown to cause root rots, but since it is very difficult to distinguish between these fungi, and many of these disease situations have not been thoroughly investigated, they are commonly referred to only as *Armillaria melea*.

**Control**

- Remove and burn the severely affected plants
- Soil fumigation in lighter soils can help in controlling the spread of the disease.
- Remove the soil from around the rotted parts of the trunk and larger roots to allow them to air dry. Cut out down the infected area to the healthy tissue and destroy the diseased tissues. Wash cutting tools in soap and water and sterilize them in rubbing alcohol afterward. Roots should be left exposed during summer, but covered over before freezing fall weather.
- Grow plants resistant (meaning they don't often get the disease) to the pathogen.
- Extending the lawn grasses to cover the affected area would seem to be a suitable option (common lawn grasses not reported to be affected by the pathogen).

**Fomes root and butt rot - Ganoderma root and butt rot****Hosts**

Usually infects conifers and occasionally on hardwoods. Red pine is highly susceptible in North America as is Norway spruce in Europe. It is much severe in arable soils which contain much nitrogen that favours the fungus. Drought also seems to favour the fungus.

**Symptoms**

When young trees are killed, thin, tissue-Paper-like mycelium felts, not noticeably veined, from between the bark and wood, small dirty-white outgrowths occur on the underside of the roots. No rhizomorphs develop. Presumably the mycelium grows little, if at all, in the soil. In the incipient stage, decayed wood is pinkish to dull-violet colour, depending on the species of the wood, but still hard and firm. In the advanced stage, the

wood shows small elongated pockets sometimes with black spots or flecks in the centre, the pockets being separated by areas of firm, brownish wood. The pockets finally run together, forming a mass of spongy or stringy white fibres flecked with black. Resin flow may occur from the butt. The perennial conks, which vary from bracket-shaped to flat layers, depending on their position, have a biscuit –coloured sterile margin. The conks usually occur on the crotches of the root collar partially hidden by the litter or even on roots abutting on cavities in the soil.

### **Pathogen**

The fungus *Fomes annosus* (*Ganoderma applanatum*) (Basidiomycota, polyporales) causes this disease, which is also called (spongy sap rot) and (brown root and butt rot).

### **Control**

- Keep stands vigorous
- Grow susceptible species in mixture with resistant species
- Reduce root contact by applying wider spacing
- Delay thinning to allow conifers become more resistant with age
- Brush the stumps a tar and creosote mixture immediately after felling to prevent the infection of stumps by wind-borne spores
- Use antagonistic fungi against *A. annosus* to colonize stumps

## **Phytophthora root rot**

### **Hosts**

Phytophthora root rot, a form of dieback, is a disease that affects many native plants and ecosystems, important crops and horticultural plants in Australia and throughout the world.

Its global spread has been the consequence of trade and human migration. In Australia, the disease infects an especially large range of mainly woody perennial plant species and is also a major threat to some rare and endangered species.

The disease is common in moist, water-retentive soils. Low soil temperatures and high clay content also increase the risk. Seedling stands can be severely damaged, but losses may also occur in established fields. Pines, cedar, chestnut, are main hosts of the disease.

### **The pathogen**

The disease caused by many species of *Phytophthora* (Oomycota, Peronosporales).

For example:

*Phytophthora lateralis* on cedar trees

*P. cinnamomi* on chestnut

### **Ecology**

*P. cinnamomi* fungus grows through the root system (and sometimes the stem) of a plant, destroying it and preventing the plant from absorbing water and nutrients. The first symptom of a plant infected by phytophthora root rot is wilting and yellowing of the foliage. The foliage then dries out and the young feeder roots darken. Infected plants usually die from lack of water and nutrients, although some can survive the disease. Once the fungus has spread through the root system of a plant, it releases zoospores (asexual spores) into the surrounding soil, if the conditions are warm and moist. The spores easily spread through storm water and drainage water. During drought or when temperatures are cooler, *P. cinnamomi* produces two different types of spores — chlamydospores and oospores — which can survive for long periods of time in soil or dead plant material. When conditions become more favourable for the spores, they will germinate and infect new plants. Major human activities that may spread phytophthora root rot include road building, timber harvesting, mine exploration, the nursery trade and bushwalking. While phytophthora root rot does not usually cause severe damage in undisturbed vegetation in areas where annual rainfall is less than 600 mm, it can cause severe epidemics in areas with higher rainfall. Many Australian native plants are susceptible to *P. cinnamomi*, including a number of threatened species and many that are currently not threatened. The fungus has often been found in eucalyptus

trees, grevilleas and banksias, native peas, heaths, hibbertias, club mosses, ferns, cycads, conifers, rushes, grasses and lilies. An outbreak of phytophthora root rot can also affect native animal species, by destroying the plants that provide them with food and shelter.

### **Symptoms**

The first over ground symptom, after the infection of root system, is gradual fading of the foliage until it becomes tan or light brown, crisp, and dry. A cinnamon-brown discolouration of the infected cambium and inner bark extends upward from the root collar a short distance. The fungus spreads locally by the movement of surface water and soil. Infected trees occur in irregular patches from a few feet to many feet in diameter. Trees up to 50 years old are attacked and killed.

### **Control**

- 1- The best control is actually careful attention to seedbed preparation. Avoid compaction and low spots that may accumulate water.
- 2- Limit of the spread of the fungus and reduce its impact. The fungus must be tackled using a management plan based on quarantine, Quarantine is important in reducing the spread of *P. cinnamomi* into areas of high conservation value.
- 3- Hygiene and treatment with the chemical phosphite.