



Saskatchewan Ministry of Environment

Forest Pest Fact Sheet

ARMILLARIA ROOT DISEASE, (*Armillaria spp.*)

BACKGROUND

Armillaria is a genus of soil borne fungi that cause root disease to a wide variety of plant species. Armillaria root disease is widespread throughout the temperate and tropical regions of the world. Many conifers and hardwoods, and some herbaceous plants, are susceptible. Armillaria can be a beneficial saprophyte decaying dead plant material, a secondary pathogen of stressed trees and a primary pathogen of healthy trees. *Armillaria ostoyae* is one of the most common and aggressive conifer pathogens of this genus.

DISTRIBUTION

Armillaria root disease is widely distributed and common throughout the forest regions of North America.

DESCRIPTION OF LIFE STAGES

The fruiting body of Armillaria is a gill mushroom called the honey mushroom. The brown to reddish brown cap is convex, but flattens with age. The gills, on the under side of the cap, are attached to the stem. The mycelium or vegetative stage of the fungus has two forms. One form is the black cord-like strands called rhizomorphs. Rhizomorphs that grow beneath the bark are flat, black to reddish-brown, and up to 5 mm. wide. The outer layer consists of a dark compact mycelium and the inner core is white mycelium. Rhizomorphs that grow in the soil are cylindrical and look like dark cords or shoelaces. The mycelium that grows on roots and into the root collar of the tree is a mycelial mat that is a bright white colour. This mycelium is often fan-shaped.

HOST SPECIES

Armillaria attacks a number of species of spruce, pine, fir and larch. Occasionally hardwoods growing in association with conifers are attacked and killed. In Saskatchewan, the major hosts are black spruce, white spruce, jack pine and balsam fir.

LIFE CYCLE

In its saprophytic phase, Armillaria decays woody material in the soil. This decaying material is a source of inoculum from which Armillaria can spread to living hosts and become parasitic. This spread is accomplished by rhizomorphs growing through the soil and contacting the roots of living trees. Rhizomorphs penetrate the root and initiate infection by mechanical pressure and enzyme action. In addition to disease spread by rhizomorphs, contact between infected and healthy roots can also initiate infection. Once infection occurs, the white mycelial phase colonizes the host tree's root system, eventually growing into the root collar at the base of the tree. At this point, the stem is girdled and the tree dies. Once the tree dies, the fungus becomes saprophytic again, providing inoculum for continued disease spread. In the autumn, if favourable moisture conditions exist, mushrooms are produced at the base of trees that have been killed by Armillaria. Basidiopores produced by these mushrooms are disseminated, causing saprophytic colonization of additional dead woody material, but they do not infect living host trees.

Signs, symptoms and damage

Above ground symptoms of Armillaria root disease are quite varied depending on host species and tree age. In general, symptoms on pine and fir are more obvious than on spruce. Pine hosts often exhibit a thinning and yellowing of the foliage throughout the tree. The foliage turns to red-brown as the tree dies. Fir hosts frequently produce a larger than normal crop of cones, shortly before they die. Once the root collar is invaded, heavy resin flow occurs at the base of the tree in many host species. This condition is especially common in pines and firs. Young spruce will experience discoloured foliage, but mature spruce often die from root disease and fall over without displaying any symptoms. Reduced current shoot growth on laterals and the main stem is a common symptom as the tree declines. Infected portions of the roots are often encrusted with resin and soil. One of the most obvious symptoms of Armillaria root disease, at the time the tree dies, is the white mycelial fan-shaped mat between the wood and the bark at the base of the tree. The honey mushroom can often be found in late September growing in clusters at the base of dead trees or stumps.

There are a number of different types of damage caused by Armillaria root disease. Young trees that become infected often die within a short period of time. Consequently, reforestation efforts can be severely impacted. In young renewed forests, there is a large amount of Armillaria inoculum on the decaying roots of recently harvested trees. As a result, Armillaria spreads rapidly colonizing roots and killing young trees quickly. Older trees may live for many years with the disease and experience significant growth reduction without displaying any disease symptoms. This growth reduction generally goes undetected. Consequently, growth loss to root disease is underestimated or often is thought to be due to poor site conditions. Armillaria root disease can cause such extensive root decay that trees fall over and die. The fungus can invade the base of the main stem causing yellow stringy butt rot, which also causes trees to topple over and die. When the mycellium grows into the cambial layer of root collar, the stem is girdled and the tree dies, leaving dead standing trees. As the disease spreads infecting and killing additional trees, well defined mortality centres develop. These centres continuously expand to form distinct openings in the forest. Over time, root disease mortality centres enlarge and coalesce, reducing stand density and causing significant timber volume loss.

Stunted shoot growth, discolouration of foliage and tree mortality



Image: Manitoba Conservation

Resin flow at base of tree



Image: Duncan Morrison, Natural Resources Canada, Canadian Forest Service

White mycelial fan at base of tree



Image: Duncan Morrison, Natural Resources Canada, Canadian Forest Service

Armillaria rhizomorphs



Image: Pierre Desrochers, Natural Resources Canada, Canadian Forest Service

Armillaria mushrooms at base of tree



Image: Manitoba Conservation

Root disease infection centre



Image: Manitoba Conservation

MANAGEMENT PRESCRIPTIONS

Management of *Armillaria* root disease should focus on reducing disease impacts in existing forest stands. Forest stand types prone to root disease and sites where significant root disease has been detected should be harvested at the pathological rotation, prior to the onset of significant mortality. When harvesting, live standing infected trees should be harvested as deterioration of wood only occurs in the bottom one meter of the tree. When renewing root disease infested sites after harvesting, the focus should be on disease prevention. The large source of inoculum in infected stumps and roots should be removed to reduce mortality in the renewed stand. Site preparation techniques that uproot stumps and roots, and therefore reduce inoculum, should be employed. Where possible renewing the forest with less susceptible species or a species mix should be considered. However, it is important that the species selected for renewal are ecologically suited to the site.

REFERENCES FOR ADDITIONAL INFORMATION

Armillaria Root Disease

R.E. Williams, C.G. Shaw, III, P.M. Wargo, and W.H. Sites

Forest Insect & Disease Leaflet 78

U.S. Department of Agriculture Forest Service

<http://www.na.fs.fed.us/spfo/pubs/fidls/armillaria/armillaria.htm>

Epidemiology of Armillaria root disease in plantations

Natural Resources Canada

Canadian Forest Service

<http://cfs.nrcan.gc.ca/news/277>

Armillaria Root Disease

Common Tree Diseases of British Columbia

http://www.forestry-dev.org/diseases/ctd/Group/Root/root1_e.html