Armillaria Root Rot

Armillaria spp.

Hosts

- Most species of Christmas trees
- Approximately 700 different species of woody plants and some herbaceous plants

Damage Potential

- Low–moderate

Symptoms and Signs

- Reduced terminal growth
- Yellowing and eventual browning of needles
- Whitish resin at the base of tree
- Creamy-white fans of fungus between bark and wood at the root collar
- Brown to black fungal rhizomes resembling shoestrings beneath the bark, on the roots, and in the soil
- Groups of tan-colored mushrooms near decaying wood in autumn
- Death of young trees, often in groups

Causes of Similar Symptoms

- Other root and canker diseases
- Pine root collar weevil
- Wood borers
- Bark beetles
- Drought
- Wet feet

Identification

Many known species of *Armillaria* exist in North America and are not easily distinguishable from one another. The most common and pathogenic species to conifers are *Armillaria mellea* (Vahl:Fr.) P. Kumm. and A. *ostoyae* (Romagnosi) Herink. Other common names for *Armillaria* include shoestring root rot, oak fungus, honey mushroom, and honey agaric.

Conifers frequently show symptoms and signs of *Armillaria* infection at different rates. Trees under stress, such as during the heat of summer or drought, are more likely to become infected and show symptoms. Young trees may show symptoms and die very rapidly compared to older trees, which may show symptoms for years before dying.

Characteristic signs of *Armillaria* are visible beneath the lower trunk bark and in the soil. The fungus produces long, black, stringlike strands called rhizomorphs, which can easily be mistaken for small roots. They are found between the bark and wood, on the surface of roots, and in the adjacent soil (Fig. 1). In addition, creamy-white, paper-thick, fan-shaped sheets of the fungus can be seen when bark is removed at the tree base (Fig. 2) or when it is exposed in the main roots (Fig. 3).

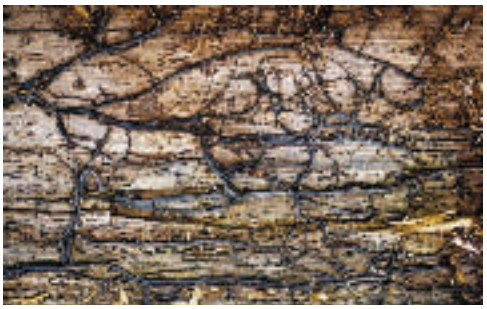

Figure 1. Black, stringlike strands, or rhizomorphs, between the bark and wood of the lower trunk and in the soil. *Courtesy of Joseph O'Brien, USDA Forest Service, Bugwood.org (#5047087)*

Figure 2. Creamy white, paper-thin, fan-shaped sheets of mycelium under the bark near the tree's base. *Courtesy of Minnesota Department of Natural Resources Archive, Bugwood.org (#4214008)*

Figure 3. White fungal sheets found under the epidermis of the tree's roots. *Courtesy of Edward L. Barnard, Florida Department of Agriculture and Consumer Services, Bugwood.org (#4822096)*

Needle yellowing and browning, a symptom of *Armillaria*. *Courtesy of Joseph O'Brien, USDA Forest Service, Bugwood.org (#5047090)*

Figure 4. Mushrooms produced by some *Armillaria* species near the trunk of infected trees. *Courtesy of Joseph O'Brien, USDA Forest Service, Bugwood .org (#5047089)*

Figure 5. Tree death as a result of *Armillaria* infection. *Courtesy of Steven Katovich, USDA Forest Service, Bugwood .org (#1479015)*

Diseased wood first looks water soaked and light brown in color. It becomes yellowish white, spongy, and stringy over time. Prolonged decay can also cause vertical cracks in the root collar. *Armillaria* has a very strong mushroom odor and some species produce clusters of yellowish-brown mushrooms (associated with the rhizomorphs) near the decaying wood after a period of rain in the fall.

Biology and Life Cycle

Some species of *Armillaria* will produce mushrooms near the trunk of infected trees (Fig. 4). Though new infections can result from airborne spores released by these mushrooms, the most common means of disease spread is by underground growth of the rhizomorphs originating from an infected tree. Rhizomorph structures can survive for many years on dead or dying tree roots and stumps and spread through the soil up to 60 feet from the point of origin. As healthy tree roots grow through the soil, they come into contact with the rhizomorphs and mycelium. By secreting an enzyme that breaks down cell walls, the rhizomorphs and mycelium adhere to the healthy tree roots and penetrate into them. The fungus infection causes the loss of the tree's fine feeder roots and results in insufficient water and nutrient transport to the trees, which leads to tree decline and death (Fig. 5). If the soil temperature reaches 79°F (26°C), *Armillaria* growth can be inhibited.

Monitoring and Management Strategies

Plantation Establishment

- Do not plant in a recently cleared hardwood stand that had a previous problem with *Armillaria*.
- Avoid areas surrounded by oak forest.
- Avoid areas that may cause extreme tree stress such as drought or excessive moisture.

Preseason

- No scouting schedule or technique is available for this disease. However, when scouting for other insect pests or diseases, watch for declining trees that may be infected with *Armillaria*.

Growing Season

- Test soil and maintain proper nutrient balance.
- Water when there is a drought.
- Control other pests affecting trees during the season to maintain plant vigor.
- At the end of the season, evaluate results and update records.

Control Options

Biological

- No recommendations are available at this time.

Mechanical

- Dig up and remove diseased trees, tree stumps, roots, pruning waste, and all infected wood and burn it on site.
- If only a few roots are infected, remove the infected soil from midspring through late fall to expose the root collar and buttress roots to air and sun. This allows them to dry out. Before the first heavy frost, replace the removed soil with *Armillaria*-free soil.

Biorational

- No recommendations are available at this time.

Chemical

- Fungicides are not recommended for treatment for this disease.
- Soil fumigants have been used with limited success after diseased material is removed from the soil. However, soil fumigants are highly toxic and should only be applied by a licensed pesticide professional.

Next Crop/Prevention

- Buy and plant disease-free stock only.