

# AGRICULTURAL GUIDE

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Tree Disease

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## Armillaria root rot in fruit orchards

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Armillaria root rot is usually considered to be a disease affecting forest trees, but it can cause significant losses in orchards. The pathogen, a fungus known as *Armillaria mellea*, will kill trees, and its persistence in the soil for many years can prevent the re-establishment of productive orchards on infested sites.

### Symptoms

During early stages of the disease, trees produce small, yellow-green leaves and show very little terminal growth. Usually, a single scaffold limb will show symptoms first. Other limbs will show symptoms in the same season or shortly thereafter. Infected limbs generally die within one year after the appearance of early symptoms (Figure 1).

*Armillaria* usually attacks trees that are under stress. The stress is often caused by excessively wet soil conditions in low areas of an orchard. Tree death in these low areas may be caused by effects of wet soil or *Armillaria* root rot, which was promoted by that stress. You can distinguish between trees infected with *Armillaria* and those affected by "wet feet" by examining the roots and crowns 6 to 12 inches below the soil line. The bark around the crown and on the roots of trees damaged by excess soil moisture is generally wet, soft, blackened, and easily removed. In contrast, the bark around the lower trunk and crown on trees showing symptoms of *Armillaria* root rot is often intact. When you peel back the bark, you'll find white fan-shaped masses of fungal threads growing between the bark and the wood (Figure 2). These fans grow about 12 inches above the ground line on trees that have been dead for more than a year. The fruiting bodies of *Armillaria* may develop at the base of dead and dying trees or on the ground emerging from infected roots. These mushrooms are 3 to 10 inches tall with honey-colored broad caps that are dotted with dark brown scales.



Figure 1. Branches of this infected peach tree are dying.

### Disease development

*Armillaria* survives for long periods of time on decaying wood and root material in the soil. The fungus produces runner hyphae called rhizomorphs. Rhizomorphs are dark brown and about the thickness of a shoestring. Rhizomorphs grow along tree roots and on buried wood. They may advance through the soil when moisture levels are optimal. Healthy roots can become infected when they contact roots of infected trees. The fungus then rapidly grows along the root to the crown of the tree. There, it girdles the tree and kills it. Trees generally die in one to three years after infection. Under some conditions, *Armillaria* will attack and kill healthy trees, but it normally only attacks trees previously weakened by stress.

### Control

*Armillaria* root rot is very difficult to control and no single treatment is completely effective in returning infested sites to full production. Effective control requires prevention, containment, and eradication.

**Prevention.** Prevention of this disease begins with establishment of the orchards. The site should be well drained and clear of all oak, maple and elm for at least five years. Work the soil thoroughly to remove all buried wood and tree roots, because this material enables the pathogen to survive in the soil for many years. Leave problem areas, such as poorly drained sites, unplanted.

Armillaria root rot can be especially severe in orchards in which trees are stressed. Thus, it is important to maintain tree vigor by avoiding management practices that place the trees under stress. Factors that contribute to overall stress include inadequate nutrition; low soil pH; erosion; excessive and extensive clean cultivation; defoliating diseases; insects; heavy bearing; drought; waterlogged soils; and winter injury. If *Armillaria* is present in an orchard soil, it will take advantage of such weakened trees and, within a short period of time, become well established.

**Containment.** Once this disease has become established in an area of the orchard, it is most important to contain *Armillaria* within that area. This pathogen can be spread within an orchard by moving infected roots and wood. This easily occurs through cultivation, erosion, and tree removal operations. It can even spread if you drive heavy equipment through infested areas that are muddy.

You may have to make difficult decisions to contain the disease effectively. Containment requires the removal not only of trees already killed by the fungus, but also those that show only early symptoms—even on just one scaffold. However, the decision to remove an infected tree early may save healthy trees around it.

In any tree removal operation, it is critical to also remove as much of the root system as possible. It is best to burn the collected wood and roots within the infested site, but this is sometimes not practical. If you must remove infected trees from the orchard before burning, they should be hauled rather than dragged. Otherwise, small wood pieces carrying the

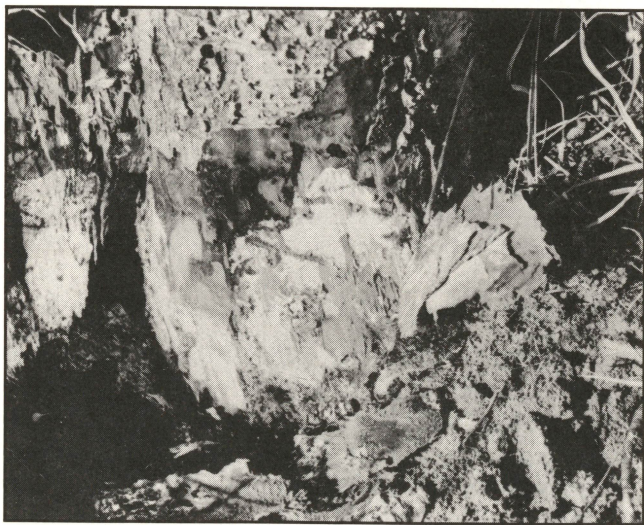


Figure 2. White, fan-shaped fungal masses grow between the bark and the wood.

fungus may be distributed throughout the surrounding healthy orchard.

Affected areas should **not** be replanted until the site is cleared of all dead wood and is fumigated with methyl bromide (see eradication below). If you can't fumigate, you should seed the site to a suitable cover crop for several years. Restrict travel through the site, especially with cultivators.

Containment will help reduce the rate at which the fungus spreads through an orchard. Measures which reduce the stress on healthy trees will also help. Effective disease control, however, depends on measures that will eradicate the fungus.

**Eradication.** Remember, you must fumigate old sites to eradicate the fungus. Before fumigating, you must remove all dead wood and roots and work the soil up thoroughly. Do not fumigate when the soil is extremely dry, excessively wet, or when the soil temperature is below 50 degrees F.

To fumigate, bore a ½-inch hole 4 to 5 feet deep in the middle of the 10 by 10 foot area to be treated. Place one end of a 10 to 15 foot long plastic tube into this hole. Cover the area to be treated with a 10 by 10 foot plastic tarp. Seal the edges of the tarp with soil, leaving the free end of the tube extending from one side. Apply 1 pound of methyl bromide to the area through this tube. Carefully follow all directions on the label for safe application of this chemical. Remove the tarp and tube 48 hours after treating if the soil temperature is 50 to 60 degrees F or 24 hours after treating if the soil temperature is above 60 degrees F. You may till and plant the soil three days after you remove the tarp.

The initial costs of such an operation will be high, but the benefits you derive from its use more than justify the expense. In addition to killing *Armillaria*, soil fumigation with methyl bromide reduces the populations of other soil microorganisms, such as bacteria, fungi, and nematodes, that can place a newly planted tree under severe stress. Done properly, methyl bromide soil fumigation is the most efficient method to clean up an orchard site for replanting.

## Summary

The control of *Armillaria* root rot in the orchard requires a disease management system that involves nearly all aspects of the tree fruit production operation. Plant and grow the orchard under the most stress-free conditions possible. Take positive measures to prevent or reduce the spread of the fungus in the orchard and to keep all infected wood out of the soil. Where necessary, thoroughly prepare and fumigate individual sites with methyl bromide.