

A photograph of an avocado tree branch with several green avocados hanging from it. The background shows a vast valley with a town, surrounded by mountains under a blue sky with light clouds.

INTEGRATED PEST MANAGEMENT FOR

Avocados

STATEWIDE INTEGRATED PEST MANAGEMENT PROGRAM
UNIVERSITY OF CALIFORNIA AGRICULTURE AND NATURAL RESOURCES
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Armillaria Root Rot

Armillaria mellea

Armillaria root rot infects many crops and native and ornamental plants. Common hosts include avocado, cherimoya, citrus, and oak trees. The fungus persists in infested roots and



This wilted, downward-hanging foliage is a symptom of infection by *Armillaria mellea*. Other symptoms of Armillaria root rot include yellowing of foliage, leaf drop, and dieback of upper limbs.



JACK KELLY CLARK

During the rainy fall and winter, short-lived mushrooms often grow around the base of *Armillaria*-infected trees such as this almond. Scout your groves for these mushrooms after rains. Mark any trees where mushrooms occur, confirm whether the cause is Armillaria root rot, and then develop and implement a management plan.

wood in soil, infecting new plantings and spreading to infect nearby plants (Figure 21).

Symptoms and Damage

The *Armillaria* fungus can become well established in roots and the root crown before any symptoms are visible above ground. Infected trees usually die prematurely, and if they are young trees they often die quickly after infection. Mature trees may die quickly or slowly, or they may recover at least temporarily if conditions become good for tree growth and poor for disease development.

Wilted, downward-hanging foliage is often the first obvious symptom of Armillaria root rot. Other symptoms include yellowing of the foliage, leaf drop, and dieback of upper limbs. During rainy fall and winter periods, short-lived mushrooms often appear around the base of *Armillaria*-infected trees. The mushroom caps vary in color from off-white to honey-yellow to almost black. Each cap is about 1 to 10 inches (2.5–25 cm) in diameter. The mushrooms always occur in groups, never singly. Mushrooms have a ring on the stalk just under the cap



The most reliable sign of Armillaria root rot is white, cottony fungal mycelial growth in cambial tissue. If trees exhibit aboveground symptoms of infection, expose the root crown and cut under the crown's bark to look for *Armillaria* mycelium.

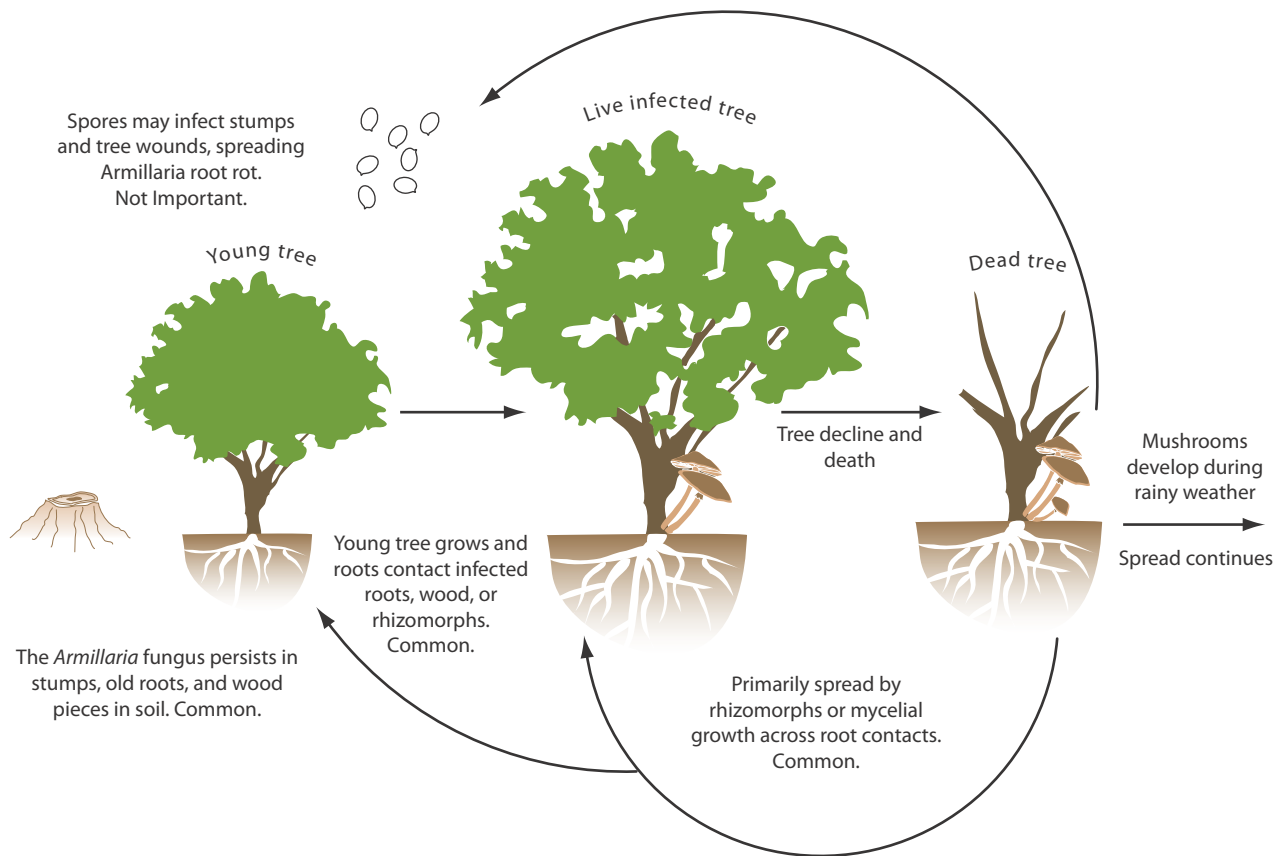


Figure 21. Armillaria root rot development cycle and spread. *Armillaria mellea* persists for years in infected roots and wood in soil. New infections occur when roots grow and contact infected roots or wood or when fungal rhizomorphs grow short distances in soil to contact nearby plants. *Armillaria* spores can infect stumps and tree wounds, but spores apparently are not an important source of Armillaria root rot in California. Eliminating infected trees and removing old stumps, large roots, and wood pieces from soil can break the disease cycle.



These scattered, small, white patches are *Armillaria mellea* mycelium growing beneath bark on the root crown of an avocado tree.

and shed numerous minuscule, white spores. Spores do not appear to be an important source of infection in California avocados.

The most reliable sign of Armillaria root rot is a white growth of fungal mycelium in the cambial tissue. If trees exhibit aboveground symptoms of infection, cut under the bark of the root crown and major roots to check for mycelium, which are whitish and have a strong mushroom odor. Growth typically occurs in patches in the cambium and inner bark.

Seasonal Development

Armillaria mycelium persists for years under the bark of a tree's diseased roots or root crown. The fungus spreads from tree to tree mainly by means of natural root-to-root grafts and by cordlike rhizomorphs, which resemble small, dark roots. In contrast, healthy avocado roots are lighter colored, usually light brown to whitish. When pulled apart, rhizomorphs have a cottony interior, while the center of a healthy root is solid and woody. Rhizomorphs grow along or out from diseased roots, eventually contacting and infecting the healthy roots of adjacent trees. *Armillaria* also spreads when

any activity moves soil containing infested wood fragments, such as during cultivation.

Long after the aerial parts of a tree have been removed, *Armillaria* can remain alive in the remaining roots and stumps. Then, when new avocado trees are planted, the new roots grow into contact with *Armillaria*-infected roots or infested wood pieces and the new tree becomes infected. *Armillaria* can also be introduced on infected nursery stock.

Management Guidelines

Provide a good growing environment and proper cultural practices and use good sanitation to manage *Armillaria* root rot. Good drainage is important, as is not irrigating excessively. *Armillaria* fungus is very susceptible to drying. Citrus growers sometimes excavate the soil around the trunk to temporarily air-dry the root crown to prolong the life of an infected citrus tree. This excavation may also be effective on avocado trees, but apparently it has not been tested. If you do expose any root crowns, shade them to protect them from sunburn. When an infected tree dies, remove it and any immediately adjacent trees, which may also be infected. Remove the stumps also, and as many root pieces as possible from the soil. Thoroughly clean all soil from the equipment that you use, and leave the soil on-site before you remove the equipment. Consider replanting the ground with crops that are not susceptible to *Armillaria*.

Soil fumigation with chemicals has successfully controlled *Armillaria* root rot under favorable soil conditions by preventing spread of the fungus and permitting growers to replant fumigated areas. Fumigation is expensive and potentially hazardous, however, and often it is only partially effective. Consult the latest update of *Avocado: UC IPM Pest Management Guidelines: Diseases* (online at www.ipm.ucdavis.edu) for more information on fungicides and disease management.



JACK KELLY CLARK

Armillaria mycelia can develop as large, white, fan-shaped plaques beneath the bark. After the aerial parts of a tree are gone, *Armillaria* can remain alive for years in roots and on pieces of wood in the soil.



JACK KELLY CLARK

Armillaria can spread by cordlike rhizomorphs (see arrows, top of photo), which resemble small dark roots. Healthy roots (bottom) are lighter-colored, usually light brown to whitish.