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UC IPM

Integrated Pest Management for Home Gardeners and Landscape Professionals

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Wood Decay Fungi in Landscape Trees

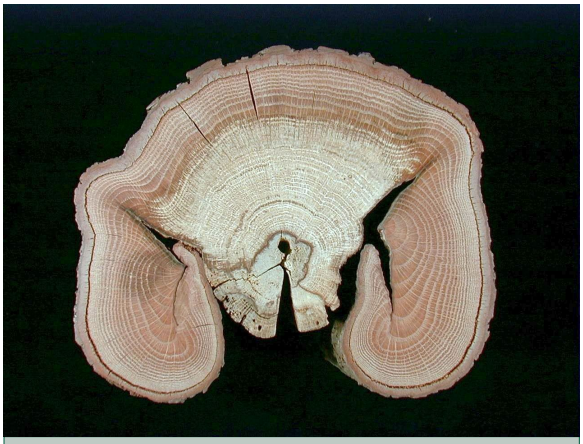

Figure 1. White rot of oak.

Figure 2. Heart brown rot in a conifer trunk.

Several fungal diseases, sometimes called heart rots, sap rots, or canker rots, decay wood in tree trunks and limbs (Figures 1 and 2). Under conditions favoring growth of specific rot fungi, extensive portions of the wood of living trees can decay in a relatively short time (i.e., months to years). Decay fungi reduce wood strength and may kill storage and conductive tissues in the sapwood. While most species of woody plants are subject to trunk and limb decay, older and weaker trees are most susceptible.

DAMAGE

Decay fungi destroy cell wall components; including cellulose, hemicellulose, and lignin, that make up the woody portion of a tree. Depending on the organism, decay fungi can destroy the living (sapwood) or the central core (heartwood) part of the tree. Decay isn't always visible on the outside of the tree, except where the bark has been cut or injured, when a cavity is present, or when rot fungi produce reproductive structures.

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Wood decay can make trees hazardous, as infected trunks and limbs become unable to support their own weight and fall, especially when stressed by wind, heavy rain, or other conditions. Decay can also be hidden, affecting wood strength without any outward sign of its presence. Decay fungi typically reduce the weight of wood by growing through the vascular tissues and degrading some or all major cell wall components and absorbing breakdown products of cellulose or hemicellulose. A 10% loss of wood weight can result in 70 to 90% loss in wood strength. Many branches that fall from trees appear sound, but upon analysis, they were colonized by wood decay organisms.

Table 1 lists several wood decay fungi found on California trees and symptoms and signs commonly associated with each organism.

Table 1. Wood Decay Fungi on California Landscape Trees.

Fungus	Common Hosts	Symptoms
Armillaria mellea **Oak root fungus** 	Many coniferous and broadleaved woody species; peach, fig (*F. carica*) and Peruvian pepper are highly susceptible hosts.	One of the most widespread plant pathogens in California. Causes a white butt and root rot. When bark is removed, white or cream-colored mycelial plaques—the vegetative part of fungi—are present between the bark and wood of roots and trunk near or slightly above the soil line. Mushrooms can form at the base of affected trees following fall and winter rains. Fungi enter susceptible plants by means of dark, rootlike structures called rhizomorphs found on the surface of affected roots. Fungal growth is most rapid under warm and wet conditions; decay has been slowed or stopped in some instances by removing soil from around the base of the tree and allowing areas to dry.
Ganoderma applanatum **Artist's conk** 	Wide variety of landscape and forest trees including acacia, alder, ash, birch, carob, citrus, elm, eucalyptus, fir, magnolia, maple, mulberry, oak, Peruvian pepper tree, pine, poplar, sweet gum, sycamore, tulip tree, and willow.	The fungus invades trees through wounds, kills the sapwood of some species, and causes white rot of the sapwood and heartwood in roots and trunks. Forms semicircular conks that are 2–30 inches wide and 1–8 inches thick. Upper surface of conk is brown, and the lower surface is white, but turns dark when scratched, hence the common name "artist's conk." Stalks are absent. Fungus can spread through natural root grafting. Conks usually are found near ground level. Columns of decaying wood can extend as far as 15 feet above and below the conk.
Ganoderma polychromum **(formerly *G. lucidum*) Varnish fungus** 	Acacia, apple, ash, birch, boxwood, cherry, citrus, elm, hackberry, sweet gum, black locust, honey locust, magnolia, maple, oak, olive, peach, Peruvian pepper tree, pine, poplar, redbud, spruce, and willow.	The fungus causes a white rot and can attack living trees, causing extensive decay of roots and the trunk. Can kill the host during a period of 3–5 years. On some trees, such as oaks and maples, the rate of decay is rapid. The red-brown, annual conks are up to 14 inches wide and coated on top with a distinctive reddish varnish-like crust; they generally appear at base of the trunk during summer. Causes decline in hardwood trees. Environmental stress, such as drought and wounding, can predispose trees to infection from this fungus.
Laetiporus gilbertsoni, L. conifericola **Sulfur fungus** 	Acacia, ash, beech, birch, carob, cherry, chestnut, elm, eucalyptus, fir, hackberry, black locust, honey locust, maple, oak, Peruvian pepper tree, pine, poplar, spruce, tulip tree, walnut, and yew.	The fungus causes a brown heart rot of living trees but also will decay dead trees. It is one of the few brown rot fungi of hardwood trees. It can enter trees through bark wounds and dead branch stubs. This fungus is one of the most serious causes of decay in oaks and eucalyptus, and one of the few fungi that cause decay in yew. The soft, fleshy, moist conks range from 2 inches to over 20 inches wide and are bright orange yellow above and red yellow below. Conks are produced annually and appear singly or in clusters, usually in fall; they become hard, brittle, and white with age. Conks do not appear until many years after the onset of decay and indicate extensive internal damage.
Pleurotus ostreatus **Oyster mushroom** 	Acacia, alder, ash, beech, birch, chestnut, elm, eucalyptus, fir, hackberry, holly, horse chestnut, linden, magnolia, maple, oak, olive, pecan, persimmon, poplar, spruce, tulip tree, walnut, and willow.	This fungus decays heartwood and sapwood, causing a white, flaky rot. Infections occur through open wounds, and decay is most extreme when wounds are large. A cluster of shelf-like mushrooms, each 2–8 inches wide, is produced annually and can indicate localized decay or heart rot that extends 10 feet in either direction. The mushrooms are smooth on the upper surface with gills that characteristically extend down along the stalk on the lower surface.

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Table 1. Wood Decay Fungi on California Landscape Trees, *continued*.

Fungus	Common Hosts	Symptoms
Schizophyllum commune **Common split gill fungus** 	More than 75 species of landscape trees including acacia, ash, birch, camphor, elm, eucalyptus, fir, juniper, laurel, locust, magnolia, oak, oleander, pepper tree, pine, plane tree, poplar, sequoia, spruce, sweet gum, tulip tree, walnut, and willow.	This fungus causes a white rot of sapwood and produces annual fruiting bodies that are hairy and white to pale brown when young but darken with age. The stalkless brackets are tough, leathery, about 1–4 inches wide, and usually found in clusters. The pale gills on the underside have the appearance of being longitudinally split, hence the common name. The fungus colonizes trees stressed by heat, sunburn, drought, or major wounds. It generally fruits on cut and fallen wood and dead parts of living trees.
Stereum **spp. Parchment fungus** 	Acacia, alder, birch, catalpa, cherry, chestnut, elm, eucalyptus, fir, juniper, magnolia, maple, oak, pine, sequoia, spruce, sweet gum, tulip tree, and willow.	This group of fungi are commonly found on dead trees, branches, and stumps but rarely cause serious decay in living trees. They can cause heart rot on trees wounded by pruning or bark injury. The annual fruiting bodies are thin, leathery, and bracket-like, lack stalks, and are 1 inch or more across. The upper surface is gray brown, and the lower side is buff to brown and smooth, lacking tubes or pores.
Trametes hirsuta ***Hairy turkey tail fungus*** 	Alder, ash, birch, catalpa, cherry, chestnut, citrus, elm, eucalyptus, fir, ginkgo, holly, juniper, locust, magnolia, maple, oak, pine, poplar, redbud, spruce, sweet gum, sycamore, tulip tree, walnut, and willow.	This fungus, which causes white rot, can enter a tree through dead wood exposed by fire scarring; decay begins as a sap rot and can continue as a heart rot on some woody species. It often produces fruiting bodies on the dead portions of live hardwoods; fruiting bodies are tough, leathery, usually stalkless, shelf-like, and 1–10 inches wide. The outer surface is dry, velvety, and has concentric zones. The under surface is poroid.
Trametes versicolor **Turkey tail fungus** 	Alder, apple, ash, beech, birch, catalpa, cherry, chestnut, crape myrtle, elm, eucalyptus, fir, gingko, hackberry, holly, juniper, laurel, lilac, linden, locust, London plane tree, maple, nectarine, oak, pepper tree, poplar, redbud, sweet gum, tulip tree, walnut, and willow.	This fungus commonly is found on cut and fallen wood and on wounded areas of living trees; it also is capable of colonizing sapwood of trees and shrubs stressed by water shortage, sunburn, freeze damage, or wounding. The fungus, which causes a white, spongy rot of wood, can actively invade and rapidly kill the cambium (the tissue between the bark and wood), causing cankers with papery bark and dieback. The annual conks are thin, leathery, stalkless, bracketlike, 1–4 inches across, and often found in groups. The upper surface is velvety with concentric zones of various colors, and the lower surface is cream colored and minutely poroid.
Phellinus igniarius **and other *Phellinus* spp.** 	American sweetgum, apple, bay tree, birch, elm, cottonwood, locust, lilac, poplar, pear, walnut, oak, sycamore, willow.	*Phellinus* produce perennial conks with a "hoof" like appearance—dark and cracked above and tan or ochre below, with small pores. A new hymenium or spore bearing layer is added each year. These are white rotting fungi that are common on various species of hardwoods and softwoods. These cause heart rots on intact trunks.

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Table 1. Wood Decay Fungi on California Landscape Trees, *continued*.

Fungus	Common Hosts	Symptoms
Biscogniauxia mediterranea, B. atropunctata 	Sycamore, oaks, maple, pecan, golden raintree, ash, walnut.	*Biscogniauxia* is an Ascomycete fungus that resides in trees as a latent infection not causing symptoms. When trees are stressed by drought, the fungus invades the sapwood, decaying it extensively and cutting water supplies to the canopy. Fruiting bodies are long sheets of charcoal-like stroma that emerge through and from under the bark of affected hardwoods. Conidia proceed the dark charcoal sexual fruiting bodies.
***Annulohypoxylon* spp.** 	Coast live oak, maple, alder, birch, apple, cottonwood, willow, elm, persimmon, mountain lilac.	*Annulohypoxylon* spp. are in the same group as *Biscogniauxia* but fruiting bodies form on the surface of bark in a concentric- or globe-shaped stroma. They only form on dead wood and indicate that the sap rot fungus has killed that portion of the standing tree. The young fruiting bodies are cream-colored and covered in asexual spores called conidia in early summer or late spring. These later darken into structures that contain the sexual ascospores.
Oxyporus latemarginatus 	Victorian box, coast live oak, maples, albizia, citrus, ash, locust, walnut, American sweetgum, magnolia, apple, cottonwood, peach, plum, apricot, willow, and elm.	This fungus produces its white poroid fruiting body covering the lower portions of trees sometimes spreading over soil around the root collar. It is annual and disappears a few weeks after its occurrence. It is a potent sap rot fungus that leads to extensive white rot, sometimes colonizing the entire trunk.

IDENTIFICATION AND BIOLOGY

Many wood decay fungi can be identified by the distinctive shape, color, and texture of the fruiting bodies they form on trees. These fruiting bodies take several forms, depending upon the fungus that produces them, but most of them fit into categories commonly referred to as mushrooms, brackets or conks. They often grow near wounds in bark, including old pruning wounds, at branch scars, in proximity to the root crown, or near surface anchor roots. Some decay fungi, such as *Armillaria mellea*, produce fleshy mushrooms at the base of infected trees or along their roots, often after rain in fall or winter. All mushrooms and some bracket fungi are annual (i.e., appearing and disappearing seasonally), but many conks are perennial and grow by adding a new spore-bearing layer (hymenium) each year.

Decay fungi are divided into those that attack heartwood (causing heart rots) and those that attack sapwood (causing sap rots and canker rots). Further subdivision is based on the appearance of the decayed wood (i.e., white rots, brown rots, and soft rots) or location in the tree (the decay is called a butt rot if it is at the base of the trunk). Canker rots usually appear on branches or the trunk. When a fruiting body is visible on a tree, it is usually associated with advanced decay; the extent of decay may be far above or below the location of the fruiting body. Trees with extensive sap rot may show symptoms of decline, including increased deadwood and a thinning canopy with reduced density of foliage.

White rots

White rots (Figure 1) break down lignin and cellulose, and commonly cause rotted wood to feel moist, soft, spongy, or stringy and appear white or yellow. Mycelia colonize much of the woody tissues. White rots usually form in flowering trees (angiosperms) and less often in conifers (gymnosperms). Fungi that cause white rots also cause the production of zone lines in wood, sometimes called spalted wood. This partially rotted wood is sometimes desirable for woodworking.

Figure 3. Wounds where large avocado limbs were pruned have been colonized by a heart rot decay fungus.

Brown Rots

Brown rots (Figure 2) primarily decay the cellulose and hemicellulose (carbohydrates) in wood, leaving behind the brownish lignin. Wood affected by brown rot usually is dry, fragile, and readily crumbles into cubes because of longitudinal and transverse cracks occurring which follow cellular lines, or across cells, respectively. The decay commonly forms columns of rot in wood. Brown rots generally occur in conifers as heart rots. Hardwood trees are more resistant to decay by brown rot than to white rot fungi.

Soft Rots

Soft rots are caused by both bacteria and fungi. These organisms break down cellulose, hemicellulose, and lignin, but only in areas directly adjacent to their growth. Soft rot organisms grow slower than brown or white rot organisms, and therefore damage occurs to the host tree more gradually. Given enough time, however, any rot can cause extensive structural damage.

INFECTION

Most wood decay in limbs and trunks is the result of infection by airborne fungal spores and by spores and mycelial fragments carried by insects to wood exposed by injury. Injuries include natural branch thinning and loss due to shading, pruning wounds (Figure 3), vandalism, and damage from machinery or construction. Other causes of wounds include sunburn, fire, ice, lightning, snow, or insects that bore into the trunk or branches. Some decay organisms can enter through natural openings in the stem such as lenticels or at branch unions. *Armillaria mellea* and *Ganoderma* spp. commonly infect woody roots and can spread to nearby trees through root grafting.

MANAGEMENT

Wood decay is usually a disease of old trees. While difficult to manage, several factors can reduce its impact. Protect trees from injuries and provide proper cultural care to keep them vigorous. Prune young trees properly to promote sound structure and minimize the need to remove large limbs from older trees, which creates large wounds. Large wounds provide greater surface area and exposure to heartwood for potential colonization by decay organisms.

Remove dead or diseased limbs. Make pruning cuts properly (Figure 4). Prune just outside the branch bark ridge, leaving a uniform collar of cambial tissue around cuts on the trunk to facilitate wound closure. Avoid leaving stubs (branch protrusions that will eventually die) that provide an infection opportunity due to wound closure failure. Proper pruning cuts are circular, not oval, and not flush to the main stem (which damages the branch bark collar or ridge). Wound dressings are not recommended as they do not hasten wound closure or prevent decay and, in some cases, may hasten the development of decay behind the dressing.

Tree failures can cause personal injury, property damage, or both. Trees near structures or other high-value potential targets should be regularly inspected by a qualified expert for signs of wood decay and other structural weakness. Hazardous trees should be assessed by a qualified arborist who can recommend mitigation, including appropriate pruning or cultural practices. Depending on the extent of decay and the structural weakness, tree removal may be necessary.

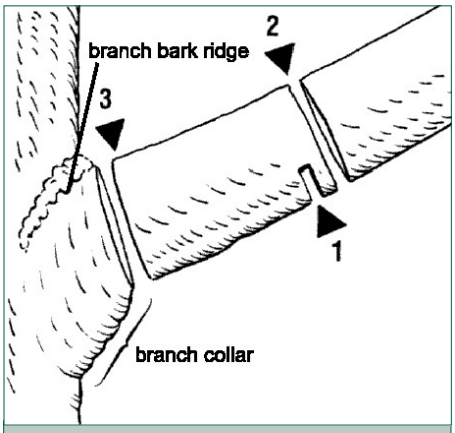

Figure 4. Remove a branch by making the pruning cut just outside the branch bark ridge and branch collar, as indicated by number 3. When removing a limb larger than about 2 inches in diameter, make three cuts in the order indicated. Make the first cut from below, about one-third of the way through the limb and 1 or 2 feet from the trunk. Make the second cut about 2 inches beyond the first cut, cutting from above until the limb drops. Make the final cut at number 3.

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WARNING ON THE USE OF PESTICIDES

Pesticides are poisonous. Some pesticides are more toxic than others and present higher risks to people, nontarget organisms, and the environment. A pesticide is any material (natural, organic, or synthetic) used to control, prevent, kill, suppress, or repel pests. "Pesticide" is a broad term that includes insecticides, herbicides (weed or plant killers), fungicides, rodenticides, miticides (mite control), molluscicides (for snails and slugs), and other materials like growth regulators or antimicrobial products such as bleach and sanitary wipes that kill bacteria.

Always read and carefully follow all precautions and directions provided on the container label. The label is the law and failure to follow label instructions is an illegal use of the pesticide. Store all chemicals in the original labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, and animals. Never place pesticides in food or drink containers. Consult the pesticide label to determine active ingredients, correct locations for use, signal words, and personal protective equipment you should wear to protect yourself from exposure when applying the material.

Pesticides applied in your garden and landscape can move through water or with soil away from where they were applied, resulting in contamination of creeks, lakes, rivers, and the ocean. Confine pesticides to the property being treated and never allow them to get into drains or creeks. Avoid getting pesticide onto neighboring properties (called drift), especially onto gardens containing fruits or vegetables ready to be picked.

Do not place containers with pesticide in the trash or pour pesticides down the sink, toilet, or outside drains. Either use all the pesticide according to the label until the container is empty or take unwanted pesticides to your local Household Hazardous Waste Collection site. Contact your county agricultural commissioner for additional information on safe container disposal and for the location of the Hazardous Waste Collection site nearest you. Follow label directions for disposal of empty containers. Never reuse or burn the containers or dispose of them in such a manner that they may contaminate water supplies or natural waterways.

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This and other Pest Notes are available at ipm.ucanr.edu.

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