Heart Rots of Central Region Hardwoods

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Oaks are the dominant tree species in the hardwood forests of central United States. Other deciduous hardwoods commonly found include hickory, maple, ash, walnut, beech, and yellow poplar. All of these tree species are subject to attack by fungi that cause decay in the central core or "heart" of the trees. The term "heart rot" is used to describe this type of decay. Considerable losses in both timber volume and quality are caused by the heart-rot fungi, which are more destructive than fire in the central hardwood region. The central hardwood region occupies an extensive area of diverse forests in central United States and includes the area from southern Minnesota, Wisconsin, and Michigan, east through Ohio, south into northern Arkansas, and west into Oklahoma, Kansas, and Nebraska.

Entry Points for Fungi

To invade the wood in living trees, most decay-causing fungi enter through either a wound or dead tissue (fig. 1). Fungi that decay the lower tree are known as root rots or sometimes butt rots, while those that decay the trunk are called trunk rots. Wounds at or near the base of the trunk can provide entry for either root, butt, or trunk rot. With few exceptions, decay is confined to the wood tissues present when the tree is wounded, that is, new wood formed is seldom invaded.

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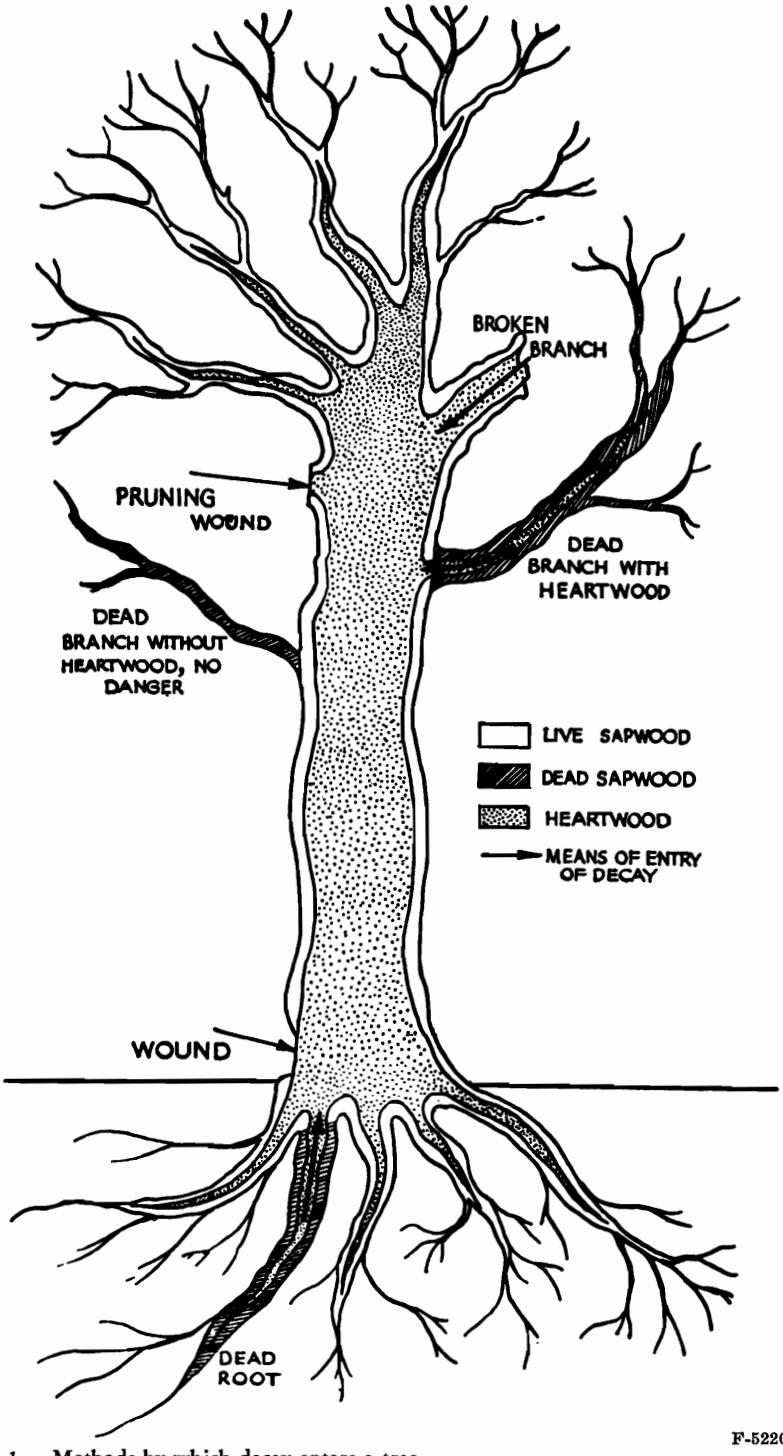

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Figure 1 — Methods by which decay enters a tree.
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Heart-rot fungi commonly enter trees through fire scars, dead branches, damaged or dead tops, dead roots, parent stumps, and mechanical injuries. In the central hardwood region, fire surpasses all other causes of wounds through which heart-rot fungi may enter. Fire scars are particularly vulnerable to decay because of the large area of exposed wood and the long period of time required for the growth of protective callus.

The Decay Process

For many years, it was thought that only heart-rot fungi were involved in the decay process. Recent investigations have shown that, in most trees, discoloration precedes decay according to a certain pattern. After a tree is wounded, it becomes discolored. Bacteria and non-decay fungi are the first microorganisms associated with this discoloration. These microorganisms play an important role in the early stages of the decay process. In many instances, it is only in the later stages that decay fungi infect wounded tissues and cause wood decomposition and disintegration.

Types of Heart-Rot Decay

Heart rots, on the basis of portion of wood decomposed, are divided into two broad groups—white rots and brown rots. Fungi causing white rots decompose all components of the wood, including lignin, while brown rots break down cellulose preferentially. Although the majority of heart rots in central hardwoods are white rots, there are a few important brown rots, such as that caused by *Polyporus sulphureus*.

On the basis of appearance and texture, white rots are further divided into white mottled rots, white pocket rots, white stringy rots, and white spongy rots. Brown rots are classified as brown cubical rots, brown friable rots, brown stringy rots, and brown spongy rots.

Important Heart-Rot Fungi

Many species of heart-rot fungi cause decay of living trees in the central hardwood region. In a recent study, 29 species of heart-rot fungi were isolated from oaks alone. Most heart-rot fungi can be identified from fruiting bodies or sporophores, commonly called "conks," that form on the tree after decay has progressed in the tree for a number of years. On oaks and some other tree species, conks rarely develop, even on severely diseased trees. Therefore, to identify the fungi responsible for decay, the pathologist must isolate them in pure culture and compare the unidentified isolates with known isolates maintained in reference culture collections.

Following are brief descriptions of some of the most common fungi causing heart-rot decay in central hardwoods. They are listed alphabetically by scientific name.

Armillaria mellea (Fr.) Quél., known as the "honey mushroom," causes a root and butt rot of many hardwoods. Mushroomlike fruiting bodies develop in clusters at the base of infected trees. They are short-lived and commonly occur in groups up to 100 or more (fig. 2). This fungus is usually classified as a white rotter.

Fomes igniarius (L.) Gill., commonly known as the false tinder fungus, causes a white heart rot in many hardwood species. The conks are usually hoof-shaped, the upper surface becoming black, rough, and cracked with age (fig. 3).

Hericium erinaceus (Fr.) Pers., the hedgehog fungus, causes a

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Figure 2. — Fruiting bodies of *Armillaria mellea* showing the gills that bear the spores on the under surface.

white rot in oak. In the advanced stage, the wood may be decomposed completely, leaving large hollows lined with yellowish mycelium. The soft annual conk, white at first, turns yellowish or brownish with age. It is globular with a hairy top and long slender teeth or spines on the lower surface (fig. 4).

Irpex mollis Berk. & Curt. causes a white spongy heart rot in oak. After becoming established in the heartwood, the fungus attacks living sapwood and the cambium, causing cankers to form on the trunk (fig. 5).

Pleurotus ostreatus Jacq., the oyster mushroom, causes a white, flaky rot of various hardwoods.

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Figure 3. — Conk of the false tinder fungus *(Fomes igniarius)* on a living beech.

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Figure 4. — Conk of the hedgehog fungus *(Hericium erinaceus)* showing the long slender teeth or spines on the lower surface.

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Figure 5. — *Irpex mollis* conks on red oak.

The fleshy annual conks are shelving structures, either sessile or on short, stout stalks (fig. 6).

Polporus compactus Overholts causes a white rot of oak and several other hardwoods. Although conks are seldom found, the large number of cultures isolated from decayed wood indicates that this fungus is common in the central hardwoods region.

Polyporus glomeratus Peck causes a light brown spongy heart rot of maples and beech (fig. 7). Only sterile conks form on living trees. The yellowish-brown fruiting conks form on dead and downed trees.

Polyporus spraguei Berk. & Curt. causes a brown friable rot, principally in oaks. The conks appear annually, are slightly bracket-shaped, and grow up to 6 inches wide.

Polyporus sulphureus Bull. ex Fr., the sulphur fungus, causes a brown cubical rot in many hardwoods, particularly oaks. When fresh, the annual, shelflike conks have a brilliant orange upper surface and a sulphur-yellow under

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Figure 6. — Fruiting bodies of the oyster mushroom *(Pleurotus ostreatus)* at the top of a fire scar on willow oak.

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Figure 7. — Decay in red maple, caused by the fungus *Polyporus glomeratus.*

surface. They frequently overlap one another in clusters up to 20 or more. Old conks are hard, brittle, and chalky or dirty white. They may fruit on the tree trunk or on the ground at the base of the tree.

Poria andersonii (Ell. & Ev.) Neuman causes a white rot of living hardwoods, especially oaks. Fruiting bodies develop under the bark of dead trees and logs.

Poria cocos (Schw.) Wolf causes a brown root and butt rot of both hardwoods and conifers and also decays timber.

Stereum frustulatum (Pers. ex Fr.) Fckl. causes a white pocket rot of oaks known as "partridge wood." The small, spindle-shaped pockets are lined with white mycelium. The conks, less than 1 inch long, are flat and dirty white.

Stereum gausapatum (Fr.) Fr. causes a white pocket or white mottled rot of oaks. The small, thin, slightly shelf-shaped conks develop abundantly on old stumps and slash. Decay is particularly prevalent in sprout stands because the fungi invade the heartwood of the sprouts from the old stumps.

Reducing Losses from Heart Rots

Although no direct control of heart rots is known, the losses they cause in central hardwoods can be minimized.

Several studies have shown that fire scars serve as entry points for a large number of the fungi that cause heart rots. With more effective fire protection, the amount of decay should decrease.

Many trees that make up hardwood stands in the central hardwood region are of sprout origin. In these stands, decay that develops in the sprouts originates from the parent stump. Heartwood serves as a connector for movement of butt rot from the parent stump to its sprouts. Thus, butt rot can be reduced by removing unwanted sprouts before heartwood is formed. In thinning operations, sprouts low on the parent stump are less likely to decay and should be favored over others at higher levels.

Because the amount of decay increases with tree age, it may be desirable to adjust rotation age (number of years trees are grown until harvested) so that trees are cut before losses from rot become significant.

Other ways in which decay losses can be reduced are: (1) by preventing basal wounds in logging operations, and (2) by controlling stand density, which lessens decay hazard by regulating branch size and reducing wind and ice damage.

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