

Ganoderma Wood-Rotting Fungi on Citrus Stumps¹

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Wood-rotting fungi are present in Florida citrus groves as well as in other citrus-producing regions around the world. Some of the early reports by Reichert (1932) described a problem associated with fine-textured soils where wooden stakes of chestnut, oak or eucalyptus infected with wood-rotting fungi were used to brace up citrus trees on sweet lime rootstock in Palestine. In Florida, L. C. Knorr (1973) identified *Ganoderma sessilis*, currently synonymous with *G. lucidum*, as a fungal agent that invaded healthy citrus wood and was also isolated from trees with heart rot. In south Texas, Skaria and Farrald (1989) reported 'Marrs' early orange trees on sour orange rootstock were infected with *G. lucidum* when replanted into a freeze-killed grove in 1984. Prior to planting the new trees, the freeze-killed trees were cut off above the soil line, leaving the stumps and root systems in place. Later, Skaria et al. (1990) found *Ganoderma* in replants on Cleopatra mandarin and Swingle citrumelo at other freeze-damaged locations in south Texas. According to the APS book, *Fungi on Plant and Plant Products in the United States* (Farr et al., 1989), there are three species of *Ganoderma* reported on citrus, i.e. *G. applanatum*, *G. brownii*, and *G. lucidum* (Farr et al., 1989). *Ganoderma brownii* has been found only in California. The

species encountered in this Florida study and pictured in Figures 1-3 is *G. applanatum*.

Some *Ganoderma* species are saprophytic, whereas others are wound pathogens that invade and kill the sapwood, causing heart rot or butt rot. Affected trees will exhibit varying degrees and combinations of dieback, loss of foliage coloration, and generally unhealthy appearance. Eventually, the tree declines or dies. *Ganoderma* spp. and other fungal species are also found on dead tree trunks or roots of many other plants, including oak and pine. The fungi can spread via airborne spores (basidiospores) or through root grafting from infected to healthy tree roots. When *Ganoderma* spp. infect main or lateral roots, they form a whitish mat of mycelium under the bark that later turns brown. The white mycelium progresses upward on crown roots to the trunk, where the fungus develops strands or ribbons called rhizomorphs. These structures produce fan-shaped fruiting bodies called brackets or semicircular conks at or near the base of the tree (Figure 1). These brackets may be either stalked or sessile. With time, the infected roots and trunk wood become spongy, decompose and disintegrate.

1. This document is HS1019, one of a series of the Horticultural Sciences Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. Published March 2006. Visit the EDIS Web site at <http://edis.ifas.ufl.edu>.

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Spores of *Ganoderma* are released from the brackets and conks, which may vary in size from 2 to 30 inches wide and 1 to 8 inches thick. These semicircular fruiting bodies produce millions of spores that are released over a five- to six-month period (Buller, 1922). Spores can be released under a variety of environmental conditions. When the soil is dry, the bracket derives its moisture from the tree to enable the continuation of spore release.

By the time the tree shows visual symptoms of infection, it is usually too late to control fungal invasion and damage (Figure 1). If the fungus is restricted to the heartwood, only the structural integrity of the tree is impaired. The infection may result in limb or trunk breakage due to wind or tree weight. Otherwise, trees with heart rot may remain productive for many years.



Figure 1. Tree with *G. applanatum* on tree trunk.

The previous recommendation to reduce the incidence of *Ganoderma* was to remove all wood (stumps and roots) from the soil prior to planting new trees. These materials (stumps and roots) provide an inoculum base for the fungi. While this is still valid, there is a higher cost associated with complete tree removal compared to shearing the trees above the soil line and leaving the stump in the soil. Many growers are successfully shearing trees as a way to reduce replant costs without a major impact on young tree replant growth.

In recent years, brackets of *G. applanatum* (Figure 2) have occasionally been noted on citrus tree stumps that remain after shearing. The number of brackets per tree stump may range from one to several that vary in size and shape.



Figure 2. Tree stump with *G. applanatum*.

In three studies around the state (Arcadia, Frostproof and east of Okeechobee), citrus resets in the first three years after planting appear to be healthy and free of infection from *Ganoderma* regardless of the tree removal method (clipping tree above the soil surface or complete removal of the tree and roots from the soil) (Figure 3). This reset study will continue for several more years to fully assess replant tree growth where both tree removal methods are utilized.



Figure 3. Study site where clipped tree bears conks of *G. applanatum*.

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