



Pitch Canker: A Fungal Disease of Southern Pine Forests

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WHAT IS PITCH CANKER?

Pitch canker is a devastating disease of pines, caused by the fungus *Fusarium circinatum* (formerly *Fusarium subglutinans* f. sp. *pini*). The pitch canker fungus is commonly found among the pine forests of the southern United States and Mexico and is considered native to the area. In the southeastern United States, pitch canker presents a serious risk to the health and productivity of southern pine stands.^{1,2} Beyond its natural range, pitch canker is an aggressive invasive disease of pine forests around the world.^{3,4} Pitch canker affects all southern pines and is most severe on slash pine (*Pinus elliotii*) and loblolly pine (*P. taeda*).⁵ The fungus infects pines of any age, from sprouting seeds to mature trees, and because the disease affects every stage of pine growth, it damages natural forests, commercial plantations, and nurseries. The most severe impacts are seen in managed forest stands,⁵ where trees of one species are planted at high density over many acres. The disease reduces stand productivity, degrades product quality, and leaves trees susceptible to other pests and diseases. On mature trees, pitch canker causes stem and branch cankers (Figure 1), areas of dead tissue, that weep large amounts of resin and reduce the growth and vigor of the trees (Figure 2). Seedlings are quickly killed by root infections that spread into the stem, causing major economic losses for nurseries.

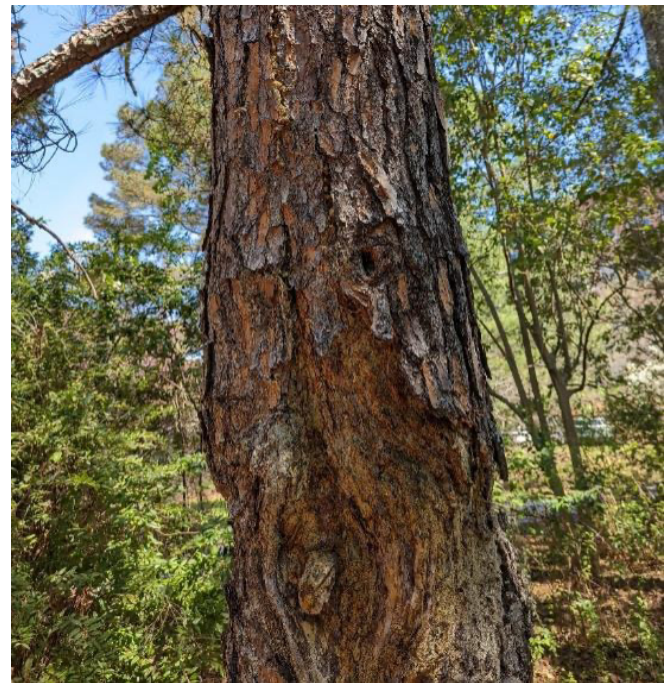


Figure 1: A massive pitch canker infection, caused by *Fusarium circinatum*, on the stem of a mature slash pine. Colton Meinecke, UGA

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SYMPTOMS OF PITCH CANKER INFECTION

All parts of pine seeds, seedlings, and trees are susceptible to infection by the pitch canker fungus,¹ which enters the tissues through wounds. Seedlings may display wilting, needle discoloration, and the interior of roots and lower stems may turn brown or purple as they become infected. Sometimes when seedlings die, tissue dieback appears from the bottom up.⁶ However, seedlings may die before any symptoms are visible on the stem or needles. In nursery beds, visible symptoms vary throughout the bed and are not grouped together.⁷ Overall, the extent of a pitch canker infestation in a nursery is difficult to assess, and extensive damage can appear suddenly and without warning.



Figure 2: Pitch canker causing extensive resin bleeding on a longleaf pine stem.
Colton Meinecke, UGA



Figure 3: Resin bleeding from a canker.
Elizabeth McCarty, UGA

Pitch canker in young and mature trees is characterized by pitch flowing from the infected tissue, also referred to as resin bleeding or heavy pitching (Figure 3), and by deformed cankers on the main stem, branches, and shoots.^{1,8} Cankers may grow, merge together, and effectively girdle the tree, cutting off the flow of water and nutrients through the plant. The girdling causes flagging and dieback of branches, including branch incurving, in which dead shoots turn downward (also called “shepherd’s crook”), and discoloration and wilting of needles (Figure 4).⁹ Dieback damage is more severe in older stands than in younger, more vigorous stands.¹⁰ Girdling by cankers on the main stem typically results in the death of the tree. Belowground, brown discoloration and resin soaking in the lower stem may be observed in cases of root infection.¹

Reproductive tissues of the tree are also affected. Branch infections may result in the premature loss of female flowers and cones.¹¹ However, it is not uncommon for cones to become infected asymptotically, without any visible sign of disease.¹² Asymptomatic infections of cones, seeds, and seedlings present a significant issue in routine inspections and complicate efforts to control the spread of pitch canker, particularly among pine nurseries.⁹



Figure 4: A slash pine branch with flagging symptoms after becoming infected with pitch canker. Tania Quesada, UF

THE DISEASE CYCLE AND SPREAD OF PITCH CANKER

Spores are produced by the fungus in fruiting bodies on infected host plants. These spores then spread through the environment by wind, rain, insects, and human activity.⁵ The spores germinate when they land on a host, and the pitch canker fungus begins to colonize the tissue, entering through wounds. Pitch canker outbreaks can be common after major weather events such as windstorms and hurricanes.⁸ As the fungus grows, it kills and feeds on the host tree and expands through the dead tissue¹³ (Figure 5).

In the southeastern United States, both the pitch canker pathogen and vulnerable pine hosts are common throughout the landscape. The risk of disease in southern pine stands is largely determined by events and activities that wound living trees.⁹ Though the pitch canker fungus can infect uninjured trees, open wounds provide easy points of entry for spores.^{14,15} Harsh weather, insects, and management activity all have the potential to wound residual trees and increase the risk of pitch canker.^{8,16,17} Additionally, deodar weevil boring is associated with pitch canker damage.¹⁸

Seedlings typically become infected belowground, either by spores in the soil or by seed coats that became contaminated or colonized prior to planting.^{19,20} Notably, the pitch canker fungus is capable of penetrating seedling roots without causing visible damage. The pathogen may remain hidden, feeding and spreading without any symptoms for up to a year, until it grows into the stem and turns aggressive.⁶ Infected, asymptomatic, seedlings may live long enough to be planted in the field, introducing pitch canker to the site.

Additionally, pitch canker can thrive and reproduce without pine hosts, living within grasses and other understory plants. Often overlooked, these other hosts are considered important reservoirs of pitch canker in pine nurseries.²¹

WHY IS PITCH CANKER A PROBLEM?

Commercial slash and loblolly pine plantations in the southeastern United States experience high levels of pitch canker damage. This is because the pathogen is ever-present throughout the region, and susceptible loblolly and slash pines are managed in dense stands. Costly outbreaks are not uncommon in commercial plantations, where, for example, slash pine stands in Florida have experienced mortality as high as 25%.⁵ In nursery settings, the disease causes catastrophic damage due to the high mortality rates in seedlings and the ability of the fungus to persist unseen in the environment.⁹

Pitch canker infections most seriously impact stands in regions with warmer temperatures and higher relative humidity.^{15,22} As a result, stands in coastal regions have higher infection rates and more severe symptoms than inland areas.^{9,10} In the southeastern United States, disease severity is typically greatest in the lower coastal plain. Impacts are worsened by the planting of highly susceptible species, intensive management regimes, and frequent severe weather.¹⁶

Furthermore, many common management practices can unintentionally increase the chance of outbreaks and their severity. Injuries left by harvesting equipment during thinning and cone-shakers open trees to infection by contaminated machinery and airborne spores.² Even fertilization may backfire in heavily infested stands, as the pathogen responds not only to the increase in freely available nutrients but also to more nutritious hosts.^{2,23}



Figure 5: A slash pine branch with dead tissue caused by a pitch canker infection. Tania Quesada, UF

MONITORING FOR AND MANAGING PITCH CANKER

A combination of active pitch canker monitoring and using sound management practices will reduce the impact of the disease. Currently, there are no effective means of suppressing an established pitch canker outbreak in natural or plantation forests. Unfortunately, there are no known effective chemical fungicides for pitch canker in forest stands or pine nurseries. Thus, other risk management strategies must be considered. The most effective means of reducing risk is to prevent new infections through integrated management strategies.³

Land managers may survey stands for pitch canker symptoms, although the extent of an infestation is not always visibly apparent. Other methods to monitor for pitch canker will give a more complete picture of the damage and risk. Samples of diseased tissue from symptomatic seedlings or trees can be sent to state and university diagnostic clinics to test for pitch canker. Methods are also being developed to use spore traps to determine the amount of pitch canker spores in the air and the risk of infection in the stand.²⁴

The effectiveness of silvicultural practices to manage pitch canker is not understood well enough to support specific recommendations. Generally, proper cultural practices to promote tree health and improve vigor are recommended to reduce potential disease severity in managed forest stands.²⁰ Planting loblolly and slash pine only on sites to which they are well adapted and avoiding overstocking will also help to reduce tree stress.²⁵ Land managers may thin to cull diseased stems and release others from competition, but care should be taken to avoid wounding the remaining trees during thinning.²⁶ Measures to reduce damage by insect pests can reduce the risk of pitch canker, due to fewer open wounds for the fungus to infect.^{17,27}

To reduce spores, diseased trees and other materials should be removed and destroyed. Practices that leave large amounts of slash behind should be reconsidered. Management activities should be avoided during warm, wet seasons if possible, as the fungus is able to spread and infect more easily in these conditions.²² Chemical fertilizers should be applied with care, as high soil nutrient levels and fertilization applications result in increased disease rates and severity.^{2,23} It is especially important to avoid fertilization shortly after severe weather, such as hurricanes, hail, and other events that cause wounding. Special care should be taken to prevent infection of high-value trees in seed orchards by following the recommendations listed previously with a focus on avoiding wounding, proactively managing insect pests, and removing severely infected stems.^{2,16}

In pine nurseries, procedures must be followed to ensure that all equipment, media, and plant materials are sanitized. While fungicides are not effective for protecting trees or treating infected trees, hydrogen peroxide and hot water can kill the pitch canker fungus in seeds.^{2,20} Soaking seeds in a 30% hydrogen peroxide solution for 15 minutes can virtually eliminate pitch canker related mortality in longleaf pine seeds.²⁰ Alternatively, seeds can be soaked in hot water (126 °F) for 30 minutes to reduce the risk of infection by up to 72% without impacting pine germination.²⁸ Soil fumigation to control other damping-off agents may be used to prevent buildup of the pitch canker fungus in nursery beds.² Nursery operators should consider sanitizing tools and equipment with 70% alcohol or 10% chlorine solutions to prevent introducing the fungus to new beds.³ To further reduce the risk of seedling infection, infected trees near the nursery should be removed and grasses in the nursery should be weeded out to remove sources of spores.^{3,7}

HOW ARE THE UNIVERSITY OF GEORGIA AND THE UNIVERSITY OF FLORIDA WORKING TO ASSIST GROWERS WITH PITCH CANKER MANAGEMENT?

Researchers at the University of Georgia and the University of Florida are working together to improve the pitch canker management options available to southern pine growers. Areas of current research include: 1) new tools to diagnose pitch canker in the field, 2) low-cost spore trapping systems and methods to interpret spore trap catches, and 3) the effectiveness of silvicultural methods to reduce pitch canker severity in managed forests.

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