Pitch canker, a disease that affects many pine species, is caused by the fungus *Fusarium circinatum*. This fungus can also infect Douglas-fir, but symptoms are usually limited to tip dieback.

Most pines native to California are susceptible to pitch canker, but Monterey pine, *Pinus radiata*, is the most widely affected host. The most recent severe outbreak of this disease in California was in populations of native bishop pine, *P. muricata*, at the Point Reyes National Seashore.

Pitch canker was first observed in California in Santa Cruz County in 1986. Since then the disease has spread rapidly and now occurs in 18 coastal counties. Pitch canker also occurs in the southeastern United States and in Mexico, Chile, Japan, South Korea, Italy, France, Spain, Portugal, and South Africa. Evidence indicates the pathogen may have originated in Mexico, and its introduction into California came by way of the southeastern United States.

**IDENTIFICATION AND DAMAGE**

The fungus causes infections (lesions) that can encircle (or girdle) branches, exposed roots, and the main stems (trunks) of pine trees. The tips of girdled branches wilt (Figure 1) as a result of obstructed water flow, causing needles to turn yellow (Figure 2) and then brown (Figure 3). The fascicles (needle clusters) eventually fall off, leaving bare branch ends. Multiple branch infections can cause extensive dieback in the crown of the tree and may lead to tree mortality (Figures 4 and 5).

The fungus isn’t known to move within the tree; therefore, each canker or lesion is a separate and distinct infection. Resin (pitch) accumulates on a branch at the site of infection (Figure 6), and removal of the bark reveals honey-colored resin-soaked wood (Figure 7). Flattened or slightly sunken cankers on the main stem of the tree usually appear after the tree already has multiple branch infections. The flow of resin from main stem infections can coat the bark up to several feet below the infection site.
May 2013 Pitch Canker

Infected trees are often attacked by engraver beetles, which may cause death of additional branches, treetops, or the entire tree.

Infections of Douglas-fir often induce no symptoms: consequently, infected seedlings or cuttings may serve as vehicles for dissemination of the pathogen.

Certain insects and other pathogens, often in combination, can cause wilting of branch tips or other damage resembling that caused by pitch canker (Table 1). Though the disease can usually be diagnosed based on symptoms, diseased tissue must be cultured in a laboratory for a definitive identification.

Fusarium circinatum can also be a cause of seedling mortality. Seedling infections can result from inoculum present on seed, in soil, or the litter layer. Emerging seedlings may die quickly and not develop symptoms that are distinctive enough to identify F. circinatum as the cause. On older seedlings, resin typically accumulates on the stem near the soil line, with honey-colored lesions beneath the bark.

Figure 6. Infected Monterey pine branch showing resin accumulation on the surface.

Figure 7. Infected Monterey pine branch showing a honey-colored lesion beneath the surface.

Table 1. Comparison of Pine Tree Maladies with Some Similar Symptoms.†

<table>
<thead>
<tr>
<th>Malady</th>
<th>Oozing or streaming pitch</th>
<th>Lumpy, protruding, or tubular masses</th>
<th>Yellow to red wilted tip needles</th>
<th>Yellow to red unwilted tip needles</th>
<th>Dead tips and needle drop</th>
<th>Cones or conelets abort</th>
<th>Swelling on branches</th>
<th>Silk webbing on tips</th>
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<td>blight, Aleppo pine</td>
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KEY:
*Symptom occasionally occurs   **Symptom usually occurs
†Other abiotic disorders such as poor growing conditions and inappropriate cultural practices can also cause many of these symptoms.
‡Extensive branch swelling and distortion caused by dwarf mistletoe might cause resin flow.


Vectors of Pitch Canker

Insects can transmit the pitch canker fungus during exploratory feeding on trees. The fungus has been isolated from a number of insects, and those capable of vectoring the pitch canker pathogen include engraver beetles (Ips species), twig beetles (Pityophthorus...
species), cone beetles (*Conophthorus radiatae*), and deathwatch beetles (*Erobia punctulata*). Adult spittlebugs, *Aphrophora canadensis*, haven’t been demonstrated to carry the fungus, but their nymphs do create wounds that may become infected if fungal spores are already present on the branch surface.

**DISTRIBUTION OF THE DISEASE**

The distribution of pitch canker in California (Figure 9) indicates that the mild climate of the central and southern coasts is conducive to disease development. In a survey of 39 plots on the Monterey Peninsula, strong trends were found with respect to disease severity and geographic location. On average, trees in plots located adjacent to the coast had significantly higher levels of disease than trees in plots located just a few miles inland. Furthermore, disease increased more rapidly in coastal plots than in inland plots. More severe disease near the coast reflects a greater frequency and longer duration of fog, which provides the moisture required for the pathogen to infect shallow wounds insects create.

The survey conducted on the Monterey Peninsula also documented significant differences in disease severity in the urban forest versus the natural forest. On average, trees in landscaped areas and small open spaces had higher levels of disease than trees in larger, less disturbed forests.

**MANAGEMENT**

Pitch canker can result in extensive damage and even death of infected trees. However, not all infected trees become severely diseased, and of those that do, some recover. Experiments under controlled conditions show that susceptible Monterey pine trees repeatedly exposed to the pathogen may gain resistance over time, and field studies have confirmed that trees in areas where pitch canker has been present for 10 or more years tend to be more resistant to the disease than trees in areas where the pathogen has only recently become established. Therefore, landowners and land managers should take a conservative approach to removing diseased trees, because there is a possibility they may recover completely.

**Resistance to Pitch Canker**

Although Monterey pine is a susceptible species, some individual trees are resistant to the disease. Resistant Monterey pines can be vegetatively propagated as rooted cuttings, and trees that develop from cuttings of resistant trees retain the resistance of the parent tree. Resistance may be a useful tool for managing the disease in landscape settings, on Christmas tree farms, and in commercial forestry.

However, genetic resistance may cease to be effective due to changes in the pathogen population over time. Trees that now appear resistant could become susceptible if more virulent strains of the fungus arise through mutations or genetic recombination due to sexual reproduction, or if new strains of the fungus are introduced from elsewhere in the world. Thus, Monterey pines will
always be at some risk of future damage from pitch canker, and resistant Monterey pine stock should be used only where planting a nonsusceptible species isn’t an option.

**Preventing Movement of the Pathogen**

In order to minimize damage caused by pitch canker, it is important to prevent movement of the pathogen to noninfested areas. With this in mind, the California State Board of Forestry designated a zone of infestation that includes most of coastal California as described on a site maintained by the Pitch Canker Task Force, http://ufei.calpoly.edu/pitch_canker/legislation.lasso#resolution. You can also contact the agricultural commissioner in your county to determine whether you are within this zone.

Local regulations may apply to moving potentially infested materials to areas outside the zone of infestation. Because the pathogen can survive in wood cut from infected trees, use or dispose of infected trees locally; see www.firewood.ca.gov. The pathogen can also survive in soil or seed and can infect seedlings that show no symptoms. Consequently, avoid moving any of these materials into areas where the disease doesn’t already occur.

**Managing the Disease in Infected Trees**

Where trees have sustained a limited number of infections, removing symptomatic branches can effectively eliminate the disease. Of course, new infections can occur, and studies have shown that pruning doesn’t slow the development of pitch canker in stands where the disease is well established. However, pruning can be used strategically to enhance the aesthetic quality of a tree and thereby delay its removal from the landscape.

In areas where Monterey pine isn’t native—most of California outside of Año Nuevo, Cambria, and Monterey—when replanting, select pines that are resistant to pitch canker (Table 2) or select other nonsusceptible trees.

Although insects often initiate infections, insecticides don’t offer a practical way to control pitch canker. Likewise, fungicides with activity against the pitch canker pathogen are available, but no effective techniques for using them to control the disease have yet been demonstrated. For more information about managing pitch canker, consult the Web site of the Pitch Canker Task Force listed in Online Resources.

**REFERENCES**


ONLINE RESOURCES


AUTHORS: C. L. Swett, Plant Pathology, UC Davis; and T. R. Gordon, Plant Pathology, UC Davis.

TECHNICAL EDITOR: M. L. Flint
EDITOR: M. L. Fayard
ILLUSTRATIONS: Figs. 1–9, T. R. Gordon.

This and other Pest Notes are available at www.ipm.ucdavis.edu.

For more information, contact the University of California Cooperative Extension office in your county. See your telephone directory for addresses and phone numbers, or visit http://ucanr.org/ce.cfm.

WARNING ON THE USE OF CHEMICALS
Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. 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, pets, and livestock.

Pesticides applied in your home and landscape can move and contaminate creeks, rivers, and oceans. Confine chemicals to the property being treated. Avoid drift onto neighboring properties, especially gardens containing fruits or vegetables ready to be picked.

Do not place containers containing pesticide in the trash or pour pesticides down the sink or toilet. Either use the pesticide according to the label, or take unwanted pesticides to a Household Hazardous Waste Collection site. Contact your county agricultural commissioner for additional information on safe container disposal and for the location of the Household Hazardous Waste Collection site nearest you. Dispose of empty containers by following label directions. 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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