Pitch Canker

PDF to Print *

Published 2/03

In this Guideline:

- Identification
- Vectors of pitch canker
- Disease progress in native and urban forests
- Management
- Publication
- Glossary

Pitch canker is a disease of pine trees that is caused by the fungus *Fusarium circinatum.* Douglas fir can also be infected, but this is rare and infected trees are not severely damaged. The disease was first observed in California in Santa Cruz County in 1986. Since then it has spread rapidly and now occurs in 18 coastal counties. Most pines native to California are susceptible to pitch canker, but Monterey pine *(Pinus radiata)* is the most widely affected host. Pitch canker has also been reported in Mexico, southeastern United States, Japan, Spain, Chile, and South Africa. Genetic analyses of *F. circinatum* populations from around the world indicate that the pathogen originated in Mexico, and its recent introduction into California came by way of the southeastern United States.

IDENTIFICATION

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 as a result of obstructed water flow, causing the needles to turn yellow, and then red. 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. The tree produces copious amounts of resin (pitch) in response to an infection. Flattened or slightly sunken cankers (large infection sites) on the main stem of the tree usually appear after the tree already has multiple branch infections. The fungus is not known to move within the tree; therefore, each canker or lesion is a separate and distinct infection. The flow of resin from main stem infections can coat the bark up to several feet below the infection site. Honey-colored, resin-soaked wood is also a characteristic symptom of the disease and can be observed by peeling back the bark near a lesion. Infected trees are often attacked by engraver beetles, which cause the death of additional branches, tree tops, and the entire tree.

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

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

Malady	Oozing or streaming pitch	Lumpy, protruding, or tubular masses	Yellow to red wilted tip needles	Yellow to red unwilted tip needles	Dead tips, needle drop	Cones or conelets abort	Swelling on branches	Silk webbing on tips
pitch canker	**		**	**	**	**		
Diplodia canker and blight	*		**	*	**	*		
blight, Aleppo pine	*		**	*	**			
western gall rust	*			**	*	*	**	
dwarf mistletoe	2			*	*		**	
pine scales			*	**	**			
pitch moths	*	**	*		*		*	
tip moths				**	*			

weevils				*	**			
red turpentine beetle		**						
Ips bark beetles		*	*	**	**	*		
cone beetles		**				**		
twig beetles			*	**	**	*		
injuries, pruning wounds	**	*						
salt, wind, or drought dieback				**	**			
shade-suppressed branches			*	**	*			
caterpillars					**			**

1 Other abiotic disorders such as poor growing conditions and inappropriate cultural practices also can cause many of these symptoms.

2 Extensive branch swelling and distortion caused by dwarf mistletoe may cause resin flow.

KEY

* Symptom occasionally occurs

** Symptom usually occurs

Adapted from: Adams, D. Unpublished. *Pitch Canker: An Introduced Disease.* Davis, CA: Calif. Dept. For. Fire Protection; Dallara, P. L., A. J. Storer, T. R. Gordon, and D. L. Wood. 1995. *Tree Notes* 20. Sacramento, CA: Calif. Dept. For. Fire Protection.

VECTORS OF PITCH CANKER

Insects are believed to transmit the pitch canker fungus during exploratory feeding on trees. The fungus has been isolated from a number of insects, and the following insects are capable of vectoring the pitch canker pathogen: engraver beetles *(Ips* spp.), twig beetles *(Pityophthorus* spp.), cone beetles *(Conophthorus radiata),* and deathwatch beetles *(Ernobius punctulatus).* Adult spittlebugs *(Aphrophora canadensis)* have not 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.

DISEASE PROGRESS IN NATIVE AND URBAN FORESTS

Based on the distribution of pitch canker in California, it can be concluded that the mild climate of the central and southern coast 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. The difference in disease development between inland and coastal locations was especially striking because the inland plots are all within a few miles of the coast.

Results from that same survey also document 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.

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 trees repeatedly exposed to the pathogen may gain resistance over time. For example, trees deliberately inoculated four times with *F. circinatum* over a 2-year period developed progressively smaller lesions each time they were inoculated. Likewise, there have been numerous observations of severely infected trees recovering from infection after a period of 6 to 7 years. Therefore, landowners and land managers should take a conservative approach to removing diseased trees because there is a possibility they may go into remission or even recover.

Resistance to Pitch Canker. It is not uncommon to observe Monterey pines that are unaffected by pitch canker, even where they are surrounded by severely infected trees. Monterey pines have a wide range of susceptibility to pitch canker. 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, Christmas tree farms, and in commercial forestry. However, the genetic resistance may be adversely affected by 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 (as a result of sexual reproduction) or if new strains of the fungus are introduced from elsewhere in the world.

Though the fungus is primarily spreading by asexual propagation in California, laboratory studies indicate that strains within California have the ability to outcross (reproduce sexually). If outcrossing begins to occur naturally in California, new strains could develop. Furthermore, strains of the fungus isolated both in Mexico and in Florida are able to cause disease on a Monterey pine that is resistant to the eight predominant strains of the fungus in California. Thus, Monterey pines will always be at some risk of future damage from pitch canker, and the use of resistant stock for landscape plantings should be undertaken only if the use of nonsusceptible tree species is not an option.

Preventing Movement of the Pathogen. In order to minimize the damage caused by pitch canker, it is important to prevent movement of the pathogen to noninfested areas. With this in mind, the California Board of Forestry has designated a zone of infestation that includes most of coastal California (see the zone of infestation map on the Pitch Canker Task Force Web site listed in Online Resources). You can also contact the agricultural commissioner in your county to determine whether or not you are within this zone. Local regulations may apply to the movement of 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. The pathogen can also survive in soil, in seed, and can infect seedlings that show no symptoms. Consequently, avoid moving any of these materials into areas where the disease does not already occur. For more information on management of pitch canker, consult the Web site of the Pitch Canker Task Force listed in Online Resources.

MANAGEMENT

As mentioned above, some infected pines do recover, even if they are severely diseased. Pruning does not slow the spread of the disease in a highly infested area. However, pruning can be used strategically to enhance the aesthetic quality of a tree and thereby delay its removal from the landscape. Because trees may recover, their removal should be delayed as long as possible, and only trees that pose a hazard should be cut down. In areas where Monterey pine is not native (most of California outside of Año Nuevo, Cambria, and Monterey), select pines that are resistant to pitch canker (Table 2) or other nonsusceptible trees for replanting.

Table 2. Susceptibility of Some Conifers Grown in California to Pitch Canker Caused by *Fusarium circinatum.*

			Susceptibility	
Species	**Common name**	**Status[1]**	**Greenhouse[2]**	**Field[3]**
Pinus attenuata	knobcone pine	native	S	S
P. canariensis	Canary Island pine	exotic	R	R
P. contorta ssp. *contorta*	shore pine	native	S	S
P. contorta ssp. *murryana*	lodgepole pine	native	S	N
P. coulteri	Coulter pine	native	S	S-
P. eldarica	Eldarica pine	exotic	S	N
P. halepensis	Aleppo pine	exotic	S	S
P. jeffreyi	Jeffrey pine	native	S	N
P. lambertiana	sugar pine	native	S	N

P. monophylla	pinyon pine	native	S-	N
P. muricata	bishop pine	native	S	S
P. pinea	Italian stone pine	exotic	R	R
P. ponderosa	ponderosa pine	native	S	S-
P. radiata	Monterey pine	native	S	S
P. sabiniana	gray pine	native	S	S-
P. sylvestris	Scotch pine	exotic	S	N
P. thunbergii	Japanese black pine	exotic	R	N
P. torreyana	Torrey pine	native	NT	S-
Pseudotsuga menziesii	Douglas fir	native	S-	S-

1 Native species are found in native forests, but may also be grown as timber species (e.g., ponderosa pine) or as landscape trees (e.g. Monterey pine); the exotic species are commonly planted in various parts of the state.

2 Greenhouse tests of susceptibility were based on the results of artificial inoculations. Species are rated as susceptible (S) if they sustained definite lesions at the site of inoculation, or resistant (R) if there was little or no lesion development. For species rated as S-, most tested individuals were resistant, but a small percentage appeared moderately susceptible. NT indicates a species that has not been tested.

3 Field susceptibility is based on observations of natural infections. Species are rated as susceptible (S) if numerous trees are known to be infected and/or some trees have sustained severe damage from pitch canker. Species that have frequently been observed in otherwise infested areas and for which few or no trees are known to have sustained natural infections and none have been heavily damaged by pitch canker are rated as resistant (R); the level of resistance differs within this group. For species rated as S-, one or more infected trees have been observed, but the number of observations is too limited to provide a meaningful estimate of their relative susceptibility. For species rated as N, no infected trees have been observed, but the occurrence of this species in proximity to natural inoculum is too infrequent to conclude that the lack of disease is indicative of resistance.

Bark Beetles

Published 4/04

PDF to Print *
Quick Tip
Quick Tip - español

In this Guideline:

- Identification
- Life cycle
- Damage
- Management
- Publication
- Glossary

Bark beetles, family Scolytidae, are common pests of conifers and some attack broadleaf trees. Several hundred species occur in the United States. The most common species infesting pines in California are the western pine beetle *(Dendroctonus brevicomis),* engraver beetles *(Ips* spp.), and the red turpentine beetle *(Dendroctonus valens).* Cedar and cypress bark beetles *(Phloeosinus* spp.) attack arborvitae, *Chamaecyparis,* cypress, and redwoods. Oak ambrosia beetles *(Monarthrum* spp.) and oak bark beetles *(Pseudopityophthorus* spp.) attack oaks and certain other broadleaves including California buckeye and tanbark oak. Shothole borer *(Scolytus rugulosus)* attacks damaged trunks of many broadleaved tree species, including English laurel, fruit trees, and hawthorn. The European elm bark beetle *(Scolytus multistriatus)* feeds only on elms and vectors the Dutch elm disease fungus. Other common wood-boring pests in landscapes include clearwing moths (family Sesiidae) (for more information, see *Pest Notes: Clearwing Moths,* listed in Suggested Reading), longhorned borers (Cerambycidae), and roundheaded borers (Buprestidae).

IDENTIFICATION

Adults are small, cylindrical, hard-bodied beetles about the size of a grain of rice. Most species are dark red, brown, or black. Their antennae are elbowed and the outer segments are enlarged and

clublike. When viewed from above, the head is partly or completely hidden by the thorax. They have strong, scooplike jaws (mandibles) for chewing. A buckshot pattern of holes is apparent on infested branches or on the trunks where the new adults have emerged. Larvae of most species are off-white, robust, grublike, and may have a dark head.

The species of tree attacked and the location of damage on the bark help in identifying the bark beetle species present (Table 1). On pines, for example, engraver beetles usually attack trees near the top, while red turpentine beetles attack pine trunks near the ground as well as below ground on the large roots. Engraver beetles are dark brown, cylindrical, and have a scooplike depression lined with stout spines at the end of the abdomen. Red turpentine beetles are larger than engraver beetles and reddish brown; their presence is indicated by large, pinkish brown to white pitch tubes, a mixture of pine sap and beetle boring dust that appears on the lower trunk.

Table 1. Bark Beetles Common to Landscapes.

Species	Trees affected	Generations per year	Comments
Red turpentine beetle *(Dendroctonus valens)*	larch, pines, spruce, and white fir	0.5 to 3	attacks lowest 2-8 ft of trunk and large roots; pitch tubes appear on bark; overwinters as adults and larvae; rarely kills tree
Western pine beetle *(Dendroctonus brevicomis)*	Coulter and Ponderosa pines	2 to 4	attacks midtrunk, then spreads up and down; larva feeds on inner bark, completes development in outer bark; attacks in conjunction with other pests
Engraver beetles *(Ips emarginatus, I. mexicanus, I. paraconfusus, I. pini,* and *I. plastographus)*	pines	1 to 5	overwinters as adult; often makes wishbone-shaped tunnels; attacks pines near top
Cedar and cypress beetles *(Phloeosinus* spp.)	arborvitae, *Chamaecyparis,* cypress, and redwoods	1 to 2	tunnels resemble centipede on inner and outer bark; adult feeds on twigs, causing discolored and dead tips; egg-laying female attracted to trunk of dead or dying trees
Oak ambrosia beetles *(Monarthrum* spp.) Oak bark beetles *(Pseudopityophthorus* spp.)	oaks; also California buckeye and tanbark oak	2 or more	overwinters beneath bark; bleeding, frothy, bubbling holes with boring dust indicate damage; attacks stressed trees
Shothole borer *(Scolytus rugulosus)*	English laurel, fruit trees, hawthorn, and other woody plants	2 or more	infestation indicated by gumming of woody parts, appearance of boring dust, or twig dieback; remove and destroy infested parts
European elm bark beetle	elms	2	overwinters as fully grown larva

(Scolytus multistriatus)			in bark; shotholes in bark indicate damage; lays eggs in limbs and trunk of injured, weakened, or recently cut elms; vectors Dutch elm disease fungus

Peeling off a portion of infested bark to reveal beetle galleries is also helpful in identifying the beetle species present. Red turpentine beetle and western pine beetle adults usually pack about 60% of their egg-laying galleries with boring dust while engraver beetles maintain clean, open adult galleries. Larval galleries of all species are packed with sawdustlike boring dust called "frass" and most radiate out perpendicularly to the parent tunnels.

LIFE CYCLE

Females lay small, oval, whitish eggs at the interface of the bark and wood. After eggs hatch, the tiny larvae mine galleries that branch out from the egg-laying gallery. At first the larval mines are very small, but they gradually increase in diameter as the larvae grow. The winding pattern of these galleries is helpful in identifying a bark beetle infestation and in distinguishing among the different species. Pupation occurs in enlarged chambers at the ends of the larval tunnels or in the outer bark. Pupae are usually whitish and occur within or beneath bark. Adults can emerge at any time of year, weather permitting, but emergence is most common in late spring and again in late summer to early fall. After emergence, adults generally disperse to attack susceptible trees elsewhere. Most bark beetle species have two or more generations a year in California, depending on temperature. At warmer locations, the season of attack is usually longer and beetles have more generations per year in comparison with cooler locations.

DAMAGE

The important pest species of bark beetles mine the inner bark (the phloem-cambial region) on twigs, branches, or trunks of trees and shrubs. This activity often starts a flow of tree pitch in conifers and is accompanied by a sawdustlike material (frass). Frass accumulates in bark crevices or may drop and be visible on the ground or in spider webs. Small emergence holes in the bark with sap weeping out of the holes are a good indication that bark beetles have been present. Bark beetles commonly attack trees weakened or predisposed to infestation by drought, disease, injuries, or other factors that may stress the tree. Beetles can contribute to the decline and eventual death of trees but with a few exceptions usually are not the initial cause.

In addition to attacking larger limbs, cedar and cypress bark beetles feed by mining twigs up to 6 inches back from their tips, resulting in dead tips or "flags" hanging on the tree. The adult European elm bark beetle also feeds on twig bark before laying eggs. If the adult has emerged from infected elm wood, its body will be contaminated with Dutch elm disease spores. The beetle then infects healthy elms with the Dutch elm disease fungus during feeding; it is during this pre-ovipositional (before egg laying) feeding, which usually takes place in limb crotches, that the fungus is transmitted. Elms showing yellowing or wilting in spring are suspect and should be reported to the county agricultural commissioner.

MANAGEMENT

Except for general cultural practices that improve tree vigor, little can be done to control most bark beetles beneath bark once trees have been attacked. Prune and dispose of bark beetle-infested limbs. Promptly remove the entire tree if its main trunk is extensively attacked by bark beetles. Unless infested trees are quickly removed, large numbers of beetles can emerge and kill nearby host trees if they are weakened or predisposed by other factors. The exception is when pines are attacked by a few red turpentine beetles. Trees can often survive low-density attacks by this species. Valuable, uninfested host trees near infested trees may be protected from bark beetles by spraying the trunk with a persistent insecticide in spring; however, do not substitute preventive sprays for proper cultural care.

Plant only species properly adapted to the area. Learn the cultural requirements of trees, and provide proper care to keep them growing vigorously. Healthy trees are less likely to be attacked and are

better able to survive the damage from a few bark beetles. Rapid, vigorous growth encourages host resistance.

Pay particular attention to old, slow-growing trees, crowded groups of trees, and newly planted trees in the landscape. Large nursery stock or transplanted trees, notably oaks and pines, can become highly susceptible to bark beetles after replanting. Transplanting success depends on the tree species and its condition, appropriate tree and site selection, characteristics of the planting site, the season of the year, the transplanting method, and follow-up care. Stresses placed on a tree caused by poor planting or planting at the wrong time of year, lack of proper care afterwards, or the planting of an inappropriate species for the site will increase the tree's susceptibility to bark beetle invasion.

Biological Control

Woodpeckers, several predaceous beetles such as the blackbellied clerid *(Enoclerus lecontei)* and trogossitid beetles (especially *Temnochila chlorodia)*, a predaceous fly *(Medetera aldrichii)*, and parasitic wasps are natural enemies of the western pine beetle, but rarely control it. Predators are more important in regulating bark beetle populations than parasites. When bark beetles attack and kill some trees, natural enemies are attracted and may eventually limit the infestation.

Cultural Control

Prevention is the most effective method of managing wood-boring insects; in most instances it is the only available control. Avoid injuries to roots and trunks, and protect trees from sunscald and other abiotic disorders. Irrigation may be important during dry summer months in drought years, especially with tree species that are native to regions where summer rain is common. Also, dense stands of susceptible trees should be thinned to increase their vigor and ability to withstand an attack.

Irrigate when appropriate around the outer canopy, not near the trunk. Avoid the frequent, shallow type of watering that is often used for lawns. The specific amount and frequency of water needed varies greatly depending on the site and tree species (i.e., whether trees are adapted to summer drought or regular rainfall).

Properly prune infested limbs, and remove and dispose of dying trees so that wood-boring insects do not emerge and attack other nearby trees. Timing of pruning is important; avoid creating fresh pruning wounds during the adult beetles' flight season. Do not prune elm trees from March to September or pines during February to mid-October. Do not pile unseasoned, freshly cut wood near woody landscape plants. Freshly cut wood and trees that are dying or have recently died provide an abundant breeding source for some wood-boring beetles. Tightly seal firewood beneath clear plastic in a sunny location for several months to exclude attacking beetles, and kill any beetles already infesting the wood.

Plant resistant species where bark beetles have been a problem. For instance, engraver beetles and red turpentine beetles do not attack redwoods or atlas cedars.

Chemical Control

Unless trees are monitored regularly so that borer attack can be detected early, any spraying is likely to be too late and ineffective. No insecticide kills larvae tunneling beneath the bark. Treatment must target the adults by spraying the bark so that they are killed when they land on trees and attempt to bore into the bark to lay eggs. If the tree was attacked during a previous year and no longer contains beetles because they have completed development and flown away, spraying that tree will provide no benefit and could kill beneficial insects. Seriously infested trees, or trees that are dead or dying due to previous beetle attacks, cannot be saved with insecticide treatments and should be removed. Systemic insecticides implanted or injected through the bark or applied to soil beneath trees do not control or prevent attack by bark beetles.

Healthy specimen or high-value trees may be protected with an insecticide if they are stressed or near infested trees that are a source of beetles. Because each bark beetle species attacks only certain tree species (for example, pine bark beetles do not attack oaks and oak bark beetles do not attack pines)

spray only healthy trees that are susceptible to the beetle species attacking nearby trees. It is not clear if products available to home gardeners can adequately prevent bark beetle attack. Most home gardeners also lack the high-pressure spray equipment and experience to effectively treat large trees. When hiring a professional applicator, discuss the specific pesticide to be applied.

Thoroughly drenching the main trunk with a pyrethroid (e.g., Astro or Dragnet) or the carbamate carbaryl can prevent new bark beetle infestations if applied when adults are flying. Be sure to use a product labeled for trunk applications and apply it at the proper rate for trunk treatments. Label rates for foliage treatments will not be effective. Effective products may not be available to home users, but are available to licensed pesticide applicators. Regardless of the insecticide used, mix only what you need. Apply the entire mix according to the label to avoid leftover insecticide, which should never be poured down a sink or storm drain. Take special care to keep pesticides from running off-site and into drains or waterways.

Remember that treatments must be applied to kill adults before they lay eggs. Treatment at any other time will not be effective. Spray the bark in spring when beetles begin to emerge, which is in early spring in warm areas of the state and late spring in cooler and high elevation areas. Depending on local conditions and the pesticide used, a second application may be needed several months later to provide season-long control.

The red turpentine beetle can have as many as three generations a year and engraver beetles can have up to five generations a year; apply the first spray for them about mid-February. Sprays made later will protect only against attack of later generations.

Insecticide sprays are not recommended against shothole borer and cedar or cypress bark beetles.

WARNING ON THE USE OF CHEMICALS