

Canker Diseases of Trees





Some cankers may develop at the base of the trunk. Photo courtesy M. Drilias.

Cankers are localized dead areas of bark in trees and shrubs caused by fungi and bacterial infection. Canker pathogens can cause annual branch and twig dieback, disfiguring perennial stem cankers, or large, diffuse trunk cankers capable of killing trees in a short time. Canker pathogens cause some of the most destructive tree diseases, including chestnut blight, butternut (white walnut) canker, and dogwood anthracnose.

Bark and Canker Formation

Bark is composed of layers of tissues that surround the woody core of the trunk or branch. The outermost layer of bark consists of corky, dead plant cells. **Outer bark** surface reduces water loss and serves as a physical barrier that protects inner bark tissue and sapwood.

Outer bark effectively prevents the entrance of most canker pathogens. Instead, these organisms usually enter and infect bark through wounds, including broken twigs or branches, pruning cuts, mower damage, insect injury, and hail damage. It can also enter through leaf scars, or small, natural bark openings called lenticels. Injured bark may be susceptible to infection for only a short period following wounding because of physical and chemical changes that occur to suppress pathogen development.

Once canker pathogens breach the outer bark barrier, they may then colonize other bark tissue. This process can reduce tree vigor, weaken the wood at the infection site, enhance the possibility of wood decay, and ultimately result in branch or trunk breakage and tree mortality.

Inner bark, or that closest to the sapwood, contains a thin, living layer of tissue called the phloem. Sugars manufactured in leaves during photosynthesis move to the roots and other areas of the tree through the phloem. Canker pathogens can kill the phloem, disrupt nutrient movement, and starve portions of the tree.

Another thin, but vital layer of tissue called the **vascular cambium** lies just inside the phloem. Each growing season, plant cells derived from the cambium differentiate to form new phloem to the outside of the trunk cylinder, and sapwood, responsible for water movement, to the inside. Addition of new sapwood each year results in an increase in branch or trunk diameter. Canker pathogens that damage the vascular cambium impair

water and nutrient movement and may reduce stem diameter growth in affected areas. Some canker pathogens are capable of colonizing and degrading the wood (called **canker rots**), but most do not invade sapwood or do so only to a limited extent.

Symptoms

Canker symptoms vary depending on the pathogen and tree species. Cankers on thin-barked trees often appear as sharply defined, slightly sunken, depressed areas. Healthy bark tissue outside the canker is light in color whereas cankered tissue is discolored shades of red, brown, or black. Diseased bark can be water-soaked, resinous, or exude a foul-smelling sap. Cankers on thick or rough-barked trees are more difficult to detect and can be viewed by carefully shaving off the outer bark with a knife. Cankers often are elongated, because canker pathogens tend to colonize the bark more rapidly up and down the stem. Canker pathogens sometimes form spore-bearing fruiting structures on the surface of dead bark. These structures are useful in pathogen identification and range from minute black pepper-like spots to small bright red, coral-like clusters.

Canker development also is variable. Some canker pathogens are only capable of colonizing bark during a relatively short period when woody plants are not actively growing (e.g. late fall through early spring). These **annual cankers** do not expand after plant growth resumes in spring because the tree produces chemicals and new tissues, including a defensive tissue layer called **callus**, which prevents further pathogen colonization. Annual cankers often are associated with branch and twig dieback initiated by temperature or moisture stresses. **Diffuse cankers** result when pathogens colonize the bark so rapidly the tree cannot develop adequate defensive barriers. These cankers may quickly girdle the trunk and kill the tree. Some pathogens are able to persist and colonize bark tissue for more than

1 year resulting in **perennial cankers**. On certain trees, a distinctive perennial **target canker** develops as the pathogen slowly colonizes rings of callus formed each spring to prevent canker enlargement.

Cankers may be more numerous and serious on trees suffering environmental stresses (freeze or drought injury). Increases in canker-related tree problems are common during extended periods of drought or following sudden temperature fluctuations. Tissue damaged by early-fall or late-spring freezes, or by extreme winter temperatures are quickly colonized by canker pathogens. Drought stress can impair the plant's ability to defend against fungal invasion. Conversely, excessive watering can kill roots and predispose plants to canker pathogens. Other factors that contribute to canker formation include root injury from construction, transplant shock, or herbicide damage.

Some tree species are especially prone to canker development. These include certain willow (*Salix* spp.) species and their hybrids; hybrids of eastern cottonwood (*Populus deltoides*); Siberian elm (*Ulmus pumila*); honeylocust (*Gleditsia triacanthos*); certain species of plum, cherry, and peach (*Prunus* spp. especially *P. cerasifera* and *P. persica*); Russian olive (*Eleagnus angustifolia*); Rocky Mountain juniper (*Juniperus scopulorum*); and ornamental cultivars of white and red mulberry (*Morus rubra* and *M. alba*).

Leucostoma and Valsa (Cytospora) Cankers

The fungi *Leucostoma* and *Valsa* cause canker diseases on species including maples (*Acer* spp.), plums and peach (*Prunus* spp.), poplar and cottonwood (*Populus* spp.), willow (*Salix* spp.) elm (*Ulmus* spp.), and spruce (*Picea*

Twig canker developing after infection of leaf scar. Note the black discoloration of diseased bark.





Bark has been removed from this trunk to show multiple, diffuse cankers.

spp.). Diseases caused by these fungi are also called Cytospora cankers (*Cytospora* refers to the Latin name of the asexual stages of these fungi). Cytospora cankers usually are found on trees that have been damaged by cold temperatures or drought.

Cytospora or perennial cankers of peach and plum (*Prunus* spp.) caused by *L. persooni* and *L. cinctum* are some of the most widespread and destructive peach and ornamental plum diseases. These diseases can cause gradual twig and branch mortality, or can result in rapid tree death. In healthy trees, fungal colonization is restricted to injured tissue and results in the formation of sunken cankers. Fungal colonization is more rapid and expansive in trees weakened by drought or freeze damage and can progress down twigs and into scaffold limbs where large, diffuse cankers are formed. Diseased sapwood beneath the canker turns reddish-brown. Small black pinpoint fruiting structures called pycnidia form in dead bark and exude brightly colored spore tendrils during wet weather. The spores are dispersed by splashing rain and insects. Canker surfaces can be covered with a gummy, resin-like coating, although this is not necessarily diagnostic since other diseases and environmental factors cause bleeding.

Valsa (Cytospora) canker of poplars and willows is caused by the fungus *Valsa sordida*. This widespread canker

disease is almost always associated with drought and/or cold temperature damage and causes annual twig and branch dieback or slowly expanding perennial cankers that are similar in appearance to those caused by *L. persooni* and *L. cincta* on *Prunus* species. Trunk cankers can be irregular in shape and difficult to see. During wet weather bright orange spore masses up to ½ inch in length exude from the fruiting bodies embedded in the canker.

Leucostoma (Cytospora) canker of Colorado blue spruce (*Picea pungens*) first appears in the lower portion of the tree crown. Needles on diseased branches turn purple or brown and drop prematurely. Branch cankers commonly develop near the junction with the main trunk and often are covered with a white pitch that drips onto adjacent branches. Wood beneath the cankered bark is resin-impregnated and dark blue-brown. Occasionally, small, black fruiting structures (pycnidia) of the fungus can be seen in diseased bark, but they often are difficult to find because of the abundant pitch. Multiple branch cankers can result in mortality of most lower branches on a tree.

Nectria Cankers

Nectria cinnabarina, also known as the coral spot fungus, is an opportunistic pathogen tree species including apple, ash (*Aesculus*),

birch (*Betula*), goldenraintree (*Koelreuteria paniculata*), honeylocust (*Gledetsia triacanthos*), maple (*Acer*), mulberry (*Morus*), and oak (*Quercus*). The fungus causes annual cankers that usually develop near branch tips weakened by drought or freeze damage. Dieback rarely extends into larger branches or the trunk except on severely weakened trees. Distinctive coral pink fruiting structures (sporodochia) of the fungus are common on dead bark.

Nectria austroamericana, (also called *Thyronectria austroamericana*) causes a widespread and serious disease of honeylocust called Thyronectria canker. Cankers are found on all aboveground woody plant parts but are particularly common at branch stubs, pruning wounds, and on bark damaged by sunburn.

Cankers initially are elliptical, slightly depressed and reddish-orange. Sapwood just beneath the canker is also stained red. A reddish brown liquid may drip from the canker and stain the outer bark. With time, dead outer bark bleaches light tan, develops cracks, and

Discolored inner bark associated with branch and trunk cankers.



begins to slough from the tree. Small clusters of red to pink fungal fruiting structures (pycnidia), eventually turning black with age, form in lenticels scattered throughout the dead bark. A second, light brown fruiting structure (perithecium) can form in older cankers. Cankers on rough-barked trunks or branches are obscure and can only be detected when bark begins to slough or fungal fruiting structures appear. Cankered trees exhibit light-colored foliage, branch dieback, and poor growth. Girdling trunk cankers can kill trees.

Honeylocust cultivars vary in susceptibility to *Thyronectria* canker. Research in Colorado indicates Sunburst is most susceptible, Moraine and Skyline intermediate, and Imperial, Holka, and Shade Master the most resistant.

Nectria galligena causes branch and trunk cankers similar to those of *N. cinnabarina* on a number of species. These cankers often are annual and are associated with poor growing conditions. However, large, perennial target-shaped cankers caused by *N. galligena* form on certain tree species.

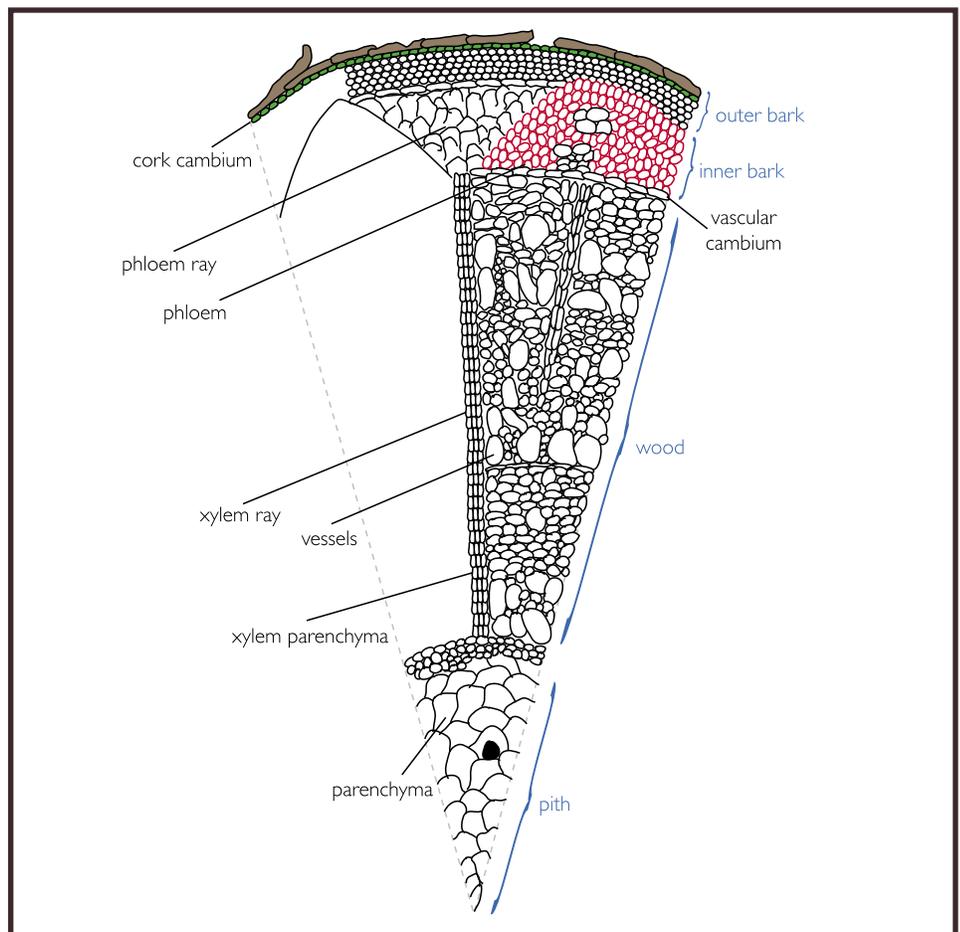
Botryosphaeria Cankers

Several species of *Botryosphaeria* cause cankers on trees and other woody ornamentals. These fungi survive as saprophytes on bark killed by natural causes or by other plant pathogens or insects. They are opportunistic pathogens and quickly colonize bark injured by drought, freeze, or sunscald. Cankers tend to be annual and ranged in size from small elongated spots restricted to the outer bark, to larger, more diffuse lesions on seriously damaged trunks and branches.

B. stevensii causes elongated, flattened, often resinous cankers on Rocky Mountain juniper (*J. scopulorum*), savin juniper (*J. sabina*), and occasionally eastern redcedar (*J. virginiana*). Cankers can occur



Perennial canker of peach. Note gummy resin leaking from canker.





(left) Branch dieback of goldenrain tree associated with winter injury and Nectria cankers.

(below left) Valsa canker of poplar. Spores of the fungus are exuded from cankers in bright orange tendrils during rainy weather.

(below) Thyronectria canker of honeylocust.



anywhere on woody stems, but are more common near branch crotches. Girdling stem cankers can cause rapid death of individual branches or the top portion of the tree crown. Small black fruiting bodies develop in the canker, but these may be partially hidden by thin pieces of dead bark.

B. dothidea is a common canker pathogen of flowering crabapple, ash, rhododendrons, and many other deciduous trees and shrubs. The disease occasionally causes branch and trunk cankers on eastern white pine, Douglas fir, and true firs. Cankers are similar to those described for *B. stevensii*.

Phomopsis Canker of Russian Olive

The fungus *Phomopsis arnoldiae* is responsible for a canker disease of Russian olive (*Eleagnus angustifolia*). Cankers on small branches are reddish-brown to black with sunken margins. Sapwood beneath diseased bark is discolored brown or black. Small black fruiting structures of the fungus dot the diseased bark tissue. Cankers on

Botryosphaeria canker is lethal to Rocky Mountain juniper in eastern Kansas.



larger branches are slightly sunken, rougher in texture, and may exhibit gummosis and bleeding. Girdling cankers restrict water movement and cause rapid wilting of foliage. Leaves on affected branches turn light-tan and become brittle, but usually remain attached to the tree. Multiple branch cankering over a period of several years results in branch dieback and a general tree decline.

Canker Management

Prevention is the key to management of canker diseases. Canker pathogens can be difficult to eradicate once the infection process has started. Avoid planting tree species that are genetically susceptible to cankers (e.g. flowering plums) or species that are predisposed to cankers because of lack of winter hardiness or drought tolerance. Optimize conditions for tree growth and minimize environmental stresses that predispose trees to cankers. This is especially important on newly transplanted trees since they are vulnerable to cankers. Protect young, thin-barked trees from sunburn damage to the trunk by proper use of tree wraps. Maintain soil moisture throughout the season by the use of organic mulches and timely watering, but do not overwater. Fertilization maintains tree vitality, but excessive fertilization can result in succulent growth that is more prone to insect and pathogen damage.

Minimize wounding of tree bark caused by careless mowing practices or unnecessary pruning. If pruning is required, make cuts flush with the branch collar located at the base of the branch. Do not cut branches flush with the trunk or leave branch stubs. Avoid pruning during wet weather. Most commercial tree wound dressings do not contain fungicides, have not been shown to prevent canker formation, and should not be used to treat fresh pruning cuts. Limited university research has shown that treating fresh pruning cuts with a fungicide may help reduce canker development



Botryosphaeria dothidea may cause trunk damage and bark sloughing to flowering crabapple and other trees following drought injury.

on fruit trees, but this practice is of questionable value for trees in the landscape.

Remove branch cankers by pruning at least 2 to 3 inches below the canker margin. Make sure to prune at a branch crotch so as not to leave branch stubs. Canker removal will improve tree appearance, but will not necessarily eliminate future canker development.

Canker development is usually more dependent on tree health rather than reduction of pathogen inoculum.

Trunk cankers are more difficult to control. As a general guideline, remove the tree if a perennial trunk canker has damaged more than one third of the trunk circumference. It is unlikely the tree will recover. On the other hand, trees with inactive trunk cankers often fully recover. The presence of a slight

swelling of light-colored callus tissue around the canker perimeter may indicate successful containment of the pathogen. Carefully remove, dead sloughing bark from the canker face, but be careful not to damage the callus tissue surrounding the canker. Do not attempt to chisel or scrape away dead tissue from the center of the canker.

Carefully scribing 1 to 2 inches outside the canker margin with a knife, then discarding all diseased bark tissue can remove some small trunk cankers. However, this process leaves a very large wound and may damage healthy tissue. In many cases, a healthy, vigorous tree likely will seal off the cankered areas naturally and no intervention is necessary. Only skilled arborists should attempt canker removal.

Branch tip dieback on oak caused by Botryosphaeria. Damage is usually restricted to the terminal 6 inches of the branch.



Phomosis canker on Russian olive is dark brown to black and often starts at the base of dead twigs (center).



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