DISEASES

Anthracnose

Colletotrichum gloeosporioides, Discula fraxinea and other host-specific fungi (fungus)

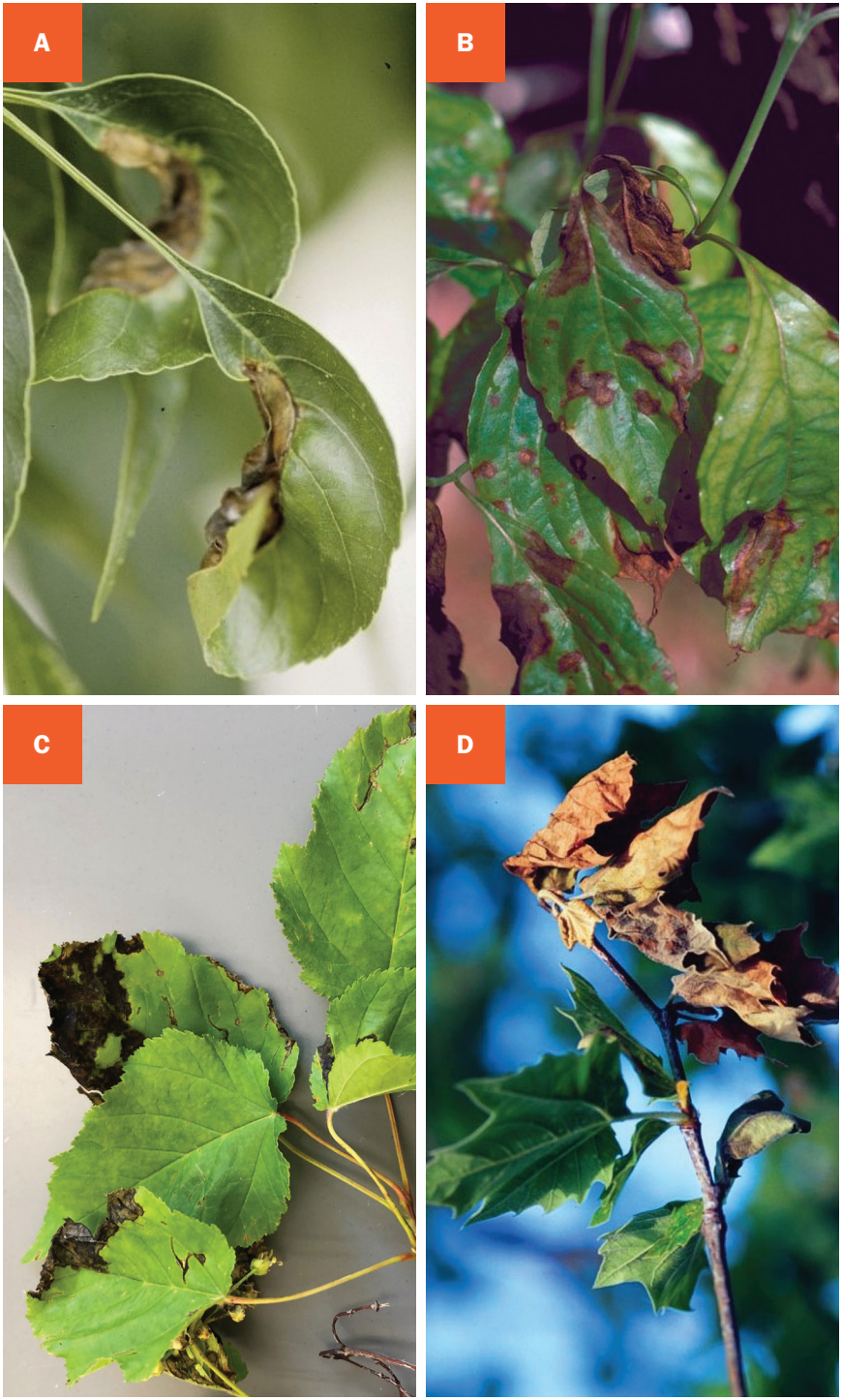
HOST Many shade trees including ash, maple, oak, elm

DAMAGE/SYMPTOMS Anthracnose is a foliar disease caused by numerous plant pathogenic fungi. In spring, tan to brown blotches appear on new leaves along leaf veins. The blotches enlarge and often cause distortion of the leaves. Young, infected leaves may drop in late spring. Leaves on lower branches are most often affected. Cankers may develop on branches and young shoots may die back. Infection is most severe under cool, wet conditions.

DISEASE CYCLE The fungus overwinters in infected leaf debris on the ground or in cankers on branches. In spring, spores are produced on the old leaf debris and canker tissues. The spores are dispersed by wind and rain and infect newly emerging leaves. New spores are produced on the newly infected leaves, which then infect new growth as long as the temperatures stay low and sufficient moisture is available.

MANAGEMENT Anthracnose infection does not result in tree death and trees usually push out new leaves by summer. Rake up fallen leaves and prune out infected twigs and branches. Disinfect pruning tools after each cut with 70% ethyl alcohol or a standard household disinfectant spray. Chemical treatments are generally not recommended unless the disease is a continuing problem. High value trees can be protected by applying chlorothalonil- or copper-containing fungicides in early spring when buds first start to open. One to two additional sprays should be applied in 10- to 14-day intervals, strictly following instructions on the pesticide labels.

A One-sided distortion of leaves. **B** Brown necrotic areas on leaves. **C** Necrotic areas on leaves increase in size. **D** Shoot dieback caused by anthracnose infection.


A
B
C
D

Apple Scab

Venturia inaequalis (fungus)

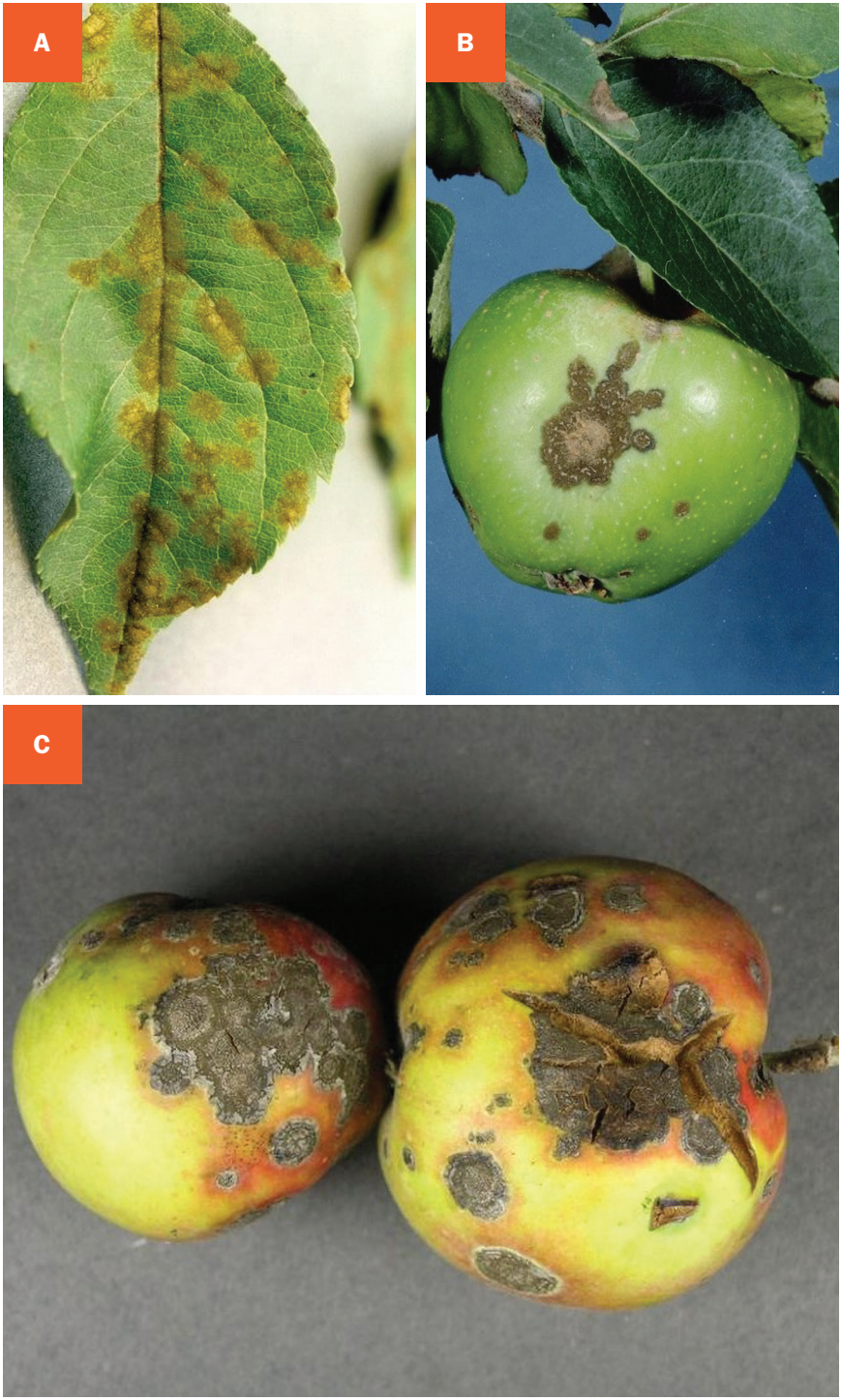
HOST Apple and crabapple trees

DAMAGE/SYMPTOMS Round, olive-green leaf spots with fringed borders appear on leaves in late spring. Spots on fruits can also appear. Leaf spots turn brown to black with age. Affected leaves turn yellow and may drop mid-summer. Infected fruits develop corky tissue and may become deformed and cracked.

DISEASE CYCLE The apple scab fungus overwinters in infected leaf debris on the ground. In spring, spores are produced on the leaf debris and dispersed by wind and rain and infect new leaves. Infection is most severe under wet conditions. Secondary infections occur throughout the growing season when spores are produced on the newly developed leaf spots which infect adjacent leaves. The secondary infections are more severe under warm and moist conditions.

MANAGEMENT Plant apple scab-resistant cultivars whenever possible. The key to controlling apple scab is to prevent the primary infection in spring. Remove fallen, infected leaves to reduce the level of inoculum. Avoid wetting the foliage for prolonged times during the growing season. Prune trees to optimize air circulation. Fruit trees can be treated with fungicides in seven- to ten-day intervals starting from green tip stage until flower petal fall. Products with the active ingredients chlorothalonil, copper, or lime-sulfur are effective in controlling this disease. Strictly follow instructions on the pesticide labels.

A Apple scab lesions on apple leaf. **B** Apple scab lesions on apple fruit.
C Apple scab lesions and cracks expanding on apple fruits.


A
B
C

Bacterial Blight of Lilac

Pseudomonas syringae pv. *syringae* (bacterium)

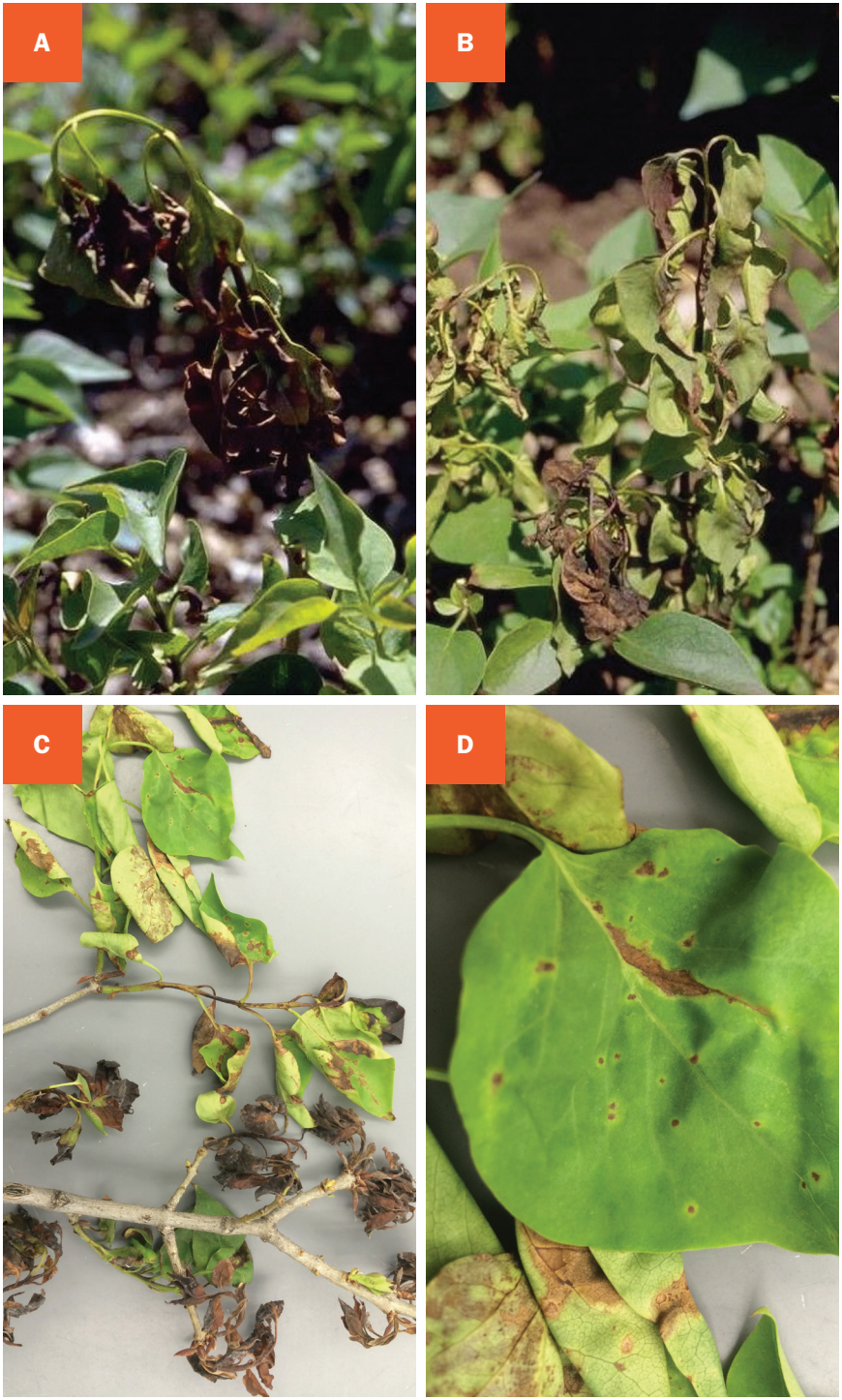
HOST All lilac shrubs and trees

DAMAGE/SYMPTOMS In spring, small, water-soaked lesions appear on the leaves. Lesions may expand and coalesce into larger brown areas. Affected young shoots are quickly girdled, and show wilting and blackening of stems, leaves, and/or flower clusters. Dark streaks may be visible on affected shoots.

DISEASE CYCLE The bacterium can overwinter in infected twigs and cankers on the plant, in dead plant debris, on neighboring plants, or in the soil surrounding the plant. In the spring, the bacterium can then be spread to susceptible plants by splashing water, insect vectors, or pruning tools. *Pseudomonas* spp. infect through open wounds in the plant.

MANAGEMENT Focus on supporting plant vigor by providing adequate water and nutrients during the growing season. Prune out and discard infected branches and leaves. Make the pruning cut 10 to 12 inches below the visible symptoms of disease and sterilize your tools between cuts with 70% ethyl alcohol or a standard household disinfectant spray. Avoid hitting the foliage during sprinkler irrigation to minimize possible spread of the bacteria. Consider healthy pruning to increase air flow and light penetration. Chemical control is not recommended in the urban setting.

A Shoot dieback following bacterial infection. **B** Multiple young shoots affected by bacterial blight. **C** Dark brown leaf spots with light green margins and dieback of branches due to bacterial blight infection. **D** Dark brown leaf spots with light green margins.


A
B
C
D

Bacterial Wetwood or Slime-flux

Several species of bacteria including *Enterobacter, Klebsiella,* and *Pseudomonas*

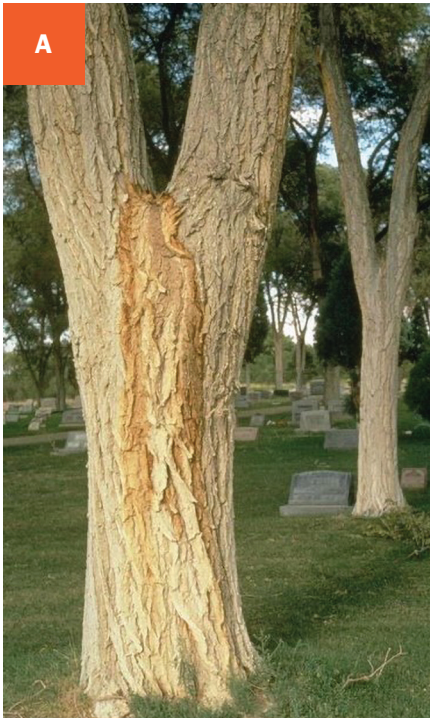
HOST Aspen, cottonwood, elm, boxelder, maple, oak, linden, cherry, honeylocust, fir, poplar

DAMAGE/SYMPTOMS Bacterial wetwood often develops in the roots or the lower part of the trunk but may also affect branches. Affected trees may show discolored and water-soaked areas of the heartwood down the trunk, just below the area of infection. Infected wood may appear yellow, olive-green, or dark brown in color. The emitted sap may have a reddish or brown color and a foul odor. After drying up, the sap appears yellow, brown, or gray. Infections usually do not kill the tree but may inhibit wound healing.

DISEASE CYCLE Wetwood-causing bacteria live naturally in soil and water and infect trees through wounds. After initial infection, bacteria grow within their host, using the plant sap as a nutrient source and emitting gasses which are produced during fermentation processes. The build-up of gas pressure is released by discharging liquid through a branch crotch, pruning cut, or wound. The liquid is a mixture of the wetwood bacteria, yeast, and water.

MANAGEMENT No preventive treatments are available. The best management practice is to support plant health by providing adequate water and nutrients during the growing season and avoiding any wounding of plants. Branches affected by bacterial wetwood can be pruned out. Disinfect pruning tools between cuts with 70% ethyl alcohol or a standard household disinfectant spray.

A Bacterial wetwood on the main trunk. **B** Multicolored bacterial wetwood on main trunk. **C** Sap oozing out of an area of active wetwood.


A


B


C

Black Canker of Willow

Glomerella miyabeana (fungus)

HOST Willow

DAMAGE/SYMPTOMS Brown, irregular leaf spots appear on leaves in late spring and early summer. The fungus grows rapidly from the leaf blade through the petiole into the twig. Infected leaves may wither and die. Cankers develop on infected twigs and may girdle the twigs from within, resulting in dieback. Twigs may appear wilted with drooped or crooked tips.

DISEASE CYCLE The fungus overwinters in infected twigs. In spring, spores and/or conidia are released from the canker tissues and infect new leaves and twigs. The disease is spread by splashing rain and secondary infections may occur during warm and humid weather throughout the growing season.

MANAGEMENT Prune out and dispose of infected branches to reduce disease severity. Disinfect tools with 70% alcohol or a standard household disinfectant spray between cuts. Healthy pruning will also optimize air circulation and shorten periods of wet leaves. Support tree vigor by providing adequate water and nutrients during the growing season. Avoid wetting the foliage for prolonged times. Fungicides are usually not recommended in an urban setting.

A Dieback of branches on willow tree affected by black canker disease. **B** Dark brown cankers develop on willow branches resulting in dieback.


A


B

Black Knot

Apiosporina morbosa (fungus)

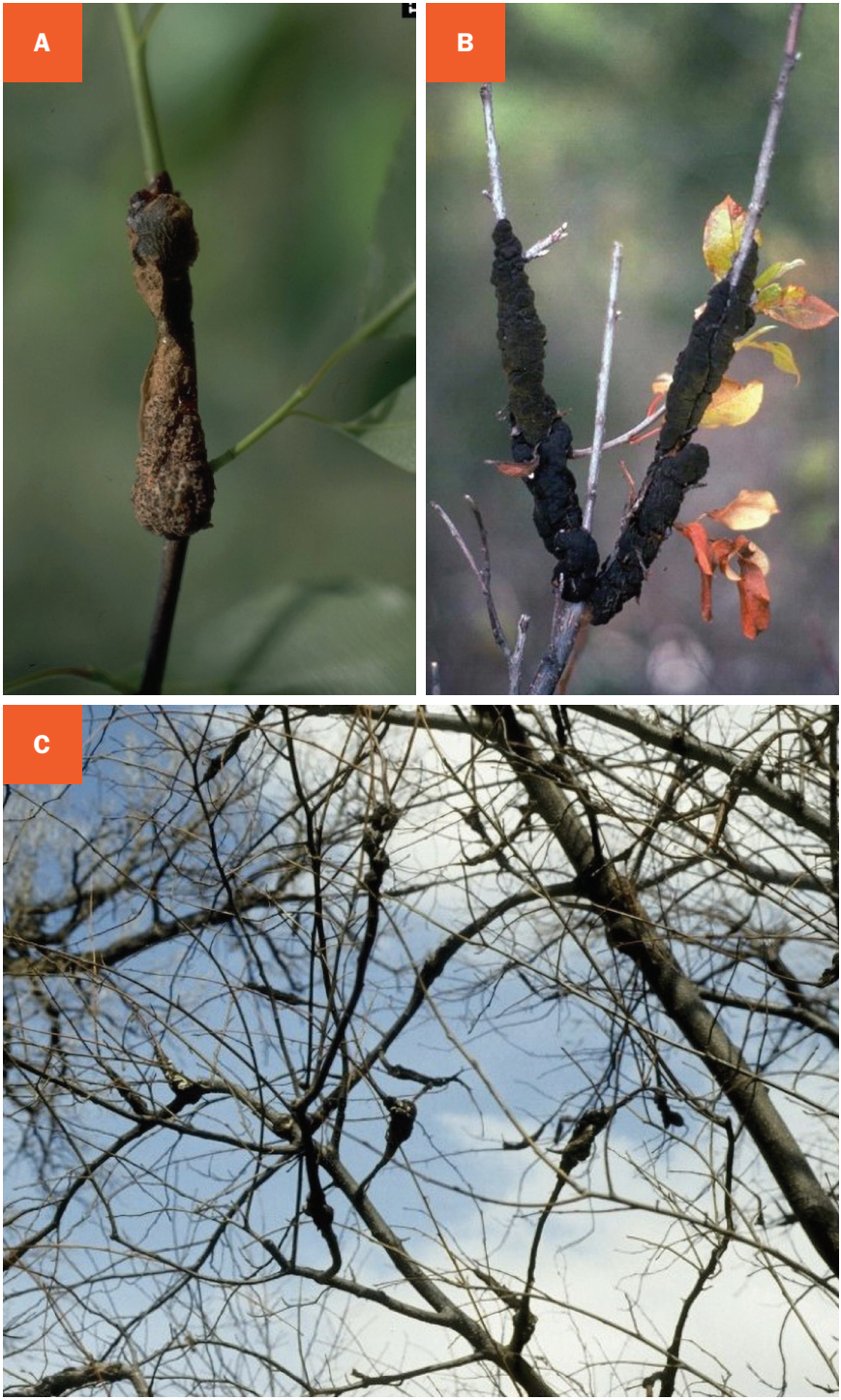
HOST Cherry, chokecherry, plum, and other ornamental *Prunus* species

DAMAGE/SYMPTOMS This fungal disease is characterized by the development of thick, black, gall-like swellings on twigs and branches. The galls can girdle the branches of highly susceptible trees, causing leaf wilt and branch dieback beyond the galls.

DISEASE CYCLE The fungus overwinters in the black, knobby galls. During wet periods in the spring, spores are released and infect young green shoots or wounded branches. New galls develop during the summer and early fall and may be covered in olive-green spores in the following spring. The new galls turn black and hard two years after infection.

MANAGEMENT Black knot can be managed by pruning out existing galls in late winter. Make the pruning cut at least four inches below the infection. Disinfect pruning tools between cuts with 70% ethyl alcohol or a standard household disinfectant spray. Dispose of the galls to reduce inoculum levels. Fungicides can be applied in spring to protect young or highly susceptible trees. Fungicide treatments must be applied when flower buds are beginning to open and may have to be repeated depending on the product used, label instructions, and weather conditions. Fungicides with one of the following active ingredients have shown good control of black knot: chlorothalonil or thiophanate-methyl. Strictly follow instructions on the pesticide labels.

A Black knot gall developing on young shoot. **B** Mature black knot galls causing dieback of branches. **C** Tree with multiple black knot galls.


A
B
C

Cedar-Apple Rust

Gymnosporangium juniperi-virginianae (fungus)

HOST Eastern red cedar, Rocky Mountain juniper, common and prostrate junipers; Alternate hosts: apple, crabapple, occasionally hawthorn

DAMAGE/SYMPTOMS **Juniper/cedar:** Bulbous, brown to reddish-brown galls of various sizes form on evergreen twigs/branches that were infected the previous year. After rainy periods in spring, bright orange to yellow gelatinous tendrils form on the galls. Galls can cause dieback of small twigs. **Apple/crabapple:** Bright orange/yellow spots appear on leaf surfaces in late spring to early summer. The spots enlarge and form finger-like structures on the underside of leaves. Affected leaves may drop during the summer. On fruits, orange/yellow spots can also form. Infection reduces fruit quality and may lead to premature fruit drop.

DISEASE CYCLE In spring, orange-yellow spores are produced on galls of infected juniper plants and dispersed by wind, infecting apple and/or crabapple trees in late spring to early summer. Leaf spots on alternate hosts produce a new set of spores on finger-like structures formed on the undersides of leaves in midsummer. This new set of spores is dispersed by wind and carried to juniper hosts.

MANAGEMENT Ideally the two hosts should be physically separated. Plant resistant varieties whenever possible. Remove galls on junipers in early spring to reduce the inoculum. Disinfect pruning tools between cuts with 70% ethyl alcohol or a standard household disinfectant spray. Consider applying a protectant fungicide (active ingredient myclobutanil, copper, or sulfur) that is labeled for rust. Apply to emerging leaves of ornamental alternate hosts during the time when the galls on the junipers are orange and gelatinous. Multiple applications might be necessary depending on the selected product.

A Cedar-apple rust gall on juniper and bright colored leaf spots on apple leaf. **B** Orange-yellow leaf spots on alternate host. **C** Orange spores developing on galls in spring. **D** Fully developed gelatinous gall on juniper host.


A
B
C
D

Cedar-Hawthorn Rust

Gymnosporangium globosum (fungus)

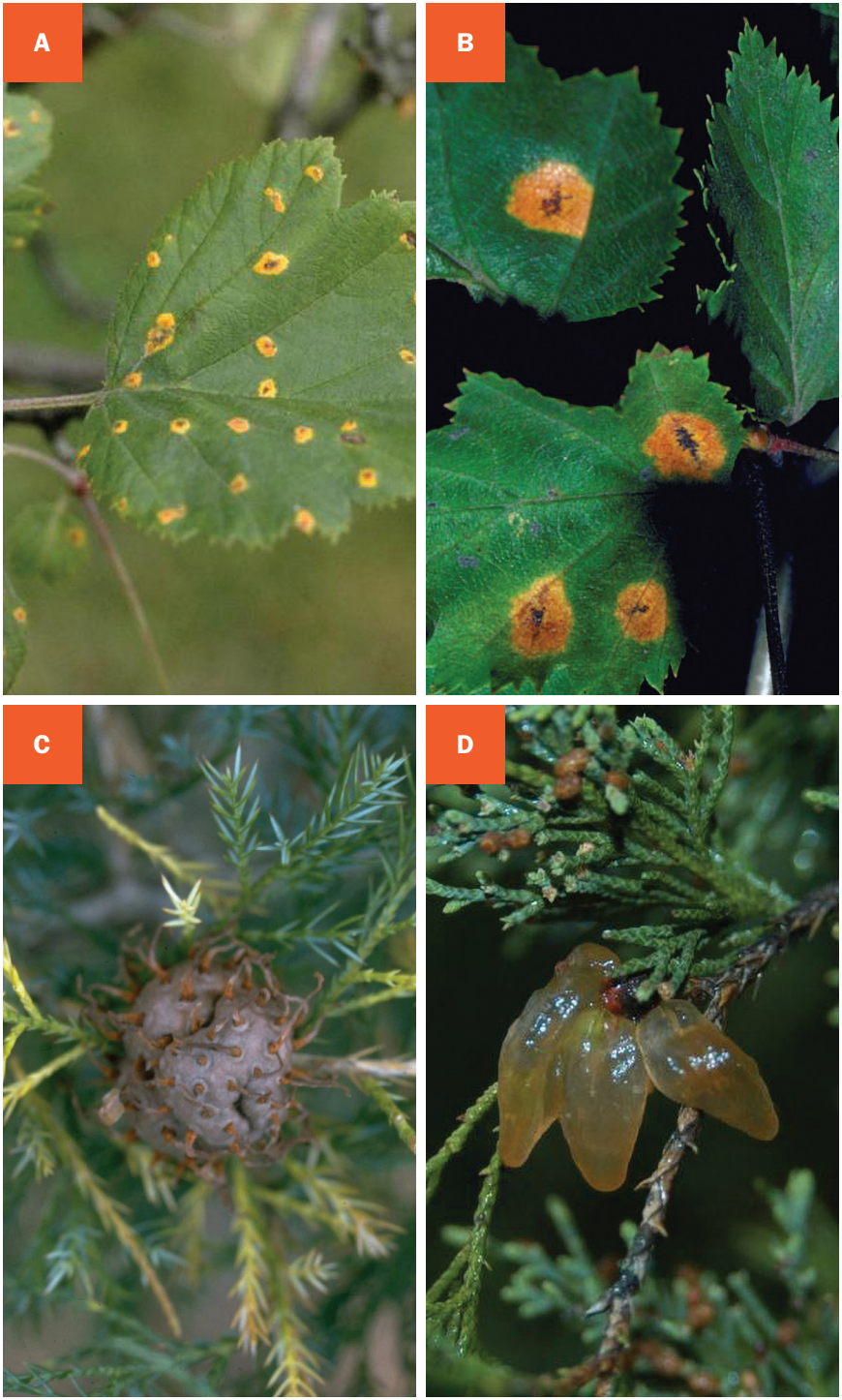
HOST Evergreen hosts: Eastern red cedar, Rocky Mountain juniper, occasionally on creeping and low junipers; Alternate hosts: hawthorn, apple, crabapple; occasionally serviceberry, quince, pear

DAMAGE/SYMPTOMS **Juniper/cedar:** Small, brown to reddish-brown galls form on evergreen twigs/branches that were infected the previous year. After rainy periods in spring, bright orange gelatinous tendrils form on the galls. Galls can cause dieback of small twigs. **Hawthorn/apple/crabapple:** Bright orange/yellow spots appear on leaf surfaces in late spring to early summer. The spots enlarge and form whitish finger-like structures on the underside of leaves. Affected hawthorn leaves turn completely yellow and are dropped prematurely.

DISEASE CYCLE In spring, orange/yellow spores are produced on galls of infected evergreen plants, dispersed by wind and infect hawthorn, apple and/or crabapple trees in late spring to early summer. Leaf spots on alternate hosts produce a new set of spores on finger-like structures formed on the undersides of leaves in midsummer. This new set of spores is dispersed by wind and can infect the evergreen hosts.

MANAGEMENT Plant resistant varieties whenever possible. Remove galls on evergreen plants in early spring to reduce the inoculum. Disinfect pruning tools between cuts with 70% ethyl alcohol or a standard household disinfectant spray. High value plants can be treated with a rust-labeled protectant fungicide containing the active ingredient myclobutanil, copper, or sulfur. Apply to emerging leaves of ornamental alternate hosts during the time when the galls on the junipers are orange and gelatinous. Multiple applications might be necessary depending on the selected product.

A Bright yellow leaf spots on hawthorn. **B** Mature leaf spots with black fungal fruiting structures developing in centers. **C** Mature gall on cedar branch with emerging gelatinous spore structures. **D** Fully developed gelatinous gall on evergreen host.


A
B
C
D

Crown Gall

Agrobacterium tumefaciens (bacterium)

HOST Affects a wide variety of woody plants; often on poplar

DAMAGE/SYMPTOMS Soft, spherical, white to cream colored galls form at the base of stems/trunks, root crown, or on roots. Young galls can be mistaken as callus tissue. As galls mature, their shape becomes irregular and they turn brown or black. The tissue can be sponge-like or woody. The size of the galls increases with the growth of affected trees. Infected plants may appear stunted and express a lack of vigor due to water stress caused by a diseased root system.

DISEASE CYCLE Crown gall bacteria are common soil inhabitants. They survive free-living in soils with good aeration and on the root surface of weeds. The bacteria enter plants through fresh wounds inflicted by cultural practices like grafting or mowing or by natural causes (wind, hail). They then stimulate the host cells to grow rapidly and irregularly, resulting in formation of galls.

MANAGEMENT There is no cure for crown gall infection. Remove young plants that are infected to minimize spread of the disease. Avoid any type of wounding during cultural practices. Consider raising the soil level above exposed tree roots to avoid spreading infection during mowing practices. Disinfect your tools with 70% ethyl alcohol or a standard household disinfectant spray after being in contact with crown galls.

A Crown gall developing on the main stem close to the base. **B** Young crown gall at the base of a young tree. **C** Mature crown gall in lawn on root of established aspen tree.


A
B
C

Cytospora Canker

Cytospora spp. (fungus); sexual form: *Valsa* spp. or *Leucostoma* spp.

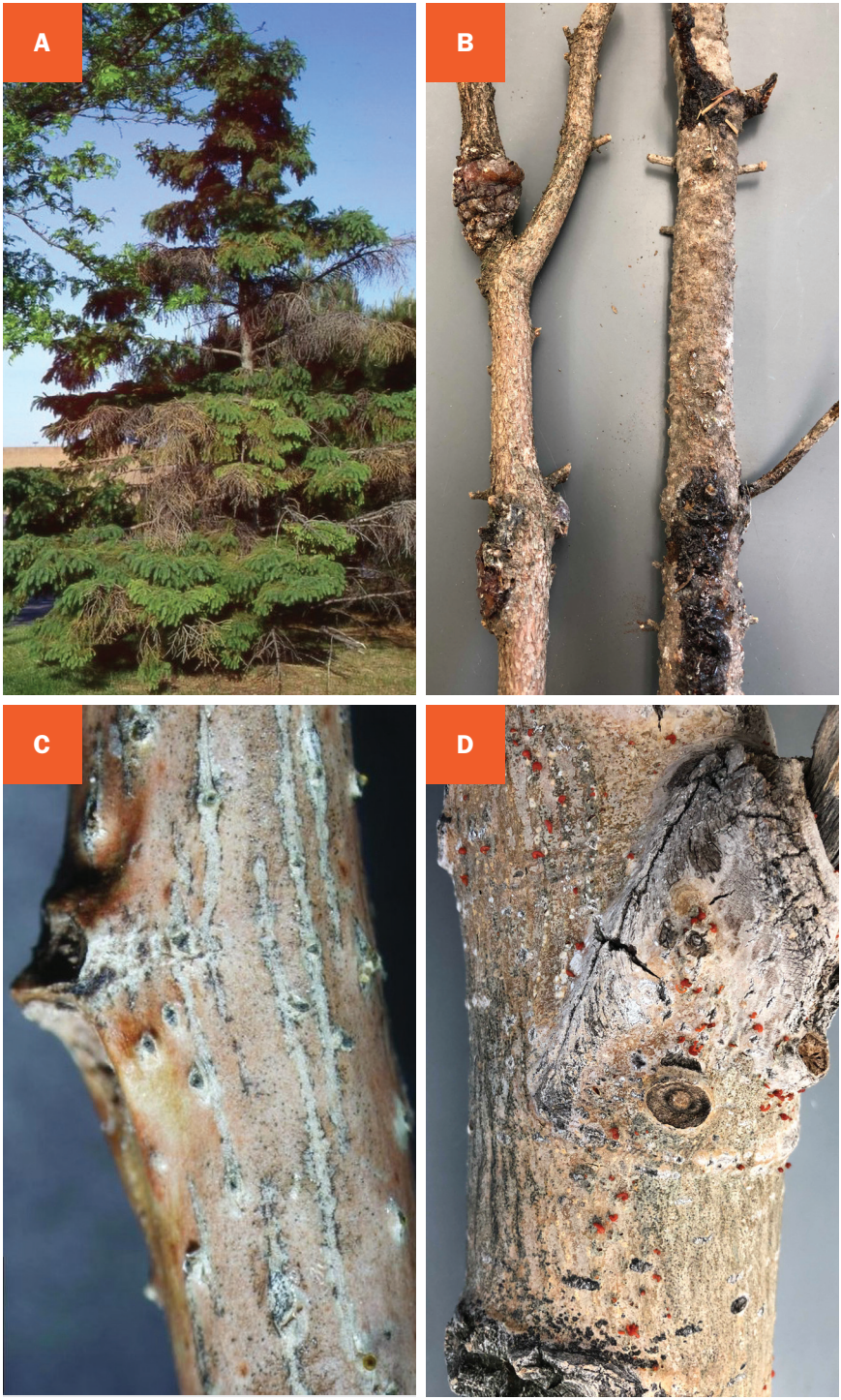
HOST Cottonwood, aspen, ash, spruce, apple, maple, birch

DAMAGE/SYMPTOMS This disease mainly affects stressed trees. **Spruce:** cankers form on infected branches and are often covered in a whitish-bluish resin. The fungus girdles the branches from within, resulting in yellowing or browning of needles and dieback of the branch above the canker. Branches appear to die in an upwardly progressing spiral pattern. **Deciduous trees:** cankers on the branches and/or trunk often are different in color than the rest of the branch. Bark might appear yellowish, brown, reddish-brown, grayish, or black. Small, black, pimple-like fruiting structures may appear on the cankers. During wet conditions, orange spirals of spores emerge from the fruiting structures. Aspen trees might emit a liquid ooze while cherry or peach trees discharge a gummy ooze.

DISEASE CYCLE The fungus overwinters in canker tissue on affected branches and/or trunks. During wet weather, spores are released from the fruiting structures and dispersed by splashing rain and wind. The spores infect stressed trees through fresh wounds.

MANAGEMENT Reduce stress on trees by providing adequate water and nutrients during the season. Avoid wounding the branches and trunks during cultural practices (lawn mower, weed trimmer). Remove and dispose of affected branches during dry weather. Disinfect pruning tools after each cut with 70% ethyl alcohol or a standard household disinfectant spray. Consider planting resistant varieties.

A Spruce tree affected by cytospora canker. **B** Young cankers on branches of spruce trees. **C** Dark colored fruiting bodies developing on infected branch. **D** Orange spores oozing out of fruiting bodies of a cottonwood tree branch.


A
B
C
D

Diplodia Tip Blight

Diplodia pinea (fungus)

HOST Two- and three-needle pines (Austrian, Scots, and Mugo pine), fir, spruce, juniper

DAMAGE/SYMPTOMS Initial infection may cause large amounts of resin to ooze out of branches. Black fruiting bodies are visible at the base of infected needles late summer to fall. Current year branch tips turn brown and die. New needles may appear stunted and change color from yellow to brown. Cankers may develop on branches. Symptoms are more severe on lower branches and infection may kill trees over time. Trees 30 years and older and weak trees are more prone to infection.

DISEASE CYCLE The fungus survives in infected needles, branches, and cones. In late spring to early summer, fruiting bodies discharge spores during wet conditions which infect young needles of the current season. The fungus grows within the needles and moves towards the base of needles and eventually into the twig. Infected needles turn brown and cankers are produced on the twigs/branches.

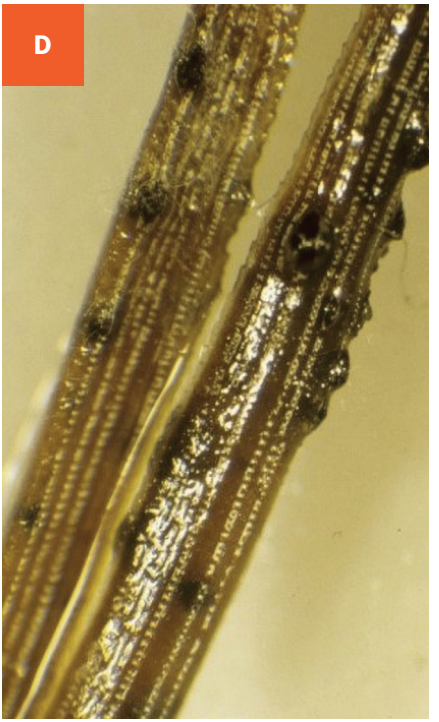
MANAGEMENT Focus on supporting tree vigor and provide adequate water and nutrients during the growing season. Remove and dispose of fallen needles, cones, and infected branches during dry weather. Spores can invade branches through wounds, therefore avoid pruning trees from late spring to early summer. Disinfect pruning tools with 70% ethyl alcohol or a standard household disinfectant spray before each cut to minimize spreading the disease. Fungicides with the active ingredient thiophanate-methyl, propiconazole, or chlorothalonil may be applied at budbreak, at half candle, and at full candle.

A Pine trees affected by diplodia. **B** Brown and stunted needles on young shoot. **C** Shoot tip dieback on pine tree. **D** Black fungal fruiting bodies on infected needles.


A


B


C


D

Dothistroma Needle Blight

Dothistroma septosporum (syn. *Mycosphaerella pini*) (fungus)

HOST Austrian pine, Ponderosa pine

DAMAGE/SYMPTOMS Reddish-brown spots appear randomly on needles in late summer to fall. The spots can enlarge into reddish-brown bands and encircle the needles. The tips of infected needles turn brown as the bases stay green. As infection continues, needles die and drop off. Infection is more severe on lower branches closest to the trunk. Small black fruiting bodies might emerge out of infected needles.

DISEASE CYCLE The fungus survives in infected needles. Throughout the growing season, spores are released from affected needles and infect two- to three-year-old needles during periods of cool, wet weather. Young needles are mostly resistant until they reach maturity.

MANAGEMENT Remove fallen needles to reduce inoculum levels. Good spacing of trees will improve air circulation and minimize duration of wetness on needles. Avoid hitting the tree canopy during irrigation. Affected trees can be treated with fungicide containing the active ingredient copper. Apply fungicides in spring when new needles have grown half their mature length. A second treatment should be applied three to four weeks later when new needles are full grown. Strictly follow instructions on the pesticide labels. Fungicide applications will not cure already-infected needles but will prevent new infections.

A Pine trees affected by dothistroma needle blight. **B** Discolored pine needles. **C** Red-brown bands on infected pine needles. **D** Black fungal fruiting bodies emerging out of infected needles.


A
B
C
D

Dutch Elm Disease

Ophiostoma novo-ulmi and *Ophiostoma ulmi* (fungi)

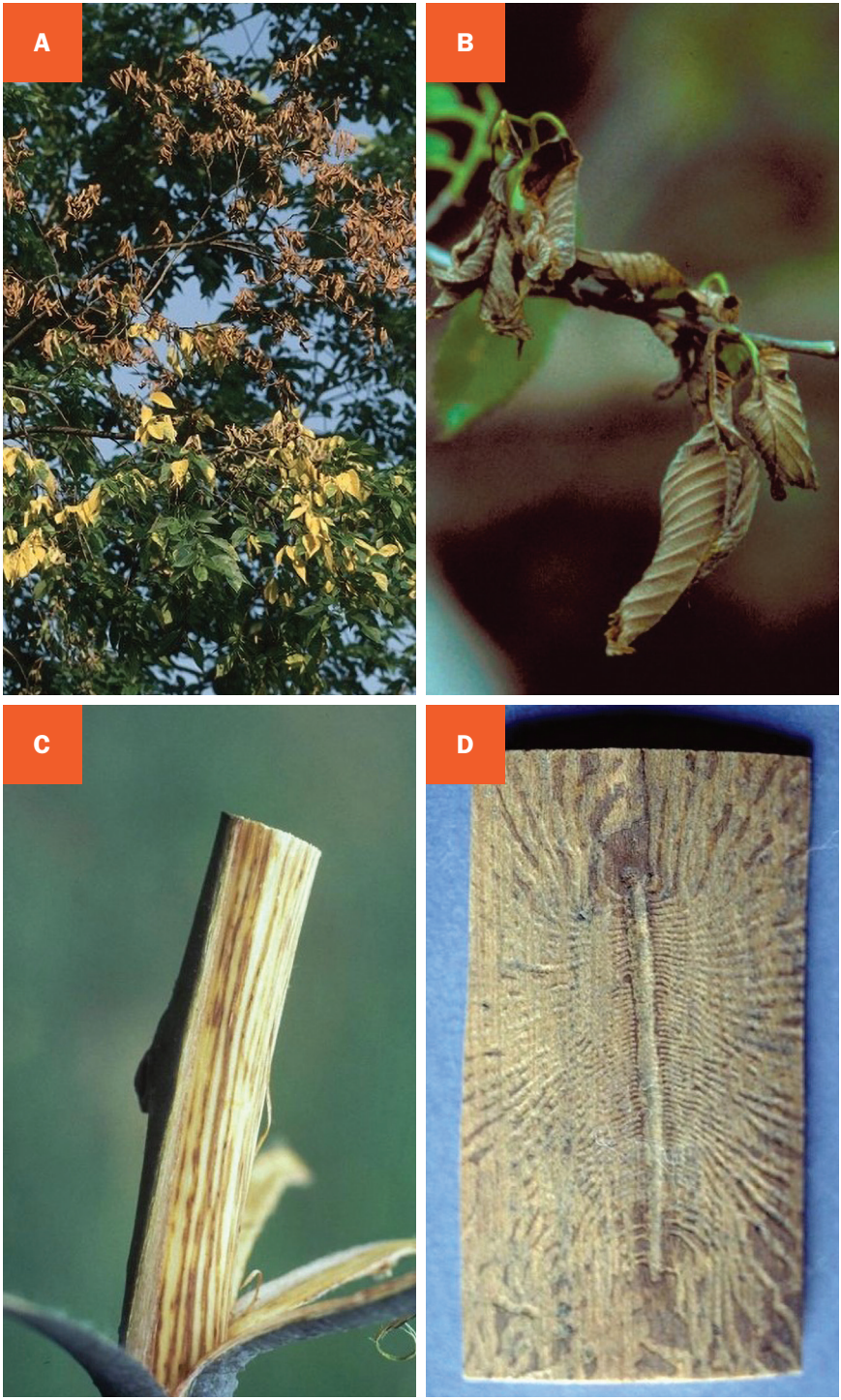
HOST American elm, European elm

DAMAGE/SYMPTOMS Starting in summer, leaves on infected branches of the upper canopy curl up, wilt, and turn a grayish-green or yellow color ("flagging"). As the disease progresses, adjacent branches show similar symptoms and major dieback in the canopy may become visible. Distinct longitudinal brown streaks are visible in the wood underneath the bark. Drought stress may intensify symptom development.

DISEASE CYCLE The pathogens overwinter in infected trees and are spread by the native elm bark beetle, the European elm bark beetle, and through root grafts. Beetles breed under the bark of dying or dead elm trees, including diseased trees. Hatching larvae feed on the inner bark and sapwood and form a distinct gallery network. *Ophiostoma* spp. grow in those galleries and spores attach to the adult beetles as they emerge to fly to new trees. As the beetles feed on new elm trees, spores are transferred to xylem vessels of trees where they germinate and grow into the water-conducting system. Root grafts, the connection of infected roots with healthy roots, can spread the disease by transferring infected water to healthy trees.

MANAGEMENT Plant only resistant varieties. Starting mid-June, scout for any flagging in the upper canopy. Immediately prune out and destroy any symptomatic branches and check for vascular discoloration. Disinfect pruning tools between cuts with 70% ethyl alcohol or a standard household disinfectant spray. High value trees may be treated with fungicide injections. Contact your local Extension professional for specific recommendations.

A Branch dieback on elm tree due to Dutch elm disease. **B** Dieback of young shoot on an elm tree. **C** Brown discoloration of infected wood underneath bark. **D** Feeding galleries of bark beetle larva in wood.


A
B
C
D

Fire Blight

Erwinia amylovora (bacterium)

HOST Fire blight affects plants in the Rosaceae family including apple, pear, crabapple, mountain-ash, hawthorn, and cotoneaster

DAMAGE/SYMPTOMS Infected blossoms develop a water-soaked appearance and turn a grey-green color. Over time the tissue shrivels and turns black, giving it a burned appearance. During periods of high humidity, amber colored drops might exude from the discolored tissues. Infected shoots may wilt rapidly and form a "shepherd's crook." Leaves on infected branches turn brown to black and may persist on the branches during fall and winter. Sunken cankers may also develop on branches.

DISEASE CYCLE The bacteria overwinter in cankers and ooze out of infected tissues in spring when the humidity is high. Insects are attracted to the ooze and transfer the bacteria to flowers. The bacteria can also be transferred by splashing rainwater and during cultural practices (e.g., pruning). The bacteria grow when temperatures are between 70 to 80°F, multiplying and invading surrounding plant tissues.

MANAGEMENT Select disease-resistant cultivars. Prune out and remove all infected twigs and branches during dry winter weather. Make the pruning cut 10 to 12 inches below the infected area. Disinfect pruning tools between cuts with 70% ethyl alcohol or a standard household disinfectant spray to avoid spreading the bacteria. Check plants regularly in spring and prune out symptomatic tissues. Copper sprays can be applied in early spring, just before buds swell, to manage this disease. Avoid using copper products every year and strictly follow instructions on the product label. Antibiotic spray applications are not recommended in the urban setting.

A Bacteria oozing out of infected plant tissue. **B** Tree branch is turning black with progressing fire blight infection. **C** Dark, sunken canker indicates a fire blight infection. **D** Dieback of branches due to fire blight infection.


A
B
C
D

Kabatina Tip Blight

Kabatina juniperi (fungus)

HOST Primarily juniper

DAMAGE/SYMPTOMS Symptoms appear in early spring. Small, black fruiting bodies appear on at least one-year-old tissues. Dieback begins on shoot tips and progresses back toward the main stem. Tips of affected branches turn yellow or brown and drop their foliage in late spring. New infections occur later in the fall when *Kabatina* sp. spores enter the plants through wounds.

DISEASE CYCLE The fungus overwinters in infected branches. Fruiting bodies produce spores which cause new infections on at least one-year-old growth in the fall. Symptoms of infection become visible in the next spring. Stressed plants are more prone to infection.

MANAGEMENT Plant resistant juniper species whenever possible. Provide good spacing between plants to increase air circulation and avoid overhead irrigation and wounding of plants. Prune out and discard affected branches/shoots during dry weather. Make the cut about two inches into the healthy wood and disinfect your pruning tools with 70% ethyl alcohol or a standard household disinfectant spray before each cut to minimize spreading the disease.

A Browning of young tips on juniper. **B** Browning and emerging fungal fruiting bodies on juniper. **C** Mature, dark fruiting bodies on dying plant tissue.


A


B


C

Marssonina Leaf Spot

Marssonina spp. (fungus)

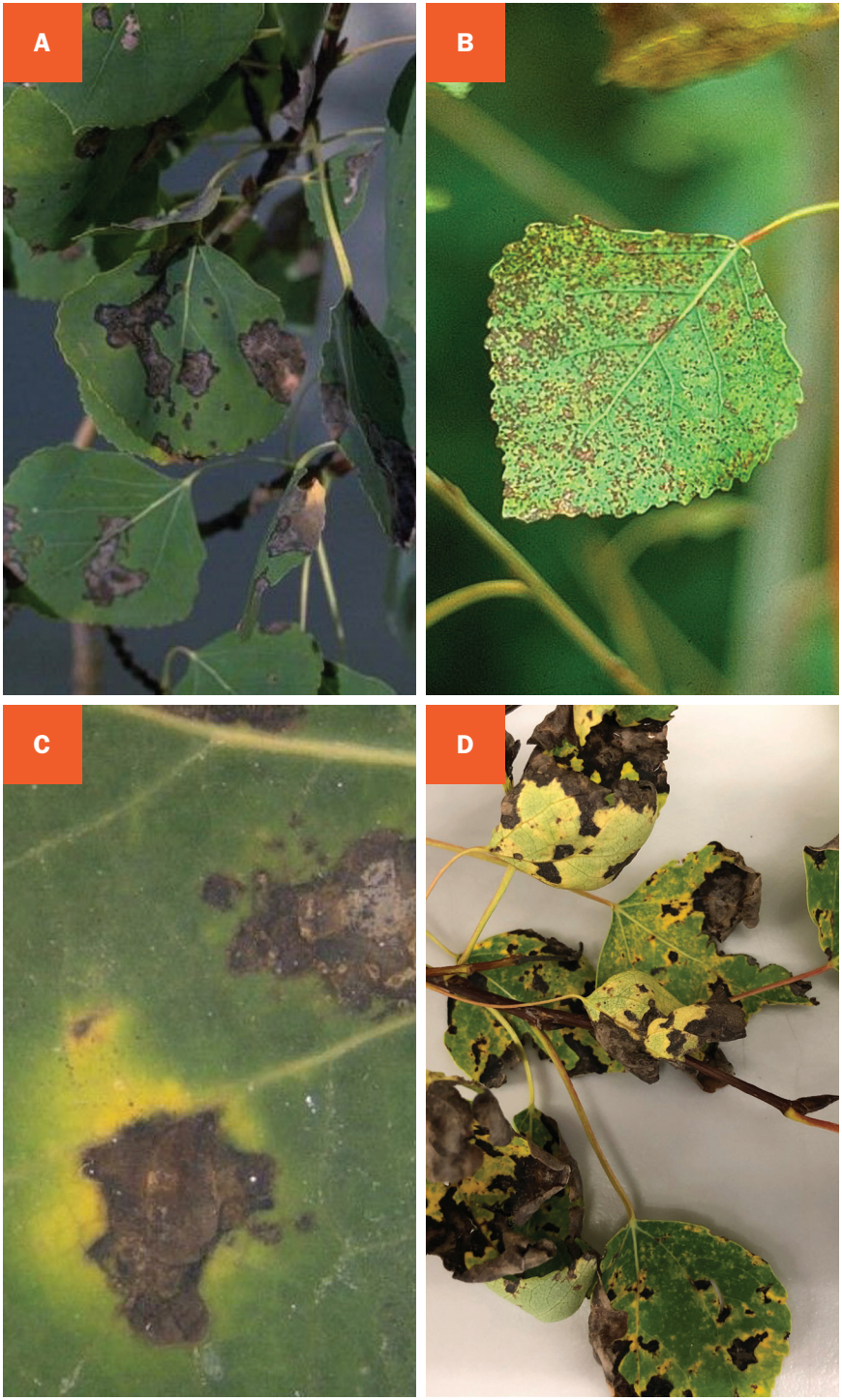
HOST Aspen, cottonwood, willow

DAMAGE/SYMPTOMS In spring, small dark-brown spots, often with yellow margins, develop on young leaves. The spots may coalesce to form larger lesions on leaves. Leaves may be stunted and drop prematurely. Young shoots are also susceptible to infection and may show lesions. Infections over several consecutive years will weaken the tree.

DISEASE CYCLE The fungus overwinters in infected leaf debris on the ground and infected shoots. In spring, spores are produced on previously infected tissues and dispersed by wind and rain, infecting new leaves. Infection is most severe under wet conditions. A second set of spores is produced on the newly infected leaf spots in late summer which infect adjacent leaves. This secondary infection is more severe under warm and moist conditions.

MANAGEMENT This disease may be unsightly, but it typically does not cause severe damage. Remove infected leaves that fall onto the ground and prune out affected shoots to reduce the level of infection. Disinfect pruning tools with 70% ethyl alcohol or a standard household disinfectant spray between cuts. Avoid wetting the foliage for prolonged times. Fungicides are not usually recommended unless the disease is a continuing problem. High value trees can be treated with a fungicide application in early spring when the buds start to swell. Applications may have to be repeated at 10- to 14-day intervals in spring as long as wet weather conditions continue. Products with the active ingredient chlorothalonil are effective in controlling this disease. Strictly follow instructions on the pesticide labels.

A Brown to tan spots on aspen leaves. **B** Brown leaf spots with yellow margins. **C** Close-up of *Marssonina* spp. leaf spots with distinct yellow margin. **D** Large necrotic areas on leaves due to *Marssonina* spp. infection.


A
B
C
D

Nectria Canker

Nectria spp. (fungus)

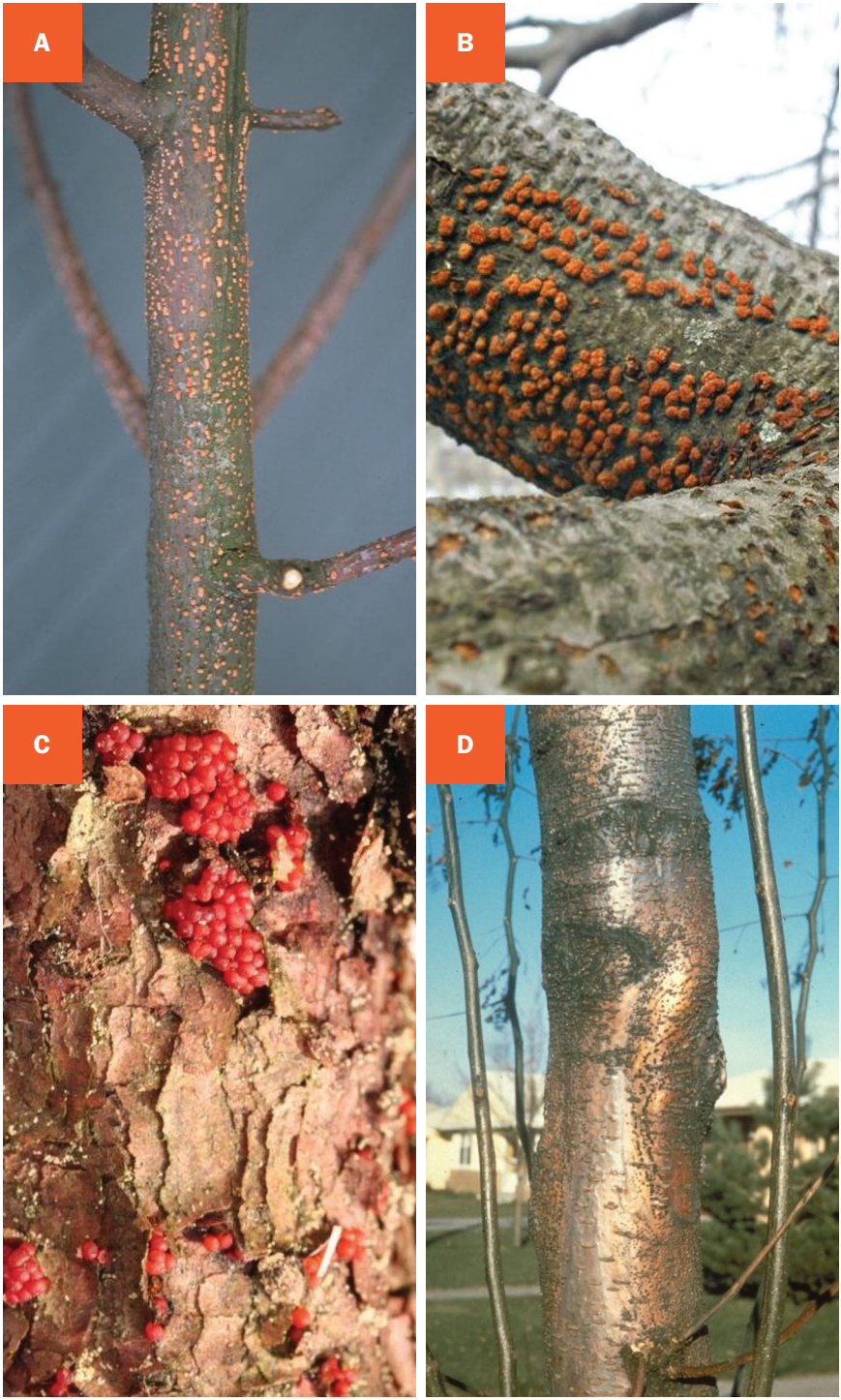
HOST Elm, honeylocust, maple, cotoneaster

DAMAGE/SYMPTOMS Following infection in spring, leaves and shoots of twigs and branches wilt. Cankers develop on branches and twigs and girdle the tissues from within, resulting in dieback. Clusters of spherical orange-colored fungal fruiting bodies (coral spots) emerge from infected bark. This disease can significantly damage newly planted, as well as established trees and shrubs.

DISEASE CYCLE *Nectria* spp. survives in canker tissue where fruiting bodies are produced. Spores emerge from the fruiting bodies and infect through wounds or weakened plant tissue. Stressed plants are especially susceptible. Infections result in the formation of cankers and in dieback of leaves, shoots, and branches.

MANAGEMENT Support plant health by providing adequate water and nutrients during the season. Avoid wounding plants. Remove and dispose of affected branches during dry weather. Disinfect pruning tools after each cut with 70% ethyl alcohol or a standard household disinfectant spray. Infections in the next season may be reduced by applying a fixed copper-containing fungicide to affected trees in early fall when leaves begin to drop.

A Coral-colored fungal fruiting structures on branch. **B** Tree severely infected by nectria canker. **C** Close-up of coral-colored fruiting bodies. **D** Canker development on tree trunk.


A
B
C
D

Oak Leaf Blister

Taphrina caerulescens (fungus)

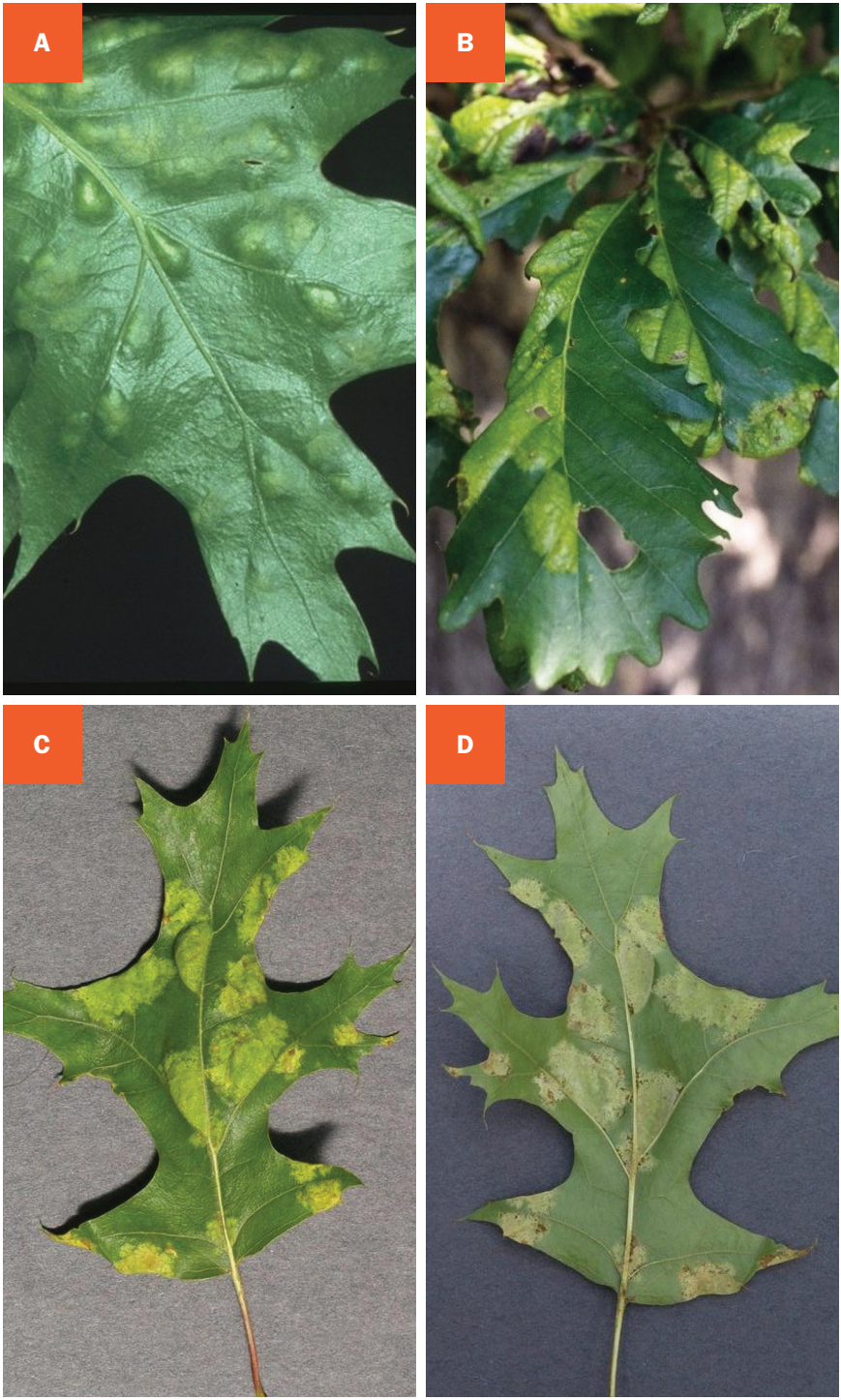
HOST Oak

DAMAGE/SYMPTOMS Symptoms appear early in the summer as blisters, bulges, or depressions on the upper leaf surface. The lower side of the leaves turns a grayish color in affected areas. The blistered areas may merge and change color from yellow to brown over time. Infection may also result in leaf distortion. Mature leaves are usually resistant to infection.

DISEASE CYCLE The fungus overwinters in infected buds, bud scales, and leaf debris. Spores are dispersed in spring and infect newly emerging leaves just after bud break. Infection is most severe under cool, wet conditions. Blisters form on the leaves and produce new spores by midsummer.

MANAGEMENT This disease may be unsightly, but it typically does not cause severe damage. Remove infected leaves that fall onto the ground to reduce the level of infection. Avoid wetting the foliage for prolonged times. Fungicides are not usually recommended unless the disease is a continuing problem. High value trees can be treated with a fungicide application in early spring when the buds start to swell. Products with the active ingredient chlorothalonil are effective in controlling this disease. Strictly follow instructions on the pesticide labels.

A Young blisters appear on leaves after infection. **B** Large areas on leaves affected by oak leaf blister disease. **C** Blisters on upper surface of an oak leaf. **D** Gray-green areas of blisters on the lower surface of an oak leaf.


A
B
C
D

Phomopsis Tip Blight

Phomopsis juniperovora (fungus)

HOST Creeping and Rocky Mountain junipers, Douglas-fir, fir, arborvitae, larch

DAMAGE/SYMPTOMS In spring, small grayish lesions appear on the terminal four to five inches of the newest shoots. The lesions enlarge and may girdle and kill the new shoots. Infected branches turn from green to reddish-brown to a grayish color. Small, black, fungal fruiting bodies can be found on the dead branches. This disease can kill the entire plant.

DISEASE CYCLE The fungus survives in infected branches. Spores can be produced in fruiting bodies throughout the growing season, depending on favorable weather conditions. While most infections occur in springtime during wet weather and when new shoots grow, late summer infections may appear when plants are water stressed and over fertilized.

MANAGEMENT Plant resistant juniper species. Prune out and discard affected branches/shoots during dry weather. Make the cut about six inches below visible symptoms and disinfect pruning tools with 70% ethyl alcohol or a standard household disinfectant spray before each cut to minimize spreading the disease. Fungicides with the active ingredient copper or mancozeb can be applied starting in spring when new shoots are growing. Multiple applications may be necessary depending on the weather conditions and the selected product.

A Browning tips on juniper shrub. **B** Dieback on young evergreen plants.
C Close-up of shoot dieback. **D** Dark fungal fruiting bodies on dead plant tissue.


A
B
C
D

Powdery Mildew

Various host-specific fungi

HOST Apple, lilac, oak, chokecherry, caragana, honeysuckle, clematis, Virginia creeper, ninebark

DAMAGE/SYMPTOMS The fungus covers buds, flowers, leaves, and fruits with a white, dusty mat. Young leaves are frequently more severely affected. Infected leaves may be distorted and yellow and may fall prematurely. In late summer, small, dark, round fruiting bodies of the fungus might be visible on the lower side of leaves. Infected fruit has a network of lines which is often referred to as russeting.

DISEASE CYCLE The fungus overwinters in buds and infected plant debris. In spring, spores germinate and invade the newly emerging leaves and flowers. Infected blossoms turn brown and shrivel. Emerging leaves are often completely covered with a white mat and appear distorted and curled. When conditions are moist, multiple cycles of infection occur. Infections of expanded leaves have round, cottony patches on the surface. Infected leaves are prematurely shed from the tree.

MANAGEMENT Plant resistant varieties. Consider healthy pruning of affected trees to promote good air circulation and light penetration. Dormant pruning of infected twigs will reduce inoculum for the next growing season but is only slightly effective. It is often not practical to prune since there are no obvious symptoms visible. Chemical control should begin when buds start to open and new inoculum is released. Fungicides containing wettable sulfur or myclobutanil provide control, but sulfur can result in leaf burn. Potassium bicarbonate products provide organic alternatives to chemical fungicides.

A Oak leaves covered with powdery mildew. **B** White mycelium and dark fruiting bodies (cleistothecia) on oak leaf. **C** Close-up of young and mature cleistothecia. **D** Symptom of russeting on apple fruit.


A
B
C
D

Rhabdocline Needle Cast

Rhabdocline weirii (fungus)

HOST Douglas-fir

DAMAGE/SYMPTOMS In late summer to fall, yellow/brown spots appear on the upper and lower sides of needles that were infected in the current year. The spots enlarge and turn reddish-brown by late winter or early spring. Margins of the splotches are very distinct. Needles on lower branches are more severely affected. Infected needles turn brown over time and are dropped prematurely. Trees express reduced vigor and are prone to insects and other plant pathogens.

DISEASE CYCLE The fungus overwinters in infected needles. During wet weather in spring, the fungus produces fruiting bodies under the epidermis of spots. Under wet and cool conditions, the epidermis of affected tissues splits lengthwise and masses of spores are released. The spores are dispersed by wind and rain and infect newly emerging needles.

MANAGEMENT Plant resistant varieties in full sun whenever possible. Prune out and discard infected branches during dry weather. Disinfect pruning tools between cuts with 70% ethyl alcohol or a standard household disinfectant spray. Affected trees can be treated with fungicides containing the active ingredient copper hydroxide, copper sulfate, mancozeb, or thiophanate-methyl. Apply fungicides in spring when new needles have grown half their mature length. A second treatment should be applied three to four weeks later when new needles are full grown. Depending on the weather conditions and the product used, a third application might be necessary. Strictly follow instructions on the pesticide labels. Fungicide applications will not cure infected needles but will prevent new infections.

A Epidermis of affected needle tissues splits lengthwise. **B** Close-up of split epidermis. **C** Browning needles on Douglas-fir. **D** Brown spots on infected needles.


A
B
C
D

Rhizosphaera Needle Cast

Rhizosphaera kalkhoffii (fungus)

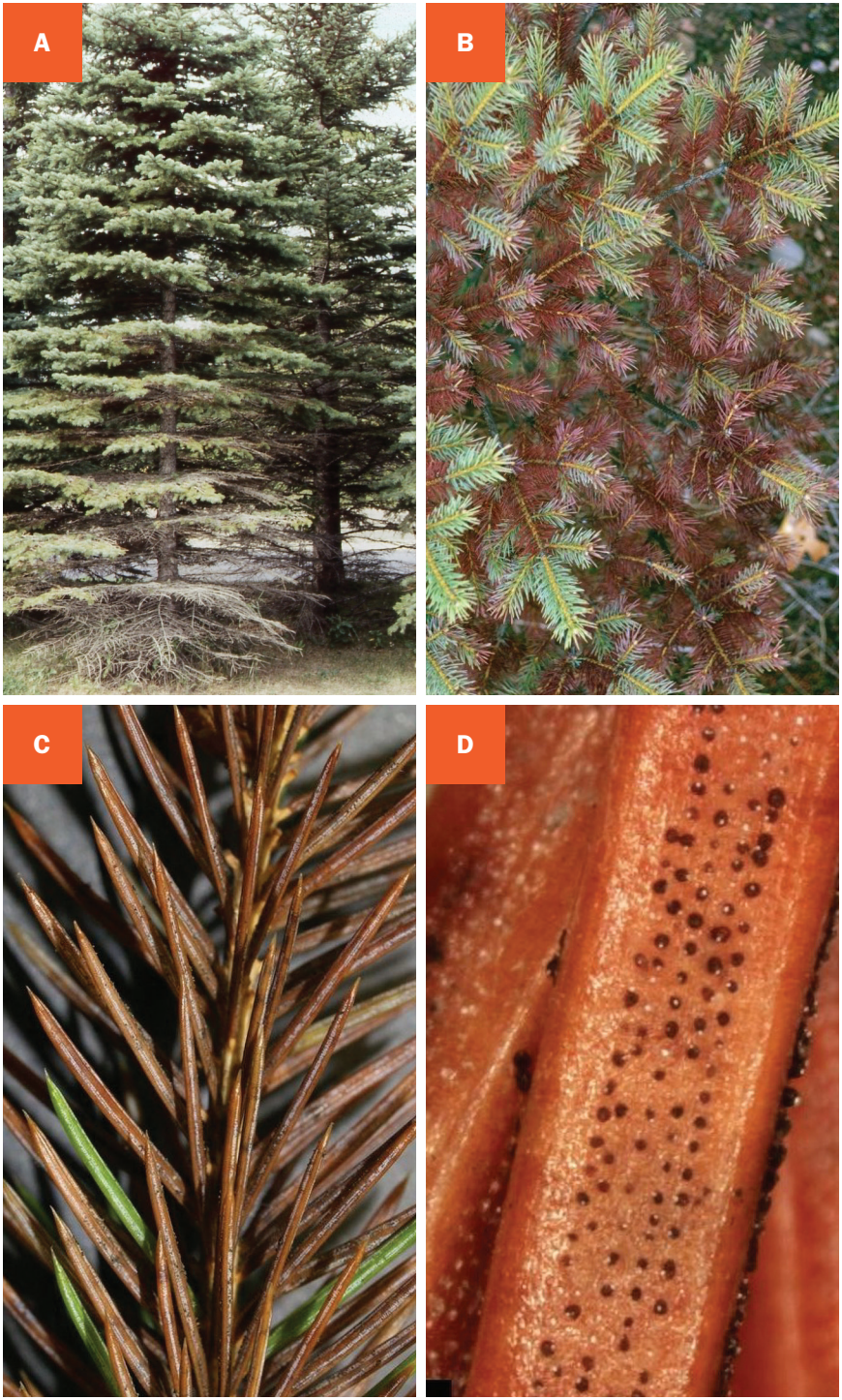
HOST Colorado blue spruce, Engelmann spruce, Douglas-fir, fir, pine, Western hemlock

DAMAGE/SYMPTOMS In spring or early summer, older innermost needles turn brown to purple while younger needles at branch tips stay green. Small, black spheres (fruiting bodies) emerge in rows out of stomata of infected needles. Infected, discolored needles fall off in late summer or fall. Symptoms are more severe on lower branches. The branches of affected trees thin over time.

DISEASE CYCLE The fungus overwinters in infected needles still living on the tree and in needles on the ground. Starting in spring, spores are released throughout the growing season from the black fruiting bodies and distributed to new needles by wind and splashing water. New needles are infected during mild and wet weather. Old needles may be infected due to high pathogen pressure and favorable environmental conditions. Affected needles are dropped approximately 12 months after initial infection.

MANAGEMENT Rake up infected needles and prune out and dispose of affected branches to reduce the disease source. Disinfect pruning tools between cuts with 70% ethyl alcohol or a standard household disinfectant spray. Provide good spacing between trees to optimize air circulation. Re-direct sprinklers to avoid hitting the tree canopy during irrigation. Affected trees can be treated with fungicides containing the active ingredient copper hydroxide or chlorothalonil. These fungicides can only protect new needles, as infected needles can't be cured. Apply fungicides in spring when new needles have grown half their mature length. A second treatment should be applied three to four weeks later when new needles are full grown. Strictly follow instructions on the pesticide labels.

A Spruce tree affected by rhizosphaera needle cast disease. **B** Bronze-brown colored older needles. **C** Dark fungal fruiting bodies emerge out of infected needles. **D** Dark, round fruiting bodies emerge out of stomata of infected needles.


A
B
C
D

Shot Hole Blight or Coryneum Blight

Wilsonomyces carpophilus (fungus)

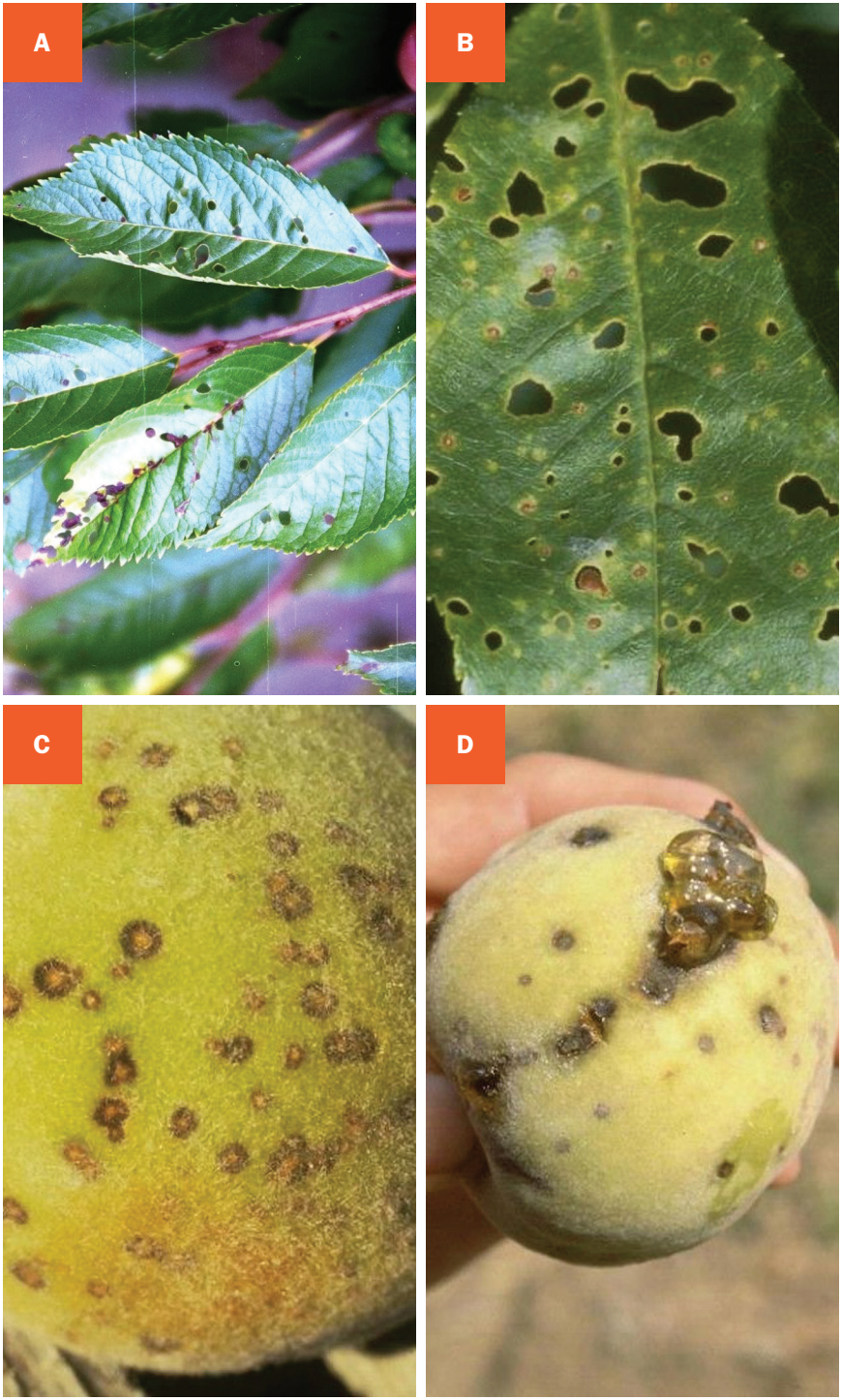
HOST Stone fruit trees including cherry, apricot, peach, and almond (ornamental)

DAMAGE/SYMPTOMS Leaf infection in spring results in small, round, purplish to brown lesions. The spots may enlarge, and the infected leaf tissue can drop out of the leaf blade, leaving a "shot hole." Cankers develop after infection and may result in killing of the twig. Infected buds are darker than healthy ones and may show gummosis. Infection of fruits starts as small purple spots which can enlarge to grayish lesions and may show gumming. Severe infection will result in fruit loss.

DISEASE CYCLE The fungus overwinters in canker tissue on twigs and in infected buds. Spores are released during rainy periods in spring and infect new buds. Susceptible tissues can also be infected later in the season if the weather conditions are favorable for the pathogen.

MANAGEMENT Effective control measures include pruning out and destroying of infected branches during the dormant season. Disinfect pruning tools between cuts with 70% ethyl alcohol or a standard household disinfectant spray. Use low-volume sprinklers or drip irrigation to avoid wetting the foliage. In fall after leaf drop, consider applying a fixed copper or chlorothalonil product to protect buds during the dormant season. High value plants can be re-treated in spring before buds start to swell. Strictly follow instructions on the pesticide labels.

A Infected leaf tissue drops out of leaves, leaving "shot holes" behind. **B** Brown leaf spots and shot holes on leaves following infection. **C** Shothole disease causes spots on infected fruits. **D** Spots and gumming on infected fruit.


A
B
C
D

Stigmina Needle Cast

Stigmina lautii (fungus)

HOST Colorado blue spruce, black spruce, white spruce, Norway spruce

DAMAGE/SYMPTOMS Symptoms are very similar to Rhizosphaera needle cast. In spring or early summer, older needles on mainly the lower branches turn yellow to brown. Small, black fuzzy-looking fruiting bodies emerge in rows out of stomata of previous season's needles. Discolored needles fall off in late summer or fall one to two years after infection. This disease results in severe thinning of the needles on the lower branches.

DISEASE CYCLE The fungus overwinters in infected needles on the tree and on the ground. In spring, during mild and wet weather, spores are released from the black fruiting bodies and distributed by wind and splashing water to newly emerging needles. Infected needles are dropped approximately one to two years after initial infection.

MANAGEMENT Plant trees that are well adapted to your area. Rake up infected needles and prune out and dispose of affected branches to reduce the disease source. Disinfect pruning tools between cuts with 70% ethyl alcohol or a standard household disinfectant spray. Provide good spacing between trees and avoid hitting the tree canopy during irrigation. Affected trees can be treated with fungicide containing the active ingredient copper or chlorothalonil to protect newly emerging needles. Apply fungicides in spring when new needles have grown half their mature length. A second treatment should be applied three to four weeks later when new needles are full grown. Strictly follow instructions on the pesticide labels.

A Spruce tree branches affected by stigmina needle cast disease. **B** Dark, round fruiting bodies with hair-like tendrils sporulate on needle. **C** *Stigmina* sp. spores.


A
B
C

Sudden Needle Drop

Setomelanomma holmii (fungus)

HOST Colorado blue spruce, white spruce, Norway spruce

DAMAGE/SYMPTOMS Older needles turn yellow and/or brown and are shed by fall. Only newest needles may stay green at the tip of branches. Affected branches may be scattered throughout the tree. The canopy of affected trees may thin out over time.

DISEASE CYCLE This problem only affects stressed trees. The fungus overwinters in infected branches. Small, black fruiting bodies can be found on the branches, bud scales, and on the woody tissue at the base of needles but not on/in the needles. Since this is a relatively new problem, not many details are known about its life cycle.

MANAGEMENT Control measures applied to control Rhizosphaera needle cast disease appear to manage sudden needle drop as well. Provide good spacing between trees to optimize air circulation. Re-direct sprinklers to avoid hitting the tree canopy during irrigation. Affected trees can be treated with a fungicide containing the active ingredient copper or chlorothalonil. Apply fungicides in spring when new needles have grown half their mature length. A second treatment should be applied three to four weeks later when new needles are full grown. Strictly follow instructions on the pesticide labels.

A Spruce tree affected by needle cast disease. **B** Dark fruiting bodies emerge on branches. **C** Close-up of fruiting bodies.


A


B


C

Swiss Needle Cast

Phaeocryptopus gaeumannii (fungus)

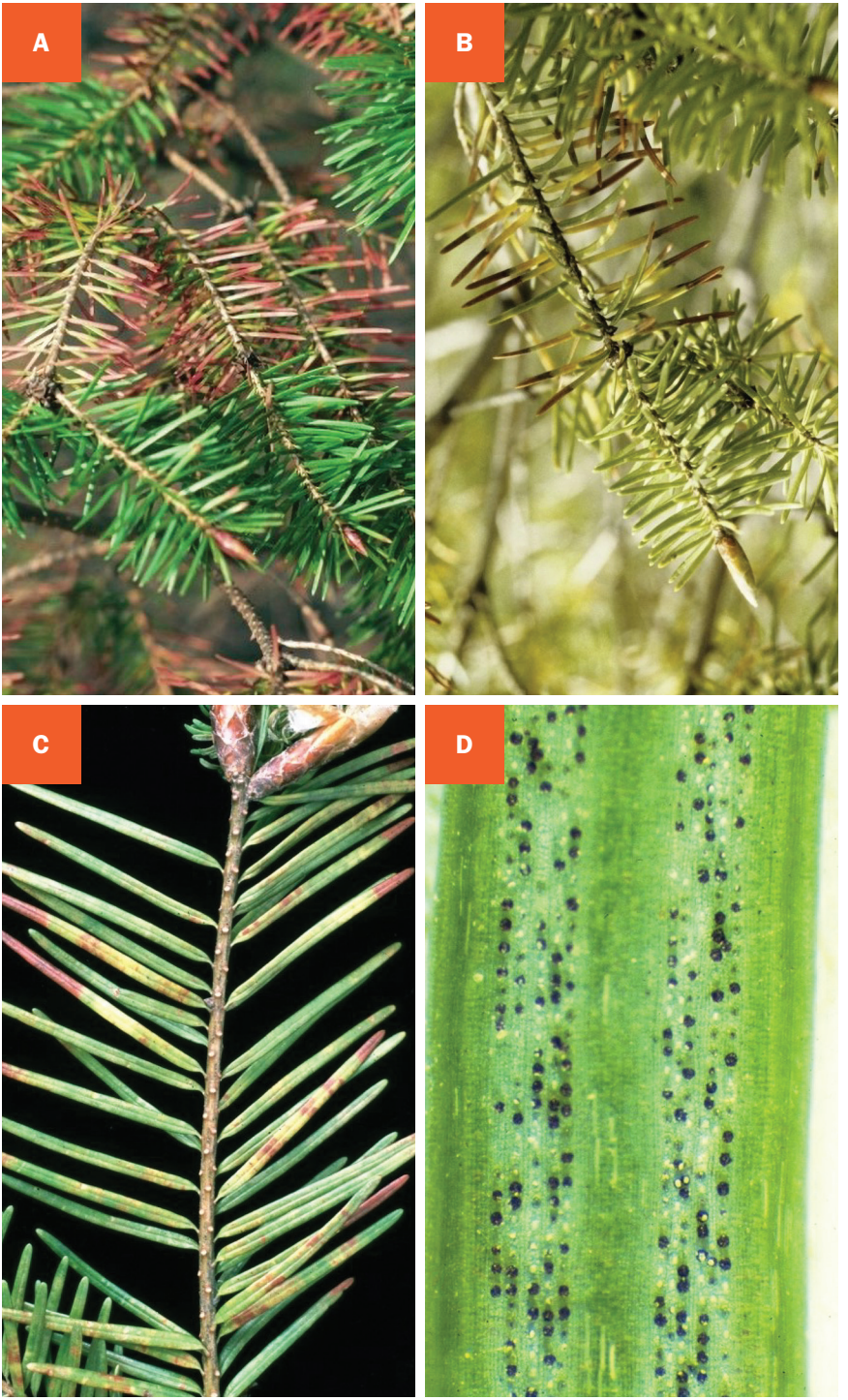
HOST Douglas-fir

DAMAGE/SYMPTOMS Infected needles turn a dull green or yellow color, followed by browning of the needle tips. Older needles are usually more severely affected. Small, black spheres (fruiting bodies) emerge in parallel rows on the lower surface of infected needles. Brown needles drop over time with only the newest needles remaining on the tips of branches.

DISEASE CYCLE The fungus overwinters in infected needles. In spring, spores are released from the black fruiting bodies and distributed to newly emerging needles by wind and splashing water. New needles are primarily infected during cool, wet weather. After infection, needles may remain on the tree and produce spores for several seasons before being dropped.

MANAGEMENT Rake up infected needles and prune out and dispose of affected branches to reduce the disease source. Disinfect pruning tools between cuts with 70% ethyl alcohol or a standard household disinfectant spray. Provide good spacing between trees to optimize air circulation. Re-direct sprinklers to avoid hitting the tree canopy during irrigation. Affected trees can be treated with a fungicide containing the active ingredient chlorothalonil or mancozeb. Fungicides can only protect new needles; infected needles can't be cured. Apply fungicides in spring when new needles have grown half their mature length. A second treatment should be applied three to four weeks later when new needles are full grown. Strictly follow instructions on the pesticide labels.

A Browning needles on Douglas-fir. **B** Discolored, infected needles. **C** Brown spots and yellowing of infected needles. **D** Dark fruiting structures emerge out of stomata of infected needles.


A
B
C
D

Venturia Leaf and Shoot Blight

Venturia populina (fungus)

HOST Eastern cottonwood, Lombardy poplar, aspen

DAMAGE/SYMPTOMS In late spring, black, necrotic areas develop on leaves and shoots which may be mistaken as frost damage. The rapid dieback of shoots leads to drooping branch tips often referred to as a "shepherd's crook." Young and immature shoots are very susceptible. Necrotic leaf areas and affected shoots may be covered in olive-green spores. This disease is most severe on young trees. Recurring infection may lead to stunted and misshapen trees.

DISEASE CYCLE The fungus overwinters in infected shoots. During wet spring weather, spores are produced in infected plant tissues and dispersed by splashing rain and wind. New infections start as black leaf spots or necrotic tissue at leaf margins. Necrotic areas increase quickly and may kill leaves and/or shoots.

MANAGEMENT Prune out and dispose of infected shoots during dry weather. Make the pruning cut at least eight inches below the symptomatic area. Disinfect pruning tools with 70% ethyl alcohol or a standard household disinfectant spray before each cut to minimize spreading the disease. Avoid overhead irrigation to reduce leaf wetness. Focus on supporting plant vigor by providing adequate water and nutrients. Consider planting resistant varieties.

A Blackening and shepherd's crook on aspen shoot. **B** Dieback of young shoot affected by *Venturia* sp.


A


B

Western Gall Rust

Endocronartium harknessii (fungus)

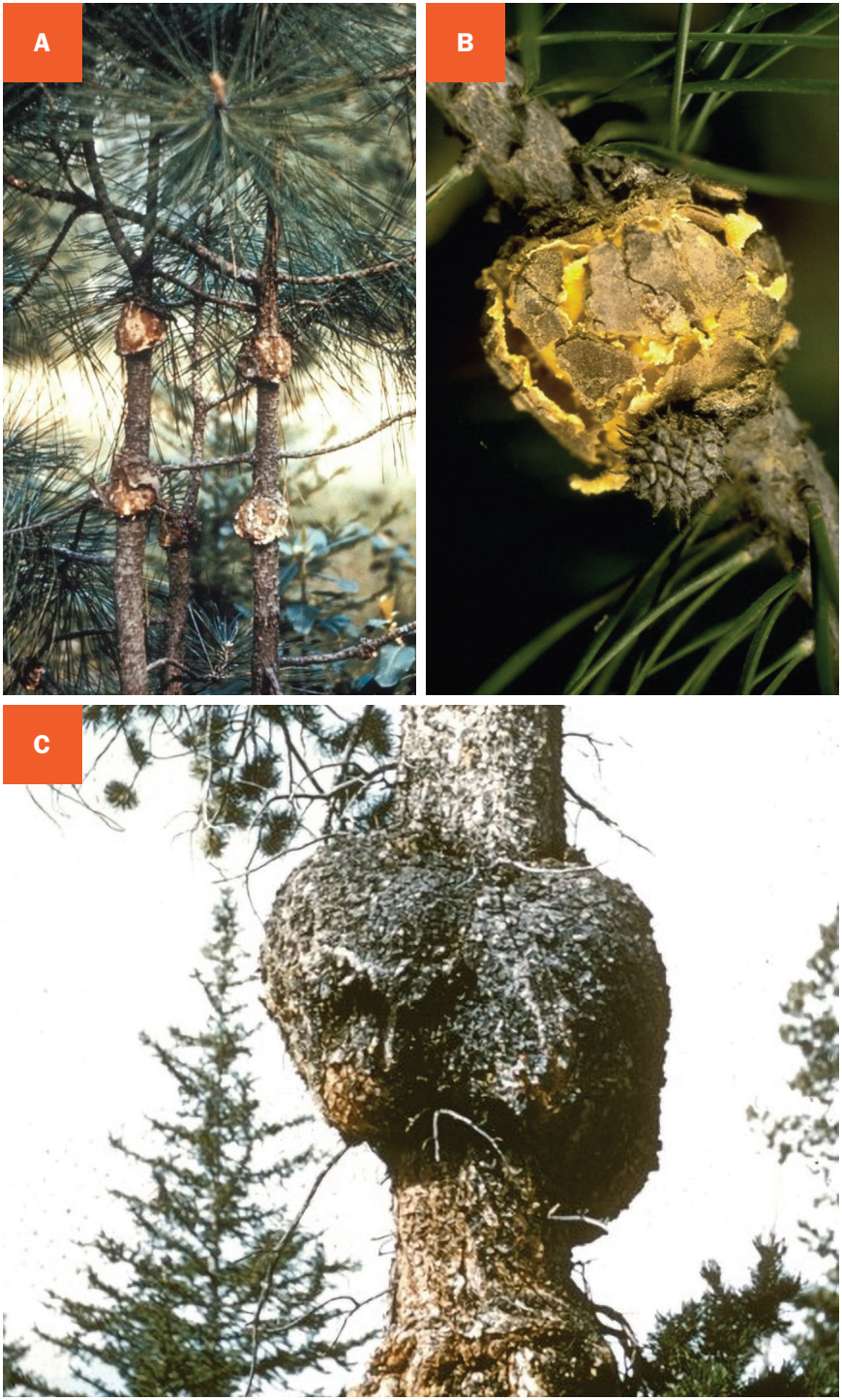
HOST Two- and three-needle pines like lodgepole pine, Mugo pine, Scots pine, Austrian pine, Ponderosa pine

DAMAGE/SYMPTOMS Rough, spherical galls develop on branches or trunks. Yellow to orange spores are produced on galls in late spring. Foliage of affected limbs may become stunted beyond the galls. Affected tree limbs are more prone to breakage where the galls grow. This disease may kill young trees but on mature trees, galls can grow and expand for many years. Severely affected limbs will die over time.

DISEASE CYCLE This fungus doesn't require an alternate host to complete its life cycle. In late spring, during shoot elongation, yellow to orange spores are produced on the galls and dispersed by wind and splashing rain and infect new shoots. Shoots are prone to infection from budbreak through shoot elongation.

MANAGEMENT Remove affected trees whenever possible, especially if their structural stability becomes compromised. Prune out and remove infected branches during the dormant season (October to January). Disinfect pruning tools between cuts with 70% ethyl alcohol or a standard household disinfectant spray. Fungicide applications are not recommended in urban areas.

A Young galls on pine trees. **B** Bright yellow to orange spores on gall.
C Mature galls on older tree.


A
B
C