CONTROL MEASURES FOR DISEASES OF SPECIFIC PLANTS

The page numbers under each disease name refer to information and illustrations in *Diseases of Trees and Shrubs* by W. A. Sinclair, H. H. Lyon, and W. T. Johnson (1987, Cornell University Press, Ithaca, NY. ISBN 0-8014-1517-9. To order, call 1-800-666-2211).

Individual fact sheets with linked photographs of much of the information below can be found by going to the Penn State home page on the Web (www.psu.edu), clicking on Search, and typing in the name of the plant followed by "diseases" into Search the Penn State site. (Example of a keyword search: dogwood diseases.)

AMELANCHIER (SHADBUSH, SERVICEBERRY)

Disease	Symptoms	Pathogen/Cause	Management
Fire blight (p. 162)	Infected flowers are killed and often remain attached throughout the season. The ends of twigs and branches become brown or black and may curl over into a shepherd's crook shape. Dead leaves may remain attached to the tree. Cankers formed the previous season may ooze a cloudy liquid during wet spring weather. Branches will be killed as slightly sunken cankers enlarge into larger branches and even into the main trunk.	*Erwinia amylovora*	During dormancy when the weather is dry, prune infected branches, cutting at least 4 inches below the base of the canker. Disinfest pruning tools frequently. Fertilize carefully to avoid promoting excessive succulent growth. Remove root suckers and water sprouts while they are small. Remove nearby unwanted plants that are susceptible to fire blight.
Rust (pp. 242–248)	Brownish-orange spots up to ¼ inch in diameter form on leaves. These spores spread to and infect junipers.	*Gymnosporangium* spp.	Do not plant close to junipers. Remove unwanted junipers from the vicinity. Apply myclobutanil.
Witches' broom (p. 20)	Abnormal numbers of shoots develop along branches. Black fungal growth coats the undersides of leaves.	*Apiosporina*	No control is recommended.

ARBORVITAE

Disease	Symptoms	Pathogen/cause	Management
Branchlet death (p. 498)	The oldest branchlets turn brown in autumn and fall off.	Normal browning.	Branchlets rather than scale leaves are shed in autumn as a normal part of the plant's development.
Kabatina twig blight (p. 138)	Tips of one-year-old branches die and turn brown or ash gray. These remain on the shrub for many months. Larger branches can be invaded and girdled. On the dead tissue where it meets the still-living wood, small, black, pimple-like fungal fruiting structures form. Microscopic examination reveals oval, colorless spores. See phomopsis below.	*Kabatina thujae*	Prune and destroy infected twigs and branches. Both kabatina and phomopsis twig blight can occur on the same plant. Apply mancozeb to protect the foliage.
Pestalotiopsis tip blight (p. 128)	Twig tips turn tan to brown in color and have black, pimple-like fungal fruiting structures dotting their surface.	*Pestalotiopsis funerea*	Protect plants from winter injury, drought, and other stresses. Apply copper to protect foliage.
Phomopsis twig blight (p. 138)	Tips of branches die and turn brown or ash-gray. These remain on the shrub for many months. Larger branches can be invaded and girdled. On the dead tissue where it meets the still-living wood, small, black, pimple-like fungal fruiting structures form. Microscopic examination reveals both oval and long, thread-like colorless spores. See kabatina above.	*Phomopsis juniperovora*	Prune and destroy infected twigs and branches. Both kabatina and phomopsis twig blight can occur on the same plant. Apply thiophanate methyl when new growth is present.

ASH

Disease	Symptoms	Pathogen/cause	Management
Anthracnose (p. 106)	Young unfolding leaves are distorted and develop greenish-brown to dark-brown spots at their tips, along their margins, and between the veins. When fully expanded leaves are attacked, light-brown to tan blotches form. Severely infected leaves fall prematurely. Infected young twigs are girdled and killed. Disease severity is greatest on the lower branches. Fungal fruiting structures (acervuli) form in the infected tissues and are only slightly darker in color than the spots. A magnifying glass is required to find the acervuli in the spots.	*Gloeosporium aridum*	Remove and destroy infected twigs and branches during dormancy. Rake and remove fallen leaves in the autumn. Apply chlorothalonil, mancozeb, or thiophanate methyl + mancozeb as the young leaves and twigs are forming to protect them against initial infections. Continued applications are required until the weather becomes dry and daily temperatures average above 65°F.

Disease	Symptoms	Pathogen/cause	Management
Decline (p. 446)	Tree growth slows. Tufts of numerous branches form. Branch dieback progresses until much of the tree is dead.	Exposed site; heavy, poorly drained soils; drought; canker-causing fungi, viruses, nematodes, and mycoplasma-like organisms combine to weaken and kill the tree.	Protect the tree from as many stresses as possible.
Ganoderma root rot (p. 334)	Branches dieback as a root rot develops. A very distinctive shelf-like fungus grows on the wood annually singly or in overlapping clusters. These shelves are brown to reddish brown on top with a cream to white margin and may become 14 inches across. The upper surface may appear to have been varnished.	*Ganoderma lucidum*	The appearance of the fungus on the tree is the last sign that the tree is severely diseased. Remove the tree immediately if it is in a location where falling limbs or the falling tree poses a threat to life or property.
Laetiporus root rot (p.346)	The bark is slightly depressed and cracked in areas on trees with dying limbs. Infected trees are very prone to wind breakage. Massive clusters of bright, sulfur-yellow to salmon to bright-orange, shelf-like fruiting structures that turn white with age initially form in the summer or autumn on the wood of the tree but fall off during the winter. The underside of the fruiting structure has tiny pores in which the spores are formed. New shelves form on the wood the following summer and autumn. Fruiting occurs long after most of the damage has been done.	*Laetiporus sulfureus* (formerly *Polyporus sulfureus*)	Remove the tree at the first sign of infection since it poses a very serious threat to life and property.
Rust (p. 252)	In the spring along the East Coast, yellow-orange spots form on the leaves of white and green ash. Leaves become distorted as orange fungal fruiting structures form on the underside of leaves and on petioles. Cankers form on twigs, and trees can be defoliated prematurely. The spores formed on ash blow to and infect *Spartina* (cordgrass) in salt marshes where the fungus overwinters.	*Puccinia sparangioides*	Apply chlorothalonil or mancozeb in the spring to protect young leaves and twigs of trees usually found with the disease. Trees usually free of the disease should not be sprayed.
Yellows (p. 394)	Twig and trunk growth slows to less than half of the growth rate before infection. Bud break is 1 to 2 weeks earlier than normal. Foliage appears to be in tufts because of the very short internodes. Witches' brooms may form. Leaves may be yellow and smaller than normal. Scattered branches die during the winter. Water sprouts form along branches or at ground level. Early fall leaf coloration is a common symptom. Highly susceptible trees die 1 to 3 years after infection.	*Phytoplasma*	Leafhoppers and spittlebugs carry the pathogen. Remove infected trees.

AZALEA AND RHODODENDRON

Disease	Symptoms	Pathogen/cause	Management
Botryosphaeria canker (pp. 172–174)	Rough, sunken, dark-brown areas form around wounds or natural openings in the bark. The wood of a recently killed branch is lighter brown than the pith. Dead bark falls off the cankered area. Leaves on affected branches wilt as affected branches die. Chocolate-brown cankers enlarge along the branch more quickly than around its circumference. Tiny black fungal fruiting structures that pepper the dead bark are most easily seen on the light tan bark.	*Botryosphaeria dothidea*	Irrigate plants to prevent drought stress, which predisposes the plants to this canker. Prune infected branches, cutting back to where growth will resume. Do not leave large stubs of nongrowing tissue. Disinfest the pruning shears frequently. No chemicals adequately control this disease. Rhododendron hybrids considered to have some resistance include Boursault, Cunningham's White, English Roseum, Lebar's Red, Roseum Elegans, and Roseum 2.

Disease	Symptoms	Pathogen/cause	Management
Botrytis blight (p. 60)	Small, water-soaked lesions develop on petals. Gray fungal growth covers infected petals.	*Botrytis cinerea*	Space plants to ensure good air circulation and to avoid excessively high humidity. Remove fading flowers and yellowing leaves. Apply chlorothalonil, copper, copper sulfate, cupric hydroxide, iprodione, fludioxanil, mancozeb, mancozeb + thiophanate methyl, or thiophanate methyl to protect healthy tissue.
Cercospora leaf spot (p. 88)	Circular to irregular brown spots up to 1/2 inch in diameter form on leaves, especially lower leaves. Spots may become tan in the center and may have a yellow halo. Dark-brown, pimple-like fungal fruiting structures form within the spots. Infected leaves may fall.	*Cercospora handelii*	Inspect new plants and do not use if found to be infected. Rake and destroy fallen leaves. Avoid overhead irrigation. Apply chlorothalonil, myclobutanil, cupric hydroxide, mancozeb + thiophanate methyl, or triadimefon to protect leaves before infection in the spring.
Cylindrocladium blight (p. 294)	Leaves turn brown to black and fall in 3 to 4 days. Stems have brown spots on which white masses of spores later form. Or roots die and plants wilt without having leaf spots form. Plants die rapidly.	*Cylindrocladium scoparium*	Rake and destroy fallen leaves. Use clean, disinfested tools. Remove severely infected plants. Apply thiophanate methyl as a soil drench (may be toxic to some cultivars) or triflumizole.
Leaf and flower gall (p. 26)	Young leaves and flowers become swollen, fleshy, and pale green. These become white due to the formation of spores by the fungus on the surface. Later, the galls become hard and brown. Infection occurs in the spring. The new spores formed on the surface of the galls are dispersed but do not cause more galls to form during that same season. They remain dormant until the following spring.	*Exobasidium vaccinii*	Remove and destroy all galls before they become white with new spores. If many plants had the disease in previous years and galls were too numerous to pick, apply mancozeb to protect new foliage and flowers as they emerge. Applications can cease when the leaves reach their full size.
Ovulinia petal blight (p. 58)	Pale-white to rust-colored spots form on petals. Spots enlarge rapidly. Petals become slimy and fall apart easily.	*Ovulinia azalea*	Remove crop debris. Water in a manner that keeps plant surfaces dry. Space plants to ensure good air circulation. Apply thiophanate methyl, chlorothalonil, mancozeb, mancozeb + thiophanate methyl, triadimefon, triforine, or myclobutanil as blossoms open. Chlorothalonil is phytotoxic to some cultivars.
Phytophthora root rot and top dieback (pp. 284–290)	Plants are stunted and wilted. Leaves yellow, and the entire plant eventually dies. Roots with few feeder roots die. Stem wood at the soil level has red-brown discoloration. In the top dieback phase, leaves have dark-brown spots. Shoots die from the tips back as dark-brown cankers form. No obvious fungal fruiting structures are formed. Compare these symptoms to those of botryosphaeria described above because these diseases are readily confused.	*Phytophthora* spp.	Purchase disease-free plants. Especially inspect southern-grown, containerized material before planting. Use clean, disinfested tools. Avoid overhead watering. Following a diagnosis confirming that the plant is infected, remove infected plants. To protect healthy plants, apply mefenoxam, etridiazole, etridiazole + thiophanate methyl, fosetyl-Al, metalaxyl, phosphates, potassium salts of phosphorus acid, or propamocarb. Fungicide applications to infected plants merely delay eventual death.
Powdery mildew (p. 16)	Faint yellow areas form on expanded leaves. White fungal growth forms on the yellow areas of some cultivars while only small dead spots with no fungal growth occur on other cultivars.	*Erysiphe polygoni* or *Microsphaera penicilata*	Apply azoxystrobin, chlorothalonil, cupric hydroxide, triflumizole, mancozeb + thiophanate methyl, myclobutanil, paraffinic oil, or triadimefon.
Rhizoctonia web blight (p. 94)	Small tan to black spots form on leaves and expand to engulf the entire leaf. Leaves fall. Webbing may develop. Small plants may die.	*Rhizoctonia solani*	Maintain good air circulation. Avoid late afternoon watering. Apply triflumizole, thiophanate methyl, chlorothalonil, fludioxonil, or iprodione.

BEECH

Disease	Symptoms	Pathogen/cause	Management
Bark disease (pp. 440–442)	Circular to horizontal elliptic cankers form on the bark. Cracks form in the cankered bark. As large areas of bark are affected, the tree is girdled and killed. White wooly specks observed on the bark in August are wooly beech scales. The fungus that invades after scale feeding forms red, pimple-like fruiting structures in the cankers.	*Cryptococcus* (Wooly beech scale) attacks the tree and opens wounds invaded by the fungus *Nectria.*	Control the wooly beech scale. There is no control of the fungus.

Disease	Symptoms	Pathogen/cause	Management
Bleeding canker (p.286)	Large cankers form on the major roots and trunk and may extend several feet up the trunk. The fungus enters wounds and succulent roots. Well-defined cankers have reddish-brown margins. Reddish-brown sap oozes from the cankers. Eventually, new leaves remain small and yellow and branches begin to die.	*Phytophthora* spp.	Remove the infected tree and do not replace it until the soil has been fumigated and aerated thoroughly.
Laetiporus root rot (p. 346)	The bark is slightly depressed and cracked in areas on trees with dying limbs. Infected trees are very prone to wind breakage. Massive clusters of bright, sulfur-yellow to salmon to bright-orange, shelf-like fruiting structures that turn white with age initially form in the summer or autumn on the wood of the tree but fall off during the winter. The underside of the fruiting structure has tiny pores in which the spores are formed. New shelves form on the wood the following summer and autumn. Fruiting occurs long after most of the damage has been done.	*Laetiporus sulfureus* (formerly *Polyporus sulfureus*)	Remove the tree at the first sign of infection since it poses a very serious treat to life and property.

BOSTON IVY (PARTHENOCISSIS)

Disease	Symptoms	Pathogen/cause	Management
Leaf spot (p. 80) (black rot)	Angular, reddish to gray-brown spots enlarge and turn brown at the margins with tiny, black fungal fruiting bodies in the spots. Dieback occurs if the plant is severely infected.	*Guignardia bidwelli* f. sp. *parthenocissi*	Avoid overhead irrigation. Apply thiophanate methyl before or soon after the plants have moisture on their leaves for 48 hours.

BOXWOOD

Disease	Symptoms	Pathogen/cause	Management
Decline	Stunted growth and dieback occur. Young foliage turns grayish green or bronze and finally straw colored. Old leaves fall prematurely. Middle or top branches die. Sunken cankers form at the soil line or on branches in the crotches where dead leaves accumulate. Wood under the sunken canker is blackened.	Attack by various fungi and nematodes adds to damage from winter injury and stress on plants, especially those in poorly drained sites.	Protect plants from winter injury and other stresses. Prune dead branches well below cankered areas. Remove dead leaves accumulated among the branches.
Leaf burn (p. 476)	Leaf tips and margins yellow and redden as leaves fall prematurely.	Water stress and low temperature.	Protect shrubs from drought and drying winds in the autumn and winter.
Leaf spot	Straw-yellow leaves are dotted with small, black fungal fruiting structures.	*Macrophoma candollei*	Only leaves weakened by winter injury are infected. Protect plants from wind, salt spray, and salt runoff.
Nematodes (pp. 298–302)	Growth is stunted, leaves have a bronzed appearance, and the shrub is in decline. Small roots have small brown dead areas which enlarge to engulf the entire root ends.	*Pratylenchus*	There are no adequate controls once the plant is infected. If a plant is removed, do not replace it with a nematode-susceptible plant unless the site is thoroughly fumigated and aerated first.

CATALPA

Disease	Symptoms	Pathogen/cause	Management
Leaf spot (pp. 90, 102–124)	Brown to black spots form on leaves. These spots may drop out or leaves may fall prematurely.	Many different fungi can cause spotting.	No control is recommended since little damage occurs.
Powdery mildew (p. 16)	White fungal growth develops on the upper surface of the lower leaves.	*Microsphaera* or *Phyllactinia*	No control is recommended since little damage occurs.
Verticillium wilt (p. 374)	Purplish to bluish-brown streaks are found under the bark in the sapwood of wilted branches. Wilting often develops on branches on one side of the tree.	*Verticillium*	Trees may die within a year or may survive to wilt to some extent every year. There are no effective controls. Do not replace a tree killed by verticillium wilt with another catalpa or other species susceptible to the disease.

CHERRY

Disease	Symptoms	Pathogen/cause	Management
Black knot (p. 152)	Dark-brown to black, hard swellings form on twigs and branches. At first these galls are small but continue to enlarge each year, becoming very rough. Each spring, galls are covered with dark, olive-green, felt-like growth. Branches may be girdled and die.	*Apiosporina morbosa*	Prune and destroy galls, cutting several inches below the gall whenever they are found but especially during dormancy. Remove unwanted *Prunus* species from the area. If the trunk or a large branch is affected, cut out the gall and also remove about 1 inch of wood around the gall.
Brown rot (p. 126)	Flowers collapse and brown quickly. Small cankers form on twigs and gum oozes out. Ripening fruits brown and shrivel as they become covered with tan to gray masses of spores. While many fruits fall, some shriveled mummies are left on the tree.	*Monilinia fructicola*	Apply chlorothalonil, cupric hydroxide, triforine, propiconazole, or ziram when blossoms first open and again at 70 to 90 percent bloom.
Coccomyces leaf spot (p. 66)	Circular, purple to reddish-brown spots up to 1/8 inch in diameter form on the leaf early in the summer and more spots develop as the season progresses. Spots may fall away, leaving a shot-hole appearance. Infected leaves yellow and fall prematurely.	*Blumeriella jaapii (Coccomyces)*	Apply propiconazole, myclobutanil or mancozeb + thiophanate methyl as leaves emerge in the spring.
Leucostoma canker (p. 198)	Branch dieback and multiple perennial cankers occur on infected trees. A gummy substance accumulates in the inner bark and erupts through cracks or lenticels in the bark. The gum becomes a blackened crust around the canker. Trees with freeze damage and those under drought stress are most susceptible.	*Leucostoma cincta or L. persoonii* (formerly *Cytospora*)	Infection can occur at any time of the year. When the tree is growing, it walls off the fungus. When tree growth slows or stops, the fungus continues invading. Prune cankered limbs and promote tree vigor.
Necrotic ring spot (pp. 408–410)	Leafing is delayed in the spring on individual branches or the entire tree. Leaves are smaller than normal and fewer in number. Expanding leaves have light green spots up to 1/4 inch in diameter and dark ring and line patterns. Leaf margins are wavy and blades are rough. Spots on the leaf die and fall out. Bark splitting and branch dieback occur on severely affected plants.	Necrotic ring spot virus	This virus can be transmitted mechanically, through grafting, through seed, and in pollen. Destroy infected trees. Plums and other stone fruits are also susceptible.

CHESTNUT

Disease	Symptoms	Pathogen/cause	Management
Blight (pp. 186–188)	Slightly sunken or slightly swollen cankers on branches or the trunk are yellow-brown and oval or irregular in shape. As the stems are girdled, the leaves yellow and brown but remain attached to the branch. Water sprouts may develop below the canker. During wet weather, yellowish masses of spores ooze from orange pimple-like fruiting structures that pepper the surface of the canker.	*Cryphonectria parasitica* (formerly *Endothia parasitica*)	American and European chestnuts are susceptible. Chinese and Japanese chestnuts are not immune but have some resistance. Remove infected trees.
Leaf spot	Small, circular, yellow to brown spots have concentric rings within them. Spots may drop out and leave a shot hole, or leaves may fall prematurely.	*Marssonina ochroleuca*	No control is recommended.
Twig canker (Chinese and Japanese chestnuts)	Cankers on any part of the tree girdle and kill the tissue.	*Cryptodiaporthe castanea*	Prune infected wood.

COTONEASTER

Disease	Symptoms	Pathogen/cause	Management
Botryosphaeria canker (pp. 172–176)	Leaves on affected branches wilt and die. Branches die back and become covered with dark brown to black, pimple-like fungal fruiting structures. Wood under the bark is dark brown.	*Botryosphaeria*	Trees most susceptible are those under drought stress. Therefore, irrigate to prevent drought stress. Prune infected branches.

Disease	Symptoms	Pathogen/cause	Management
Fire blight (pp. 162–164)	Infected flowers are killed and often remain attached throughout the season. The ends of twigs and branches become brown or black and may curl over into a shepherd's crook shape. Dead leaves may remain attached to the tree. Cankers formed the previous season may ooze a cloudy liquid during wet spring weather. Branches will be killed as slightly sunken cankers enlarge into larger branches and even into the main trunk.	*Erwinia amylovora*	During dormancy when the weather is dry, prune infected branches, cutting at least 4 inches below the base of the canker. Disinfest pruning tools frequently. Fertilize carefully to avoid promoting excessive succulent growth. Remove root suckers and water sprouts while they are small. Remove nearby unwanted plants that are susceptible to fire blight.

Fire blight–resistant plants: *Cotoneaster anoenus, C. adpressus, C. canadensis, C. dammeri* var. *radicans, C. horizontalis, C. microphyllus, C. praecox,* and *C. zabelii*.

CRABAPPLE

Disease	Symptoms	Pathogen/cause	Management
Botryosphaeria canker (pp. 172–176)	Leaves on affected branches wilt and die. Branches die back and become covered with dark-brown to black, pimple-like fungal fruiting structures. Wood under the bark is dark brown.	*Botryosphaeria*	Trees most susceptible are those under drought stress. Therefore, irrigate to prevent drought stress. Prune infected branches.
Fire blight (pp. 162–164)	Infected flowers are killed and often remain attached throughout the season. The ends of twigs and branches become brown or black and may curl into a shepherd's crook shape. Dead leaves may remain attached to the tree. Cankers formed the previous season may ooze a cloudy liquid during wet spring weather. Branches will be killed as slightly sunken cankers enlarge into larger branches and even into the main trunk.	*Erwinia amylovora*	During dormancy when the weather is dry, prune infected branches, cutting at least 4 inches below the base of the canker. Disinfest pruning tools frequently. Fertilize carefully to avoid promoting excessive succulent growth. Remove root suckers and water sprouts while they are small. Grow resistant cultivars (see list below). Remove nearby unwanted plants that are susceptible to fire blight.

Fire blight–resistant crabapples: Adams, Callaway, David, Dolgo, Harvest Gold, Indian Summer, Jewelberry, Liset, Profusion, Red Baron, Selkirk, and Sentinel.

Scab (p. 96)	Dull, olive-green, velvety fungal growth develops on the surface of leaves and petioles in the spring. Leaves yellow and fall prematurely, giving the tree a thin, bare appearance by mid-season. Infected fruit have circular, rough spots on their surface.	*Venturia inaequalis*	Grow resistant cultivars (see list below). Rake and destroy fallen leaves and fruit. Apply propiconazole + chlorothalonil as flower buds begin to show color (early pink) and again 3 weeks later.

Scab-resistant crabapples: Adams, Baskatong, Brandywine, Callaway, David, Dolgo, Donald Wyman, *Malus floribunda*, Henry Kohankie, Henningi, Jewelberry, Ormiston Roy, Professor Sprenger, *Malus seiboldi* var. *zum* cultivar Calocarpa, Silver Moon, Sugartyme, *Malus tschonoski*, Weeping Candy Apple, White Angel, and White Cascade have been observed in many locations to have only slight to moderate scab infections.

Cedar-apple rust (pp. 242–248)	Bright-yellow or yellow-orange spots form on leaves. On the upper surface of the leaf spot, small, black fungal fruiting structures form. Later, clusters of cup-shaped structures with fringed edges can be observed on the underside of the infected leaves.	*Gymnosporangium juniperi-virginianae*	Remove unwanted junipers growing near crabapples. Do not plant junipers close to crabapples. Remove the galls from juniper branches during dormancy. Where the disease seldom occurs or few leaves are infected, no control is necessary. Where disease is frequent and severe, apply chlorothalonil, mycolbutanil, fenarimol, propiconazole, triadimefon, or mancozeb first when crabapple flower bud tissue can be seen and at petal fall.
Frogeye leafspot (p. 176)	Small distinct spots with purple margins form soon after the leaves unfold. Old spots become gray with a concentric pattern within them. Leaves yellow and fall prematurely.	*Botryosphaeria*	Prune dead twigs and branches and remove them from the vicinity of the tree.

DOGWOOD

Disease	Symptoms	Pathogen/cause	Management
Anthracnose (pp. 122–124) and Decline (p. 404)	Brown spots up to 1/4-inch in diameter go entirely through the leaf and have reddish-brown halos. Tiny, dark-brown fungal fruiting structures dot the brown areas. Small, reddish-brown spots without brown centers may pepper portions of the leaf or extend along veins. Also, large, brown blotches of dead tissue may occur on leaf tips, along the margin of leaves, or between the veins. Leaves on branch tips may be completely blighted and remain attached over the winter. Reddish-brown dead spots occur on the flower bracts. Lower twigs and branches die. Small, raised, pimple-like fruiting structures form on the dead twigs. Water sprouts form along the trunk of severely affected trees. The entire tree may be killed over a period of years.	*Discula destructiva*	Prune and destroy dead twigs and branches during dormancy and when observed during the growing season. Protect trees from drought stress, winter injury, and dogwood borer attack. Rake and destroy fallen leaves. Apply propiconazole, azoxystrobin, myclobutanil, thiophanate methyl + mancozeb, chlorothalonil, or mancozeb, or during bud break to protect new flowers, twigs, and foliage. Kousa dogwood (*C. kousa*) and hybrids of kousa and native dogwood (*C. florida*) are resistant to anthracnose and decline and should be used to replace dying trees.
Leaf and flower blight (p. 60)	Irregular, brown, wrinkled patches form on flower bracts and leaves in the spring. Patches of gray mold grow on the patches if the weather remains very humid.	*Botrytis cinerea*	This disease occurs only if weather conditions are very wet and humid in the spring. Warm, dry weather will curtail the disease.
Crown canker (p. 284)	Leaves are smaller than normal, light green, and exhibit premature fall leaf coloration. Twigs and large branches die as a canker forms at the base of the tree. The canker slowly girdles the tree. During this time, the tree flowers and fruits profusely but eventually dies.	*Phytophthora cactorum*	Remove the infected tree and do not replace it with another woody ornamental until the soil has been fumigated and aerated. Apply metalaxyl or mefenoxam to nearby dogwoods to protect them from invasion.
Powdery mildew (pp. 14–16)	White fungal growth develops on the surface of leaves late in the summer and during the autumn.	*Microsphaera pulchra*	Apply azoxystrobin, myclobutanil, chlorothalonil, potassium bicarbonate, or triadimefon as soon as symptoms are seen.
Septoria leaf spot (p. 74)	Angular gray to brown spots with yellow or dark purple halos form on leaves. Spots can be up to 1/4 inch in diameter. Small dark brown fruiting structures of the fungus are visible within the brown spots.	*Septoria cornicola*	Apply chlorothalonil to protect new leaves during bud break.
Spot anthracnose	Reddish-purple spots on flower bracts are up to 1/10 inch in diameter. Leaf spots are circular to angular, dark-purple areas less than 1/32 inch in diameter and often drop out, leaving shot holes. Spotting can occur on twigs and fruit also.	*Elsinöe corni*	See anthracnose above.

DOUGLAS-FIR

Disease	Symptoms	Pathogen/cause	Management
Rhabdocline needlecast (p. 40)	During March through May, yellow spots form on the previous year's needles. These enlarge and become reddish-brown patches on an otherwise green needle. These needles then fall.	*Rhabdocline pseudotsugae* and *R. weirii*	Place plants in locations where good air circulation is available. Maintain good weed control so that air circulation is not impeded. When approximately 10 percent of the buds have broken in the spring, apply chlorothalonil. Repeat the application 1 week later and again 3 weeks after bud break. If spring is cold and new shoots mature slowly, apply a fourth spray 2 to 3 weeks after the third spray.
Swiss needlecast (p. 40)	From March through June, the previous year's needles gradually brown and fall. Rows of tiny, black fungal fruiting structures line the midrib on the underside of the needles. A magnifying glass is needed to see individual structures.	*Phaeocryptopus*	Place plants in locations where good air circulation is available. Maintain good weed control so that air circulation is not impeded. When new shoots are 1½ inches long, apply chlorothalonil or azoxystrobin. Repeat the application 3 weeks later.
Twig blight (p. 136)	A very few twig tips curl downward, turn dark brown, and die.	*Diplodia*	Prune and destroy blighted tips.

ELM

Disease	Symptoms	Pathogen/cause	Management
Black leaf spot (p. 108)	Small, black, slightly raised, rough spots form on leaves. Leaves yellow and fall prematurely.	*Stegophora ulmea* (formerly *Gnomonia ulmea*)	No control is recommended for trees in the landscape.
Botryodiplodia canker (p. 182)	Cankers form on twigs and branches. The junction of cankered and healthy wood is sharply defined under the bark where reddish-brown, infected wood meets white, healthy wood. Leaves on infected branches turn bright yellow and fall without wilting. (Compare to Dutch elm disease and phloem necrosis below.) In the autumn, fungal fruiting structures roughen the bark of infected twigs.	*Botryodiplodia*	Irrigate to prevent drought stress. Prune infected branches well below the canker. Disinfest pruning tools frequently.
Dutch elm disease (p. 366)	Leaves on one or more branches wilt, yellow, and fall prematurely. Progressively more branches exhibit symptoms. Outer layers of sapwood of affected branches have brown streaks.	*Ophiostoma ulmi*	See details below. Grow resistant cultivars.

Management of Dutch elm disease: Remove severely infected trees promptly. Peel the bark off the stump to below the soil line. Promptly burn or bury all wood greater than ½ inch in diameter. Do not stockpile it for later burning unless it is first tarped and fumigated promptly to kill bark beetles. Midway between elms within 50 feet of the infected elm, trench 2 feet deep to cut root grafts, or drill 2-inch diameter holes 2 feet deep, 6 to 8 inches apart in a line between the infected elm and elms within 50 feet of infected elms. Mix 1 part sodium methyl dithiocarbamate and 4 parts water and pour 1 cup into each hole. Plug the holes with a chunk of sod. This fumigant will kill root grafts.

If less than 5 percent of the crown of a tree exhibits symptoms, find the lowest point of vascular streaking and prune the branch at least 12 feet below that point. Inject benzimidazole or propiconazole fungicide. Maintain good elm bark beetle control.

Treating unwanted elms with cacodylic acid (an herbicide) has been found to kill elms and make them very attractive to elm bark beetles, which carry the fungus, but brood production in those trees is greatly suppressed. Thus, the number of infested elm bark beetles is reduced in the area.

Dutch elm disease–resistant cultivars: Accolade, Cathedral, Discovery, Dynasty, Frontier, Homestead, Independence, Jefferson, Morton Glossy, Morton Plainsman, Morton Stalwart, New Harmony, New Horizon, Ohio, Pathfinder, Patriot, Pioneer, Princeton, Prospector, Regal, Sapporo Autumn Gold, Urban, and Valley Forge.

Ganoderma root rot (p. 332)	Very distinctive shelf-like fruiting structures form annually on the wood singly or in overlapping clusters. They are brown to reddish brown on top with a cream to white margin. Shelves may become 14 inches across. The upper surface may appear to have been varnished. Branches and eventually the entire tree die as the root rotting progresses.	*Ganoderma lucidum*	A tree with fungal fruiting structures on the trunk, butt, or roots should be removed promptly if it is in a location where property damage may occur or where people or pets could be struck by falling limbs or the falling tree.
Inonotus root rot (p. 328)	Root and butt rot may cause trees to topple before any obvious symptoms are noted. Infected trees often have branch dieback and fewer than normal leaves that are yellowed. Although the root rot begins well out on the root system, the fungus eventually reaches the butt of the tree where it forms large, tough, irregularly shaped, light-brown to dark-brown shelves at or just above the soil line. With age, these become very rough and dark brown to black. Cutting the shelf reveals a reddish-brown center. The underside of the shelf is brown with millions of tiny pores in which the spores are formed.	*Inonotus dryadeus* (formerly *Polyporus dryadeus*)	A sure sign of severe damage to the tree is the presence of the fruiting structures. Infected trees should be removed immediately.
Laetiporus root rot (p. 346)	Massive clusters of bright sulfur-yellow to salmon to bright-orange, shelf-like fruiting structures that turn white with age initially form in the summer or autumn on the wood of the tree but fall off during the winter. The underside of the fruiting structure has tiny pores in which the spores are formed. New shelves form on the wood the following summer and autumn. The bark where the fruiting structure forms is slightly depressed and cracked.	*Laetiporus sulfureus* (formerly *Polyporus sulfureus*)	Fruiting structures form long after most of the damage has been done. Infected trees are very prone to wind breakage even before the fungus begins to form fruiting structures and should be removed at the first sign of infection.

Disease	Symptoms	Pathogen/cause	Management
Leaf scorch (p. 386)	Early to midsummer, leaves on a few branches have a marginal leaf burn or scorch. Symptoms increase on the leaves later in the summer. The line marking the boundary between dead and living tissue is wavy and has a definite yellow halo. Leaves usually fall prematurely. More branches become involved in following years.	*Xylella fastidiosa*	Leafhoppers and spittle bugs carry the bacteria from tree to tree. Infected trees are very attractive to elm bark beetles, which may be carrying the Dutch elm disease fungus.
Phloem necrosis (elm yellows; p. 388)	Leaves yellow and wilt over the entire crown of the tree and fall prematurely in summer. Trees may die within 1 year. Roots are killed early in disease development. The inner bark (phloem) and the outer most layer of xylem (water-conducting tissue) is yellow or butterscotch in color and has a definite oil of wintergreen odor if held close to the nose immediately after cutting. If a piece of the discolored bark is placed in a tightly sealed jar, the wintergreen smell will intensify.	Phytoplasmas	White-banded American leafhoppers feeding on the phloem of elms move the phytoplasmas from tree to tree. Remove infected trees.
Wetwood (slime flux; p. 382)	Foul smelling liquid oozing from branch stubs, pruning cuts, or cracks in the bark runs down the trunk and leaves gray streaks. Bark and turf where the ooze lands may be killed. Affected wood within the tree has a water-soaked appearance but is rarely rotted.	Many bacteria	Wetwood does no apparent damage to the tree unless the tree comes under some other severe stress. Protect the tree from stresses such as soil compaction, excavation, or drought. Avoid wounding the tree in any way. Do not insert pipes to relieve pressure.

ENGLISH IVY (HEDERA)

Disease	Symptoms	Pathogen/cause	Management
Bacterial leaf spot (p. 158)	Circular, dark-brown to black spots with yellow halos develop on leaves. Leaves yellow, die, and fall.	*Xanthomonas campestris* pv. *hederae*	Purchase plants free of the disease. Discard infected plants. Water in a manner that keeps the surface of the leaves dry. Apply cupric hydroxide, potassium salts of phosphorus acid, or fosetyl-Al to protect leaves.
Fungal leaf spot	Large, irregularly shaped, tan to brown spots have numerous, tiny dark-brown dots (fruiting structures) within them.	*Colletotrichum trichellum*	Purchase plants free of the disease. Discard infected plants. Water in a manner that keeps the surface of the leaves dry. Apply azoxystrobin or copper.

EUONYMUS

Disease	Symptoms	Pathogen/cause	Management
Anthracnose (p. 124)	Small spots pepper leaves of evergreen euonymus. An orange-brown, slightly raised stem canker may develop and cause branch dieback.	*Glomerella cingulata* (asexual stage is *Colletotrichum gloeosporiodes*)	Avoid overhead watering in the nursery and landscape. Inspect containerized plants and do not use those already infected. Apply chlorothalonil, cupric hydroxide, mancozeb, or thiophanate methyl + mancozeb or azoxystrobin to protect healthy leaves.
Crown gall (p. 156)	Galls 1/4 inch to several inches in diameter form on stems or roots. These are white at first and firm like cauliflower but become hard and dark brown with age.	*Agrobacterium tumefaciens* carrying a gall-causing plasmid	Purchase gall-free plants. Never plant galled material. Plants not severely affected should be cared for well so that they are not under other stresses. Severely affected plants should be removed. Do not replace the plant with gall-susceptible woody or herbaceous plants. Dip cuttings in *Agrobacterium radiobacter.*

FORSYTHIA

Disease	Symptoms	Pathogen/cause	Management
Gall (p. 146)	Knobby galls form along branches.	Unknown. Crown gall, the fungus *Phomopsis*, and genetic abnormality have been blamed for this disease but none has been conclusively proven to be the cause.	Prune infected branches. Disinfest the pruning shears thoroughly after use.
Twig blight	The ends of lower branches, especially those near the ground, die. Black nodules of fungal tissue are found inside the stems when split open. Young nodules of fungus in the pith are white at first.	*Sclerotinia*	Avoid overhead watering in the spring. Prune infected branches. Thin the shrub to ensure good air circulation. Apply thiophanate methyl + flutolanil.

HACKBERRY

Disease	Symptoms	Pathogen/cause	Management
Witches' broom (p. 120)	Many short twigs develop close together from a swelling on a branch. The tree may be covered with witches' brooms.	*Sphaerotheca phytophila* (a powdery mildew) and an eryophyid mite (*Eriophyes celtis*)	Remove unsightly trees.

HAWTHORN

Disease	Symptoms	Pathogen/cause	Management
Fire blight (pp. 162–164)	Flower clusters are killed and turn dark brown to black. Dead leaves and aborted flower parts remain on the tree. Long, slightly sunken cankers are seen where the dead wood meets the live wood. In the spring, slime may ooze from the canker if the weather is warm and wet. No fungal fruiting structures are found in the canker.	*Erwinia amylovora*	During dormancy when the weather is dry, prune infected branches, cutting at least 4 inches below the base of the canker. Disinfest pruning tools frequently. Use fertilization practices that do not promote excessive succulent growth. Remove root suckers and water sprouts while they are small. Remove unwanted plants that are susceptible to the disease from near cultivated plants.
Fire blight–resistant plants: *Crataegus arnoldiana*, *C. coccinea*, *C. crus-galli*, *C. douglasii*, *C. phaenopyrum*, *C. prunifolia*, *C. puntata* Ohio Pioneer, and *C. viridis* Winter King			
Cedar-hawthorn rust (pp. 246–248)	Orange-yellow spots form on leaves. Severely affected leaves fall prematurely. Green fruit is deformed.	*Gymnosporangium globosum*	Plant resistant hawthorns including cockspur thorn, yellow fruited thorn, *Crataegus intricata*, and *Crataegus pruinosa*. Apply chlorothalonil, propiconazole, fenerimol, flutolanil, mancozeb + thiophanate methyl, or triadimefon azoxystrobin, or myclobutanil at 10-day intervals beginning just as flower bud break occurs. Do not plant close to junipers.
Cedar-quince rust (pp. 246–248)	Petioles, twigs, and thorns swell and become distorted. Fruit is covered with spore horns during the summer. Orange-yellow spots form on leaves, which, if severely affected, fall prematurely.	*Gymnosporangium clavipes*	Apply chlorothalonil, mancozeb + thiophanate methyl, azoxystrobin, myclobutanil, tridimefon, propiconazole, fenerimol, or flutolanil, at 10-day intervals beginning just as flower bud break occurs. Do not plant close to junipers.
Leaf blight and fruit rot (p. 126)	Leaves wilt, turn brown, and die in the spring. Flower clusters die. Fruits turn brown, mummify, and fall.	*Monilinia johnsonii*	Remove and destroy fallen mummified fruits before bud break occurs.

Disease	Symptoms	Pathogen/cause	Management
Leaf spot (p. 64)	Many small, reddish-brown to gray leaf spots develop, sometimes with dark-brown borders. Spots may be so numerous that they merge. Infected leaves yellow quickly and fall by August. On twigs, slightly raised, brown, irregular spots form. English hawthorn (*Crataegus oxycantha*) and Pauls Scarlet (*Crataegus oxycantha pauli*) are very susceptible.	*Diplocarpon mespili* (*Entomosporium,* asexual stage)	Rake and destroy fallen leaves. Apply chlorothalonil, azoxystrobin, myclobutanil, mancozeb, copper hydroxide, or mancozeb + thiophanate methyl during bud break and at 10-day intervals during wet weather. Two or three applications may be sufficient. Cease spraying if the weather dries.

HEMLOCK

Disease	Symptoms	Pathogen/cause	Management
Cytospora canker (p. 194)	Slightly sunken cankers girdle and kill branches.	*Valsa (Cytospora)*	Prune infected branches.
Rust (p. 258)	Current-season growth is slightly swollen and curled. Orange-yellow spores coat the infected tissue. Infected plant parts die in the summer. Orange-yellow spores develop on poplar leaves where the fungus overwinters.	*Melampsora*	No control is recommended for this fungus, which overwinters on poplar and then spreads to hemlock and back to poplar.

HICKORY

Disease	Symptoms	Pathogen/cause	Management
Leaf spot (p. 108)	Irregular, reddish-brown spots on the upper leaf surface form while brown spots occur on the lower leaf surface. In severe cases, leaves may fall prematurely.	*Gnomonia caryae*	No control is recommended since the disease occurs late in the season and little damage results. However, raking and destroying leaves in the fall can reduce the amount of inoculum near the trees.

HOLLY

Disease	Symptoms	Pathogen/cause	Management
Leaf scorch (p. 242)	Circular to irregular, tan spots appear in early spring or summer. Tiny, black fungal fruiting structures pepper the spot surface as a result of attack by a secondary fungus.	Young leaves formed during cool, damp weather are damaged easily if exposed to hot, dry, windy weather.	No control is recommended.
Nematodes (p. 298)	Yellowing, stunting, and twig dieback occur. The root system is small and has dead areas, as well as galls in some cases.	*Criconemella, Meloidogyne, Pratylenchus,* or *Tylenchorhynchus*	An analysis of soil and roots must be done to confirm that nematodes are actually causing the symptoms. Care for plants well so that they are not under stress from other factors. If the shrub is replaced, first fumigate and thoroughly aerate the soil.
Phytophthora root rot	Leaves yellow and brown spots develop. Branches and eventually the entire plant die.	*Phytophthora cinnamomi*	Remove the infected plant. Do not replace it with a woody ornamental unless the planting site is first fumigated and aerated thoroughly. Protect surrounding plants with mefenoxam, metalaxyl, etridiazole, or fosetyl-Al.
Spine spot	Pinhead-sized or larger spots frequently surrounded by a purple halo appear on leaves in late winter and early spring.	Once thought to be caused by the sharp points of leaves puncturing each other, spine spot is now known to be caused by the ovipositing of certain insects.	No control is recommended.

Disease	Symptoms	Pathogen/cause	Management
Tar spot (p. 54)	Small, yellow spots form on leaves and turn reddish brown with a small, yellow halo later in the summer. In the autumn, a flat black, cushion-shaped fungal structure forms beneath the leaf surface.	*Rhytisma prini*	No control is recommended.
Thielaviopsis root rot (p. 294)	Plants are stunted and have branch dieback. Roots are blackened.	*Thielaviopsis*	Inspect the roots of containerized hollies before planting. Do not use those with blackened roots. Apply thiophanate methyl, triflumizole, or thiophanate methyl + etridiazole as a soil drench to protect healthy roots.

HONEYSUCKLE

Disease	Symptoms	Pathogen/cause	Management
Powdery mildew (pp. 16–18)	White fungal growth develops on the upper surface of lower leaves.	*Microsphaera*	If severe, apply myclobutanil.

HORSE CHESTNUT

Disease	Symptoms	Pathogen/cause	Management
Leaf blotch (pp. 76, 80)	Small irregular, reddish-brown spots and large blotches with yellow halos form in late June or early July. Most infected leaves brown and fall prematurely. Tiny, black fruiting structures are found in the dead areas.	*Guignardia aesculi*	Apply mancozeb to protect the foliage of highly valuable trees in early summer. Trees not highly valued should not be treated.

HYDRANGEA

Disease	Symptoms	Pathogen/cause	Management
Botrytis blight (p. 60)	During wet weather, white to gray fungal growth covers flower clusters. This frequently happens after a frost has damaged flowers.	*Botrytis cinerea*	Remove infected flowers. Protect flowers with mancozeb, copper, or chlorothalonil.
Leaf spot (pp. 122–124)	Brown spots form along leaf margins. If the disease is severe, leaves and flowers are killed.	*Phyllosticta hydrangeae*, *Colletotrichum*, or *Cercospora*	Protect new foliage with mancozeb, copper, or chlorothalonil.
Powdery mildew (p. 16)	White fungal growth develops on the upper surface of lower leaves.	*Erysiphe polygoni*	Apply thiophanate methyl, triadimefon, piperalin, myclobutanil, azoxystrobin, chlorothalonil, sulfur, or fenarimol to protect leaves.
Rust (p. 260)	Spores that form on hemlock needles blow to hydrangea leaves. A spore-forming structure develops on the underside of the leaf and results in tiny blister-like protrusions that release orange-yellow spores. In late summer, reddish-brown spores (teliospores) form on the top and bottom leaf surfaces. These spores give rise to another spore type that blows to and infects hemlocks.	*Pucciniastrum hydrangeae*	No control is recommended.

JUNIPER

Disease	Symptoms	Pathogen/cause	Management
Cedar-apple rust (pp. 240–248)	Smooth, round galls on twigs are up to golf ball size. Their surface may be dimpled like a golf ball.	*Gymnosporangium juniperi-virginianae*	Prune and destroy galls before the spore horns develop. In the nursery, apply azoxystrobin, mancozeb, triadimefon, or mancozeb + thiophanate methyl in the summer.
Cedar-quince rust (pp. 240–248)	Young leaves and twigs have bright-orange spots that look like paint splatters in the spring. These spots darken and become dull orange to rust colored. Slight twig swellings are not obvious except in the spring when their surface is orange with spores. The bark on infected twigs flakes away, growth slows, and twigs die back.	*Gymnosporangium clavipes*	Prune and destroy infected twigs before the spore horns develop. In the nursery, apply triadimefon, mancozeb, or mancozeb + azoxystrobin, thiophanate methyl in the summer.

Disease	Symptoms	Pathogen/cause	Management
Cercospora blight (p. 86)	In the summer, needles become bronzed, tan, and eventually gray. The needles of the inner and lower branches are affected first. The disease progresses upward on the shrub and outward toward the branch tips. This differs from twig blights which start at branch tips. Dark fungal fruiting structures break through the surface of infected needles. Microscopic examination of the spores reveals dark, multicelled spores that are longer than they are wide. Affected branches thin and fall, giving the shrub an open, bare appearance.	*Cercospora sequoiae* var. *juniperi*	The fungus overwinters on the plant, spores are present all year, and infection can occur whenever temperatures are mild and moisture is on the needles. Removal of the plant is better than attempting to control this disease with fungicides. However, copper hydroxide, azoxystrobin, tridimefon, mancozeb, or myclobutanil can be used.
Kabatina twig blight (p. 138)	Tips of branches die and turn brown or ash gray. These remain on the shrub for many months. Larger branches can be invaded and girdled. On the dead tissue where it meets the still-living wood, small, black, pimple-like fungal fruiting structures form. Microscopic examination reveals oval, colorless spores. See *Phomopsis* below.	*Kabatina juniperi*	Prune and destroy infected twigs and branches. It is possible for both kabatina and phomopsis twig blight to occur on the same plant. If only *Kabatina* is present, apply mancozeb. Otherwise, apply mancozeb + thiophanate methyl whenever new growth is present on the shrub.
Phomposis twig blight (p. 138)	Tips of branches die and turn brown or ash gray. These remain on the shrub for many months. Larger branches can be invaded and girdled. On the dead tissue where it meets the still-living wood, small, black, pimple-like fungal fruiting structures form. Microscopic examination reveals both oval and long, thread-like colorless spores. See *Kabatina* above.	*Phomopsis juniperovora*	Prune and destroy infected twigs and branches. It is possible for both Kabatina and Phomopsis twig blight to occur on the same plant. If only *Phomopsis* is present, apply, azoxystrobin, thiophanate methyl. Otherwise, apply mancozeb thiophanate + mancozeb whenever new growth is present on the shrub.

LEUCOTHOE

Disease	Symptoms	Pathogen/cause	Management
Cylindrocladium leaf spot (p. 294)	Dark spots form on leaves. Lesions on stems can girdle and kill them.	*Cylindrocladium*	Avoid overhead irrigation. Apply triflumizole as a drenching spray.
Cylindrocladium root rot (p. 294)	Plants are stunted. Leaves yellow and wilt as branches die. Many dark-brown to black lesions form on roots, enlarge, and girdle roots. Longitudinal cracks may develop in the stem at the soil line.	*Cylindrocladium*	Avoid overhead irrigation. Apply triflumizole as a soil drench.

LILAC

Disease	Symptoms	Pathogen/cause	Management
Ascochyta blight (p. 130)	In the spring, the current year's shoots and flower stalks are girdled, wilted, and brown. The base of the dead area is tan to gray and shriveled. In wet weather, dark gray pimple-like fungal fruiting structures dot the dead tissue. In summer and autumn, olive green round leaf spots turn tan and have indefinite edges. Fungal fruiting structures dot the upper surface of the spots.	*Ascochyta syringae*	Prune infected tissue. Avoid overhead irrigation. Apply thiophanate methyl, thiophanate methyl + mancozeb, or chlorothalonil to protect healthy shoots.
Bacterial blight (p. 160)	Leaves turn completely brown to black and remain attached to the branch. Shoots are girdled and killed. Flower buds are blackened while flower clusters become limp and brown. See shoot blight below.	*Pseudomonas syringae*	Avoid overhead watering in the spring. Prune infected branches, cutting well below the diseased tissue. Disinfest the pruning shears between cuts. Apply mancozeb + copper to protect new growth.
Powdery mildew (p. 16)	Dry white fungal growth develops on the surface of leaves. Leaves become distorted.	*Microsphaera syringae*	Apply paraffinic oil as soon as mildew is observed.before mildew appears, usually June, July, and August 15. Reapply the material if mildew reappears. Or apply thiophanate methyl + mancozeb, triadimefon, kresoxim methyl, cholorothalonil, propiconazole, myclobutanil, or triforine.
Shoot blight	Shoots are killed extensively, up to 4 to 5 feet, and turn very black. Root sprouts at the base of the plant are killed and blackened. See bacterial blight above	*Phytophthora cactorum*	Remove the infected plant; do not replace it with plants susceptible to *Phytophthora.* Avoid overhead watering of healthy plants.

Disease	Symptoms	Pathogen/cause	Management
Witches' brooms (p. 396)	Short, thin twigs and branches originating from one area of the stem form dense clusters. Leaves may be distorted, small, and yellow. Twigs forming the brooms are abnormally upright and often retain green leaves too long in the autumn and die back in winter.	Phytoplasmas	Prune affected branches. Remove severely infected plants.

MAPLE

Disease	Symptoms	Pathogen/cause	Management
Anthracnose (p. 104)	Norway maple: narrrow, purple to brown streaks occur along the leaf veins. Sugar maple: large, irregular, brown or red-brown areas develop along and between the veins similar to injury due to drought and heat stress. Small, brown fruiting structures of the fungus are found near the affected leaf veins. Under very wet spring conditions, some defoliation can occur.	*Discula (Gloeosporium)*	Prune dead twigs and branches. Rake and destroy fallen leaves. Usually, little damage occurs and no treatment is necessary. In a nursery situation, apply mancozeb or mancozeb + thiophanate methyl at bud break and at 7- to 10-day intervals until the weather dries and the daily average temperature is above 65°F.
Bacterial leaf scorch (red maple) (pp. 384–386)	Leaf margins on localized, individual branches brown in mid- to late July. The light-brown area is separated from green tissue by a dark reddish-brown band and a narrow but distinct yellow halo. Leaves may fall in August.	*Xylella fastidiosa*	Leafhoppers and spittle bugs carry the bacteria from tree to tree. Promote plant vigor by protecting the tree from stresses.
Bleeding canker (p. 286)	Reddish-brown cankers develop in the inner bark of the main trunk and branches. The bark over the canker becomes sunken, and reddish-brown sap oozes out. Leaves wilt and branches die.	*Phytophthora cactorum*	Remove the infected tree and do not replace it with a woody ornamental until the soil has been fumigated and aerated thoroughly.
Decline (p. 444)	Tree growth slows. Branch dieback progresses until much of the tree is dead.	Depending upon the site, combinations of poor soil aeration, poor soil drainage, deicing salt damage, high temperatures at the site, drought, excavation damage, soil compaction, paving close to trees, verticillium wilt, and armillaria root rot weaken and kill the tree.	Protect the tree from stresses, particularly insect defoliation.
Fomes root rot (p. 346)	A fungal fruiting structure that is hard, gray topped, hoof shaped, and 6 to 8 inches across and enlarges perennially. The underside of the "hoof" is white with tiny pores in which the spores are formed. Heart rot and dying limbs may be apparent.	*Fomes fomentarius*	A tree with fungal fruiting structures on the trunk should be removed promptly if it is in a location where property damage may occur or where people or pets could be struck by falling limbs or the falling tree.
Ganoderma root rot (p. 332)	Very distinctive shelf-like fruiting structures form annually on the wood singly or in overlapping clusters. They are brown to reddish brown on top with a cream to white margin, and may reach 14 inches across. The upper surface may appear to have been varnished. Branches and eventually the entire tree die as the root rotting progresses.	*Ganoderma lucidum*	A tree with fungal fruiting structures on the trunk, butt, or roots should be removed promptly if it is in a location where property damage may occur or where people or pets could be struck by falling limbs or the falling tree.
Laetiporus root rot (p. 346)	Massive clusters of bright sulfur-yellow to salmon to bright-orange, shelf-like fruiting structures that turn white with age initially form in the summer or autumn on the wood of the tree but fall off during the winter. The underside of the fruiting structure has tiny pores in which the spores are formed. New shelves form on the wood the following summer and autumn. The bark where the fruiting structure forms is slightly depressed and cracked.	*Laetiporus sulfureus* (formerly *Polyporus sulfureus*)	Fruiting structures form long after most of the damage has been done. Infected trees are very prone to wind breakage even before the fungus begins to form fruiting structures and should be removed at the first sign of infection.

Disease	Symptoms	Pathogen/cause	Management
Leaf spot (p. 76)	Leaf spots up to 1/4 inch in diameter with a pronounced purple border are round or irregular in shape. Tiny, black fungal fruiting structures dot the upper surface of the spots.	*Phyllosticta minima*	See anthracnose control above.
Powdery mildew	White fungal growth develops on the upper surface of leaves in the late summer and autumn.	*Phyllactinia*	No control is necessary since the disease begins too late to cause significant damage.
Tar spot (p. 54)	Oval to irregularly shaped, shiny, black spots up to ½ inch in diameter form on the leaves of silver or red maples.	*Rhytisma acerinum* or *R. punctatum*	No control measures are necessary.
Verticillium wilt (p. 374)	Early symptoms of verticillium wilt include heavy seed production, leaves that are smaller than normal, and browning of the margins of leaves. Frequently, the foliage on only one side of a tree wilts. The wood under the bark of wilting branches is discolored with green to black streaks. The smallest branches may not exhibit the discoloration.	*Verticillium*	Do not replant susceptible species where a specimen was killed by *Verticillium*. When a tree exhibits mild symptoms, prune out affected limbs and water to maintain tree vigor. Some trees recover. Do not fertilize heavily.

MOUNTAIN-ASH

Disease	Symptoms	Pathogen/cause	Management
Cytospora canker (p. 198)	Trunks and larger branches have brown, sunken cankers, circular or irregular in shape, which gradually enlarge and girdle the wood. Black, pimple-like fruiting structures form on infected bark. Yellow threads of spores ooze out of the fruiting structures during wet weather.	*Cytospora*	Prune infected limbs well below the canker. Disinfest the pruning tools thoroughly between cuts. Remove severely infected trees.
Fire blight (pp. 162–164)	Flower clusters are killed and turn dark brown to black. Dead leaves and aborted flower parts remain on the tree. Long, slightly sunken cankers are seen where the dead wood meets the live wood. In the spring, slime may ooze from the canker if the weather is warm and wet. No fungal fruiting structures are found in the canker. Flower clusters are killed and turn dark brown to black.	*Erwinia amylovora*	During dormancy when the weather is dry, prune infected branches, cutting at least 4 inches below the base of the canker. Disinfest pruning tools frequently. Use fertilization practices that do not promote excessive succulent growth. Remove root suckers and water sprouts while they are small. Remove unwanted plants that are susceptible to the disease from near cultivated plants. Apply copper hydroxide or copper hydroxide + mancozeb. *Sorbus aucuparia* and *S. intermedia* are resistant.
Leaf spot (p. 78)	Round to irregular, brown spots form on leaflets. Tiny, black fruiting structures form within older spots.	*Phyllosticta*	No control is recommended.

MOUNTAIN LAUREL

Disease	Symptoms	Pathogen/cause	Management
Leaf spot (p. 88)	Large, tan to brown spots on leaves have a dark line on their perimeter and a purple halo. Dark-brown, pimple-like fruiting structures are scattered within the spot.	*Cercospora kalmiae*	Avoid overhead irrigation. Apply myclobutanil, chlorothalonil, or triadimefon.

OAK

Disease	Symptoms	Pathogen/cause	Management
Anthracnose (p. 110)	During wet weather, young leaves are blighted as bud break occurs or large dead areas form between the leaf veins primarily on lower branches. Winter twig dieback may occur. Slightly raised, brown dots (fungal fruiting structures) form on the lower surface of leaves and on dead twigs. Often, these can be seen without a magnifying glass. However, magnification helps greatly in finding these small structures.	*Apiognomonia*	Only highly valued trees should be treated with a fungicide to protect new twigs and leaves as they form. Otherwise, prune and destroy dead twigs and branches during dormancy. Apply chlorothalonil, azoxystrobin, propiconazole, copper sulfate, copper hydroxide, myclobutanil,or mancozeb.

Disease	Symptoms	Pathogen/cause	Management
Armillaria root rot (p. 308)	Branches die back. A fleshy, firm, honey-colored mushroom forms annually in the autumn in groups of a few to 100 or more in a cluster at the tree base. The cap of the mushroom is 1½ to 6 inches in diameter with a slightly depressed center and may have brown, scale-like spots. Although the cap is usually dry, it may be slimy after a rain. Its stem is ½ to 1 inch thick and may be 2 to 6 inches long. The spores are formed on flat, plate-like structures (gills) on the underside of the cap. A white fan of fungal growth is often found just under the bark at the base of the infected tree. Dark-brown rhizomorphs (very coarse shoestring-like threads) may be found under the bark or on the surface of the roots or trunk.	*Armillaria*	Remove infected trees. Protect healthy trees in the area from stresses, especially those that cause defoliation, such as insect feeding (gypsy moth larval feeding or leaf rollers).
Bacterial leaf scorch (p. 386)	Browning of the oldest leaves along their margins begins in mid to late summer on one branch or a few branches on inner and lower portions of the tree. A wavy, reddish-brown band sometimes develops between the brown and green tissue of the leaf. The browning of leaves progresses to include more leaves toward the ends of branches. Branches and eventually entire trees die.	*Xylella fastidiosa*	Leafhoppers and spittle bugs carry the bacteria from tree to tree. See information on this disease under to “Common Plant Diseases” section of this manual. Promote plant vigor by protecting the tree from stresses.
Bacterial wetwood (p. 382; slime flux)	Dark streaks of sap, usually foul smelling, ooze from holes or cracks in the bark. The heartwood is discolored dark brown. Pin oaks are especially prone to wetwood.	Various bacteria can be involved.	Avoid wounding the bark of affected trees. Care for the tree as normal, minimizing any stresses.
Ganoderma root rot (pp. 332–334)	A butt rot may take several years to kill the tree but makes the tree very susceptible to windthrow. A distinctive shelf-like fruiting structure forms singly on the wood at or near the soil line. It is brown to reddish brown on top with a cream to white margin. The brown portion appears to have been varnished. The shelf grows perennially for 5 to 10 years and may reach 8 to 12 inches across. The underside of the shelf is light colored with tiny pores in which the spores are formed. The underside turns brown where scratched and forms an interesting drawing surface, thus the common name “artist’s conk.” Infected trees slow in growth rate and have dying branches with small, yellowed leaves.	*Ganoderma applanatum* (formerly *Fomes applanatus*)	Although it may require several years for the tree to die, an infected tree poses a hazard. A tree with fungal fruiting structures on it should be removed promptly if it is in a location where property damage may occur or where people or pets could be struck by falling limbs or the falling tree.
Inonotus root rot (p. 328)	A root and butt rot develops. Trees may topple before any obvious symptoms are noted. Infected trees often have branch dieback and fewer than normal leaves that are yellowed. Although the root rot begins well out on the root system, the fungus eventually reaches the butt of the tree where it forms large, tough, irregularly shaped, light- to dark-brown shelves at or just above the soil line. With age, these become very rough and dark brown to black. Cutting the shelf reveals a reddish-brown center. The underside of the shelf is brown with tiny pores in which the spores are formed. A sure sign of severe damage to the tree is the presence of the fruiting structures.	*Inonotus dryadeus* (formerly *Polyporus dryadeus*)	Infected trees should be removed immediately.
Laetiporus root rot (p. 346)	Massive clusters of bright sulfur-yellow to salmon to bright-orange, shelf-like fruiting structures that turn white with age initially form in the summer or autumn on the wood of the tree but fall off during the winter. The underside of the fruiting structure has tiny pores in which the spores are formed. New shelves form on the wood the following summer and autumn. The bark where the fruiting structure forms is slightly depressed and cracked.	*Laetiporus sulfureus* (formerly *Polyporus sulfureus*)	Fruiting structures form long after most of the damage has been done. Infected trees are very prone to wind breakage even before the fungus begins to form fruiting structures and should be removed at the first sign of infection.

Disease	Symptoms	Pathogen/cause	Management
Leaf spot	In mid- to late summer, irregular, dark-brown spots form between the leaf veins and enlarge up to 3/8 inch in diameter and become reddish brown, often with a yellow halo. Trees with iron chlorosis and those under other stresses are most severely affected.	*Tubakia* (formerly *Actinopelte*)	Little damage results from this disease, which does not cause defoliation. No control action is recommended for landscape situations. Mancozeb or propiconazole can be applied in the nursery beginning at bud break.
Oak leaf blister (p. 22)	Spots ¼ to ½ inch in diameter turn light green as young leaves expand. Leaf cells in the spots multiply more than surrounding cells, and a raised blister-like buckling of the leaf results. As the spots age, their upper surface becomes covered with a buff white coating of fungal growth that later turns brown. The leaves usually do not fall prematurely.	*Taphrina caerulescens*	Fungicide application in the landscape is not necessary because the leaves are seldom severely spotted and do not fall prematurely. Although infections may be extensive some years, little damage actually results. In the nursery, chlorothalonil or mancozeb must be applied late in dormancy prior to bud break to prevent spotting. Once bud break has occurred and symptoms are visible, it is too late to spray.
Powdery mildew (p. 14)	White fungal growth develops on the surface of leaves in the autumn.	*Microsphaera*	This disease develops so late in the year that no significant damage occurs. No control is recommended. Where trees are being readied for fall sale, apply triadimefon, azoxystrobin, or myclobutanil.
Oak wilt	Most oaks but especially red oaks are susceptible. White oaks tend to be resistant. Leaves at the top of the tree turn brown along the tips and margins, wilt, and soon begin to fall while there is still some green color left in them. This damage progresses down the tree. Twigs and branches die. Brown streaks often observed in the outer sapwood are sometimes difficult to find. Trees usually die within a year after infection.	*Ceratocystis fagacearum*	Remove infected trees as soon as the diagnosis is made. Do not stack the wood since insects in it may leave and carry the fungus to neighboring trees. Cut root grafts first and then inject mildly infected tree and neighboring oaks with propiconazole. This will not eliminate the fungus from root systems but will inhibit the fungus in twigs and branches.

PACHYSANDRA

Disease	Symptoms	Pathogen/cause	Management
Volutella blight (p. 206)	Brown to tan spots on the leaves are small at first but enlarge and may cover the entire leaf. Concentric line patterns form within the brown spots as leaves yellow and fall. Infected stems become dark brown to black in color and die. Under moist conditions, salmon to pink masses of fungal spores form on the surface of dead stems. Large patches of plants are killed.	*Pseudonectria pachysandricola (Volutella)*	Inspect transplants carefully and discard infected material. Avoid planting in areas of heavy shade or areas where moisture will be retained on leaves for prolonged periods. In established beds, remove diseased plants and thin the bed. Remove fallen leaves and other debris that inhibits good air circulation. Protect plants from winter injury and deicing salt runoff. Control oystershell and euonymus scales. Fertilize plants moderately to prevent nutrient deficiencies. Avoid using sprinkler irrigation but protect plants from drought stress. Apply copper hydroxide, chlorothalonil, mancozeb, or thiophanate methyl + mancozeb to protect plants when the weather is wet.

PIERIS

Disease	Symptoms	Pathogen/cause	Management
Phytophthora root rot (p. 209)	Plants are stunted and then wilt, yellow, and die. Roots with few feeder roots die. Stem wood at the soil level has red-brown discoloration. No obvious fungal fruiting structures are formed.	*Phytophthora*	Purchase disease-free plants. Especially inspect southern-grown, containerized material before planting. Use clean, disinfested tools. Following a positive diagnosis, remove infected plants. Avoid overhead watering. Apply etridiazole, fosetyl-Al, phosphates, or mefenoxam to protect healthy plants.

PINE

Disease	Symptoms	Pathogen/cause	Management
Cyclaneusma needlecast (p. 38)	Needles on Scots and Austrian pines yellow and have dark-brown bands from September through December the year after infection or from April through June, 2 years after infection. The brown bars become filled with a tan fungal fruiting structure, which opens wide under very moist conditions.	*Cyclaneusma minus*	Space plants and control weeds to ensure good air circulation around the tree. Apply chlorothalonil first in mid-March and again in early May, mid-June, mid-August, and mid-October to protect the needles since they can be attacked any time the temperature is above 32°F and water is on the needle.
Sphaeropsis tip blight (p. 136)	Shoot tips are attacked in the spring and a canker forms at the base of the new shoot. Resin oozes from the canker. This often occurs on scattered branches low on the tree at first. Close examination of the dead and dying tips reveals that the tissue was killed before the needles reached full size. Lower branches are killed in succeeding years. Old cones and dead needles persist on the tree and have small, dark-brown to black, pimple-like fruiting structures peppering their surface.	*Sphaeropsis sapinae* (formerly *Diplodia*)	Do not plant young, healthy two- and three-needled pines near older, infected pines. Remove infected twigs to reduce the amount of fungus in the tree. Apply azoxystobin, thiophanate methyl, or copper salts beginning as the buds swell in the spring and repeat application until the needles reach full size. Spraying at other times is not effective. Do not apply high-nitrogen fertilizer.
Ploioderma needlecast (p. 34)	From March through May the year following infection, red-brown spots develop on needles. Tips of needles girdled by spots die while needle bases remain green and needles remain attached to twig. Black fungal fruiting structures that look like lines in the dead area of the needle form. Needles are cast in May through June the year after infection.	*Ploioderma lethale* (formerly *Hypoderma*)	Space plants and control weeds to ensure good air circulation around the tree. Apply chlorothalonil or mancozeb three times at 3-week intervals beginning in late May.
Lophodermium needlecast (p. 32)	From March through May the year following infection, needles on lower branches turn completely brown and fall. Black fungal fruiting structures that look like lines in the dead area of the needle form on the cast needles.	*Lophodermium*	Space plants and control weeds to ensure good air circulation around the tree. Apply chlorothalonil, azoxystrobin, or mancozeb three times beginning in mid-July and at 3-week intervals. However, if early summer is warm, begin in mid-June.
Needle rust (p. 268)	Two- and three-needled pines develop small, cream-colored, bag-like pustules on the needles. These rupture and release orange spores that blow to and infect goldenrod and asters where the fungus overwinters. Pines are infected the following summer by spores from asters and goldenrod.	*Coleosporium asterum*	Little damage occurs, and no control measures are recommended.
Pine-pine gall rust (p. 282)	Many round galls form on the branches and enlarge up to several inches in diameter. Approximately 15 months after infection, masses of yellow spores erupt from the galls and infect new pine shoots.	*Endocronartium harknessii*	Inspect plants very carefully and prune all galls. Inspect all newly purchased seedlings carefully for galls. Destroy infected seedlings. Apply mancozeb as new needles emerge and again 2 weeks later.
Pine-oak gall rust (p. 274)	A few galls, which may swell to 10 inches in diameter, form on two- and three-needled pines. Masses of yellow-orange spores erupt from the galls about a year after infection and blow to red oaks. Small areas of yellow-orange spores develop on the underside of oak leaves in the summer. These spores reinfect oak. Small, brown, hair-like fungal structures, where the fungus overwinters, develop on the underside of oak leaves late in the growing season.	*Cronartium quercuum*	Inspect plants very carefully and prune all galls. Do not establish a two- and three-needled pine nursery close to or within a red oak stand. Inspect all newly purchased seedlings carefully for galls. Destroy infected seedlings.
Root rot (p. 370)	Trees, particularly white pines, are stunted before any other symptoms appear. Infected trees decline, yellow, wilt, and die. Dead needles remain attached. Resin oozes from a girdling canker at the soil line or several inches above the soil. Wood beneath the bark where resin is oozing is chocolate brown to black.	*Verticicladiella procera*	Trees most susceptible are ones growing on poor sites for pines. Remove infected trees and do not replace them with pine.

Disease	Symptoms	Pathogen/cause	Management
White pine blister rust (p. 272)	White pines develop swollen cankers on the trunk or branches. Resin flows from the cankers. Powdery, yellow to cream-colored spores erupt from the cankers in May through July, two to three seasons after infection. Branches and entire trees are girdled and die. Spores formed on the pine infect the leaves of currants and gooseberries (*Ribes*). Spores formed on currants and gooseberries infect pines through the needle. The fungus then grows into twigs, branches, and the main trunk.	*Cronartium ribicola*	Destroy currants and gooseberries in and around nurseries. Purchase and plant only rust-free plants. Inspect pines frequently and prune out any infected branches, cutting 12 inches below the canker.

POPLAR

Disease	Symptoms	Pathogen/cause	Management
Cryptodiaporthe canker (p. 184)	At first, a few twigs are killed. The fungus spreads rapidly to cause many variously shaped cankers and kill large branches as it does so. Perennial canker formation leads to leaf yellowing, premature defoliation, and water sprout formation. Green-brown material filled with spores oozes out of the canker during wet weather and dries to a brown color. When the tree walls off the canker, the bark covering the canker may crack, fall away, and thereby expose inner wood to decay fungi. Trees most susceptible are those under drought or other stress.	*Cryptodiaporthe populea*	Irrigate to prevent drought stress in the late summer and autumn. Remove infected trees.
Cytospora canker (p. 200)	Twigs and larger branches die. Brown, circular, sunken cankers form on the bark. During wet weather, yellowish threads of spores ooze out of fruiting structures in the canker. Lombardy poplar is very susceptible.	*Cytospora*	Remove infected branches cutting well below the canker. Remove severely infected trees.
Rust (pp. 256–258)	Small, yellowish-orange areas of powdery spores form on the underside of leaves. These spores spread to the alternate host, hemlock.	*Melampsora*	No control is recommended since little damage occurs.
Scab and shoot blight (p. 100)	Branch tips and young leaves blacken and die rapidly. Olive-green spores of the fungus develop on the surface of dead and dying tissue. Small trees are most susceptible.	*Venturia tremulae*	Remove severely infected trees.

PRIVET

Disease	Symptoms	Pathogen/cause	Management
Gall (p. 146)	Knobby galls 6 inches in length and 1½ inches in diameter occur on stems of common privet.	*Phomopsis*	Prune infected stems.
Twig blight and canker (pp. 122–124)	Common or European and Lodenese privet twigs die. Cankers have pinkish fungal fruiting structures. Affected bark splits and plants die when girdled.	*Glomerella cingulata*	Plant resistant cultivars such as Amure, California, Ibota, or Regal.

PYRACANTHA

Disease	Symptoms	Pathogen/cause	Management
Fire blight (p. 162)	Twigs, branches, and leaders on shrubs wilt and blacken, especially during flowering. Affected twigs and branches may bend over into the shape of a shepherd's crook. Blackened flower parts remain attached to the plant. Cream-colored liquid may ooze out of the cankers and run down the trunk and branches in the spring if conditions are very wet. No fungal fruiting structures are found in the cankers.	*Erwinia amylovora*	Do not purchase or plant infected material. Remove severely infected plants. During dormancy when the weather is dry, prune infected branches, cutting at least 4 inches below the base of the canker. Disinfest pruning tools frequently. Fire blight resistant plants include: Mojave, Navaho, Teton, Yunan, and Shawnee.

Disease	Symptoms	Pathogen/cause	Management
Scab (p. 98)	Velvety, olive green spots can form on all plant parts. Leaves and fruit fall prematurely.	*Spilocaea pyracanthae (Fusicladium)*	Plant resistant cultivars such as Bella, Duval, Flava, Firey Cascade, Government Red, Prostrata, Rutgers Shawnee, and Santa Cruz Prostrata. Avoid using sprinkler irrigation. Apply chlorothalonil, mancozeb, mancozeb + thiophanate methyl, myclobutanil, or thiophanate methyl in the spring and at regular intervals until the weather dries.

REDBUD

Disease	Symptoms	Pathogen/cause	Management
Dieback and canker (p. 172)	Leaves wilt and die as branches are slowly killed. Small, sunken cankers slowly increase in size. The wood beneath the canker is discolored. Trees cankered near the base will die.	*Botryosphaeria*	Prune infected branches well below the canker. Remove severely infected trees. Protect trees from drought stress and winter injury.

ROSE

Disease	Symptoms	Pathogen/cause	Management
Anthracnose (pp. 122–124)	Dark-purple to black spots are bordered by a narrow, dull-brown band. Centers of spots turn gray and fall out. Spots similar to leaf spots form on canes.	*Sphaceloma rosarum*	Maintain good sanitation. Black spot control procedures (below) also control anthracnose.
Black spot (p. 66)	Brown to black round spots with feathery edges form on leaves. Leaves yellow and fall. Small, purplish spots form on canes.	*Diplocarpon rosae*	Remove infected canes. Remove and destroy fallen leaves. Water in a manner that keeps foliage surfaces dry. Apply one of the following to protect new foliage: chlorothalonil, mancozeb, thiophanate methyl, thiophanate methyl + mancozeb, azoxystrobin, myclobutanil, triforine or ziram. Triadimefon can stunt some cultivars.
Botrytis blight (p. 60)	Small, water-soaked lesions form on petals. Gray fungal growth covers infected petals. Stubs left after harvest become infected. The fungus then moves down to girdle the cane.	*Botrytis cinerea*	Space plants to ensure good air circulation. Remove fading flowers and yellowing leaves. Apply chlorothalonil, fludioxonil, or iprodione to protect healthy tissue.
Cankers (pp. 82, 294)	Reddish-brown spots on canes turn light to dark brown and become covered with tiny, black dots (fungal fruiting structures). Cankers girdle and kill the cane.	*Coniothyrium fuckelii, Cryptosporella umbrina, Coniothyrium wernsdorffiae, Cylindrocladium scoparium*	Do not plant stock with cankers. Remove infected canes, making the cut immediately above a bud. Apply a fungicide (see black spot) after pruning. Sterilize the shears with bromine disinfestant between cuts. Maintain even soil moisture and moderate fertilization.
Crown gall (p. 156)	Small white to cream-colored galls that form on stems may enlarge to 6 inches in diameter. Galls can form on roots or stems.	*Agrobacterium tumefaciens*	Do not plant infected material. Apply *Agrobacterium radiobacter* to protect healthy plants at transplant.
Downy mildew (p. 12)	Purplish-brown spots form on leaves during cool, damp spring weather. Leaves yellow and fall. Small spots or long, purplish areas may form on and kill twigs.	*Peronospora sparsa*	Water in a manner that keeps leaf surfaces dry. Apply mancozeb, azoxystrobin, potassium salts of phosphorus acid, or mancozeb + thiophanate methyl.
Powdery mildew (p. 16)	Spots on leaves, stems, and flower parts expand and become covered with white fungal growth. Small dead spots form on some cultivars.	*Sphaerotheca pannosa*	Apply azoxystrobin, myclobutanil, potassium bicarbonate, kresoxim methyl, chlorothalonil, triflumizole, piperalin, fenarimol, sulfur, triadimefon, triforine, or ziram. Triadimefon can stunt many cultivars.
Rust (p. 238)	Lower leaves and cane tissue in the spring and summer have masses of orange powdery spores. Black spores form on the leaves and other parts in autumn.	*Phragmidium*	Infected plants should be immediately destroyed since this disease is not common in the U.S. and poses a serious threat to roses. Bury infected plant material or seal in a plastic bag and send it to a landfill. Only roses are susceptible. The fungus will die quickly if no roses are available for infection.

Disease	Symptoms	Pathogen/cause	Management
Viruses (pp. 410, 414)	Leaves may exhibit mosaic, mottling, yellow line, or ring patterns. Veins may turn yellow.	Rose mosaic, mottle, yellow mosaic, ring pattern, or streak virus. Tobacco streak. Rose rosette, rose wilt, spring dwarf, or color break virus. Strawberry latent ring spot.	Destroy infected plants. Plant only healthy, virus-free plants. Maintain good insect and mite control.

SPRUCE

Disease	Symptoms	Pathogen/cause	Management
Cytospora canker (p. 196)	Sunken dead areas of bark and underlying wood form on the lower branches of the trees girdling small branches in 1 or 2 years and large branches after several years. Resin flows out of the cankers and may drip down on lower branches. Scattered lower branches die. Branch death progresses up the tree.	*Leucostoma kunzei (Cytospora)*	Since the fungus readily infects wounded tissue but remains latent in the tree without causing symptoms until the tree is drought stressed, fungicide sprays can not be effectively timed to prevent this disease. Select the planting site carefully, avoiding drought prone sites. Anticipate the future needs of the mature tree and consider whether the site has the potential to supply the water required of a specimen 50 to 60 feet tall. Prune infected branches. Blue, white, red, black, Engelmann, and Norway spruces are all susceptible to this disease.
Needle rust (p. 266)	Year-old needles are cast after turning rust colored in the spring. Blue spruce is very susceptible, as are black, Engelmann, red, Sitka, and white spruces.	*Chrysomyxa weirii*	Notify the Bureau of Plant Industry immediately to obtain a positive diagnosis. Destroy infected trees. To protect trees not yet affected, apply chlorothalonil first when 10 percent of the tree is in bud break, again 1 week later, and again 3 weeks after the first spray.
Rhizosphaera needlecast (p. 42)	Year-old needles turn lavender in color and have tiny, black fungal fruiting structures in rows on either side of the midvein on the underside of the needle. Large bare areas develop on the tree as needles fall.	*Rhizosphaera*	Space trees and provide good weed control to ensure free air circulation around the tree. Apply chlorothalonil when new shoots are 1½ inches long and again 3 weeks later to protect young needles from infections that occur in May through June. Some locations have an additional infection period in September and October. Blue and Engelmann spruce are highly susceptible. White spruce is somewhat susceptible. Norway spruce is relatively resistant.

SYCAMORE

Disease	Symptoms	Pathogen/cause	Management
Anthracnose (p. 112)	Dead twigs and branches have sunken cankers. Bud death followed by new bud formation and more bud death results in witches' broom-like proliferation of branch ends as well as very crooked branching patterns. Black fungal fruiting structures are visible on the bark covering newly killed twigs early in the spring. Young shoots are killed. Leaves, especially on lower and inner branches, are blighted and fall early in the season only to be replaced by new leaves in mid-season. Tan, dead areas expand along leaf veins. Large, irregularly shaped areas are killed along the leaf margins and between the veins. Fungal fruiting structures can be found with a magnifying glass along the veins.	*Apiognomonia*	Prune and destroy dead twigs and branches during dormancy, cutting 3 to 4 inches below the canker. Plant resistant cultivars that have been vegetatively propagated from Bloodgood, Columbia, or Liberty clones of London plane trees. If trees are of high value, benzimidazole can be injected in the autumn before the leaves have fallen, the next spring after the leaves emerge, and again in the autumn to obtain protection of new tissue for the following two to three springs. Or spray chlorothalonil, copper salts, cupric hydroxide, or mancozeb + thiophanate methyl in the spring at bud break and repeatedly until the weather dries and daily temperatures average above 65°F.

Disease	Symptoms	Pathogen/cause	Management
Bacterial leaf scorch (p. 386)	Oldest leaves brown along their margins and eventually between the veins beginning in mid to late summer on one branch or a few branches on inner and lower portions of the tree. A brown band sometimes develops between the brown and green tissue of the leaf. The browning of leaves progresses to include more leaves toward the ends of branches. Infected trees have delayed bud break in the spring and produce smaller-than-normal leaves.	*Xylella fastidiosa*	Leafhoppers and spittle bugs carry the bacteria from tree to tree. See the information on this disease in the "Common Plant Diseases" section. Promote plant vigor by protecting the tree from stresses. *X. fastidiosa* from elm does not infect sycamore or vice versa.
Canker stain (p. 360)	London plane and sycamore trees have sparse foliage, small leaves, and elongated sunken cankers on the trunk and larger branches. Beneath the cankers, the wood is stained bluish black or reddish brown. Viewed in cross section, the discolored wood is wedge shaped with the point of the wedge extending toward the center of the trunk or branch.	*Ceratocystis fimbriata* f. sp. *platani*	Since the fungus enters only through wounds, pruning tools, ropes, ladders, and other equipment must be disinfested immediately after use on a tree before proceeding to another tree. Do not use wound paints since brushes efficiently move spores from tree to tree. Sap-feeding beetles can also transmit the fungus.
Powdery mildew (p. 16)	Heavy white fungal growth develops on the upper surface of leaves in late summer and in the autumn. Leaf shape is very distorted.	*Microsphaera*	Little damage occurs to the tree itself other than deforming the leaf appearance. No control is recommended unless the tree is of very high value. Chlorothalonil, cupric hydroxide, mancozeb + thiophanate methyl, or triadimefon can be applied in late summer to protect leaves. Benzimidazole injection (described under anthracnose) gives some powdery mildew control.

TAXUS

Disease	Symptoms	Pathogen/cause	Management
Dieback (p. 128)	Needles on branches yellow as the branch dies.	Excessive soil moisture.	Do not plant *Taxus* in poorly drained locations, especially in areas of heavy clay.
Edema (p. 486)	Bumps of scab-like tissue form on the underside of needles.	Excessive soil moisture.	See dieback above.

TULIPTREE

Disease	Symptoms	Pathogen/cause	Management
Powdery mildew (p. 16)	White fungal growth forms on the upper surface of leaves.	*Erysiphe* or *Phyllactinia*	No control is recommended since little damage occurs.
Sooty mold (p. 30)	Black fungal growth covers the leaf surface where a shiny, sticky material has been deposited.	Sooty mold is not a pathogen. It merely grows on honeydew secreted by aphids higher up on the tree and drips onto lower leaves.	Control aphids.

VIBURNUM

Disease	Symptoms	Pathogen/cause	Management
Botryosphaeria canker (pp. 172–176, 180)	Leaves on affected branches wilt and die. Branches die back and become covered with dark-brown to black pimple-like fungal fruiting structures. Wood under the bark is dark brown.	*Botryosphaeria*	Plants most susceptible are those under drought stress. Therefore, irrigate to prevent drought stress. Prune infected branches.
Downy mildew (p. 12)	Angular spots limited in shape by the leaf veins form blotches that die and shrivel in the spring when the weather is wet. Severely affected leaves fall. Light- colored fungal growth sparsely covers the spots on the underside of the leaf.	*Plasmopara viburni*	Rake and destroy fallen leaves in the autumn. Avoid overhead irrigation in the spring. Apply azoxystrobin or chlorothalonil + thiophanate methyl.
Powdery mildew (p. 16)	White fungal growth forms on the upper surface of leaves.	*Erysiphe* or *Phyllactinia*	No control is recommended since little damage occurs. If severe, apply azoxystrobin, triadimefon, chlorothalonil or myclobutanil.

VINCA

Disease	Symptoms	Pathogen/cause	Management
Blight	Branches and eventually the entire plant blackens at the base and dies.	*Phoma*	Avoid overhead irrigation. Apply thiophanate methyl + mancozeb or thiophanate methyl as a drenching spray.

WALNUT

Disease	Symptoms	Pathogen/cause	Management
Anthracnose (p. 118)	Circular, brown spots with yellow halos form on the undersides of leaflets as the leaves reach full size. Leaflets yellow, brown, and fall prematurely, leaving trees very bare by August. Tiny, brown fungal fruiting structures form mostly along leaf veins on the undersides of leaves.	*Gnomonia leptostyla*	It is thought that little actual damage occurs to the tree since most of the growth has occurred before the leaves fall. However, repeated severe defoliation gradually weakens the tree. Fertilize the tree well to maintain good vigor.

WILLOW

Disease	Symptoms	Pathogen/cause	Management
Crown gall (p. 156)	Rough galls form on stems at the soil line or on roots. If the galls engulf the stem or root, that tissue will be killed.	*Agrobacterium tumefaciens*	Remove severely affected trees. Do not replace them with herbaceous or woody plants susceptible to crown gall.
Black canker	Black areas form on leaves and spread to engulf and kill larger woody twigs in the summer. If the weather is wet, pink spore masses form on blackened twig cankers. This disease often occurs on trees with blight. See below.	*Phyalospora miyabeana*	Do not plant highly susceptible cultivars in the landscape.
Blight or scab (p. 102)	Newly formed leaves and twigs are quickly browned in the spring during wet weather. Infected leaves fall. Olive-brown spores form on the surface of infected tissue.	*Venturia saliciperda*	Apply mancozeb, copper hydroxide, myclobutanil, or azoxystrobin to protect the foliage of highly valued trees.

Other useful references include the disease compendium series available from the American Phytopathological Society (APS Press Customer Service, 3340 Pilot Knob Road, Saint Paul, MN 55121-2097; Phone: 1-800-328-7560; Fax: 1-651-454-0766; e-mail: aps@scisoc.org; Web site: www.shopapspress.org). Disease compendia are available on pines, azalea and rhododendrons, roses, elm, flowering potted plants, chrysanthemums, and foliage plants.