

Disease Management Guide

***Abies* (Fir)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Armillaria Root Rot <i>(Armillaria spp. complex)</i> p. 326	Also called shoestring root rot and honey mushroom rot; this disease is difficult to identify since aboveground symptoms appear as general and progressive decline that leads to the eventual death of trees; trees can die singly or in groups; trees under environmental or site-related stresses are particularly susceptible; on conifers, excessive resin production at points of infections or at the bases of trees can be important symptoms of infection; the diagnostic black strands of the fungus called rhizomorphs (shoestrings) are usually not present on conifers; signs of the infection include white fans of fungal growth with “mushroomy” odors under the bark and the occasional growth of honey mushrooms at the base of infected trees in autumn; the fungus can persist in stumps and large, woody roots for as long as 30 years;	<ul style="list-style-type: none"> • maintain tree vigor; • avoid any unnecessary stresses, esp. drought stress; • avoid planting susceptible trees in a site where this disease has been confirmed; • if replanting in the site, the stump and all woody roots greater than ½ inch in diameter should be removed; 	No chemical control is suggested.
Canker <i>(Leucostoma)</i> p. 166	Symptoms include needle browning, bare twigs, and dead or dying branches; most obvious in spring and early summer; associated with cankers that appear as sunken, dead areas on branches or the main trunk; cankers are sometimes difficult to see but excessive resin flow can be used as an indicator of cankered areas;	<ul style="list-style-type: none"> • avoid wounding trunk and limbs; • maintain vigor; • prune and remove diseased limbs back to healthy wood when bark is dry and disinfest tools between cuts; • avoid unnecessary stresses, esp. drought stress; 	No chemical control is suggested.

Abies (Fir) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Diplodia Blight [Sphaeropsis Tip Blight] <i>(Diplodia pinea)</i> p. 130	Tip blight results from infection of newly emerging buds and shoots; infected buds or shoots usually stop growing before or during needle elongation and needles are frequently stunted and short; infected tissues are straw-colored and have excessive resin flow; usually kills only current-season buds and shoots and second-year cones, but can cause significant dieback on stressed trees; black fruiting structures of the fungus may be visible at the base of needles and on cones; symptoms may be distributed uniformly throughout the canopy or concentrated in lower branches; drought-stressed trees are particularly susceptible; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove blighted twigs, branches, and cones during dry weather in autumn; • maintain tree vigor; special attention should be given to watering during periods of drought; • fungicide sprays can be applied at budbreak and repeated 2-3 times at label intervals; 	*copper hydroxide copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i> *potassium bicarbonate propiconazole thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon
Fungal Needlecast <i>(Lophodermium)</i> p. 46	Needles turn yellow, brown, and drop prematurely; diagnostic, elongate, football-shaped fruiting bodies of the fungus may be evident on the infected needles;	<ul style="list-style-type: none"> • rake and remove symptomatic needles; • maintain tree vigor; • chemical control is usually not necessary except for new transplants, young, or specimen trees, or when defoliation has been heavy for several years; fungicide sprays can be applied in late June or early July and repeated according to label directions; 	chlorothalonil copper sulphate pentahydrate *harpin protein mancozeb *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl

***Abies* (Fir) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Phytophthora Root Rot <i>(Phytophthora spp.)</i> p. 362	General decline, poor growth and vigor due to root decay; needles become chlorotic, droop, and brown; symptomatic trees may occur singly or in enlarging groups; can result in tree death; excessive resin is sometimes visible on the outer bark at the base of the tree; a diagnostic brown discoloration may be evident on the inner bark and cambium at the root/crown area; frequently more serious on trees in sites where excess water is a persistent problem (e.g., clay soils, low areas); seedlings are highly sensitive; Fraser fir is particularly susceptible;	<ul style="list-style-type: none"> • avoid excessive fertilization and planting in wet areas; • protectant fungicides can be applied to uninfected, asymptomatic trees adjacent to infected trees; infected trees cannot be cured; 	fosetyl-Al *harpin protein mefenoxam mono- and di- potassium salts of phosphorous acid *QST 713 strain of <i>Bacillus subtilis</i> phosphorous acid
Rusts <i>(Uredinopsis, Pucciniastrum)</i> p. 280	Yellow, orange, reddish-brown, or white pustules develop on needles; infected needles usually dry up, turn brown, and drop by late summer; most rust fungi require alternate hosts to complete their life cycles; fir-fern or Uredinopsis needle rust (<i>Uredinopsis pteridis</i>) has been prevalent on white and grand fir in landscape and plantation trees in Connecticut; the alternate host is bracken fern; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • maintain tree vigor; • control measures are usually not necessary except in Christmas tree plantations or for specimen trees; • fungicides can be applied when new growth emerges in the spring and repeated according to label directions; do not use triadimefon on Concolor (white) fir; • remove alternate hosts, when applicable; 	azoxystrobin *harpin protein mancozeb *QST 713 strain of <i>Bacillus subtilis</i> triadimefon

***Abies* (Fir) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Sirococcus Tip Blight <i>(Sirococcus)</i> p. 118	Symptoms first appear on succulent shoots and 1-year-old twigs; the fungus attacks at needle bases, girdles the shoot, and results in tip dieback; affected tips turn brown, drop needles, and often develop a characteristic crook or droop; pinpoint, brown fruiting structures may be visible along the stems of dead shoots; infections can appear at random in the canopy; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove infected shoots when bark is dry; • rogue and remove heavily infected trees; • maintain vigor; • fungicide sprays can be applied when needles are ½ inch long and repeated 2-4 times at label intervals until needles are fully expanded; 	azoxystrobin chlorothalonil chlorothalonil + fenarimol *harpin protein mancozeb *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl + chlorothalonil

Acer (Maple)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Anthracnose (<i>Discula</i> , <i>Aureobasidium</i>) p. 96, 110	Irregular, brown to reddish-brown (often papery) areas develop along and sometimes between veins and at leaf margins; symptoms are very similar to those associated with drought and heat stress; some defoliation may occur when infection is heavy; can result in tip dieback; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune dead twigs and branches; • chemical control is usually not necessary except for new transplants, young or specimen trees, or when defoliation has been heavy for several years; fungicide sprays can be applied at budbreak and repeated 2-3 times at label intervals; 	azoxystrobin chlorothalonil copper salts of fatty and rosin acids *copper sulfate copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + thiophanate methyl *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil

Acer (Maple) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Bleeding Canker (<i>Phytophthora</i> spp.) p. 354	Primary symptoms include oozing of reddish-brown fluid from fissures or cracks in the bark; these are usually centered over diffuse cankers; infected inner bark, cambium, and sapwood appear distinctly reddish-brown; some dieback of branches and thinning of the canopy can occur; can result in tree death; quite prevalent in landscape trees in 2006 growing season;	<ul style="list-style-type: none"> • maintain tree vigor by attention to irrigation, soil compaction; • mildly infected trees have occasionally been reported to recover; • rogue and remove heavily infected trees to reduce the potential of spread to nearby trees; • recent trials have demonstrated anecdotal success with directed basal bark sprays and injections of mono- and di-potassium salts of phosphorous acid; 	*harpin protein mono- and di- potassium salts of phosphorous acid *QST 713 strain of <i>Bacillus subtilis</i> phosphorous acid
Botryosphaeria Canker (<i>Botryosphaeria</i>) p. 120	Random dieback of branches and limbs; usually associated with sunken cankers in which black fruiting structures of the fungus may be visible; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding; • maintain tree vigor; • avoid unnecessary stresses, esp. drought stress; 	No chemical control is suggested.
Decline (<i>Abiotic Complex-Unknown</i>) p. 460	General poor growth and vigor; progressive dieback and thinning of the canopy; premature fall coloration;	<ul style="list-style-type: none"> • avoid stress by attention to planting site; • maintain tree vigor; • avoid exposure to road salt and minimize soil compaction; • prune dead branches; 	No chemical control is suggested.

Acer (Maple) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Eutypella Canker (<i>Eutypella parasitica</i>) p. 196	General dieback and thinning of the canopy; cankers can develop on branches or the main trunk; Eutypella cankers are distinctly different from Nectria cankers; they have a pronounced bulge of callus around a dead center; cankers consist of somewhat flattened, concentric rings of callus; these weak areas are prone to storm breakage;	<ul style="list-style-type: none"> • avoid wounding trunk and limbs; • maintain vigor; • prune and remove diseased limbs when bark is dry and disinfest tools between cuts; 	No chemical control is suggested.
Fungal Leaf Spot (<i>Phyllosticta</i>) p. 42	Circular spots approx. ¼ inch in diameter with tan to brown centers and distinct purplish-brown margins develop on leaves (sometimes referred to as a “frog-eye” symptom); small, black fruiting bodies may be visible on upper surfaces of spots; usually more severe on red, sugar, and silver maple but can occur on Japanese and Norway maple; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune dead twigs and branches; • chemical control is usually not necessary except for new transplants, young or specimen trees, or when defoliation has been heavy for several years; fungicide sprays can be applied at budbreak and repeated as necessary at label intervals; 	azoxystrobin chlorothalonil copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + myclobutanil mancozeb + thiophanate methyl *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil

Acer (Maple) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Girdling Root (Abiotic) p. 504	Roots growing closely appressed to the main trunk result in poor vigor, weak growth, general decline, and canopy dieback; symptoms often develop on one side of a tree; girdling roots develop at or below the soil line; a diagnostic symptom is a “telephone pole” appearance to the base of the tree (i.e., lack of a root flare); Norway maple is prone to this problem;	<ul style="list-style-type: none"> • maintain vigor; • examine young trees, especially Norway maples, during the first 10 years after planting for any symptoms; if a girdling root at an early stage of development is found, it can be excised and removed; • prune and remove any dead branches; 	No chemical control is suggested.
Nectria Cankers [Coral Spot Canker, Perennial Canker] (Nectria and Neonectria) p. 176, 182	Random dieback of branches and limbs; usually associated with sunken cankers that are often covered with distinctive coral-colored or reddish-orange fruiting structures of the fungus; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs as soon as detected when bark is dry; • avoid wounding; • maintain tree vigor; • avoid unnecessary stresses, esp. drought stress; 	No chemical control is suggested.
Powdery Mildew (Erysiphe) p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	copper sulphate pentahydrate fenarimol *harpin protein mancozeb + myclobutanil myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon

Acer (Maple) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Scorch (<i>Abiotic</i>) p. 492	Irregular, brown to reddish-brown (often papery) areas develop along veins or at leaf margins; symptoms are very similar to those caused by anthracnose and occasionally by heavy feeding damage from leafhoppers;	<ul style="list-style-type: none"> • avoid plant stress, esp. drought stress; • promote tree vigor and pay attention to planting site; 	No chemical control is suggested.
Tar Spot (<i>Rhytisma</i> spp.) p. 66	Distinctive, shiny black, tar-like spots develop on leaves; depending on the fungal species, spots can be irregular and range from ½ - 1 inch in diameter or can appear as clusters of tiny, pinpoint dots; when infection is heavy (esp. on Norway maple) significant chlorosis and premature defoliation can occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • usually not serious enough for chemical control except perhaps on Norway maple; fungicide sprays can be applied at budbreak and repeated 2-3 times at label intervals; 	*harpin protein mancozeb mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl
Verticillium Wilt (<i>Verticillium</i> spp.) p. 242	Flagging or wilting of individual limbs or portions of the canopy, usually in midsummer; leaves can be undersized and infected trees sometimes have heavy seed set; trees die slowly or suddenly, depending on the extent of infection and overall health of the tree; a distinctive olive-brown streaking may be evident in the wood of symptomatic branches or twigs; laboratory examination and culturing are usually required for definitive identification; particularly severe on Japanese and Norway maples in Connecticut in recent years;	<ul style="list-style-type: none"> • prune and remove affected limbs as soon as symptoms are evident; • disinfest tools between cuts; • promote tree vigor; • avoid drought stress; • do not replant susceptible species in the area since the fungus is soilborne (refer to list of resistant species, Table 1); 	No chemical control is suggested.

***Aesculus* (Buckeye, Horsechestnut)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Anthracnose <i>(Glomerella)</i> p. 114	Newly emerging shoots die and appear blighted in spring; irregular, brown areas can also develop on leaves; these necrotic areas are often defined by the leaf veins; some early-season defoliation may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune infected twigs and branches when bark is dry; • maintain tree vigor; • chemical control is usually not necessary except for new transplants, young or specimen trees, or when defoliation has been heavy for several years; fungicides can be applied at budbreak and repeated as necessary according to label directions; 	chlorothalonil chlorothalonil + fenarimol *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + thiophanate methyl *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil

***Aesculus* (Buckeye, Horsechestnut) cont'd**

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Leaf Blotch (<i>Guignardia</i> , <i>Phyllosticta</i>) p. 40	Initial leaf symptoms appear as water-soaked areas of variable size; these patches turn reddish-brown and symptomatic leaves become quite brittle; when entire leaves and petioles become symptomatic, significant leaf drop can occur; pinpoint, black fruiting structures can be found in the necrotic areas; the presence of these structures helps to distinguish this disease from scorch due to abiotic stresses; symptoms usually don't appear until July and early defoliation usually starts in August;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • some resistance is available (e.g., <i>Aesculus arguta</i>, <i>A. glabra</i> var. <i>sargentii</i>); • chemical control is usually not necessary; fungicides can be applied at budbreak and repeated for 2-4 applications according to label directions; 	chlorothalonil chlorothalonil + fenarimol *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + myclobutanil mancozeb + thiophanate methyl *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl + chlorothalonil
Powdery Mildew (<i>Erysiphe</i>) p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	fenarimol *harpin protein myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon

***Aesculus* (Buckeye, Horsechestnut) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Scorch <i>(Abiotic)</i> p. 492	Margins of leaves turn brown and curl; entire leaves develop a scorched appearance by late July or August; often associated with drought or heat; some premature leaf drop can occur; symptoms are very similar to leaf blotch but no fruiting structures are evident in symptomatic leaves;	<ul style="list-style-type: none"> maintain tree vigor and water during periods of drought; 	No chemical control is suggested.

***Ailanthus* (Tree-of-Heaven)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Armillaria Root Rot <i>(Armillaria spp. complex)</i> p. 326	Also called shoestring root rot and honey mushroom rot; this disease is difficult to identify since aboveground symptoms appear as general and progressive decline, which leads to the eventual death of trees; trees can die singly or in groups; trees under environmental or site-related stresses are particularly susceptible; diagnostic signs of the infection include black strands of the fungus called rhizomorphs (shoestrings) on the surface of the bark or at the base of infected trees, white fans of fungal growth with “mushroomy” odors under the bark, and the occasional growth of honey mushrooms at the base of infected trees in autumn; narrow, black lines are often evident in infected wood; the fungus can persist in stumps and large, woody roots for as long as 30 years;	<ul style="list-style-type: none"> • maintain tree vigor; • avoid any unnecessary stresses, esp. drought stress; • avoid planting susceptible trees in a site where this disease has been confirmed; • if replanting in the site, the stump and all woody roots greater than ½ inch in diameter should be removed; 	No chemical control is suggested.

***Ailanthus* (Tree-of-Heaven) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Verticillium Wilt <i>(Verticillium spp.)</i> p. 242	Flagging or wilting of individual limbs or portions of the canopy, usually in midsummer; leaves can be undersized and infected trees sometimes have heavy seed set; trees die slowly or suddenly, depending on the extent of infection and overall health of the tree; a distinctive brownish streaking may be evident in the wood of symptomatic branches or twigs; laboratory examination and culturing are usually required for definitive identification;	<ul style="list-style-type: none"> • prune and remove affected limbs as soon as symptoms are evident; • disinfest tools between cuts; • promote tree vigor; • avoid drought stress; • do not replant susceptible species in the area since the fungus is soilborne (refer to list of resistant species, Table 1); 	No chemical control is suggested.

***Albizia* (Mimosa, Silk-tree)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Mimosa Wilt <i>(Fusarium oxysporum</i> <i>var. perniciosum)</i> p. 248	Initial symptoms of this highly destructive disease usually develop in early to midsummer; leaves become chlorotic or olive-green and wilt; a distinctive feature is that they hang down from the twig; affected leaves eventually shrivel, dry, and drop; symptoms may first appear on one or two limbs but quickly spread to the entire tree; brown streaks are often evident in the sapwood of symptomatic limbs; tan, raised, or cushion-like fruiting structures of the fungus frequently develop at lenticels of symptomatic branches and are visible with a hand lens; most diseased trees die within one year after symptoms first appear;	<ul style="list-style-type: none"> • rogue and remove heavily infected trees to reduce the potential of spread to nearby trees; • promote tree vigor; • do not replant susceptible species in the area since the fungus can form resting structures that persist in the soil; 	No chemical control is suggested.
Nectria Canker <i>(Nectria spp.)</i> p. 176	Random dieback of branches and limbs; usually associated with sunken cankers that are often covered with distinctive coral-colored or orange fruiting structures of the fungus; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding; • maintain tree vigor; 	No chemical control is suggested.

***Amelanchier* (Serviceberry, Shadblow)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Brown Rot <i>(Monilinia)</i> p. 76	Symptoms appear as a blossom blight characterized by a sudden collapse and browning of blossoms; shoot and twig blights can occur as the fungus grows from infected flowers into the wood; sunken, discolored cankers may persist on twigs or branches; fruit rot is a diagnostic symptom that is most obvious as fruit ripen; diagnostic signs are powdery, brownish-gray masses of fungal spores covering the surfaces of infected fruit and tissues; fruit mummies may persist on the tree into the winter; particularly problematic during the 2006 season;	<ul style="list-style-type: none"> • rake and remove infected fruit mummies and leaves; • prune dead or cankered twigs or branches; • on specimen trees, fungicide sprays can be applied at budbreak and continued according to label directions; critical sprays are early in the season, particularly during bloom; 	*harpin protein myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl

Entomosporium Leaf Spot
(*Diplocarpon mespili*)
p. 78

Numerous small, reddish-brown spots appear on upper surfaces of leaves; as they increase in size, they frequently coalesce and result in significant midsummer defoliation; infections of highly susceptible species develop twig and branch dieback if they are defoliated for several successive years;

- rake and remove fallen leaves;
- maintain tree vigor;
- provide good air circulation and avoid overhead irrigation;
- for specimen trees, fungicides can be applied at budbreak and repeated 2-3 times as necessary according to label directions;

chlorothalonil
chlorothalonil +
fenarimol
*harpin protein
mancozeb
mancozeb +
myclobutanil
mancozeb +
thiophanate
methyl
myclobutanil
*QST 713 strain of
Bacillus subtilis
thiophanate methyl
thiophanate methyl
+ chlorothalonil
thiophanate methyl
+ flutolanil

***Amelanchier* (Serviceberry, Shadblow) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Fire Blight <i>(Erwinia amylovora)</i> p. 376	Flowers wither and blacken; young twigs and branches die from the terminals back and appear as though "burned"; affected limbs frequently develop a characteristic shepherd's crook at the tip; dead leaves usually remain attached to the branch; sunken, discolored cankers may be evident on branches or the main trunk; this disease can result in tree death; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • overwintering cankers should be pruned and removed during the winter; make cuts at least 10-12 inches below visible symptoms when bark is dry; • during the growing season, prune and remove infected branches as soon as they develop; make cuts at least 10-12 inches below visible symptoms when bark is dry; • disinfest tools between cuts; • recent studies with infected fruit trees have shown that the old method of cutting 8-10 inches below visible symptoms of growing-season blight strikes has certain limitations; new research has shown that bacteria can sometimes be found as far as 9 feet beyond visible symptoms on highly susceptible trees; they suggest that cuts on symptomatic shoots should be made back to 2-year or older wood and at least 8-12 inches below the visible symptoms; these cuts often leave a 4-5 inch naked stub above the next leaf or branch, so this method has been called the "ugly stub" method; cuts should be made when the bark is dry; the presence of "ugly stubs" in the tree will flag infection sites for follow-up with winter pruning; • avoid excessive nitrogen fertilization or vigor; (continued on next page) 	*copper hydroxide copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i>

***Amelanchier* (Serviceberry, Shadblow) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Fire Blight (Cont'd)		<ul style="list-style-type: none"> preventative copper sprays can be applied to the bark before growth emerges in spring; additional applications may be necessary to protect newly emerging shoots until flowering; select the appropriate product if harvesting fruit for consumption; 	
Powdery Mildew <i>(Erysiphe, Podosphaera)</i> p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> rake and remove fallen leaves; avoid excessive fertilization since tender, succulent leaves are more susceptible; provide good air circulation around the tree; spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	copper sulphate pentahydrate *harpin protein myclobutanil propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil triadimefon
Rusts <i>(Gymnosporangium spp.)</i> p. 262	Several rust species attack this host and symptoms vary with species; diagnostic orangy-yellow spots form on leaves and severely infected leaves fall prematurely; other symptoms include swelling and distortion of petioles and twigs, often with a distinctive yellowish-orange coloration; severe infection may kill fruit and cause conspicuous leaf and shoot blight; these fungi require other hosts (<i>Juniperus</i> spp.) in order to complete their life cycles; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> prune and remove infected branches or limbs; if possible, eliminate the alternate hosts (any red cedar or juniper species) within a one-mile radius; for specimen trees, fungicide sprays can be applied when new growth is emerging in spring and repeated 2-3 times at label intervals; this is usually when the gelatinous, orange telial horns are evident on the junipers (usually mid-May); 	*harpin protein myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> triadimefon

***Berberis* (Barberry)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Bacterial Leaf Spot <i>(Pseudomonas)</i> p. 370	Infected leaves first develop irregular, water-soaked areas, which gradually become purplish-brown; when tender, new shoots are infected, limited dieback may occur;	<ul style="list-style-type: none"> • avoid excessive nitrogen fertilization; • prune and remove affected twigs when the bark is dry and make cuts approx. 8-10 inches below symptoms; • disinfest tools between cuts; 	No chemical control is suggested.
Phytophthora Root Rot <i>(Phytophthora spp.)</i> p. 354	General decline, poor growth and vigor due to root decay; leaves become chlorotic, droop, and brown; symptomatic plants may occur singly or in enlarging groups; can result in plant death; new transplants are highly sensitive; a distinctive cinnamon brown discoloration is sometimes visible in wood at the root/crown region; often associated with saturated soils or poor drainage;	<ul style="list-style-type: none"> • avoid excessive fertilization and planting in wet areas; • protectant fungicides can be applied to uninfected, asymptomatic plants adjacent to infected ones; 	fosetyl-Al *harpin protein mefenoxam mono- and di-potassium salts of phosphorous acid phosphorous acid *QST 713 strain of <i>Bacillus subtilis</i>
Powdery Mildew p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	azoxystrobin copper sulphate pentahydrate *harpin protein myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil triadimefon

***Betula* (Birch)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Anthracnose, Leaf Spots <i>(Marssoninia, Apiognomonia)</i> p. 82, 108	Brown spots with irregular, indistinct margins or brown to black margins develop on leaves; some premature defoliation may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation around the tree; • spraying is usually not necessary since these diseases have no significant impact on tree health; on specimen trees, fungicides can be applied at budbreak and repeated as necessary according to label directions; 	copper sulphate pentahydrate *harpin protein mancozeb *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl
Armillaria Root Rot <i>(Armillaria spp. complex)</i> p. 326	Also called shoestring root rot and honey mushroom rot; this disease is difficult to identify since aboveground symptoms appear as general and progressive decline, which leads to the eventual death of trees; trees can die singly or in groups; trees under environmental or site-related stresses are particularly susceptible; diagnostic signs of the infection include black strands of the fungus called rhizomorphs (shoestrings) on the surface of the bark or at the base of infected trees, white fans of fungal growth with “mushroomy” odors under the bark, and the occasional growth of honey mushrooms at the base of infected trees in autumn; narrow, black lines are often evident in infected wood; the fungus can persist in stumps and large, woody roots for as long as 30 years;	<ul style="list-style-type: none"> • maintain tree vigor; • avoid any unnecessary stresses, esp. drought stress; • avoid planting susceptible trees in a site where this disease has been confirmed; • if replanting in the site, the stump and all woody roots greater than ½ inch in diameter should be removed; 	No chemical control is suggested.

Betula (Birch) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Leaf Blister (<i>Taphrina carnea</i>) p. 4	Pale-green spots ¼ - ¾ inch in diameter appear on newly expanding leaves; spots expand and develop into blister-like bulges on the leaves; as the blisters age they become necrotic; trees with heavy infections usually appear off-colored since the symptomatic leaves remain attached to the tree;	<ul style="list-style-type: none"> • maintain vigor; • spraying is usually not necessary; however, on specimen or newly transplanted trees, fungicide sprays can be applied before buds begin to swell in spring; 	chlorothalonil chlorothalonil + fenarimol *harpin protein mancozeb mancozeb + myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl + chlorothalonil
Leaf Rust (<i>Melampsorium betulinum</i>) p. 274	Symptoms usually appear in late summer as bright, yellowish-orange pustules on the undersides of leaves; chlorotic areas develop on upper leaf surfaces and may be so prevalent that they coalesce to form large, necrotic patches; leaves often drop prematurely; larch is the alternate host but is not necessary for the disease cycle; dwarf, gray, paper, swamp, European white, and yellow birch are susceptible;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • some resistance is available (e.g., Japanese white birch, sweet birch, <i>B. utilis</i>, <i>B. ernami</i>); • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied at budbreak and repeated as necessary according to label directions; 	azoxystrobin copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> triadimefon
Perennial Canker (<i>Neonectria galligena</i>) p. 182	Irregular swellings and cracks develop on branches or the main trunk; these are frequently associated with branch forks; thick callus rolls or rings are sometimes evident at the margins; cankered areas are weak and prone to breakage; black, paper, and yellow birch are highly susceptible;	<ul style="list-style-type: none"> • maintain tree vigor; • prune and remove cankered branches back to healthy wood when bark is dry; • avoid unnecessary wounds or injuries; 	No chemical control is suggested.

***Betula* (Birch) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Powdery Mildew <i>(Erysiphe)</i> p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	azoxystrobin copper sulphate pentahydrate *harpin protein *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil triadimefon

***Buxus* (Boxwood)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Canker and Leaf Blight <i>(Pseudonectria rousseliana [Volutella buxi])</i>	First symptoms of this common disease of boxwood are evident in spring; individual shoots or entire plants exhibit poor growth; leaves of affected limbs turn from green to a distinctive straw-tan color; salmon-colored, waxy pustules of the fungus develop on infected leaves and stems and are readily visible with a hand lens; bark may be loose and readily peel to reveal gray or black discolored wood; extensive dieback and leaf drop can occur;	<ul style="list-style-type: none"> • prune and remove dead branches as soon as evident when bark is dry; • any fallen leaves or those that have lodged in crotches or branches should be removed; • avoid winter injury and other stresses; • fungicides can be applied when new growth emerges in the spring and repeated at label intervals as necessary; 	chlorothalonil *copper hydroxide *copper sulfate copper sulphate pentahydrate *harpin protein mancozeb *QST 713 strain of <i>Bacillus subtilis</i>
Fungal Leaf Spots <i>(Macrophoma, Phyllosticta, Fusarium)</i>	Leaves turn yellow or straw-colored; diagnostic fruiting structures of the fungus appear as small, black dots on the symptomatic leaves; extensive leaf drop can occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation and avoid overhead irrigation; • spraying is usually not necessary since the disease has no significant impact on plant health; on specimen plants, fungicides can be applied as new growth emerges in spring and repeated as necessary; 	chlorothalonil *copper hydroxide copper salts of fatty and rosin acids *harpin protein mancozeb *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i>

***Buxus* (Boxwood) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Phytophthora Root Rot <i>(Phytophthora spp.)</i> p. 354	Foliage has poor color and becomes tan and desiccated; plants have poor vigor and show general, progressive decline symptoms due to root decay; individual sections of the plant may be symptomatic in an otherwise healthy canopy; symptomatic plants may occur singly or in enlarging groups; can result in plant death; a distinctive brown discoloration is sometimes visible in wood at the root/crown region; often associated with waterlogged soils; all boxwoods are susceptible;	<ul style="list-style-type: none"> • avoid excessive fertilization and planting in wet areas; • protectant fungicides can be applied to uninfected, asymptomatic plants adjacent to infected plants; 	fosetyl-AI *harpin protein mefenoxam mono- and di-potassium salts of phosphorous acid phosphorous acid *QST 713 strain of <i>Bacillus subtilis</i>
Root Nematodes <i>(Meloidogyne, Pratylenchus)</i> p. 432	Plants undergo progressive decline; symptoms include stunting, wilting, loss of vigor, and chlorosis; bronzing of internal foliage is common; depending upon the nematode, root symptoms include formation of swollen galls or lesions; disease severity is influenced by nematode populations and other environmental factors that impair root function such as drought; diagnosis requires soil samples from the vicinity of symptomatic plants;	<ul style="list-style-type: none"> • maintain plant vigor and avoid stress; 	No chemical control is suggested.

***Buxus* (Boxwood) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Winter Injury/Sunscald <i>(Abiotic)</i> p. 492	Damage to the cambium and sapwood from freezing and sunscalding results in dieback of leaves, twigs, and even entire plants; leaves develop a brown to reddish-brown, bronze color; bark splitting and peeling on stems and branches is common and may also result in dieback; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • maintain vigor; • avoid late-season or excessive fertilization; • prune and remove symptomatic branches or limbs; • provide appropriate winter protection in exposed areas or in areas that are subject to extreme temperature fluctuations during winter; 	No chemical control is suggested.

***Carpinus* (Hornbeam, Blue Beech)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Anthracnose <i>(Apiosporopsis)</i> p. 112	Irregular, brown to reddish-brown (often papery) areas develop along and sometimes between veins and at leaf margins; symptoms are very similar to those associated with drought and heat stress; some defoliation may occur when infection is heavy; occasional tip dieback; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune dead twigs and branches; • chemical control is usually not necessary except for new transplants, young or specimen trees, or when defoliation has been heavy for several years; fungicide sprays can be applied at budbreak and repeated 2-3 times at label intervals; 	azoxystrobin chlorothalonil *copper hydroxide copper salts of fatty and rosin acids *copper sulfate *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + thiophanate methyl *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil
Botryosphaeria Canker <i>(Botryosphaeria)</i> p. 120	Random dieback of branches and limbs; usually associated with sunken cankers in which black fruiting structures of the fungus may be visible; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding; • maintain tree vigor; • avoid unnecessary stresses, esp. drought stress; 	No chemical control is suggested.

***Carpinus* (Hornbeam, Blue Beech) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Nectria Canker <i>(Neonectria galligena)</i> p. 182	Irregular swellings and cracks develop on branches or the main trunk; these are frequently associated with branch forks, and/or branch scars or stubs; thick callus rolls or rings are sometimes evident at the margins; cankered areas are weak and prone to storm breakage;	<ul style="list-style-type: none"> • maintain tree vigor; • prune and remove cankered branches back to healthy wood when bark is dry; • avoid unnecessary wounds or injuries; 	No chemical control is suggested.

Carya (Hickory)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Anthracnose (<i>Glomerella</i>) p. 114	Symptoms usually don't appear until late summer or early autumn; irregular, brown spots with yellow indefinite edges develop on leaves; when spots are numerous, they coalesce and entire leaves turn brown, curl, and drop prematurely; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • usually not serious enough for chemical control since defoliation occurs late in the season; • on specimen trees, fungicides can be applied at budbreak and repeated 2-3 times at label intervals; 	*harpin protein mancozeb mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl
Canker (<i>Nectria</i> and <i>Neonectria</i> spp.) p. 176	Irregular swellings and cracks develop on branches or the main trunk; these are frequently associated with branch forks, and/or branch scars or stubs; thick callus rolls or rings are sometimes evident at the margins; cankered areas are weak and prone to storm breakage;	<ul style="list-style-type: none"> • maintain tree vigor; • prune and remove cankered branches back to healthy wood when bark is dry; • avoid unnecessary wounds or injuries; 	No chemical control is suggested.
Microstroma Leaf Spot and Witches' Broom (<i>Microstroma juglandis</i>) p. 252	Yellow lesions with indefinite margins develop on the upper surfaces of leaflets; distinct patches of white fruiting structures of the fungus are visible on corresponding areas on the under surfaces of the leaflets; this fungus has also been associated with the presence of witches' brooms on infected trees;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • usually not serious enough for chemical control since defoliation occurs late in the season; • on specimen trees, fungicides can be applied at budbreak and repeated 2-3 times at label intervals; 	*harpin protein mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i>

Carya (Hickory) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Powdery Mildew (<i>Erysiphe</i>) p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	*harpin protein myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon

Castanea (Chestnut)

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Blight <i>(Cryphonectria parasitica)</i> p. 160	This highly destructive disease has almost eliminated chestnuts in most of the United States; symptoms include twig and branch blights and girdling cankers on the main trunk; cankers vary in appearance and can appear as slightly sunken or swollen areas or as spindle-shaped or elongate swellings; reddish-orange fruiting structures of the fungus can occasionally be seen in the cankered areas; since the fungus does not infect the roots, numerous sprouts can often be found around old stumps; American chestnuts are most susceptible followed by European chestnuts; Japanese, Chinese, and hybrid chestnuts have varying levels of resistance;	<ul style="list-style-type: none"> • prune and remove affected limbs as soon as symptoms are evident; cuts should be made several inches below visible symptoms; • disinfest tools between cuts; • promote tree vigor; • resistant hybrids and varieties of trees are available; 	No chemical control is suggested.

Catalpa (Catalpa)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Fungal Leaf Spots (<i>Phyllosticta</i> , <i>Alternaria</i> , <i>Cercospora</i>) p. 74, 84	Irregular to circular, brown spots develop on leaves; the size, shape, and color vary with the causal agent; some premature defoliation can occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied at budbreak and repeated as necessary according to label directions; 	azoxystrobin *harpin protein mancozeb mancozeb + copper hydroxide myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil
Powdery Mildew (<i>Erysiphe</i>) p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	*harpin protein myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil

Catalpa (Catalpa) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Verticillium Wilt <i>(Verticillium spp.)</i> p. 242	Flagging or wilting of individual limbs or portions of the canopy, usually in midsummer; leaves can be undersized; trees die slowly or suddenly, depending on the extent of infection and overall health of the tree; a distinctive brown streaking may be evident in the wood of symptomatic branches or twigs; laboratory examination and culturing are usually required for definitive identification; especially problematic on street trees;	<ul style="list-style-type: none"> • prune and remove affected limbs as soon as symptoms are evident; • disinfest tools between cuts; • promote tree vigor; • avoid drought stress; • do not replant susceptible species in the area since the fungus is soilborne (refer to list of resistant species, Table 1); 	No chemical control is suggested.

***Cedrus* (Atlas Cedar, Deodar Cedar)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Armillaria Root Rot <i>(Armillaria spp. complex)</i> p. 326	Also called shoestring root rot and honey mushroom rot; this disease is difficult to identify since aboveground symptoms appear as general and progressive decline that leads to the eventual death of trees; trees can die singly or in groups; trees under environmental or site-related stresses are particularly susceptible; on conifers, excessive resin production at points of infections or at the bases of trees can be important symptoms of infection; the diagnostic black strands of the fungus called rhizomorphs (shoestrings) are usually not present on conifers; signs of the infection include white fans of fungal growth with “mushroomy” odors under the bark and the occasional growth of honey mushrooms at the base of infected trees in autumn; the fungus can persist in stumps and large, woody roots for as long as 30 years;	<ul style="list-style-type: none"> • maintain tree vigor; • avoid any unnecessary stresses, esp. drought stress; • avoid planting susceptible trees in a site where this disease has been confirmed; • if replanting in the site, the stump and all woody roots greater than ½ inch in diameter should be removed; 	No chemical control is suggested.

***Cedrus* (Atlas Cedar, Deodar Cedar) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Diplodia Blight [Sphaeropsis Tip Blight] <i>(Diplodia pinea)</i> p. 130	Tip blight results from infection of newly emerging buds and shoots; infected buds or shoots usually stop growing before or during needle elongation and needles are frequently stunted and short; infected tissues are straw-colored and have excessive resin flow; usually kills only current-season buds and shoots and second-year cones, but can cause significant dieback on stressed trees; black fruiting structures of the fungus may be visible at the base of needles and on cones; symptoms may be distributed uniformly throughout the canopy or concentrated in lower branches; drought-stressed trees are particularly susceptible; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove blighted twigs, branches, and cones during dry weather in autumn; • maintain tree vigor; special attention should be given to watering during periods of drought; • fungicide sprays can be applied at budbreak and repeated 2-3 times at label intervals; 	*copper hydroxide copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon

***Cedrus* (Atlas Cedar, Deodar Cedar) cont'd**

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Phomopsis Blight (<i>Phomopsis juniperivora</i>) p. 146	Tips and whole sections of branches progressively die and turn brown; affected needles usually remain attached to the branches; symptoms are frequently uniformly distributed over the shrub and are most obvious in spring or early summer; immature or newly expanding needles are most susceptible; upon close inspection, black fruiting bodies are visible in browned tissues; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove infected twigs and branches; • avoid overhead irrigation and excessive crowding; • severely infected plants should be rogued and removed; • maintain vigor; • fungicide sprays can be applied as new growth emerges in spring and repeated at label intervals until growth is fully expanded and mature; 	chlorothalonil *harpin protein mancozeb mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil
Winter Dieback (<i>Abiotic</i>) p. 492	Portions of the tree may discolor and fail to develop when growth resumes in spring; in severe cases, entire trees may die; this species often has problems with winter hardiness associated with extended periods of extremely cold temperatures; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • avoid stress; • maintain vigor and pay attention to planting site; 	No chemical control is suggested.

Celtis (Hackberry)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Fungal Leaf Spots (<i>Phyllosticta</i> , <i>Cercospora</i>) p. 84	Circular or irregular, necrotic spots develop on leaves and are frequently uniformly distributed over the surface of the leaf; some early leaf drop can occur when infection is heavy; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation around the tree; • avoid overhead irrigation of small trees; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied when new growth emerges and repeated as necessary according to label directions; 	chlorothalonil *harpin protein mancozeb myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl triadimefon
Powdery Mildew (<i>Erysiphe</i> , <i>Podosphaera</i>) p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	copper sulphate pentahydrate *harpin protein myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil triadimefon
Witches' Broom (<i>Podosphaera</i> and <i>Eriophyid mite</i>) p. 14	Witches' brooms occur when many short twigs develop in close proximity at a conspicuous swelling or knot on the branch; brooms can be quite numerous and distributed throughout the canopy;	<ul style="list-style-type: none"> • trees appear to bear many brooms without any obvious loss of vigor; • unsightly trees can be removed; • no controls are effective; 	No chemical control is suggested.

***Cercidiphyllum* (Katsura-tree)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Armillaria Root Rot <i>(Armillaria spp. complex)</i> p. 326	Also called shoestring root rot and honey mushroom rot; this disease is difficult to identify since aboveground symptoms appear as general and progressive decline that leads to the eventual death of trees; trees can die singly or in groups; trees under environmental or site-related stresses are particularly susceptible; diagnostic signs of the infection include black strands of the fungus called rhizomorphs (shoestrings) on the surface of the bark or at the base of infected trees, white fans of fungal growth with “mushroomy” odors under the bark, and the occasional growth of honey mushrooms at the base of infected trees in autumn; narrow, black lines are often evident in infected wood; the fungus can persist in stumps and large, woody roots for as long as 30 years;	<ul style="list-style-type: none"> • maintain tree vigor; • avoid any unnecessary stresses, esp. drought stress; • avoid planting susceptible trees in a site where this disease has been confirmed; • if replanting in the site, the stump and all woody roots greater than ½ inch in diameter should be removed; 	No chemical control is suggested.

***Cercidiphyllum* (Katsura-tree) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Botryosphaeria Canker <i>(Botryosphaeria)</i> p. 120	Random dieback of branches and limbs; usually associated with sunken cankers in which black fruiting structures of the fungus may be visible; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding; • maintain tree vigor; • minimize unnecessary stresses, esp. drought stress; 	No chemical control is suggested.
Verticillium Wilt <i>(Verticillium spp.)</i> p. 242	Flagging or wilting of individual limbs or portions of the canopy, usually in midsummer; leaves can be undersized; trees die slowly or suddenly, depending on the extent of infection and overall health of the tree; a distinctive olive or brown streaking may be evident in the wood of symptomatic branches or twigs; laboratory examination and culturing are usually required for definitive identification;	<ul style="list-style-type: none"> • prune and remove affected limbs as soon as symptoms are evident; • disinfest tools between cuts; • promote tree vigor; • avoid drought stress; • do not replant susceptible species in the area since the fungus is soilborne (refer to list of resistant species, Table 1); 	No chemical control is suggested.

Cercis (Redbud)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Anthracnose (unknown) p. 108	Initial symptoms include necrotic lesions that usually follow the veins or leaf margins; these expand into large, brown blotches; can result in premature leaf drop; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as new growth emerges and repeated as necessary according to label directions; 	azoxystrobin chlorothalonil copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + thiophanate methyl methyl *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil
Canker and Dieback (<i>Botryosphaeria</i>) p. 120	Cankers begin as small, sunken areas on branches; these areas gradually increase in size and the bark in the center blackens and cracks; the most obvious symptom is a flag or a branch on which the foliage dries out and turns orangy-brown; leaves wilt and branches die as the cankers girdle the stem; the most prevalent disease of redbud in the landscape;	<ul style="list-style-type: none"> • prune and remove infected branches well below cankered areas when the bark is dry; • severely infected trees should be rogued and removed; • maintain tree vigor and avoid insect and mechanical injuries; 	No chemical control is suggested.

Cercis (Redbud) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Fungal Leaf Spots (<i>Mycosphaerella</i> , <i>Phyllosticta</i>) p. 44	Lesions develop as irregular to circular areas on leaves; when infection is severe, spots coalesce and premature defoliation can occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as new growth emerges and repeated as necessary according to label directions; 	azoxystrobin *harpin protein mancozeb mancozeb + copper hydroxide propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl
Verticillium Wilt (<i>Verticillium</i> spp.) p. 242	Flagging or wilting of individual limbs or portions of the canopy, usually in midsummer; leaves can be undersized; trees die slowly or suddenly, depending on the extent of infection and overall health of the tree; a distinctive brown streaking may be evident in the wood of symptomatic branches or twigs; laboratory examination and culturing are usually required for definitive identification;	<ul style="list-style-type: none"> • prune and remove affected limbs as soon as symptoms are evident; • disinfest tools between cuts; • promote tree vigor; • avoid drought stress; • do not replant susceptible species in the area since the fungus is soilborne (refer to list of resistant species, Table 1); 	No chemical control is suggested.

Chaenomeles (Quince)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Canker and Dieback (<i>Botryosphaeria</i> spp.) p. 120	Cankers begin as small, sunken areas on branches; these areas gradually increase in size and the bark in the center blackens and cracks; the most obvious symptom is a flag or a branch on which the foliage dries out and turns orangy-brown; leaves wilt and branches die as the cankers girdle the stem;	<ul style="list-style-type: none"> • prune and remove infected branches well below cankered areas; • severely infected trees should be rogued and removed; • maintain tree vigor and avoid insect and mechanical injuries; 	No chemical control is suggested.
Fire Blight (<i>Erwinia amylovora</i>) p. 376	Flowers wither and blacken; young twigs and branches die from the terminals back and appear as though "burned"; affected limbs frequently develop characteristic shepherd's crooks at the tips; dead leaves usually remain attached to the branch; sunken, discolored cankers may be evident on branches or the main trunk; symptoms often develop in a relatively short period of time; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • overwintering cankers should be pruned and removed during the winter; make cuts at least 10-12 inches below visible symptoms when bark is dry; • during the growing season, prune and remove infected branches as soon as they develop; make cuts at least 10-12 inches below visible symptoms when bark is dry; • disinfest tools between cuts; • recent studies with infected fruit trees have shown that the old method of cutting 8-10 inches below visible symptoms of growing-season blight strikes has certain limitations; new research has shown that bacteria can sometimes be found as far as 9 feet beyond visible symptoms on highly susceptible trees; they suggest that cuts on symptomatic shoots should be made back to 2-year or older wood and at least 8-12 inches below the visible symptoms; these cuts often leave a 4-5 inch naked stub above the next leaf or branch, so this method has been called the "ugly stub" method; 	*copper hydroxide copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i>

(continued on next page)

Chaenomeles (Quince) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Fire Blight (Cont'd)		<ul style="list-style-type: none"> cuts should be made when the bark is dry; the presence of “ugly stubs” in the tree will flag infection sites for follow-up with winter pruning; avoid excessive nitrogen fertilization or vigor; preventative copper sprays can be applied to the bark before growth emerges in spring; additional applications may be necessary to protect newly emerging shoots until flowering; select the appropriate product if harvesting fruit for consumption; 	
Leaf Spot (<i>Diplocarpon mespili</i>) p. 78	Discrete, circular, dark-brown spots develop on leaves; when numerous, they coalesce and form large, dead blotches; fruiting structures of the fungus develop under the cuticle of lesions and give the spots a blister-like appearance; significant early leaf drop can occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> rake and remove fallen leaves; provide good air circulation around the tree and avoid overhead watering; spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied when new growth emerges and repeated as necessary according to label directions; 	chlorothalonil *harpin protein mancozeb myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil

Chaenomeles (Quince) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Rusts (<i>Gymnosporangium</i> spp.) p. 262	Several species of rust fungi attack quince and symptoms vary with species; diagnostic orangy-yellow spots form on leaves and severely affected leaves fall prematurely; other symptoms include swelling and distortion of petioles and twigs; severe infection may kill fruit and cause conspicuous leaf and shoot blights; these fungi require other hosts (<i>Juniperus</i> spp.) in order to complete their life cycles; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove infected branches or limbs; • for specimen trees, eliminate the alternate hosts (any red cedar or juniper species) within a one-mile radius, if possible; • fungicide sprays can be applied when new growth is emerging in spring; this is usually when the gelatinous, orange telial horns are visible on the junipers (usually mid-May); sprays are repeated as necessary at label intervals; 	chlorothalonil + fenarimol *harpin protein mancozeb myclobutanil *QST 713 strain of <i>Bacillus subtilis</i>

***Chamaecyparis* (False Cypress, White Cedar)**

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Blight (<i>Phomopsis</i>) p. 146	Branch tips turn brown and progressively die back; needles on infected branches usually persist on the tree; small, black fruiting structures may be evident at the base of dead tissues; symptoms are especially pronounced in late winter and early spring;	<ul style="list-style-type: none"> • prune and remove infected twigs and branches when bark is dry; • avoid overhead irrigation and crowding; • resistant varieties are available (e.g., <i>C. pisifera</i> 'Plumosa Aurea,' 'Filifera'); • fungicide sprays can be applied when new growth appears in the spring and continued at label intervals until tissues are fully elongated and mature; 	azoxystrobin *harpin protein *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + mancozeb thiophanate methyl + flutolanil
Needle and Tip Blight (<i>Pestalotiopsis</i>) p. 190	Affected needles and shoots are characterized by progressive yellowing and browning that begins at the tips and moves toward the base of the needles; shoots wilt and brown as the fungus causes girdling cankers in succulent tissues; usually more problematic on weak trees;	<ul style="list-style-type: none"> • maintain vigor; • avoid unnecessary stress; • prune and remove infected twigs when bark is dry; 	No chemical control is suggested.
Phytophthora Root Rot (<i>Phytophthora</i> spp.) p. 354	General decline, poor growth and vigor due to root decay; needles become chlorotic, droop, and brown; symptomatic trees may occur singly or in enlarging groups; can result in tree death; excessive resin is sometimes visible on the outer bark at the base of the tree; a diagnostic brown discoloration may be evident on the inner bark and cambium at the root/crown area; frequently more serious on trees in sites where excess water is a persistent problem (e.g., clay soils, low areas); seedlings are highly sensitive;	<ul style="list-style-type: none"> • avoid excessive fertilization and planting in wet areas; • no fungicides are curative; protectant fungicides can be applied to uninfected, asymptomatic trees adjacent to infected trees; 	fosetyl-Al *harpin protein mefenoxam mono- and di-potassium salts of phosphorous acid phosphorous acid *QST 713 strain of <i>Bacillus subtilis</i>

***Chamaecyparis* (False Cypress, White Cedar) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Tip Blight <i>(Abiotic)</i>	Tip and branch dieback, with symptoms similar to those associated with Phomopsis blight (without fungal fruiting structures);	<ul style="list-style-type: none"> • prune affected branches back to healthy wood to minimize secondary invaders or opportunistic pests; • avoid wounds and stresses; • maintain vigor; 	No chemical control is suggested.

***Cladrastis* (Yellowwood)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Botryosphaeria Canker <i>(Botryosphaeria spp.)</i> p. 120	Random dieback of branches and limbs; usually associated with sunken cankers in which black fruiting structures of the fungus may be visible; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding and other unnecessary stresses, esp. drought stress; • maintain tree vigor; 	No chemical control is suggested.
Powdery Mildew <i>(unknown)</i> p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	*harpin protein *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil
Verticillium Wilt <i>(Verticillium spp.)</i> p. 242	Flagging or wilting of individual limbs or portions of the canopy, usually in midsummer; leaves can be undersized and infected trees sometimes have heavy seed set; trees die slowly or suddenly, depending on the extent of infection and overall health of the tree; a distinctive brown discoloration or streaking may be evident in the wood of symptomatic branches or twigs; laboratory examination and culturing are usually required for definitive identification;	<ul style="list-style-type: none"> • prune and remove affected limbs as soon as symptoms are evident; • disinfest tools between cuts; • promote tree vigor; • avoid drought stress; • do not replant susceptible species in the area since the fungus is soilborne (refer to list of resistant species, Table 1); 	No chemical control is suggested.

Cornus (Dogwood)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Anthracnose (<i>Discula destructiva</i>) p. 106	<p>This is considered the most serious disease of dogwood in Connecticut and the Eastern Seaboard; it has resulted in the death of many dogwoods throughout its native range; initial symptoms include brown spots up to ¼ inch in diameter that can be seen on both leaf surfaces; spots frequently develop distinctive purplish-brown margins and pinpoint, black fruiting structures can be seen in the centers of the lesions; spots may be so numerous that they coalesce, resulting in large, necrotic sections on the leaves; a diagnostic symptom is the persistence of infected, necrotic leaves that hang on the tree throughout the winter; these leaves serve as a source of fungal spores in spring; reddish-brown spots may also develop on flower bracts; sunken, discolored cankers can develop on twigs, branches, and the main trunk; symptoms and branch dieback typically begin on the lower limbs and move progressively up the tree; these result in branch dieback or whole tree death when the main trunk is girdled; refer to fact sheet for more detailed information;</p>	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune and remove cankered limbs and dead wood; • maintain tree vigor; • provide adequate spacing for good air circulation; • control insects and avoid unnecessary mechanical injuries; avoid soil compaction; • resistant species are available (<i>Cornus kousa</i>, <i>C. florida</i> X <i>C. kousa</i> hybrids, 'Stellar' series); • fungicide applications can be made at budbreak, when bracts fall, and 4 weeks later; a late-summer fungicide application is also necessary when fruit and leaves begin to color; 	<p>azoxystrobin chlorothalonil *copper hydroxide copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + myclobutanil mancozeb + thiophanate methyl *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil</p>

Cornus (Dogwood) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Armillaria Root Rot <i>(Armillaria spp. complex)</i> p. 326	Also called shoestring root rot and honey mushroom rot; this disease is difficult to identify since aboveground symptoms appear as general and progressive decline that leads to the eventual death of trees; trees can die singly or in groups; trees under environmental or site-related stresses are particularly susceptible; diagnostic signs of the infection include black strands of the fungus called rhizomorphs (shoestrings) on the surface of the bark or at the base of infected trees, white fans of fungal growth with “mushroomy” odors under the bark, and the occasional growth of honey mushrooms at the base of infected trees in autumn; narrow, black lines are often evident in infected wood; the fungus can persist in stumps and large, woody roots for as long as 30 years;	<ul style="list-style-type: none"> • maintain tree vigor; • avoid any unnecessary stresses, esp. drought stress; • avoid planting susceptible trees in a site where this disease has been confirmed; • if replanting in the site, the stump and all woody roots greater than ½ inch in diameter should be removed; 	No chemical control is suggested.

Cornus (Dogwood) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Botrytis Blight (<i>Botrytis cinerea</i>) p. 72	Irregular, necrotic patches develop on flower bracts and leaves in wet weather; lesions expand and disease spreads when senescing bracts fall on asymptomatic leaves; infected tissues are frequently covered with a distinctive grayish-brown, fuzzy mass of fungal growth that gives this disease the common name "gray mold";	<ul style="list-style-type: none"> • rake and remove fallen leaves; • maintain tree vigor; • IF conditions are wet during bloom, preventative fungicides can be applied at budbreak and repeated as necessary during the season according to label directions; 	chlorothalonil copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + thiophanate methyl *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil
Crown Canker (<i>Phytophthora cactorum</i>) p. 358	Infected trees have poor vigor, small leaves with pale color, and often exhibit premature fall coloration; progressive dieback of twigs and branches may occur as basal cankers enlarge and girdle the tree; cankers appear as discolored, sunken areas that are often visible near the base of the tree; some bleeding of reddish-brown fluid can occur in affected areas of the trunk;	<ul style="list-style-type: none"> • maintain tree vigor by attention to irrigation, soil compaction; • mildly infected trees have occasionally been reported to recover; • rogue and remove heavily infected trees to reduce the potential of spread to nearby trees; • recent studies have demonstrated preliminary success with directed basal bark sprays or injections of mono- and di-potassium salts of phosphorous acid; 	*harpin protein mono- and di-potassium salts of phosphorous acid phosphorous acid *QST 713 strain of <i>Bacillus subtilis</i>

Cornus (Dogwood) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Powdery Mildew (<i>Erysiphe</i>) p. 8	Leaves appear distinctively purple or reddish-brown in mid- to late summer; diffuse lesions can also develop on upper leaf surfaces; this is usually followed by the typical whitish-gray, thin, superficial, powdery growth of the fungus; symptoms usually appear late in the season and can result in some premature defoliation; recent reports suggest that this disease has a greater impact on tree health and vigor than previously suggested; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation around the tree; • spraying is usually not necessary; however, recent reports indicate that sprays may be helpful; fungicides can be applied as soon as symptoms are evident and repeated at label intervals as necessary; 	azoxystrobin copper sulphate pentahydrate fenarimol *harpin protein mancozeb + myclobutanil myclobutanil *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> *sulfur thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon
Scorch (<i>Abiotic</i>) p. 492	Margins and tips of leaves turn brown and occasionally roll upward; symptoms usually appear in mid- or late summer; some premature leaf drop may occur;	<ul style="list-style-type: none"> • avoid plant stress, especially drought stress; • promote tree vigor and pay attention to planting site; • avoid soil compaction; 	No chemical control is suggested.

Cornus (Dogwood) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Spot Anthracnose (<i>Elsinoe corni</i>) p. 18	Very small, purplish-red spots with distinct margins no more than 1/10 inch in diameter develop on flower bracts, leaves, petioles, fruit, peduncles, and green twigs; centers sometimes have a tan coloration and can drop out; can result in some distortion of the leaves and in premature defoliation; repeated defoliation can weaken trees;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied at budbreak and repeated as necessary according to label directions; 	azoxystrobin chlorothalonil *copper hydroxide *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + myclobutanil mancozeb + thiophanate methyl myclobutanil *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil triadimefon
Tip Blight (<i>Botryosphaeria</i>) p. 120	Dieback of twigs and small branches is associated with sunken, discolored, girdling cankers; black, pimple-like, fungal fruiting structures may be visible in the canker; disease is more problematic on trees stressed by site or environmental factors;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs and branches; • maintain tree vigor; • avoid unnecessary stresses, esp. drought stress; 	No chemical control is suggested.

***Corylus* (Contorted Walking Stick, Filbert, Hazelnut)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Eastern Filbert Blight (Twig Blight/Canker) <i>(Anisogramma anomala)</i> p. 158	Progressive dieback of twigs, branches, and limbs; a diagnostic symptom develops on infected or dead twigs or branches and appears as distinctive rows of longitudinal splits that contain black fruiting structures of the fungus; this symptom is often confused with egg-laying scars of cicadas; can be an extremely destructive disease;	<ul style="list-style-type: none"> • prune and remove affected twigs and branches below symptomatic portions when bark is dry; • rogue and remove heavily infected plants; • maintain tree vigor; • chemical control may not be effective or practical in many landscape situations; • if nuts are harvested for consumption, check the fungicide label; 	<p>chlorothalonil *copper hydroxide copper salts of fatty and rosin acids fenarimol *harpin protein propiconazole *QST 713 strain of <i>Bacillus subtilis</i></p>
Powdery Mildew <i>(Erysiphe)</i> p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; • if nuts are harvested for consumption, check the fungicide label; 	<p>fenarimol *harpin protein *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl</p>

Cotinus (Smoke Tree)

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Armillaria Root Rot <i>(Armillaria spp. complex)</i> p. 326	Also called shoestring root rot and honey mushroom rot; this disease is difficult to identify since aboveground symptoms appear as general and progressive decline that leads to the eventual death of trees; trees can die singly or in groups; trees under environmental or site-related stresses are particularly susceptible; diagnostic signs of the infection include black strands of the fungus called rhizomorphs (shoestrings) on the surface of the bark or at the base of infected trees, white fans of fungal growth with “mushroomy” odors under the bark, and the occasional growth of honey mushrooms at the base of infected trees in autumn; narrow, black lines are often evident in infected wood; the fungus can persist in stumps and large, woody roots for as long as 30 years;	<ul style="list-style-type: none"> • maintain tree vigor; • avoid any unnecessary stresses, esp. drought stress; • avoid planting susceptible trees in a site where this disease has been confirmed; • if replanting in the site, the stump and all woody roots greater than ½ inch in diameter should be removed; 	No chemical control is suggested.
Botryosphaeria Canker <i>(Botryosphaeria spp.)</i> p. 120	Random dieback of branches and limbs; usually associated with sunken cankers in which black fruiting structures of the fungus may be visible; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding and other unnecessary stresses, esp. drought stress; • maintain tree vigor; 	No chemical control is suggested.

Cotinus (Smoke Tree) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Powdery Mildew (<i>Erysiphe</i>) p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; • if nuts are harvested for consumption, check the fungicide label; 	fenarimol *harpin protein *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl
Verticillium Wilt (<i>Verticillium</i> spp.) p. 242	Flagging or wilting of individual limbs or portions of the canopy, usually in midsummer; leaves can be undersized; trees die slowly or suddenly, depending on the extent of infection and overall health of the tree; a distinctive olive to brown discoloration or streaking may be evident in the wood of symptomatic branches or twigs; laboratory examination and culturing are usually required for definitive identification; a common cause for tree death;	<ul style="list-style-type: none"> • prune and remove affected limbs as soon as symptoms are evident; • disinfest tools between cuts; • promote tree vigor by fertilizing and watering; • do not replant susceptible species in the area since the fungus is soilborne (refer to list of resistant species, Table 1); 	No chemical control is suggested.

Cotoneaster (Cotoneaster)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Canker (<i>Botryosphaeria</i>) p. 120	Progressive wilting and dieback of branches; infected limbs are covered with black, pinpoint fruiting structures of the fungus; wood in the affected areas is usually discolored; stressed plants are highly susceptible;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs and branches; • maintain tree vigor; • avoid wounding or unnecessary stresses, esp. drought stress; 	No chemical control is suggested.
Fire Blight (<i>Erwinia amylovora</i>) p. 376	Flowers wither and blacken; young twigs and branches die from the terminals back and appear as though "burned"; dead leaves usually remain attached to the branch; sunken, discolored cankers may be evident on branches or the main trunk; symptoms often develop in a relatively short period of time; plants are often killed by this disease; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove infected branches, making cuts at least 10-12 inches below visible symptoms when bark is dry; • disinfest tools between cuts; • avoid excessive nitrogen fertilization or vigor; • many species are reported to be resistant (e.g., <i>C. adpressa</i>, <i>C. microphylla</i>, <i>C. francheti</i>); 	No chemical control is suggested.

***Crataegus* (Hawthorn)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Botrytis Blight <i>(Botrytis cinerea)</i> p. 72	Irregular, necrotic patches develop on senescing flowers and leaves in wet weather; lesions expand and disease spreads when senescing flowers fall on asymptomatic leaves; infected tissues are frequently covered with a distinctive grayish-brown, fuzzy mass of fungal growth that gives this disease the common name “gray mold”;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • maintain tree vigor; • IF conditions are wet during bloom, preventative fungicides can be applied at budbreak and repeated as necessary during the season according to label directions; 	chlorothalonil copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + thiophanate methyl *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil

Crataegus (Hawthorn) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Entomosporium Leaf Spot [Hawthorn Leaf Blight] <i>(Diplocarpon mespili)</i> p. 78	Numerous small, reddish-brown spots appear on upper surfaces of leaves; as they increase in size, they frequently coalesce and result in significant midsummer defoliation; English hawthorn (<i>C. oxycantha</i>) and 'Paul's Scarlet' (<i>C. oxycantha</i> var. <i>paulii</i>) are particularly susceptible;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • maintain tree vigor; • provide good air circulation and avoid overhead irrigation; • for specimen trees, fungicides can be applied at budbreak and repeated 2-3 times as necessary according to label directions; 	chlorothalonil chlorothalonil + fenarimol *harpin protein mancozeb + myclobutanil mancozeb + thiophanate methyl myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil

Crataegus (Hawthorn) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Fire Blight (<i>Erwinia amylovora</i>) p. 376	Flowers wither and blacken; young twigs and branches die from the terminals back and appear as though "burned"; affected limbs frequently develop a characteristic shepherd's crook at the tip; dead leaves usually remain attached to the branch; sunken, discolored cankers may be evident on branches or the main trunk; trees are often killed by this disease; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • avoid excessive nitrogen fertilization or vigor; • overwintering cankers should be pruned and removed during the winter; make cuts at least 10-12 inches below visible symptoms when bark is dry; • during the growing season, prune and remove infected branches as soon as they develop; make cuts at least 10-12 inches below visible symptoms when bark is dry; • disinfest tools between cuts; • recent studies with infected fruit trees have shown that the old method of cutting 8-10 inches below visible symptoms of growing-season blight strikes has certain limitations; new research has shown that bacteria can sometimes be found as far as 9 feet beyond visible symptoms on highly susceptible trees; • they suggest that cuts on symptomatic shoots should be made back to 2-year or older wood and at least 8-12 inches below the visible symptoms; these cuts often leave a 4-5 inch naked stub above the next leaf or branch, so this method has been called the "ugly stub" method; cuts should be made when the bark is dry; the presence of "ugly stubs" in the tree will flag infection sites for follow-up with winter pruning; <p style="text-align: center;">(continued on next page)</p>	*copper hydroxide copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i>

Crataegus (Hawthorn) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Fire Blight (Cont'd)		<ul style="list-style-type: none"> preventative copper sprays can be applied to the bark before growth emerges in spring; additional applications may be necessary to protect newly emerging shoots until flowering; select the appropriate product if harvesting fruit for consumption; 	
Powdery Mildew (<i>Phyllactinia</i>) p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> rake and remove fallen leaves; avoid excessive fertilization since tender, succulent leaves are more susceptible; provide good air circulation around the tree; spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	fenarimol *harpin protein mancozeb + myclobutanil mancozeb + thiophanate methyl *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon

Crataegus (Hawthorn) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Rusts <i>(Gymnosporangium</i> <i>spp.)</i> p. 262	At least nine species of rust fungi attack hawthorn and symptoms vary with rust species; with some species, diagnostic orangy-yellow lesions form on leaves and on fruit and severely affected leaves drop prematurely; other symptoms include swelling and distortion of petioles and twigs or as a twisting and curling of leaves followed by death and drop; severe infections may kill fruit and cause conspicuous leaf and shoot blights; these fungi require other hosts (<i>Juniperus</i> spp.) in order to complete their life cycles; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove infected branches or limbs; • for specimen trees, eliminate the alternate hosts (any red cedar or juniper species) within a one-mile radius, if possible; • resistant species are available (e.g., Cockspur thorn, <i>C. crusgalli</i>; yellow fruited thorn, <i>C. intricata</i>; and <i>C. pruinosa</i>); • for specimen trees, fungicide sprays can be applied when new growth is emerging in spring and repeated 2-3 times at label intervals; this is usually when the gelatinous, orange telial horns are evident on the junipers (usually mid-May); 	chlorothalonil chlorothalonil + fenarimol copper sulphate pentahydrate fenarimol *harpin protein mancozeb mancozeb + myclobutanil mancozeb + thiophanate methyl myclobutanil propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl + chlorothalonil triadimefon

Crataegus (Hawthorn) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Scab <i>(Venturia inaequalis)</i> p. 86	Velvety, olive-brown lesions with diffuse margins develop on leaves and fruit; severe infections usually result in significant defoliation; fruit are often cracked and disfigured; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves and fruit; • maintain tree vigor; • for specimen trees, fungicide sprays can be applied at budbreak and repeated 2-3 times as necessary at label intervals; early-season sprays are most important; 	fenarimol *harpin protein mancozeb mancozeb + myclobutanil myclobutanil propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil

***Cryptomeria* (Cryptomeria, Japanese Cedar)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Botryosphaeria Canker <i>(Botryosphaeria)</i> p. 120	Random dieback of branches and limbs; usually associated with sunken cankers in which black fruiting structures of the fungus may be visible; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding and unnecessary stress such as drought stress; • maintain tree vigor; 	No chemical control is suggested.
Leaf Blight <i>(Phomopsis)</i> p. 146	Branch tips turn brown and progressively die back; needles on infected branches usually persist on the tree; small, black fruiting structures may be evident at the base of dead tissues; symptoms are especially pronounced in late winter and early spring;	<ul style="list-style-type: none"> • maintain vigor; • prune and remove infected twigs and branches when bark is dry; • avoid overhead irrigation and crowding; • fungicide sprays can be applied when new growth appears in the spring and continued at label intervals until tissues are fully elongated and mature; 	*harpin protein *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil
Leaf Spot <i>(Pestalotiopsis)</i> p. 190	Affected needles and shoots are characterized by progressive yellowing and browning that begins at the tips and moves toward the base of the needles; shoots wilt and brown as the fungus causes girdling cankers in succulent tissues; usually more problematic on weak trees;	<ul style="list-style-type: none"> • maintain vigor; • prune and remove infected twigs and branches when bark is dry; • avoid overhead irrigation and crowding; 	No chemical control is suggested.

***Euonymus* (Euonymus)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Anthracnose <i>(Glomerella)</i> p. 114	Small, brown lesions develop on leaves and young shoots; leaves turn brown as individual lesions frequently coalesce, resulting in substantial defoliation; salmon-colored spores can often be seen in infected tissues; the fungus moves into twigs and slightly raised, discolored cankers develop; significant dieback can result when cankers girdle twigs and new shoots; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune and remove symptomatic tips and twigs well below visible symptoms when bark is dry; • maintain tree vigor; • avoid mechanical injuries and overhead irrigation; • fungicide applications can be made at budbreak and repeated as necessary at label intervals; since fungicide resistance is well documented for this pathogen, it is important to rotate between different fungicide “families”; 	azoxystrobin chlorothalonil chlorothalonil + fenarimol *copper hydroxide copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + myclobutanil mancozeb + thiophanate methyl *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil

***Euonymus* (*Euonymus*) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Crown Gall <i>(Agrobacterium tumefaciens)</i> p. 382	Galls ranging in size from ¼ inch to several inches in diameter develop on branches and roots; young galls appear white or cream-colored when cut in half; older galls darken to brown and have no recognizable internal structure (e.g., no vascular tissue);	<ul style="list-style-type: none"> • prune and remove young stem galls as soon as evident; • disinfest tools between cuts; • severely infected plants should be rogued and removed; • avoid mechanical injuries to neighboring plants using careful cultivation since the bacterium requires wounds to infect; • plant resistant species (refer to list of resistant species, Table 2); 	No chemical control is suggested.
Fungal Leaf Spots <i>(Cercospora, Phyllosticta)</i> p. 42	Irregular or circular, dead patches develop over the leaves, particularly during wet weather; some early defoliation can occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation and avoid overhead watering; • spraying is usually not necessary since the disease has no significant impact on plant health; for specimen trees, fungicides can be applied at budbreak and repeated as necessary according to label directions; 	chlorothalonil *harpin protein mancozeb mancozeb + copper hydroxide propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil

***Euonymus* (*Euonymus*) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Powdery Mildew <i>(Erysiphe)</i> p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; corky lesions may develop on some species; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	copper sulphate pentahydrate fenarimol *harpin protein mancozeb + myclobutanil myclobutanil *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> *sulfur thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon

Fagus (Beech)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Beech Bark Disease (<i>Neonectria coccinea</i> var. <i>faginata</i> and beech scale, <i>Cryptococcus fagisuga</i>) p. 184	Infected trees have sparse, often chlorotic foliage and significant branch and twig dieback; circular to elliptical, sunken cankers form on the bark, typically on the main trunk; cankers can result in significant disfigurement of the tree and when they girdle the trunk, trees are killed; upon close inspection of cankered areas, reddish fruiting structures of the fungus are sometimes visible; since the disease is also associated with the woolly beech scale, <i>Cryptococcus</i> , white specks and/or waxy secretions of the insect are frequently visible along the trunk in late summer and autumn;	<ul style="list-style-type: none"> disease management relies on control of the scale insect since the fungus is introduced through the feeding wounds produced by this insect; refer to the <i>Pesticide Guide Toward Integrated Pest Management for Connecticut Arborists</i> by K. Welch and T. Abbey for specific information on insecticides; maintain general tree health and vigor; heavily disfigured trees can be removed; 	No chemical control is suggested.
Bleeding Canker (<i>Phytophthora</i> spp.) p. 354	Primary symptoms include oozing of reddish-brown sap from fissures or cracks in the bark; these are usually centered over diffuse cankers; infected inner bark, cambium, and sapwood appear reddish-brown; foliage may be undersized and chlorotic as the cankers enlarge and girdle the trunk; some dieback of branches and thinning of the canopy can occur; can result in tree death; of particular concern on European beech in the past few years in Connecticut; culturing is often necessary for definitive diagnosis;	<ul style="list-style-type: none"> maintain tree vigor by attention to irrigation and soil compaction; avoid tree stress and mechanical injuries to the trunk; mildly infected trees have occasionally been reported to recover; rogue and remove heavily infected trees to reduce the potential of spread to nearby trees; recent trials have demonstrated anecdotal success with directed basal bark sprays and injections of mono- and di-potassium salts of phosphorous acid; 	*harpin protein mono- and di-potassium salts of phosphorous acid phosphorous acid *QST 713 strain of <i>Bacillus subtilis</i>

Fagus (Beech) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Powdery Mildew (<i>Erysiphe</i>) p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	chlorothalonil *harpin protein *QST 713 strain of <i>Bacillus subtilis</i> *sulfur thiophanate methyl thiophanate methyl + flutolanil
Sooty Mold (<i>Scorias spongiosa</i>) p. 16	Irregular, sponge-like masses of mycelium develop on limbs and trunks of trees infested by the beech blight aphid; the fungus grows on the honeydew excreted by this insect pest; fungal masses are soft and tan at first and gradually become blackened and brittle; they can be quite large and can cover substantial portions of trees, giving them a charred or burned appearance; symptoms are most obvious during the winter;	<ul style="list-style-type: none"> • no control is necessary; • the fungus is not a pathogen although it can represent an aesthetic problem to landscape trees; large masses of this sooty mold can be pulled from the tree without harm if done carefully; injuries associated with beech blight aphid infestations are presently not quantified and are poorly understood; 	No chemical control is suggested.

***Forsythia* (*Forsythia*)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Bacterial Blight <i>(Pseudomonas syringae</i> pv. <i>syringae)</i> p. 370	Symptoms can develop on leaves, shoots, and stems; irregular, water-soaked lesions appear on leaves as they emerge and veins of infected leaves are water-soaked and blackened; lesions often coalesce, blacken, and kill leaves very quickly; when petioles become infected, the pathogen moves into tender wood; shoots and tender stems wilt and blacken; sunken, black cankers can be seen on infected stems; symptoms can easily be confused with frost damage although frost or other types of physical injury can provide sites for infection; this disease has been particularly problematic for the past several years, especially during cool, wet, spring weather;	<ul style="list-style-type: none"> • prune all symptomatic tissues back to healthy wood as soon as they are evident; this should be done when bark is dry; • disinfest tools between cuts; • maintain vigor but avoid excessive nitrogen fertilization; • provide adequate spacing for good air circulation; • avoid overhead irrigation; • bactericide applications can be made when the new growth is emerging in spring and repeated as necessary at label intervals; these products have limited efficacy against internal infections; 	<ul style="list-style-type: none"> *copper hydroxide copper sulphate pentahydrate *harpin protein mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i>
Fungal Leaf Spots <i>(Phyllosticta, Alternaria)</i> p. 42, 84	Irregular or circular, dead patches develop over the leaves, particularly during wet weather; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • spraying is usually not necessary since the disease has no significant impact on plant health; on specimen plants, fungicides can be applied as new growth emerges in spring and repeated as necessary at label intervals; 	<ul style="list-style-type: none"> azoxystrobin *harpin protein mancozeb mancozeb + copper hydroxide *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl

***Forsythia* (*Forsythia*) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Gall <i>(Unknown, Phomopsis?)</i> p. 148	Numerous abnormal growths, swellings, or knobby galls appear on stems, sometimes resulting in twig dieback; symptoms are similar to those associated with crown gall but, to date, no causal agent has been definitively associated with this deformity;	<ul style="list-style-type: none"> • prune and remove symptomatic branches to eliminate secondary invaders or opportunistic pests; • maintain vigor; 	No chemical control is suggested.

Fraxinus (Ash)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Anthracnose (<i>Gnomoniella</i> , <i>Discula</i>) p. 98	<p>Newly emerging leaves develop brown spots at margins and tips, often resulting in distortion or twisting of the leaves; when infection is heavy, leaves brown and fall prematurely; tender, young twigs can also become infected and girdled resulting in tip dieback; symptoms are frequently most severe on lower portions of the tree; from a distance, individuals or clusters of heavily infected trees often have the appearance of being burned; black and white ash are susceptible and green ash is fairly resistant; very heavy in recent years due to cool, wet conditions during leaf emergence; refer to fact sheet for more detailed information;</p>	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune affected twigs and limbs when bark is dry; • spraying is usually not necessary but fungicide sprays can be applied at budbreak and repeated 2-3 times as necessary according to label directions; 	<p>chlorothalonil chlorothalonil + fenarimol copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + myclobutanil mancozeb + thiophanate methyl *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil</p>

Fraxinus (Ash) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Decline (Unknown Complex) p. 462	Trees have poor vigor and a general unthrifty appearance; can develop on trees of any age but is frequently found on older trees; other symptoms include canopy thinning, undersized chlorotic foliage, branch dieback, and in extreme cases, whole tree death; particularly affected in Connecticut is white ash; this complex remains poorly understood but is thought to be exacerbated by drought, freeze damage, and air pollution; ash yellows (see below) is probably one component of the decline syndrome; recovery is not common; quite noteworthy during the past few years;	<ul style="list-style-type: none"> • prune and remove dead branches to avoid secondary invaders or opportunistic pests; • maintain tree vigor; • avoid unnecessary stresses or injuries; 	No chemical control is suggested.
Fungal Leaf Spots (<i>Cercospora</i> , <i>Cercosporidium</i> , <i>Septoria</i>) p. 20	Individual spots or large, necrotic sections develop on leaves after cool, wet, spring weather; some early leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as new growth begins and repeated as necessary; 	chlorothalonil chlorothalonil + fenarimol *harpin protein mancozeb mancozeb + myclobutanil mancozeb + thiophanate methyl propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil

Fraxinus (Ash) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Leaf Rust (<i>Puccinia sparaganooides</i>) p. 270	<p>Yellowish-orange spots develop on leaves and petioles; as the fungus develops in these areas, some distortion of tissues occurs; when lesions girdle petioles, leaves brown and die; in cases of severe infections, trees appear burned or scorched and significant premature leaf drop occurs; repeated years of defoliation can significantly weaken trees and make them more vulnerable to winter injury; this disease has been reported to kill young trees; the fungus requires an alternate host for completion of its life cycle so the disease does not spread directly from ash to ash; the alternate host is <i>Spartina</i> (marsh or cord grass); leaf rust fungus overwinters on <i>Spartina</i> hosts; refer to fact sheet for more detailed information;</p>	<ul style="list-style-type: none"> • maintain tree vigor; • remove alternate hosts within close proximity of ash hosts, if possible; • not usually serious enough for control measures; on specimen trees, fungicides can be applied at budbreak and repeated 2-3 times as necessary; 	<p>chlorothalonil *harpin protein mancozeb mancozeb + myclobutanil myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil</p>
Powdery Mildew (<i>Erysiphe</i>) p. 8	<p>White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;</p>	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	<p>copper sulphate pentahydrate *harpin protein propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon</p>

Fraxinus (Ash) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Verticillium Wilt (<i>Verticillium</i> spp.) p. 242	This disease is often misdiagnosed since no distinctive vascular discoloration is visible in infected trees; symptoms include sudden scorching and leaf drop, often on a single branch or a portion of a tree; affected branches usually die but occasionally re-foliate; chronic infections can be identified by random patches of chlorotic leaves, reduced growth, and branch dieback; trees can die slowly or suddenly; laboratory examination and culturing are usually required for definitive identification;	<ul style="list-style-type: none"> • prune and remove affected limbs as soon as symptoms are evident; • disinfest tools between cuts; • promote tree vigor by fertilizing and watering; • do not replant susceptible species in the area since the fungus is soilborne (refer to list of resistant species, Table 1); 	No chemical control is suggested.
Yellows (<i>Candidatus</i> <i>Phytoplasma fraxini</i>) p. 390	Infected trees exhibit slow growth, deliquescent branching, undersized leaves, and early budbreak, as much as 1-2 weeks earlier than normal; progressive branch and twig dieback results in thinning of the canopy; witches' brooms and epicormic sprouts may occur along the trunk or at the root collar; white ash is highly susceptible and sustains the most damage; considered a key contributing factor to the "Decline" syndrome;	<ul style="list-style-type: none"> • prune and remove symptomatic limbs; • maintain vigor; • insect vectors such as leafhoppers are involved in disease transmission but have not yet been identified; • although green ash is susceptible, it is more tolerant than many other ash species; • install barriers for landscape trees to prevent root grafts from developing; 	No chemical control is suggested.

***Gleditsia* (Honeylocust)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Powdery Mildew <i>(Erysiphe)</i> p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil
Thyronectria Canker <i>(Nectria austroamericana)</i> p. 178	Trees have progressively thinning canopies with yellowed or wilted leaves due to the presence of elongate, sunken, reddish-brown discolored annual and perennial cankers on branches or trunks; reddish-brown discoloration can develop in sapwood beneath or near the cankers and can extend into the heartwood; cracks and ridges develop in old cankers and blackened fruiting structures of the fungus are sometimes visible; cankers are frequently associated with pruning wounds or southwest injuries; trees die when the main trunk is girdled by cankers; this disease is exacerbated by drought and site-related stresses; considered the most serious disease of honeylocust in Connecticut;	<ul style="list-style-type: none"> • prune and remove cankered branches; • avoid unnecessary wounding; • maintain overall vigor; • avoid unnecessary stresses, esp. drought stress; • resistant cultivars are available (e.g., 'Skyline' and 'True Shade' appear more resistant than 'Shademaster' or 'Rubylace'); 	No chemical control is suggested.

Hamamelis (Witch Hazel)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Botryosphaeria Canker (<i>Botryosphaeria</i>) p. 120	Random dieback of branches and limbs; usually associated with sunken cankers in which black fruiting structures of the fungus may be visible; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding and unnecessary stress such as drought stress; • maintain tree vigor; 	No chemical control is suggested.
Crown Gall (<i>Agrobacterium tumefaciens</i>) p. 382	Galls ranging in size from ¼ inch to several inches in diameter develop on branches and roots; young galls appear white or cream-colored when cut in half; older galls darken to brown and have no recognizable internal structure (e.g., no vascular tissue);	<ul style="list-style-type: none"> • prune and remove young stem galls as soon as evident; • disinfest tools between cuts; • severely infected plants should be rogued and removed; • avoid mechanical injuries to neighboring plants using careful cultivation since the bacterium requires a wound in order to infect; • plant resistant species (refer to list of resistant species, Table 2); 	No chemical control is suggested.
Fungal Leaf Spots (<i>Phyllosticta</i>) p. 42	Individual spots or large, necrotic sections develop on leaves during rainy weather; some leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied at budbreak and repeated as necessary according to label directions; 	*harpin protein mancozeb mancozeb + copper hydroxide thiophanate methyl

Hamamelis (Witch Hazel) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Powdery Mildew (<i>Podosphaera</i>) p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	*harpin protein *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil

Hibiscus (Rose-of-Sharon)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Botryosphaeria Canker (<i>Botryosphaeria</i>) p. 120	Random dieback of branches and limbs; usually associated with sunken cankers in which black fruiting structures of the fungus may be visible; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding and unnecessary stress such as drought stress; • maintain tree vigor; 	No chemical control is suggested.
Botrytis Blight (<i>Botrytis cinerea</i>) p. 72	Flowers and flower buds appear shriveled and brown; affected portions are often covered with gray, fuzzy, fungal growth; leaf symptoms can develop if senescing flowers or shriveled buds fall onto leaves during wet weather; more prevalent after periods of prolonged humidity, rain, or cloud cover; can result in some twig dieback;	<ul style="list-style-type: none"> • prune and remove infected twigs and senescing or blighted flowers; • maintain vigor; • spraying is usually not necessary since the disease has no significant impact on tree health; however, on specimen trees, fungicide sprays can be applied at budbreak in wet springs or when symptoms first appear; sprays can be repeated as necessary according to label directions; 	chlorothalonil *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + myclobutanil *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i> *sulfur thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil
Canker (<i>Nectria</i> spp.) p. 176	Random dieback of branches and limbs; usually associated with sunken cankers that are often covered with distinctive coral-colored or red-orange fruiting structures of the fungus; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding; • maintain tree vigor; 	No chemical control is suggested.

***Hibiscus* (Rose-of-Sharon) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Powdery Mildew <i>(Podosphaera)</i> p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	<ul style="list-style-type: none"> *harpin protein *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil

Hydrangea (Hydrangea)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Bacterial Blight (<i>Pseudomonas</i>) p. 368	Sudden and conspicuous blighting and dieback of young leaves and inflorescences; infected tissues appear blackened and water-soaked; disease is more severe during cool, wet weather or after late-season frosts in spring; quite prevalent in the past few years;	<ul style="list-style-type: none"> • prune and remove infected twigs 8-10 inches below visible symptoms; • disinfest tools between cuts; • maintain vigor but avoid excessive fertilization; • preventative sprays can be applied when new growth emerges and repeated as necessary; 	*copper hydroxide copper salts of fatty and rosin acids *harpin protein *QST 713 strain of <i>Bacillus subtilis</i>
Bacterial Leaf Spot (<i>Xanthomonas</i>) p. 370	Symptoms appear as small, water-soaked spots, usually first on lower leaves, but they quickly spread upward in the plant; the lesions darken with age and become angular and are often delineated by the veins; the centers of the spots frequently drop out; most common under warm, wet conditions in late spring and early summer;	<ul style="list-style-type: none"> • avoid overhead irrigation and prune to maintain adequate air circulation; • preventative sprays can be applied at budbreak and repeated as necessary according to label directions; 	*copper hydroxide copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein *QST 713 strain of <i>Bacillus subtilis</i>

Hydrangea (Hydrangea) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Botrytis Blight <i>(Botrytis cinerea)</i> p. 72	Flowers and flower buds appear shriveled and brown; affected portions are often covered with gray, fuzzy, fungal growth; serious after periods of prolonged humidity, rain, or cloud cover; can result in some twig dieback;	<ul style="list-style-type: none"> • prune and remove infected twigs and senescing or blighted flowers; • maintain vigor; • spraying is usually not necessary since the disease has no significant impact on tree health; however, on specimen trees, fungicide sprays can be applied at budbreak in wet springs or when symptoms first appear; sprays can be repeated as necessary according to label directions; 	chlorothalonil copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + myclobutanil *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i> *sulfur thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil

Hydrangea (Hydrangea) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Fungal Leaf Spots <i>(Cercospora, Phyllosticta, Septoria)</i> p. 20	Individual spots with defined margins or large, necrotic sections develop on leaves during rainy weather; some early leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation around the plant and avoid overhead watering; • spraying is usually not necessary since the disease has no significant impact on plant health; on specimen plants, fungicides can be applied when new growth emerges in spring and repeated as necessary according to label directions; 	azoxystrobin chlorothalonil chlorothalonil + fenarimol copper salts of fatty and rosin acids copper sulphate pentahydrate ferbam *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + myclobutanil myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil

Hydrangea (Hydrangea) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Powdery Mildew (<i>Erysiphe</i> , <i>Oidium</i>) p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	azoxystrobin copper salts of fatty and rosin acids copper sulphate pentahydrate fenarimol *harpin protein myclobutanil *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon
Winter Dieback (<i>Abiotic</i>) p. 498	Symptoms include dieback of shoots and lack of flowering due to the killing of flower buds by winter conditions; flower buds are more vulnerable to winter kill than leaf or shoot buds; some species of hydrangea (e.g., <i>H. macrophylla</i>) are not adequately winter-hardy in many regions of Connecticut; as a consequence, tops often die back to ground level; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • promote overall vigor; • pay attention to plant selection and site; • prune any dead branches; • <i>H. macrophylla</i> 'Endless Summer' is a new cultivar that blooms on both old and new wood so it minimizes the impact of winter dieback problems; 	No chemical control is suggested.

***Ilex* (Holly)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Armillaria Root Rot <i>(Armillaria spp. complex)</i> p. 326	Also called shoestring root rot and honey mushroom rot; this disease is difficult to identify since aboveground symptoms appear as general and progressive decline that leads to the eventual death of trees; trees can die singly or in groups; trees under environmental or site-related stresses are particularly susceptible; diagnostic signs of the infection include black strands of the fungus called rhizomorphs (shoestrings) on the surface of the bark or at the base of infected trees, white fans of fungal growth with “mushroomy” odors under the bark, and the occasional growth of honey mushrooms at the base of infected trees in autumn; narrow, black lines are often evident in infected wood; the fungus can persist in stumps and large, woody roots for as long as 30 years;	<ul style="list-style-type: none"> • maintain tree vigor; • avoid any unnecessary stresses, esp. drought stress; • avoid planting susceptible trees in a site where this disease has been confirmed; • if replanting in the site, the stump and all woody roots greater than ½ inch in diameter should be removed; 	No chemical control is suggested.
Botryosphaeria Canker <i>(Botryosphaeria)</i> p. 120	Random dieback of branches and limbs; usually associated with sunken cankers in which black fruiting structures of the fungus may be visible; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding and unnecessary stress such as drought stress; • maintain tree vigor; 	No chemical control is suggested.

Ilex (Holly) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Botrytis Blight (<i>Botrytis cinerea</i>) p. 72	Flowers and flower buds appear shriveled and brown; affected portions are often covered with gray, fuzzy, fungal growth; serious after periods of prolonged humidity, rain, or cloud cover; can result in some twig dieback;	<ul style="list-style-type: none"> • prune and remove infected twigs and senescing or blighted flowers; • maintain vigor; • spraying is usually not necessary since the disease has no significant impact on plant health; on specimen trees, fungicides can be applied at budbreak and repeated as necessary according to label directions; 	chlorothalonil copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + myclobutanil *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i> *sulfur thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil

Ilex (Holly) cont'd

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Fungal Leaf Spots <i>(Cercospora, Phyllosticta)</i> p. 20	Brown to purple spots develop on leaves during wet weather; some yellowing and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation and avoid overhead watering; • spraying is usually not necessary since the disease has no significant impact on plant health; on specimen trees, fungicides can be applied at budbreak and repeated as necessary according to label directions; 	chlorothalonil *copper hydroxide copper salts of fatty and rosin acids *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + myclobutanil propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil
Leaf Blotch [Purple Leaf Scorch] <i>(Abiotic)</i>	Irregular, purplish blotches develop on leaves of any age; one of the most common abiotic problems of all species of holly; attributed to as yet undetermined factors but is thought to be associated with nutrient deficiencies;	<ul style="list-style-type: none"> • maintain vigor; • apply fertilizer based on soil and tissue analyses; 	No chemical control is suggested.

Ilex (Holly) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Powdery Mildew (<i>Erysiphe</i>) p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	azoxystrobin chlorothalonil copper sulphate pentahydrate *harpin protein mancozeb + copper hydroxide myclobutanil *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> *sulfur thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon
Spine Spot (<i>Abiotic</i>)	Pinhead-sized, grayish-purple spots appear on leaves and are most obvious in spring; upon close examination with a hand lens, a hole can be seen in the center of each spot; holes were initially thought to occur when spines of adjacent holly leaves punctured neighboring leaves since they often appeared after storms involving high winds; recently suggested to be associated with oviposition scars of certain insects;	<ul style="list-style-type: none"> • no control is necessary but it can be helpful to provide protection if plants are located in wind-swept areas; 	No chemical control is suggested.

***Ilex* (Holly) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Tar Spot <i>(Rhytisma)</i> p. 66	Initial symptoms include small, yellow spots on leaves; these turn reddish-brown, and are often associated with a yellow halo in summer; by autumn, typical black, tar-like stroma are visible on infected leaves;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as new growth is emerging in spring and repeated as necessary; 	azoxystrobin chlorothalonil *harpin protein mancozeb + copper hydroxide myclobutanil *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil triadimefon
Winter Injury/Scorch <i>(Abiotic)</i> p. 498	Tan-colored spots or irregular, scorched areas develop on portions or over the entire leaf; upon close examination, the epidermal layers appear shriveled and dry and can sometimes be easily peeled apart; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • maintain vigor; • provide protection if located in wind-swept areas or in areas subject to extreme temperature fluctuations during the winter; • ensure sufficient moisture in the root zone by a deep soaking before the ground freezes; 	No chemical control is suggested.

***Juglans* (Black Walnut, Butternut, Walnut)**

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Anthracnose (<i>Gnomonia</i>) p. 104	Small to irregularly shaped, brown to black spots develop on leaflets; spots are frequently so numerous that they coalesce and form large, dead patches; where lesions are located at leaflet margins, distortion and curling of the leaflet may occur; heavily infected leaves turn brown and drop prematurely, sometimes as early as July or August; significant defoliation is not uncommon; dark-brown lesions may also develop on petioles and fruit husks; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves and fruit; • maintain vigor since repeated defoliation can weaken trees; • spraying is usually not necessary since the disease has no significant impact on plant health; on specimen trees, fungicides can be applied at budbreak and repeated as necessary according to label directions; 	chlorothalonil *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + myclobutanil mancozeb + thiophanate methyl myclobutanil propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil
Bacterial Blight (<i>Xanthomonas</i>) p. 374	Infection usually begins on catkins, which appear water-soaked and blackened; water-soaked, pale yellow, angular spots that gradually darken also develop on leaves; when located at leaflet margins, they result in deformity; petioles may also develop angular, dark-brown to black lesions; fruit may be infected at anytime; symptoms on fruit appear as reddish-brown or blackened depressions;	<ul style="list-style-type: none"> • rake and remove fallen leaves and fruit; • prune any dead or cankered limbs at least 8-10 inches below visible symptoms when bark is dry; • disinfest tools between cuts; • sprays can be applied at prebloom, bloom, and early nutlet stages; 	*copper hydroxide *harpin protein mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i>

***Juglans* (Black Walnut, Butternut, Walnut) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Bunch Disease [Witches' Broom] (Prunus X-disease group of phytoplasmas) p. 390	Fast-growing witches' brooms develop on trunks and limbs; leaflets in brooms tend to be longer and narrower than normal leaflets and can also be curled and chlorotic; fruit may fall prematurely; extent of symptom development varies with host species; vectors have not been identified;	<ul style="list-style-type: none"> • rogue and remove heavily infected trees; • maintain vigor; • resistance is variable: <i>J. nigra</i> is highly tolerant, <i>J. ailanthifolia</i> and <i>J. microcarpa</i> are highly intolerant; 	No chemical control is suggested.
Canker [Butternut Canker] (<i>Sirococcus clavigignenti-juglandacearum</i>) p. 116	This highly destructive disease is specific to butternut ; cankers can develop on stems, branches, and the main trunk; young cankers appear as elongate, sunken areas, often originating at leaf scars, branch stubs, and buds; they usually have a diagnostic inky-black center and white margin; when bark is peeled back, brown to black, elliptical areas of dead cambium are visible; tree decline and death are common;	<ul style="list-style-type: none"> • rogue and remove heavily infected trees; • prune and remove infected limbs below visible canker symptoms; • maintain vigor; 	No chemical control is suggested.

***Juglans* (Black Walnut, Butternut, Walnut) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Powdery Mildew <i>(Erysiphe)</i> p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	<ul style="list-style-type: none"> *harpin protein mancozeb + myclobutanil myclobutanil *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon

***Juniperus* (Juniper, Red Cedar)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Red Cedar Decline (Abiotic)	Since 2004, many native eastern red cedars (<i>J. virginiana</i>) have exhibited dramatic and conspicuous browning and dieback; damage occurred on trees in all age and size classes, care regimes, and locations; tree death has been observed in extreme cases; no pathogens or arthropod pests have been identified; a combination of weather events (e.g., winter, excess water, drought) have been suggested as contributing to the problem; work to identify the causal agent(s) is ongoing; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • maintain vigor; • prune and remove infected twigs and branches; • water during periods of drought; 	No chemical control is suggested.

Juniperus (Juniper, Red Cedar) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Rusts (<i>Gymnosporangium</i> spp.) p. 260	<p>Several rust species attack juniper and the symptoms vary with species; the most common rusts are cedar-apple (<i>G. juniperi-virginianae</i>), cedar-hawthorn (<i>G. globosum</i>), and quince (<i>G. clavipes</i>); symptoms are first evident during the winter; cedar-apple rust infection results in the formation of smooth, round, brown galls, often with depressions on the surface, on twigs and branches; galls range from marble to golf ball size; other rust species cause somewhat inconspicuous swellings on twigs; in spring, both galls and swollen areas develop their diagnostic bright-orange coloration--gelatinous, telial "horns" appear on galls, and gelatinous, orange patches can be seen oozing out of swollen areas on twigs; in some cases, symptoms can appear dramatically overnight, especially after rain; these fungi require other hosts (many members of the Rose Family) in order to complete their life cycles; refer to fact sheet for more detailed information;</p>	<ul style="list-style-type: none"> • not considered serious on junipers although limited branch dieback may occur on twigs with galls or near swollen areas of twigs where bark may fall off and girdle the twig; • to reduce disease on the primary hosts (e.g., apple, crabapple, mountain ash, serviceberry), galls and swollen twigs can be pruned and removed during the winter or before spore horns develop in spring; • avoid planting junipers in close proximity to the primary hosts; • resistant species are available (e.g., <i>J. chinensis</i> 'Femina,' 'Hetzii,' <i>J. communis</i> 'Depressa,' <i>J. virginiana</i> 'Tripartita'); more extensive lists are available upon request; • fungicide sprays to juniper are generally not practical in the landscape; however, sprays can be applied in mid- to late summer at regular label intervals; 	<p>azoxystrobin copper salts of fatty and rosin acids *copper sulfate ferbam flutolanil *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + thiophanate methyl myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil triadimefon</p>

Tip Blight-Abiotic <i>(Abiotic)</i>	Tips and whole sections of branches progressively turn brown and die; affected needles usually remain attached to the branches; symptoms are frequently distributed uniformly on the shrub and are most obvious in spring; since secondary fungi occasionally infect these dead tissues, microscopic examination is necessary to rule out fungal tip blights (see below);	<ul style="list-style-type: none">• prune and remove as much of the affected portions of the shrub as practical since this helps to reduce problems associated with secondary invaders and opportunistic pests;• maintain vigor;	No chemical control is suggested.
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Juniperus (Juniper, Red Cedar) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Tip Blight-Kabatina (<i>Kabatina</i>) p. 146	Symptoms appear in late winter or early spring, usually before symptoms of <i>Phomopsis</i> ; tips and whole sections of branches progressively die and turn brown; affected needles usually remain attached to the branches but symptomatic tips eventually drop off; upon close inspection, black fruiting bodies of the fungus are evident in the ash-brown tissues; microscopic examination is necessary for fungal identification; unlike <i>Phomopsis</i> , this fungus usually requires a wound (from mechanical damage or, more frequently, from insect activities) in order to infect; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove infected twigs and branches; • avoid overhead irrigation and excessive crowding; • severely infected plants should be rogued and removed; • maintain vigor and control insects; • resistant varieties are available (e.g., <i>J. chinensis</i> 'Pfitzeriana,' 'Hetzii'; <i>J. communis</i> 'Hibernica'); more extensive lists are available upon request; • fungicide sprays can be applied in midsummer according to label directions; 	*harpin protein mancozeb *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil

Juniperus (Juniper, Red Cedar) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Tip Blight-Phomopsis (<i>Phomopsis</i>) p. 146	<p>Symptoms appear in early spring and develop throughout the growing season; tips and whole sections of branches progressively die and turn brown; affected foliage turns dull red or brown and then ash-gray; needles usually remain attached to the branches; symptoms are frequently uniformly distributed over the shrub; immature or newly expanding needles are most susceptible; upon close inspection, black fruiting bodies of the fungus are evident on browned tissues; microscopic examination is necessary for fungal identification; refer to fact sheet for more detailed information;</p>	<ul style="list-style-type: none"> • prune and remove infected twigs and branches; • avoid overhead irrigation and excessive crowding; • severely infected plants should be rogued and removed; • maintain vigor by fertilizing and watering; • resistant varieties are available (e.g., <i>J. chinensis</i> 'Femina,' 'Pfitzeriana aurea'; <i>J. communis</i> 'Aureo-spica,' 'Prostrata aurea'; <i>J. horizontalis</i> 'Depressa'; <i>J. virginiana</i> 'Tripartita'); more extensive lists are available upon request; • fungicide sprays can be applied when growth begins in spring and repeated as necessary at label intervals; 	<p>azoxystrobin chlorothalonil *copper hydroxide copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + myclobutanil mancozeb + thiophanate methyl *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil</p>

***Kalmia* (Mountain Laurel)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Armillaria Root Rot <i>(Armillaria spp. complex)</i> p. 326	Also called shoestring root rot and honey mushroom rot; this disease is difficult to identify since aboveground symptoms appear as general and progressive decline that leads to the eventual death of trees; trees can die singly or in groups; trees under environmental or site-related stresses are particularly susceptible; diagnostic signs of the infection include black strands of the fungus called rhizomorphs (shoestrings) on the surface of the bark or at the base of infected trees, white fans of fungal growth with “mushroomy” odors under the bark, and the occasional growth of honey mushrooms at the base of infected trees in autumn; narrow, black lines are often evident in infected wood; the fungus can persist in stumps and large, woody roots for as long as 30 years;	<ul style="list-style-type: none"> • maintain tree vigor; • avoid any unnecessary stresses, esp. drought stress; • avoid planting susceptible trees in a site where this disease has been confirmed; • if replanting in the site, the stump and all woody roots greater than ½ inch in diameter should be removed; 	No chemical control is suggested.
Botryosphaeria Canker <i>(Botryosphaeria)</i> p. 120	Random dieback of branches and limbs; usually associated with sunken cankers in which black fruiting structures of the fungus may be visible; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding and unnecessary stress such as drought stress; • maintain tree vigor; 	No chemical control is suggested.

***Kalmia* (Mountain Laurel) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Chlorosis <i>(Abiotic)</i>	Symptoms often develop on the newest growth, which generally appears pale green or yellow; the veins of yellowed leaves frequently remain green; usually associated with an iron deficiency due to soil and site conditions (e.g., soil pH, root damage due to drought or excess moisture); refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • maintain vigor; • test the soil to help determine the cause of the problem; 	No chemical control is suggested.
Fungal Leaf Spots <i>(Pseudocercospora, Pestalotiopsis)</i> p. 34, 190	Irregular, occasionally circular, gray-brown spots with purple borders develop on leaves; sizes may vary from pinpoint to ½ inch in diameter; dark-brown fruiting structures may be scattered within the spots; infected leaves usually persist on the tree although leaves with many spots may turn yellow and drop prematurely; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation around the plant and avoid late-day watering; • spraying is usually not necessary since the disease has no significant impact on plant health; on specimen plants, fungicides can be applied at budbreak and repeated as necessary according to label directions; 	chlorothalonil chlorothalonil + fenarimol *harpin protein mancozeb mancozeb + myclobutanil myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon

***Kalmia* (Mountain Laurel) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Leaf/Twig Blight <i>(Phomopsis)</i> p. 140	Fairly large, irregular spots develop on leaves, often at the margins; these spots are frequently mistaken for winter injury; lesions can appear "zonated" or have purple margins; when leaf margins are infected, leaves become cupped; severely infected leaves often drop prematurely; the fungus may penetrate tender twigs and cause dieback and blighting of affected shoots; wounds can be important to infection;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune and remove symptomatic twigs or branches; • maintain vigor and avoid wounds; • when infection is heavy, fungicide sprays can be applied when shoots are elongating in spring and continued at label intervals until tissues are mature; 	*harpin protein mancozeb *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl + flutolanil
Necrotic Ringspot <i>(Virus)</i> p. 420	Symptoms appear as distinct, necrotic, reddish-brown ringspots; these are usually scattered in a random pattern over the leaf surface; symptoms are most pronounced on 2-year-old leaves as the new growth emerges; leaves occasionally drop prematurely but the disease does not appear to affect the overall health or vigor of the plant; no insect vectors have been identified to transmit this virus;	<ul style="list-style-type: none"> • maintain vigor; 	No chemical control is suggested.

***Kalmia* (Mountain Laurel) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Phytophthora Root Rot <i>(Phytophthora spp.)</i> p. 354	Infected plants generally exhibit poor vigor; leaves appear dull, olive-green, and wilted but usually remain attached to branches; branches and twigs shrivel; symptoms may be confined to individual branches or may develop progressively until the entire plant is involved; a diagnostic cinnamon-brown discoloration may be evident on the inner bark and cambium at the root/crown area; frequently more serious on shrubs planted in sites where excess water is a persistent problem (e.g., clay soils, low areas);	<ul style="list-style-type: none"> once infected, plants cannot be cured; rogue and remove symptomatic plants and improve drainage; avoid excessive irrigation and maintain vigor; healthy, uninfected plants adjacent to symptomatic plants can be protected with fungicides applied according to label directions; 	fosetyl-Al *harpin protein mefenoxam mono- and di-potassium salts of phosphorous acid phosphorous acid *QST 713 strain of <i>Bacillus subtilis</i>
Powdery Mildew <i>(Erysiphe)</i> p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> rake and remove fallen leaves; avoid excessive fertilization since tender, succulent leaves are more susceptible; provide good air circulation around the tree; spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	chlorothalonil *harpin protein mancozeb + myclobutanil myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon

***Kalmia* (Mountain Laurel) cont'd**

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Tip Blight (<i>Phytophthora</i> spp.) p. 354	Leaves and terminal buds begin to discolor; leaves turn brown and droop; a diagnostic V-shaped, water-soaked discoloration may be evident on the leaves, usually beginning at the point of petiole attachment to the leaf lamina; browning of the petiole often continues as the fungus-like organism moves into the twig; girdling cankers may form on twigs and branches and result in dieback;	<ul style="list-style-type: none"> • prune and remove affected tips well below obvious symptoms; • avoid excessive vigor; • fungicide sprays can be applied when new growth begins and repeated according to label intervals; 	*harpin protein mancozeb mancozeb + myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl + chlorothalonil
Winter Injury (<i>Abiotic</i>) p. 498	Browning of leaf tips or margins, often most evident in spring; considerable dieback and shriveling of branches and twigs can also occur; symptoms are most evident in late winter or early spring as growth resumes but can also develop later in the season; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove symptomatic tissues to minimize secondary invaders and opportunistic pests; • maintain vigor; • provide adequate moisture in the root zone before the ground freezes; • provide protection in wind-swept areas or in areas prone to extreme temperature fluctuations during the winter; 	No chemical control is suggested.

***Koelreuteria* (Goldenrain Tree)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Armillaria Root Rot <i>(Armillaria spp. complex)</i> p. 326	Also called shoestring root rot and honey mushroom rot; this disease is difficult to identify since aboveground symptoms appear as general and progressive decline that leads to the eventual death of trees; trees can die singly or in groups; trees under environmental or site-related stresses are particularly susceptible; diagnostic signs of the infection include black strands of the fungus called rhizomorphs (shoestrings) on the surface of the bark or at the base of infected trees, white fans of fungal growth with “mushroomy” odors under the bark, and the occasional growth of honey mushrooms at the base of infected trees in autumn; narrow, black lines are often evident in infected wood; the fungus can persist in stumps and large, woody roots for as long as 30 years;	<ul style="list-style-type: none"> • maintain tree vigor; • avoid any unnecessary stresses, esp. drought stress; • avoid planting susceptible trees in a site where this disease has been confirmed; • if replanting in the site, the stump and all woody roots greater than ½ inch in diameter should be removed; 	No chemical control is suggested.
Botryosphaeria Canker <i>(Botryosphaeria)</i> p. 120	Random dieback of branches and limbs; usually associated with sunken cankers in which black fruiting structures of the fungus may be visible; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding and unnecessary stress such as drought stress; • maintain tree vigor; 	No chemical control is suggested.

***Koelreuteria* (Goldenrain Tree) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Canker <i>(Nectria cinnabarina)</i> p. 176	Small, depressed, dead areas develop on twigs, branches, and the main trunk; as these cankers enlarge, they encircle and girdle the affected plant part and result in death of these tissues; numerous small, coral-colored fruiting structures of the fungus usually form in the cankered areas; symptoms are more pronounced on trees weakened by environmental or site-related stresses;	<ul style="list-style-type: none"> • prune and remove affected limbs as soon as symptoms are evident; cuts should be made when bark is dry; • disinfest tools between cuts; • promote tree vigor; 	No chemical control is suggested.
Verticillium Wilt <i>(Verticillium spp.)</i> p. 242	Flagging or wilting of individual limbs or portions of the canopy, usually in midsummer; leaves can be undersized; trees die slowly or suddenly, depending on the extent of infection and overall health of the tree; a distinctive olive to brown streaking may be evident in the wood of symptomatic branches or twigs; laboratory examination and culturing of the fungus are usually necessary for definitive identification;	<ul style="list-style-type: none"> • prune and remove affected limbs as soon as symptoms are evident; • disinfest tools between cuts; • promote tree vigor; • do not replant susceptible species in the area since the fungus is soilborne (refer to list of resistant species, Table 1); 	No chemical control is suggested.

Laburnum (Golden-Chain Tree)

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Botryosphaeria Canker <i>(Botryosphaeria)</i> p. 120	Random dieback of branches and limbs; usually associated with sunken cankers in which pinpoint, black fruiting structures of the fungus may be visible; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding; • maintain vigor; 	No chemical control is suggested.
Twig Blight <i>(Fusarium lateritium)</i> p. 186	Cankers associated with twig dieback cause thinning of the canopy; cankers are annual and are often initiated at wounds; they are elliptical and tan, with purplish-brown margins that make them readily distinguished from adjacent, healthy tissues; cankers are often associated with freeze damage; peach-colored fruiting structures are often found erupting from lenticels within the cankers;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding; • maintain vigor; 	No chemical control is suggested.

***Larix* (Larch, Tamarack)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Canker <i>(Botryosphaeria, Leucostoma)</i> p. 120, 160	Progressive wilting and dieback of branches; cankered tissues are often flat or sunken; wood under the cankered areas is usually discolored; black, pinpoint fruiting structures of the fungus can be visible in infected bark;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs or branches back to healthy wood when the bark is dry; • maintain tree vigor; • avoid wounding or unnecessary stresses such as drought stress; 	No chemical control is suggested.

Leucothoe (Leucothoe)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Fungal Leaf Spots (<i>Pseudocercospora</i> , <i>Mycosphaerella</i> , <i>Phyllosticta</i>) p. 34	Necrotic spots with brown to purple margins develop on leaves, especially during wet weather; some leaf drop may occur; purple lesions on stems can girdle and kill small shoots;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation and avoid overhead watering; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied at budbreak and repeated as necessary according to label directions; 	*harpin protein mancozeb myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil triadimefon
Powdery Mildew (<i>Erysiphe</i>) p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	*harpin protein myclobutanil *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon
Winter Injury (<i>Abiotic</i>) p. 498	Browning of leaf tips or margins, often most evident in spring; considerable dieback and shriveling of branches and twigs can occur; symptoms are most evident in late winter or early spring as growth resumes but can also develop later in the season; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove symptomatic tissues to minimize secondary invaders and opportunistic pests; • maintain vigor; • provide adequate moisture in the root zone before the ground freezes; • provide protection in wind-swept areas or in areas prone to extreme temperature fluctuations during the winter; 	No chemical control is suggested.

***Ligustrum* (Privet)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Anthracnose/Twig Blight <i>(Glomerella)</i> p. 114	Symptoms include development of irregular, necrotic spots on leaves followed by shriveling and drying of the leaves; a blighting of twigs can also occur; when cankers develop and girdle main shoots, plant death can occur; pinkish pustules of the fungus are sometimes visible during wet weather; plants weakened by environmental stress and poor nutrition are particularly susceptible;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune infected twigs and branches when bark is dry; • maintain vigor; • chemical control is usually not necessary except for new transplants, young or specimen plants, or when defoliation has been heavy for several years; fungicides can be applied at budbreak and repeated 2-3 times according to label directions; 	chlorothalonil *harpin protein mancozeb mancozeb + thiophanate methyl *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil

Ligustrum (Privet) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Armillaria Root Rot <i>(Armillaria spp. complex)</i> p. 326	Also called shoestring root rot and honey mushroom rot; this disease is difficult to identify since aboveground symptoms appear as general and progressive decline that leads to the eventual death of plants; trees can die singly or in groups; plants under environmental or site-related stresses are particularly susceptible; diagnostic signs of the infection include black strands of the fungus called rhizomorphs (shoestrings) on the surface of the bark or at the base of infected plants, white fans of fungal growth with "mushroomy" odors under the bark, and the occasional growth of honey mushrooms at the base of infected plants in autumn; narrow, black lines are often evident in infected wood; the fungus can persist in stumps and large, woody roots for as long as 30 years;	<ul style="list-style-type: none"> • maintain vigor; • avoid any unnecessary stresses, esp. drought stress; • avoid planting susceptible plants in a site where this disease has been confirmed; • if replanting in the site, the stump and all woody roots greater than ½ inch in diameter should be removed; 	No chemical control is suggested.
Oedema <i>(Abiotic)</i>	Symptoms appear as raised, water-soaked blisters that eventually become corky and tan to rusty-brown; they develop primarily on lower leaf surfaces but can extend to petioles and tender, new shoots;	<ul style="list-style-type: none"> • maintain vigor; 	No chemical control is suggested.

***Ligustrum* (Privet) cont'd**

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Powdery Mildew (<i>Erysiphe</i>) p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the plant; • spraying is usually not necessary since the disease has no significant impact on plant health; on specimen plants, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	<ul style="list-style-type: none"> *harpin protein myclobutanil *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon

Liquidambar (Sweetgum)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Bleeding Necrosis (<i>Botryosphaeria</i>) p. 120	Profuse bleeding on branches and bark such that these areas appear shiny or oily; upon close examination, numerous discolored cankers are usually visible in these areas; occasional callus growth can occur but cankers frequently coalesce and girdle the branch or trunk; young infections have a distinctive phenolic odor; inner bark and wood in cankered areas are usually discolored and brown; infected trees may die in a relatively short time when cankers girdle the trunk; can be quite destructive;	<ul style="list-style-type: none"> • prune and remove cankered limbs well below visible symptoms as soon as possible; • maintain tree vigor; • rogue and remove heavily infected trees; 	No chemical control is suggested.
Fungal Leaf Spots (<i>Cercospora</i> , <i>Septoria</i>) p. 34	Brown, necrotic spots develop on leaves, especially during wet weather; some early leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied at budbreak and repeated as necessary according to label directions; 	*harpin protein mancozeb propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil

***Liriodendron* (Tuliptree)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Canker <i>(Botryosphaeria)</i> p. 120	Probably the most destructive disease of tuliptrees in the landscape; characterized by progressive wilting and dieback of branches; cankered tissues are often flat or sunken; wood under the cankered areas is usually discolored; black, pinpoint fruiting structures of the fungus can be visible in infected bark;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs and branches; • maintain tree vigor; • avoid wounding or unnecessary stresses, esp. drought stress; 	No chemical control is suggested.
Fungal Leaf Spots <i>(Gloeosporium, Phyllosticta)</i> p. 42	Circular, brown spots develop on leaves during wet weather; some leaf drop may occur when infection is heavy; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied when new growth emerges and repeated as necessary according to label directions; 	*harpin protein mancozeb *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl
Leaf Yellowing <i>(Abiotic)</i>	Leaves begin to yellow and drop prematurely in midsummer after extended periods of hot, dry weather;	<ul style="list-style-type: none"> • maintain tree vigor; 	No chemical control is suggested.
Powdery Mildew <i>(Erysiphe)</i> p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	*harpin protein *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil

***Liriodendron* (Tuliptree) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Sooty Mold <i>(Capnodium)</i> p. 16	Leaves, stems, and branches are covered with black, sooty, fungal growth; while not a pathogen of the tree, this fungus represents an aesthetic problem; the sooty mold fungus grows on the honeydew associated with infestations by tuliptree aphids and scales;	<ul style="list-style-type: none"> • control insect pests, particularly aphids and scales; • sooty mold itself is not a problem but an indication of these insect problems; • maintain tree vigor; 	No chemical control is suggested.
Verticillium Wilt <i>(Verticillium spp.)</i> p. 242	Flagging or wilting of individual limbs or portions of the canopy, usually in midsummer; leaves can be undersized; trees die slowly or suddenly, depending on the extent of infection and overall health of the tree; a distinctive olive or brown streaking may be evident in the wood of symptomatic branches or twigs; laboratory examination and culturing of the fungus are necessary for definitive identification;	<ul style="list-style-type: none"> • prune and remove affected limbs as soon as symptoms are evident; • disinfest tools between cuts; • promote tree vigor; • do not replant susceptible species in the area since the fungus is soilborne (refer to list of resistant species, Table 1); 	No chemical control is suggested.

***Lonicera* (Honeysuckle)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Leaf Blight <i>(Insolibasidium deformans)</i> p. 254	Blight symptoms develop in early spring; newly emerging leaves turn yellow and brown and appear twisted and rolled; diffuse tan spots with yellow margins can also develop on leaves later in the season; as these lesions coalesce, large sections of leaves appear tan and necrotic; severely diseased leaves drop prematurely; white, powdery masses of fungal spores are sometimes visible on undersurfaces of leaves during wet weather; this disease is particularly severe in wet weather; usually only a problem in nurseries;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation and avoid overhead watering; • maintain vigor; • spraying is usually not necessary if the infection is light; however, on specimen plants, fungicides can be applied as soon as new growth emerges and repeated as necessary according to label directions; 	*harpin protein mancozeb mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i>
Powdery Mildew <i>(Erysiphe)</i> p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the plant; • spraying is usually not necessary since the disease has no significant impact on plant health; on specimen plants, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	*harpin protein mancozeb + myclobutanil myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil

Magnolia (Magnolia)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Leaf Spots (<i>Alternaria</i> , <i>Mycosphaerella</i>) p. 20	Lesions can appear as minute, purplish-black spots that enlarge to ¾ inch or more or they can remain as small, discrete, brown spots; some early leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation around the tree; • maintain tree vigor; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied when new growth emerges and repeated as necessary according to label directions; 	azoxystrobin chlorothalonil *copper hydroxide copper salts of fatty and rosin acids *harpin protein mancozeb mancozeb + copper hydroxide propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil
Powdery Mildew (<i>Erysiphe</i>) p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	copper sulphate pentahydrate *harpin protein mancozeb + myclobutanil myclobutanil propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil

Magnolia (Magnolia) cont'd

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Verticillium Wilt <i>(Verticillium spp.)</i> p. 242	Flagging or wilting of individual limbs or portions of the canopy, usually in midsummer; leaves can be undersized; trees die slowly or suddenly, depending on the extent of infection and overall health of the tree; a distinctive olive to brown streaking may be evident in the wood of symptomatic branches or twigs; laboratory examination and culturing of the fungus are necessary for definitive identification;	<ul style="list-style-type: none"> • prune and remove affected limbs as soon as symptoms are evident; • disinfest tools between cuts; • promote tree vigor; • do not replant susceptible species in the area since the fungus is soilborne (refer to list of resistant species, Table 1); 	No chemical control is suggested.

Malus (Apple, Crabapple)

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Botryosphaeria Canker <i>(Botryosphaeria)</i> p. 120	Random dieback of branches and limbs; usually associated with sunken cankers in which pinpoint, black fruiting structures of the fungus may be visible; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding and unnecessary stress, esp. drought stress; • maintain tree vigor; 	No chemical control is suggested.
Fire Blight <i>(Erwinia amylovora)</i> p. 376	While only an occasional problem, when infection does occur, disease can develop quite rapidly and destroy individual trees in a single season; flowers appear water-soaked, burned, and then shrivel but usually remain attached to the tree throughout the season; when new shoots are infected they develop a distinctive "shepherd's crook" and appear scorched or burned; blackened leaves cling to the branch and don't fall off; cankers, identified as sunken, discolored areas on branches or the main trunk, may appear wet and oozing during wet weather in spring; remove wild or worthless hosts (e.g., abandoned apple, pear, quince) in the immediate vicinity to reduce sources of the bacterium; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • avoid excessive nitrogen fertilization or vigor; • overwintering cankers should be pruned and removed during the winter; make cuts at least 10-12 inches below visible symptoms when bark is dry; • during the growing season, prune and remove infected branches as soon as they develop; make cuts at least 10-12 inches below visible symptoms when bark is dry; • disinfest tools between cuts; • recent studies with infected fruit trees have shown that thieold method of cutting 8-10 inches below visible symptoms of growing-season blight strikes has certain limitations; new research has shown that bacteria can sometimes be found as far as 9 feet beyond visible symptoms on highly susceptible trees; they suggest that cuts on symptomatic shoots should be made back to 2-year or older wood and at least 8-12 inches below the visible symptoms; 	*copper hydroxide copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i>

(continued on next page)

Malus (Apple, Crabapple) cont'd

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Fire Blight (Cont'd)		<ul style="list-style-type: none"> • these cuts often leave a 4-5 inch naked stub above the next leaf or branch, so this method has been called the “ugly stub” method; cuts should be made when the bark is dry; the presence of “ugly stubs” in the tree will flag infection sites for follow-up with winter pruning; • cultivars vary in susceptibility and resistant varieties are available (e.g., <i>Malus baccata</i> ‘David,’ ‘Dolgo’; <i>M. hupehensis</i> ‘Indian Summer,’ ‘Red Baron’; <i>M. sargentii</i> ‘Sentinel’); a more extensive list is available upon request; • preventative copper sprays can be applied to the bark before growth emerges in spring; additional applications may be necessary to protect newly emerging shoots until flowering; select the appropriate product if harvesting fruit for consumption; 	

Malus (Apple, Crabapple) cont'd

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Frogeye Leaf Spot [Black Rot] <i>(Botryosphaeria)</i> p. 120	Symptoms can develop on leaves, fruit, and stems; leaf symptoms first appear as small, purple flecks; they enlarge to ¼ inch and have purple margins and tan centers (giving a frogeye appearance); heavily infected leaves become chlorotic and drop; fruit are infected when young but symptoms don't appear until they begin to mature; lesions appear black, sunken, and develop concentric rings; stem cankers appear as discolored, sunken, or flattened areas; bark is often rough in and around the cankered areas;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune and remove overwintering cankers when bark is dry; • fungicide sprays are usually not necessary for established, landscape trees that are not intended to produce fruit for consumption; on specimen trees, newly transplanted trees, or trees intended to produce crops for consumption, spraying can begin when new growth emerges and repeated as necessary at label intervals; • select the appropriate fungicide if harvesting fruit for consumption; 	chlorothalonil chlorothalonil + fenarimol ferbam *harpin protein mancozeb *QST 713 strain of <i>Bacillus subtilis</i> *sulfur thiophanate methyl + chlorothalonil
Nectria Canker <i>(Nectria spp.)</i> p. 176	Random dieback of branches and limbs; usually associated with sunken cankers that are often covered with distinctive coral-colored or orange fruiting structures of the fungus; problematic on trees weakened by other factors such as winter or drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding; • maintain tree vigor; 	No chemical control is suggested.

Malus (Apple, Crabapple) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Powdery Mildew (<i>Podosphaera</i>) p. 8	White to grayish, powdery growth on leaves, usually first evident on the upper leaf surfaces; typically develops fairly late in the season; however, when infection occurs early in the season when tissues are young, some distortion and twisting of leaves and tips can occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation around the tree; • resistance has been reported (e.g., <i>Malus</i> 'Adams'; <i>M. baccata</i>, 'Bob White,' 'Donald Wyman'); • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary according to label directions; • select the appropriate fungicide if harvesting fruit for consumption; 	chlorothalonil chlorothalonil + fenarimol copper sulphate pentahydrate fenarimol *harpin protein mancozeb + copper hydroxide mancozeb + myclobutanil mancozeb + thiophanate methyl myclobutanil *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon trifloxystrobin

Malus (Apple, Crabapple) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Rusts (<i>Gymnosporangium</i> spp.) p. 262	<p>Since several rust species attack this host, symptoms can vary; the most common rusts in the landscape are cedar-apple (<i>G. juniperi-virginianae</i>), cedar-hawthorn (<i>G. globosum</i>), and quince (<i>G. clavipes</i>); distinctive yellowish-orange spots first appear on upper leaf surfaces in late May or June; as the fungus develops in the leaf, spots become noticeable on the undersurfaces; on close examination and depending on which species of fungus is responsible, rings of small, cup-like structures or long, tendrils of the fungus are visible; heavily infected leaves become chlorotic and often drop prematurely by mid-July; these rust fungi require other hosts (<i>Juniperus</i> spp.) in order to complete their life cycles; refer to fact sheet for more detailed information;</p>	<ul style="list-style-type: none"> • for specimen trees, eliminate the alternate hosts (any red cedar or juniper species) within a one-mile radius, if possible; • resistant species are available (e.g., <i>M. baccata</i> 'Ellwangerina'; <i>M. floribunda</i> 'Henry Kohankie,' 'Ormiston Roy,' 'Red Baron'); a more extensive list is available upon request; • fungicide sprays can be applied when new growth is emerging in spring; this is usually when the gelatinous, orange telial horns are visible on the junipers (usually mid-May); sprays are repeated as necessary at label intervals; • select the appropriate fungicide if harvesting fruit for consumption; 	azoxystrobin chlorothalonil chlorothalonil + fenarimol copper salts of fatty and rosin acids fenarimol ferbam flutolanil mancozeb mancozeb + myclobutanil mancozeb + thiophanate methyl myclobutanil propiconazole *QST 713 strain of <i>Bacillus subtilis</i> *sulfur thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon trifloxystrobin

Malus (Apple, Crabapple) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Scab (<i>Venturia inaequalis</i>) p. 86	Symptoms appear as distinctive circular, olive-black, velvety spots with feathery, diffuse margins; they can develop on leaves, fruit, and young fruit stems; leaf lesions often first appear along the midvein but can develop anywhere on the leaf; heavily infected leaves yellow prematurely and highly symptomatic trees defoliate by midsummer; lesions on infected fruit can crack as the fruit expand; when infection is heavy, fruit can drop prematurely; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune dead twigs and branches; • maintain vigor since repeated defoliation weakens trees; • resistant cultivars are available (e.g., <i>M. baccata</i> 'Cotton Candy,' 'Dolgo,' 'Donald Wyman'; <i>M. sargentii</i> 'Tina,' 'Sentinel'); • for ornamental trees, chemical control is usually not necessary except for new transplants, young or specimen trees, or when defoliation has been heavy for several years; fungicide sprays can be applied at budbreak and repeated 2-4 times at label intervals; early-season sprays are very important; • for trees grown for fruit production, susceptible varieties usually require a season-long fungicide program in order to harvest quality fruit; select the appropriate fungicide if harvesting fruit for consumption; 	azoxystrobin chlorothalonil chlorothalonil + fenarimol copper salts of fatty and rosin acids copper sulphate pentahydrate fenarimol ferbam *harpin protein mancozeb mancozeb + myclobutanil mancozeb + thiophanate methyl myclobutanil propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil trifloxystrobin

***Metasequoia* (Dawn Redwood)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Canker <i>(Botryosphaeria)</i> p. 120	Random dieback of branches and limbs; usually associated with sunken cankers in which black fruiting structures of the fungus may be visible; problematic on trees weakened by stress factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding and other unnecessary stresses, esp. drought stress; • maintain tree vigor; 	No chemical control is suggested.

Morus (Mulberry)

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Canker <i>(Botryosphaeria)</i> p. 120	Symptoms include progressive dieback of twigs and branches, usually first evident on lower limbs and proceeding up the tree; cankers appear as sunken areas of bark on branches or the main trunk;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs and branches as soon as evident; • cuts should be made below visible symptoms when bark is dry; • maintain vigor since drought-stressed or winter-injured trees are more vulnerable; • avoid mechanical injuries; • maintain vigor; 	No chemical control is suggested.
Fungal Leaf Spots <i>(Cercospora, Cercospora, Mycosphaerella)</i> p. 20	Spots can appear as small, brown to black spots; they can be circular or irregular in shape; spots may coalesce to form large blotches; some early leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation around the tree; • maintain tree vigor; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied when new growth emerges and repeated as necessary according to label directions; 	*copper hydroxide copper salts of fatty and rosin acids *harpin protein mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil
Powdery Mildew <i>(Erysiphe)</i> p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some pre-mature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	*harpin protein mancozeb + copper hydroxide *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil

Nyssa (Black Gum, Tupelo)

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Canker <i>(Botryosphaeria, Nectria)</i> p. 120, 176	Symptoms include progressive dieback of twigs and branches, usually first evident on lower limbs and proceeding up the tree; cankers appear as sunken areas of bark on branches or the main trunk;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs and branches as soon as evident; • cuts should be made below visible symptoms when bark is dry; • maintain vigor since drought-stressed or winter-injured trees are more vulnerable; • avoid mechanical injuries; • maintain vigor; 	No chemical control is suggested.

***Ostrya* (Hop-hornbeam, Ironwood)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Armillaria Root Rot <i>(Armillaria spp. complex)</i> p. 326	Also called shoestring root rot and honey mushroom rot; this disease is difficult to identify since aboveground symptoms appear as general and progressive decline that leads to the eventual death of trees; trees can die singly or in groups; trees under environmental or site-related stresses are particularly susceptible; diagnostic signs of the infection include black strands of the fungus called rhizomorphs (shoestrings) on the surface of the bark or at the base of infected trees, white fans of fungal growth with “mushroomy” odors under the bark, and the occasional growth of honey mushrooms at the base of infected trees in autumn; narrow, black lines are often evident in infected wood; the fungus can persist in stumps and large, woody roots for as long as 30 years;	<ul style="list-style-type: none"> • maintain tree vigor; • avoid any unnecessary stresses, esp. drought stress; • avoid planting susceptible trees in a site where this disease has been confirmed; • if replanting in the site, the stump and all woody roots greater than ½ inch in diameter should be removed; 	No chemical control is suggested.
Canker <i>(Nectria, Neonectria)</i> p. 176, 182	Random dieback of branches and limbs; usually associated with sunken cankers that are often covered with distinctive coral-colored or reddish-orange fruiting structures of the fungus; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding; • maintain tree vigor; 	No chemical control is suggested.

***Ostrya* (Hop-hornbeam, Ironwood) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Powdery Mildew <i>(Erysiphe)</i> p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	<ul style="list-style-type: none"> *harpin protein *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil

***Oxydendrum* (Sorrel-tree, Sourwood)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Botryosphaeria Canker <i>(Botryosphaeria)</i> p. 120	Symptoms include progressive dieback of twigs and branches, usually first evident on lower limbs and proceeding up the tree; cankers appear as sunken areas of bark on branches or the main trunk;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs and branches as soon as evident; • cuts should be made below visible symptoms when bark is dry; • maintain vigor since drought-stressed or winter-injured trees are more vulnerable; • avoid mechanical injuries; • maintain vigor; 	No chemical control is suggested.
Nectria Canker <i>(Neonectria galligena)</i> p. 182	Random dieback of branches and limbs; usually associated with sunken or target cankers that are often covered with distinctive reddish-orange fruiting structures of the fungus; cankers are often centered on branch stubs or poor pruning cuts; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding and other stresses such as drought stress; • maintain tree vigor; 	No chemical control is suggested.

***Paulownia* (Empress Tree)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Botryosphaeria Canker <i>(Botryosphaeria)</i> p. 120	Symptoms include progressive dieback of twigs and branches, usually first evident on lower limbs and proceeding up the tree; cankers appear as sunken areas of bark on branches or the main trunk;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs and branches as soon as evident; • cuts should be made below visible symptoms when bark is dry; • maintain vigor since drought-stressed or winter-injured trees are more vulnerable; • avoid mechanical injuries; • maintain vigor; 	No chemical control is suggested.

***Picea* (Spruce)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Armillaria Root Rot <i>(Armillaria spp. complex)</i> p. 326	Also called shoestring root rot and honey mushroom rot; this disease is difficult to identify since aboveground symptoms appear as general and progressive decline that leads to the eventual death of trees; trees can die singly or in groups; trees under environmental or site-related stresses are particularly susceptible; on conifers, excessive resin production at points of infections or at the bases of trees can be important symptoms of infection; the diagnostic black strands of the fungus called rhizomorphs (shoestrings) are usually not present on conifers; signs of the infection include white fans of fungal growth with “mushroomy” odors under the bark and the occasional growth of honey mushrooms at the base of infected trees in autumn; the fungus can persist in stumps and large, woody roots for as long as 30 years;	<ul style="list-style-type: none"> • maintain tree vigor; • avoid any unnecessary stresses, esp. drought stress; • avoid planting susceptible trees in a site where this disease has been confirmed; • if replanting in the site, the stump and all woody roots greater than ½ inch in diameter should be removed; 	No chemical control is suggested.

***Picea* (Spruce) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Botrytis Blight <i>(Botrytis cinerea)</i> p. 72	Affected tissues initially appear water-soaked and then turn brown; infections are identified by the gray, fuzzy, cottony growth of the fungus on the surface of needles and shoots; the fungus moves from the needles to the shoots and into the stems; with the exception of weak trees, infections usually do not extend beyond the tips or current season's growth and are often confined to tissues that have been damaged by frost; most symptomatic tissues drop off during the season;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs; • maintain vigor; • attention to planting site to avoid potential frost pockets; 	No chemical control is suggested.
Cytospora Canker <i>(Leucostoma)</i> p. 168	Symptoms include progressive dieback of twigs and branches, usually first evident on lower limbs and proceeding up the tree; cankers appear as sunken areas of bark on branches or the main trunk but are often very difficult to see because of the nature of the spruce bark; however, heavy amounts of white resin are usually associated with the cankers and can help to identify cankered areas; resin can be so excessive that it drips onto foliage and lower branches; needle drop may occur on infected, girdled branches; Colorado and Norway spruce are particularly susceptible;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs and branches as soon as evident; • cuts should be made at least 8-10 inches below visible symptoms when bark is dry; • maintain vigor since drought-stressed or winter-injured trees are more vulnerable; • take care in selecting planting site; • avoid mechanical injuries; 	No chemical control is suggested.

***Picea* (Spruce) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Phytophthora Root Rot <i>(Phytophthora spp.)</i> p. 354	Infected trees generally exhibit poor vigor; needles appear dull olive-green and eventually turn reddish-brown but usually remain attached to branches; branches and twigs die back; symptoms may be confined to individual branches or may develop progressively until the entire tree is involved; excessive resin is sometimes visible on the outer bark at the base of the tree; a diagnostic cinnamon-brown discoloration may be evident on the inner bark and cambium at the root/crown area; frequently more serious on trees growing in sites where excess water is a persistent problem (e.g., clay soils, low areas);	<ul style="list-style-type: none"> • once infected, trees cannot be cured; • rogue and remove symptomatic trees and improve drainage; • avoid excessive irrigation and maintain vigor; • healthy, uninfected trees adjacent to symptomatic trees can be protected with fungicides applied according to label directions; 	fosetyl-Al *harpin protein mefenoxam mono- and di-potassium salts of phosphorous acid phosphorous acid *QST 713 strain of <i>Bacillus subtilis</i>

**Rhizosphaera
Needlecast**
(*Rhizosphaera*)
p. 56

Needles on lower branches are usually attacked first and the symptoms gradually progress up the tree; diagnostic symptoms may develop in September but typically don't appear until spring; infected needles turn a distinctive lavender or purplish-brown; upon close inspection with a hand lens, rows of fuzzy, black spots appear in place of the rows of white stomates on the needles; significant needle drop usually occurs and defoliated twigs and branches eventually die; drought-stressed trees are most susceptible; blue spruce is most susceptible, white spruce is intermediate, and Norway spruce is relatively resistant; refer to fact sheet for more detailed information;

- prune and remove infected twigs and branches;
- maintain vigor since drought-stressed trees are highly susceptible;
- control weeds at base to optimize air circulation;
- fungicide sprays can be applied when new growth is approx. 1½ inches long and repeated as necessary at label intervals;

chlorothalonil
chlorothalonil +
fenarimol
*copper hydroxide
copper salts of fatty
and rosin acids
ferbam
*harpin protein
mancozeb
*QST 713 strain of
Bacillus subtilis
thiophanate methyl
+ chlorothalonil

***Picea* (Spruce) cont'd**

Disease
(*Pathogen/Cause*)

Diagnostic Symptoms

Management

Materials

Rusts

(*Chrysomyxa weirii*
and *Chrysomyxa* spp.)
p. 288

Although at least ten different rust fungi have been reported on spruce, the most common rust in the landscape in Connecticut is caused by *Chrysomyxa weirii*; the disease caused by this fungus is also called repeating spruce rust or Weir's spruce cushion rust; this rust is autoecious and does not require other hosts to complete its life cycle; most of the other *Chrysomyxa* rusts are heteroecious and require alternate hosts to complete their life cycles; symptoms of rust infections first appear as yellow spots or flecks on needles; these break open to reveal yellow or orange, powdery spores; symptoms of repeating needle rust develop in late winter or early spring whereas symptoms of the heteroecious rusts develop in mid- to late summer; this timing is helpful in determining the type of rust; infected trees are rarely killed but the primary damage is extensive needle discoloration and drop; blue spruce is highly susceptible to repeating spruce rust; black, Englemann red, and Sitka are also susceptible to this rust; Norway and Black Hills spruce are fairly resistant to the heteroecious rusts; refer to fact sheet for more detailed information;

- maintain vigor;
- fungicide sprays are only effective for the autoecious rust (repeating needle rust); spraying begins when the new growth emerges in spring and is repeated as necessary at label intervals;

chlorothalonil
*harpin protein
mancozeb
*QST 713 strain of
Bacillus subtilis

***Picea* (Spruce) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Sirococcus Blight <i>(Sirococcus)</i> p. 118	Symptoms first appear on succulent shoots and 1-year-old twigs; the fungus attacks at needle bases, girdles the shoot, and results in tip dieback; affected tips turn brown, drop needles, and often develop a characteristic crook or droop; pinpoint, brown fruiting structures may be visible along the stems of dead shoots; affected shoots can develop at random in the tree; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove infected shoots when bark is dry; • rogue and remove heavily infected trees; • maintain vigor; • fungicide sprays can be applied when new growth is ½ inch long and repeated as necessary at label intervals; 	azoxystrobin *harpin protein *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl + chlorothalonil

***Pieris* (Japanese Andromeda, Pieris)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Canker and Dieback <i>(Botryosphaeria)</i> p. 120	Twigs and branch tips wilt and die back; may be first confined to individual limbs but can encompass the entire shrub; leaves usually droop and turn brown yet remain attached to the stem; discolored, reddish-brown cankers appear as flattened areas on killed stems or branches;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs or branches back to healthy wood when bark is dry; • avoid wounds and drought stress since the fungus is more aggressive on plants that have been predisposed by drought or winter injuries; 	No chemical control is suggested.
Fungal Leaf Spots <i>(Alternaria, Phyllosticta)</i> p. 42	Circular, brown spots develop on leaves during wet weather; some leaf drop may occur when infection is heavy; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation and avoid overhead watering; • spraying is usually not necessary since the disease has no significant impact on plant health; on specimen plants, fungicides can be applied when new growth emerges and repeated as necessary according to label directions; 	azoxystrobin chlorothalonil chlorothalonil + fenarimol *copper hydroxide *harpin protein iprodione mancozeb *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil

***Pieris* (Japanese Andromeda, Pieris) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Phytophthora Root Rot <i>(Phytophthora spp.)</i> p. 354	Infected plants generally exhibit poor vigor; needles appear dull olive-green and eventually turn reddish-brown but usually remain attached to branches; branches and twigs die back; symptoms may be confined to individual branches or may develop progressively until the entire plant is involved; a diagnostic cinnamon-brown discoloration may be evident on the inner bark and cambium at the root/crown area; frequently more serious on shrubs where excess water is a persistent problem (e.g., clay soils, low areas);	<ul style="list-style-type: none"> • once infected, plants cannot be cured; • rogue and remove symptomatic plants and improve drainage; • avoid excessive irrigation and maintain vigor; • fungicides are not curative; healthy, uninfected plants adjacent to symptomatic plants can be protected with fungicides applied according to label directions; 	fosetyl-Al *harpin protein mefenoxam mono- and di-potassium salts of phosphorous acid phosphorous acid *QST 713 strain of <i>Bacillus subtilis</i>
Tip Dieback and Blight <i>(Phytophthora spp.)</i> p. 354	Leaves and terminal buds begin to discolor; leaves turn brown and droop; a diagnostic V-shaped, water-soaked discoloration may be evident on the leaves, usually beginning at the point of petiole attachment to the leaf lamina; browning of the petiole often continues as the fungus-like organism moves into the twig; girdling cankers may form on twigs and branches and result in dieback;	<ul style="list-style-type: none"> • prune and remove affected tips well below obvious symptoms; • avoid excessive vigor; • avoid overhead irrigation; • fungicide sprays can be applied according to label directions when new shoots are growing; 	chlorothalonil chlorothalonil + fenarimol *copper hydroxide fosetyl-Al *harpin protein mancozeb mefenoxam *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl + chlorothalonil

***Pinus* (Pine)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Armillaria Root Rot <i>(Armillaria spp. complex)</i> p. 326	Also called shoestring root rot and honey mushroom rot; this disease is difficult to identify since aboveground symptoms appear as general and progressive decline that leads to the eventual death of trees; trees can die singly or in groups; trees under environmental or site-related stresses are particularly susceptible; on conifers, excessive resin production at points of infections or at the bases of trees can be important symptoms of infection; the diagnostic black strands of the fungus called rhizomorphs (shoestrings) are usually not present on conifers; signs of the infection include white fans of fungal growth with “mushroomy” odors under the bark and the occasional growth of honey mushrooms at the base of infected trees in autumn; the fungus can persist in stumps and large, woody roots for as long as 30 years; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • maintain tree vigor; • avoid any unnecessary stresses, esp. drought stress; • avoid planting susceptible trees in a site where this disease has been confirmed; • if replanting in the site, the stump and all woody roots greater than ½ inch in diameter should be removed; 	No chemical control is suggested.

***Pinus* (Pine) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Brown Spot Needle Blight <i>(Mycosphaerella)</i> p. 26	Symptoms appear as reddish-brown, resin-soaked spots on needles in summer; affected needles turn yellow and eventually turn brown from the tips back; black fruiting structures of the fungus can be seen in infected spots during the fall; infected needles usually drop in fall; Austrian, Japanese black, Scots, mugo, and Italian stone pine are particularly susceptible; easily confused with other needlecasts;	<ul style="list-style-type: none"> • rake and remove fallen needles; • provide adequate spacing for good air circulation; • maintain vigor; • fungicide sprays can be applied when new growth emerges in spring and repeated as necessary according to label directions; 	chlorothalonil chlorothalonil + fenarimol *copper hydroxide copper salts of fatty and rosin acids *copper sulfate *harpin protein mancozeb mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil

***Pinus* (Pine) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Canavirgella Needlecast <i>(Canavirgella banfieldii)</i> p. 50	This new disease of white pine for Connecticut was first identified in 1998; infected trees appear distinctly reddish-brown in late July and early August; symptoms are usually confined to current-season needles; tips of infected needles initially appear yellowish-tan and develop a distinct reddish-brown color by late August; infected needles curl and fade to tan or gray the following spring; diagnostic characteristics are: not all needles within a fascicle are infected and individual needles within a fascicle usually exhibit differing amounts of symptomatic tissue; frequently confused with acute ozone injury and other needlecast diseases; laboratory examination is usually required for definitive identification; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rogue and remove heavily infected trees; • provide adequate spacing for good air circulation; • maintain vigor; 	No chemical control is suggested.

***Pinus* (Pine) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Cenangium Blight <i>(Cenangium)</i> p. 210	Random, "flagged" branches are early indicators of disease; symptoms include twig blight, branch dieback, and thinning of the canopy; trees can be significantly disfigured; outbreaks are often associated with severe winter weather, especially when it follows a mild autumn; brown needles drop prematurely, right after branches are killed; diagnostic symptoms include a sharp delineation between brown, dead cambium and inner bark and healthy tissues; yellowish-tan to brown, blister-like clusters of fruiting structures of the fungus are sometimes seen erupting from dead branches;	<ul style="list-style-type: none"> • maintain vigor; • prune and remove infected limbs as soon as symptoms appear; • cuts should be made several inches below visible symptoms when the bark is dry; • avoid unnecessary stress; 	No chemical control is suggested.
Cyclaneusma Needlecast <i>(Cyclaneusma)</i> p. 54	Symptoms first appear as yellowish-green spots that gradually enlarge into bands until entire needles appear yellow; diagnostic symptoms include drop of straw-colored, second-year needles in autumn; distinct brown bands appear on infected needles of Scots pine; under conditions of high moisture, longitudinal, elliptical splits with creamy-tan fruiting structures of the fungus develop in the epidermis; heavily infected trees have only current-season needles; needles of all ages are susceptible; Austrian and mugo pines are particularly susceptible; easily confused with other needlecasts;	<ul style="list-style-type: none"> • rogue and remove heavily infected trees; • provide adequate spacing for good air circulation; • maintain vigor; • fungicide sprays can be applied when there is approx. 1½ inches of new growth and repeated in mid-May, mid-June, mid-August, and mid-October; 	chlorothalonil chlorothalonil + fenarimol *copper hydroxide *harpin protein mancozeb mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil

***Pinus* (Pine) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Diplodia Blight [Sphaeropsis Tip Blight] <i>(Diplodia pinea)</i> p. 130	Tip blight results from infection of newly emerging buds and shoots; infected buds or shoots usually stop growing before or during needle elongation and needles are frequently stunted and short; infected tissues are straw-colored and have excessive resin flow; usually kills only current-season buds and shoots and second-year cones, but can cause significant dieback on stressed trees; black fruiting structures of the fungus may be visible at the base of needles and on cones; symptoms may be distributed uniformly throughout the canopy or concentrated in lower branches; drought-stressed trees are particularly susceptible; many pines are susceptible but two- and three-needled pines (e.g., Austrian and black pine) are highly susceptible; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove blighted twigs, branches, and cones during dry weather in autumn; • maintain tree vigor; special attention should be given to watering during periods of drought; • fungicide sprays can be applied at budbreak and repeated 2-3 times at label intervals; 	*copper hydroxide copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon

***Pinus* (Pine) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Dothistroma Needle Blight [Red Banded Needle Blight] <i>(Dothistroma)</i> p. 28	Water-soaked spots or bands that turn yellow to reddish-brown appear on needles anytime from spring to fall; sharp lines mark the transition from green to discolored tissues; some swelling may occur in symptomatic bands on the needles; when the reddish-brown bands encircle the needles, the tips of the needles die but needle bases usually remain green; small, black fruiting bodies of the fungus break through the epidermis in symptomatic regions of the needles; diseased needles drop prematurely; Austrian, mugo, and Scots pines are particularly susceptible; easily confused with other needlecasts;	<ul style="list-style-type: none"> • rake and remove fallen needles as much as practical; • maintain vigor and provide adequate spacing for good air circulation; • fungicide sprays can be applied when new growth first appears and repeated for several applications at label intervals; 	chlorothalonil chlorothalonil + fenarimol *copper hydroxide copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i>
Lophodermium Needlecast <i>(Lophodermium)</i> p. 54	Infection is evident as needles first turn reddish-brown and eventually straw-colored by July; during the following winter, infected needles brown and drop; diagnostic, football-shaped fruiting structures of the fungus may be visible with a hand lens in the browned needles; two- and three-needled pines are most susceptible (e.g., Austrian, Scots, red); easily confused with other needlecasts;	<ul style="list-style-type: none"> • rogue and remove heavily infected trees; • provide adequate spacing for good air circulation; • maintain vigor; • fungicide sprays can be applied from July until October at label intervals; 	chlorothalonil chlorothalonil + fenarimol *copper hydroxide ferbam *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil

***Pinus* (Pine) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Phytophthora Root Rot <i>(Phytophthora spp.)</i> p. 354	Infected trees generally exhibit poor vigor; needles appear dull olive-green and eventually turn brown but usually remain attached to branches; branches and twigs die back; symptoms may be confined to individual branches or may develop progressively until the entire tree is involved; excessive resin is sometimes visible on the bark at the base of the tree; a diagnostic cinnamon-brown discoloration may be evident on the inner bark and cambium at the root/crown area; frequently more serious on trees in sites where excess water is a persistent problem (e.g., clay soils, low areas);	<ul style="list-style-type: none"> • once infected, trees cannot be cured; • rogue and remove symptomatic trees and improve drainage; • avoid excessive irrigation and maintain vigor; • healthy, uninfected trees adjacent to symptomatic trees can be protected with fungicides applied according to label directions; 	fosetyl-AI *harpin protein mefenoxam mono- and di-potassium salts of phosphorous acid phosphorous acid *QST 713 strain of <i>Bacillus subtilis</i>
Pine-Pine Gall Rust <i>(Endocronartium harknessii)</i> p. 304	This autoecious rust fungus infects many two- and three-needled pines (e.g., Scots pine is highly susceptible); fairly high incidences of this disease have been observed in recent years; symptoms include globose or pear-shaped, woody galls on branches and occasionally on the main stem; galls are perennial and enlarge from year to year, eventually causing the branches to die; severely infected, established trees can be disfigured; fruiting structures of the fungus break through the surface of existing galls and yellowish-orange spores are carried by wind and splashing rain to tender, elongating shoots;	<ul style="list-style-type: none"> • maintain vigor; • prune and remove infected branches back to healthy wood when bark is dry; • rogue and remove heavily infected trees to reduce the inoculum; 	No chemical control is suggested.

***Pinus* (Pine) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Pine Wood Nematode <i>(Bursaphelenchus)</i> p. 436	Early symptoms are inconspicuous and include arrested or slowed growth and off-colored needles; trees commonly die abruptly in mid- to late summer; needles usually remain attached to the dead branches; the nematode is transmitted by wood-boring beetles (<i>Monochamus</i> sp.); possibly a complex involving as yet unidentified factors; trees under site-related and environmental stresses are more susceptible; branch or trunk "cookies" are necessary for identification;	<ul style="list-style-type: none"> • maintain vigor; • remove and destroy symptomatic trees; 	No chemical control is suggested.
Pitch Canker <i>(Fusarium)</i> p. 188	Infected tissues have excessive resin flow associated with sunken, discolored lesions that girdle twigs, small branches, and trunks; diseased bark appears dark-red and the wood underneath is also discolored; shoot and branch dieback are usually most obvious from late autumn to early spring; needles may be glued together from excessive resin; wounds from insect activities, weather (hail, high winds), and mechanical injuries (poor pruning) are important for infection;	<ul style="list-style-type: none"> • maintain vigor; • prune and remove infected limbs as soon as symptoms appear; • cuts should be made several inches below visible symptoms; • avoid unnecessary wounding by careful cultural practices and insect control; 	No chemical control is suggested.

***Pinus* (Pine) cont'd**

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Ploioderma Needlecast (<i>Ploioderma</i>) p. 48	Reddish-brown spots develop on 1-year-old needles during the late winter and early spring following summer infection; initial symptoms appear as yellow spots and bands that gradually turn brown; by late spring these bands appear straw-colored and, in some cases, the base of the needle remains green; fruiting structures of the fungus appear as black splits in the epidermis; whole needles may drop prematurely or symptomatic tips will break off leaving part of the needle attached to the tree; easily confused with other needlecasts;	<ul style="list-style-type: none"> • space trees to allow for good air circulation; • rake and remove fallen needles; • maintain tree vigor; • fungicide sprays can be applied when shoots are ½ -1 inch long and repeated at label intervals; 	<p>chlorothalonil *copper hydroxide *harpin protein mancozeb mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i></p>
Procerum Root Disease (<i>Leptographium</i>) p. 228	Also known as white pine root decline; this fungus infects the inner bark and sapwood of the roots and lower trunk of white pine; although most serious on white pine, it can also kill Scots and Austrian pines; in spring, trees that have been infected for several years show delayed budbreak and reduced candle elongation; mature foliage then fades, droops, and turns brown; mortality appears to be at random with a few trees dying each year; resin flow is visible at the tree base and is associated with a girdling, chocolate brown to dark olive-brown canker under the bark; weevils and other bark-infesting insects may serve as vectors for this disease;	<ul style="list-style-type: none"> • avoid planting eastern white pine on wet sites; trees planted on wet sites seem to be more susceptible to the fungus; excessively dry sites also seem to predispose trees to attack; • remove and destroy infected trees including stumps, if possible; • do not replant eastern white pine among the stumps of recently killed trees; • if trees need to be replaced, do not plant a pine-- use arborvitae or spruce; 	No chemical control is suggested.

***Pinus* (Pine) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Sirococcus Tip Blight <i>(Sirococcus)</i> p. 118	Symptoms first appear on succulent shoots and 1-year-old twigs; the fungus attacks at needle bases, girdles the shoot, and results in tip dieback; affected tips turn brown, drop needles, and often develop a characteristic crook or droop; pinpoint, brown fruiting structures may be visible along the stems of dead shoots; affected tips can appear at random in the canopy; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove infected shoots when bark is dry; • rogue and remove heavily infected trees; • maintain vigor; • Austrian and white pine are less susceptible than other species; • fungicide sprays can be applied when needles are ½ inch long and repeated 2-4 times at label intervals until needles are fully expanded; 	azoxystrobin chlorothalonil chlorothalonil + fenarimol *harpin protein mancozeb mancozeb + copper hydroxide propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl triadimefon
White Pine Blister Rust <i>(Cronartium ribicola)</i> p. 292	This historically important disease is still endemic in many parts of Connecticut; the fungus requires alternate hosts (<i>Ribes</i> spp., currants and gooseberries) in order to complete its life cycle; symptoms on pine include general thinning, dieback, and decline in the canopy associated with girdling cankers; cankers appear sunken and discolored and are often covered with resin; at certain times of the year, pustules or blisters develop in the cankers and break open to reveal powdery, yellow spores; cankers that girdle the main trunk result in tree death;	<ul style="list-style-type: none"> • eradicate alternate hosts (e.g., gooseberries, wild currants) within 500 feet; • scout for branch cankers and prune any visible cankers at least 4-6 inches below visible symptoms when bark is dry; • young cankers on the main trunk can sometimes be successfully removed by cutting out the canker and 2-4 inches of bark around the visible canker; • maintain vigor; 	No chemical control is suggested.

***Pinus* (Pine) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Winter Injury/Drying <i>(Abiotic)</i> p. 432	Symptoms include tipburn, chlorotic mottling or uniform yellowing of needles, and tip or branch dieback; damage often appears on one side of the tree or only on one branch, usually the side facing prevailing winds; one-third to one-half of each needle is often browned; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • maintain vigor; • trees, especially new transplants, benefit from a deep soaking prior to the ground freezing; 	No chemical control is suggested.

***Platanus* (London Plane, Sycamore)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Anthracnose <i>(Apiognomonina)</i> p. 102	Large, brown patches develop along veins or at leaf margins as the leaves expand in spring; this often results in extensive tattering and distortion; severely infected leaves drop and refoiation usually occurs; tender shoots are often infected and die; blighting of shoots, dieback, cankers, and deformity of branches may also occur as the fungus infects young shoots and twigs; repeated defoliation significantly weakens trees as evidenced by loss of vigor, dieback, and thinning of the canopy, and increased susceptibility to winter injury and insects (e.g., borers); most severe during cool, wet springs; sycamore is more susceptible than London and Oriental planes; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune and remove infected limbs or tips when possible; • maintain vigor; • select resistant cultivars of London plane (e.g., 'Bloodgood,' 'Columbia,' 'Liberty'); • fungicide sprays usually aren't necessary or practical but can be applied at budbreak and repeated at label intervals until leaves are fully expanded; 	carbendazim chlorothalonil chlorothalonil + fenarimol *copper hydroxide copper salts of fatty and rosin acids *copper sulfate copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + thiophanate methyl propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiabendazole thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil

***Platanus* (London Plane, Sycamore) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Canker and Dieback <i>(Botryosphaeria)</i> p. 120	Twigs and branch tips wilt and die back; may be first confined to individual limbs but can encompass the entire shrub; leaves usually droop and turn brown yet remain attached to the stem; discolored, brown cankers appear as flattened areas on killed stems or branches; symptoms are often confused with those of anthracnose;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs or branches back to healthy wood when bark is dry; • avoid wounds and drought stress since the fungus is more aggressive on plants that have been weakened by drought or winter injuries; 	No chemical control is suggested.
Canker Stain <i>(Ceratocystis)</i> p. 234	Although considered to be the most important disease of London plane, very few samples have been diagnosed in recent years; symptoms appear as elongated, brown or black discolorations that develop on the bark of branches or trunks; these develop into flattened cankers; numerous cankers can be found on an individual branch or trunk and can coalesce and girdle the affected tissues; infected phloem and cambium appear black and the wood underneath is stained bluish-black; old cankers crack to reveal the discoloration; when the trunk is girdled, trees decline and die;	<ul style="list-style-type: none"> • avoid wounding; • all pruning equipment should be clean and routinely disinfested during use; • rogue and remove heavily infected trees; 	No chemical control is suggested.

***Platanus* (London Plane, Sycamore) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Leaf Spots <i>(Mycosphaerella, Phyllosticta)</i> p. 22	Irregular to circular spots develop on leaves in mid- to late summer; lesions are dark-brown and have indefinite margins; heavily infected leaves yellow and drop prematurely; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • spraying is usually not necessary since the disease has no significant impact on tree health; however, on specimen or newly transplanted trees, fungicides can be applied as new growth emerges in spring and repeated as necessary according to label directions; 	chlorothalonil copper salts of fatty and rosin acids *harpin protein mancozeb mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil
Powdery Mildew <i>(Erysiphe)</i> p. 8	Heavy coating of whitish-gray, powdery growth usually on upper surfaces of leaves; some distortion of leaves and young shoots may occur if infection is early in the season; London plane trees are particularly susceptible; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	*harpin protein mancozeb + copper hydroxide myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> *sulfur thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon

Populus (Cottonwood, Poplar)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Canker (<i>Cryptodiaporthe</i>) p. 154	Early symptoms aren't very obvious and include dieback of scattered twigs associated with cankers; elongate, dark, sunken cankers can form on the bark of twigs, branches, or the main trunk; the bark and cambium are killed and the sapwood is discolored; extensive dieback occurs when cankers girdle twigs or branches; trees under environmental and site-related stresses are most susceptible; Lombardy poplar is highly susceptible;	<ul style="list-style-type: none"> • prune and remove infected limbs when bark is dry; • rogue and remove heavily infected trees; • maintain vigor since weakened trees are highly susceptible; 	No chemical control is suggested.
Fungal Leaf Spots (<i>Marssonina</i>) p. 82	Brown spots or blotches develop on leaves and pustules or eruptions develop on petioles; in wet weather, infections can be heavy enough to cause extensive defoliation by early August; if this occurs, trees often regrow but the new growth is not winter-hardy and dies back by the following spring; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • fungicide sprays can be applied when new growth emerges in spring and repeated at label intervals until fully mature; • maintain vigor; 	azoxystrobin chlorothalonil chlorothalonil + fenarimol *harpin protein mancozeb mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil

Populus (Cottonwood, Poplar) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Leaf Blister (<i>Taphrina</i>) p. 4	Irregular, chlorotic blisters develop on upper leaf surfaces during late spring or summer; a yellow "bloom" is often visible on the undersurface of the blister;	<ul style="list-style-type: none"> • maintain vigor; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen or newly transplanted trees, fungicide sprays can be applied before buds begin to swell in spring; 	chlorothalonil + fenarimol *harpin protein mancozeb *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl + chlorothalonil
Powdery Mildew (<i>Erysiphe</i>) p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	copper sulphate pentahydrate *harpin protein mancozeb + thiophanate methyl propiconazole *QST 713 strain of <i>Bacillus subtilis</i> *sulfur thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon

Populus (Cottonwood, Poplar) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Rust (<i>Melampsora</i> spp.) p. 284	Several species of fungi cause rust symptoms on poplar; small, bright yellow or orange pustules or blisters develop on upper or lower surfaces of leaves in late spring or summer; angular, chlorotic areas can also develop on the surface opposite the pustule; heavy infections result in premature leaf drop; these fungi overwinter on fallen poplar leaves; several of the alternate hosts of these fungi are Douglas-fir, pine, and larch; in spring, spores develop on fallen poplar leaves and infect emerging conifer needles; yellow pustules develop on these needles and spores produced on these infected needles infect tender poplar leaves;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as new growth emerges in spring and repeated as necessary according to label directions; 	*harpin protein mancozeb mancozeb + copper hydroxide myclobutanil propiconazole *QST 713 strain of <i>Bacillus subtilis</i> triadimefon

***Prunus* (Cherry, Flowering Cherry, Peach, Plum)**

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Bacterial Canker (<i>Pseudomonas syringae</i> pv. <i>syringae</i>) p. 368	Infected buds fail to open in spring; small, greasy-looking spots develop on newly emerged leaves and symptomatic leaves often turn brown; shoots appear blackened and cankers develop on branches or the main trunk; leaves on cankered branches wilt; under optimum conditions, cankers ooze; infected trees decline and die; particularly problematic on weakened trees;	<ul style="list-style-type: none"> • prune and remove infected twigs 8-10 inches below visible symptoms; • disinfest tools between cuts; • maintain vigor but avoid excessive fertilization; • preventative sprays can be applied before and during shoot expansion and repeated as necessary; select the appropriate fungicide if harvesting fruit for consumption; 	*copper hydroxide copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein *QST 713 strain of <i>Bacillus subtilis</i>
Black Knot (<i>Apiosporina morbosa</i>) p. 152	Distinctive, dark-brown to black charcoal-like swellings or knots develop on twigs or branches; they first appear as green swellings but gradually develop their diagnostic character; knots continue to enlarge from year to year and often become quite rough in appearance; significant dieback of branches and twigs can occur; girdling knots on the main trunk kill trees; in late spring, knots are covered with pinkish-white spores of the fungus; most <i>Prunus</i> species have some level of susceptibility, but cherries and plums are highly susceptible; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove symptomatic tissues 6-8 inches below visible knots; • severely infected trees should be removed; • any unwanted <i>Prunus</i> species (e.g., wild plum, wild black cherry, chokecherry) in nearby woodlots should be removed to reduce inoculum (trees within 600 feet); • fungicide sprays can be applied when new growth emerges in spring and repeated at label intervals until fully mature; select the appropriate fungicide if harvesting fruit for consumption; 	chlorothalonil *harpin protein mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i>

***Prunus* (Cherry, Flowering Cherry, Peach, Plum) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Brown Rot <i>(Monilinia fructicola)</i> p. 76	Infected flowers collapse, turn brown, and are frequently covered with the fuzzy, tannish-brown growth of the fungus; tender twigs and leaves may shrivel and appear blighted due to girdling cankers; ripening fruit, if present, may shrivel and become covered with tan masses of the fungus; infected fruit may also mummify and persist on the tree into the winter; particularly severe during wet weather; prevalent in spring 2006; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove mummified fruit; • prune and remove blighted or cankered twigs and limbs; • maintain vigor; • for ornamental trees, fungicide sprays can be applied at budbreak and repeated 2-4 times as necessary; early-season sprays, especially during bloom, are very important; • for trees grown for fruit production, susceptible varieties usually require a season-long fungicide program in order to harvest quality fruit; select the appropriate fungicide if harvesting fruit for consumption; 	chlorothalonil chlorothalonil + fenarimol *copper hydroxide copper salts of fatty and rosin acids *copper sulfate fenarimol *harpin protein mancozeb mancozeb + copper hydroxide propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil
Gummosis <i>(Abiotic)</i> p. 358	Gummosis is associated with many factors including mechanical injury, winter injury, insect damage, and overfertilization; amber-colored gum is exuded from buds, twigs, branches, and trunks; deposits collect beneath the bark, eventually break, and are often visible at branch crotches and on the main trunk;	<ul style="list-style-type: none"> • maintain vigor and avoid injuries; • control insects; 	No chemical control is suggested.

***Prunus* (Cherry, Flowering Cherry, Peach, Plum) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Leaf Curl <i>(Taphrina deformans)</i> p. 4	As leaves emerge in spring, they appear thickened and have blister-like distortions that are often reddish; in some cases, succulent shoots may also be deformed; heavily symptomatic leaves brown and drop prematurely; trees usually refoliate with normal leaves shortly thereafter; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • maintain vigor; • fungicide sprays can be applied before buds begin to swell in spring; select the appropriate fungicide if harvesting fruit for consumption; 	chlorothalonil copper salts of fatty and rosin acids ferbam mancozeb + copper hydroxide *harpin protein *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl + chlorothalonil
Leaf Spot [Coccomyces Leaf Spot] <i>(Blumeriella jaapii)</i> p. 80	Discrete, small, dark-purple spots appear on the leaves when they are fully expanded; in wet weather, white masses of conidia are visible on undersides of infected leaves; the spots can drop out and give the leaves a shot-holed appearance; this is usually followed by widespread yellowing and drop of the leaves; particularly severe after cool, wet spring weather; very heavy in 2006;	<ul style="list-style-type: none"> • maintain vigor; • rake and remove fallen leaves; • fungicide sprays can be applied when new growth emerges in spring and repeated at label intervals until fully mature; select the appropriate fungicide if harvesting fruit for consumption; 	*harpin protein mancozeb mancozeb + copper hydroxide myclobutanil propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil

***Prunus* (Cherry, Flowering Cherry, Peach, Plum) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Powdery Mildew <i>(Podosphaera)</i> p. 8	White to grayish, powdery growth on leaves, usually first evident on the upper leaf surfaces; typically develops fairly late in the season; however, when infection occurs early in the season when tissues are young, some distortion and twisting of leaves and tips can occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary according to label directions; select the appropriate fungicide if harvesting fruit for consumption; 	azoxystrobin chlorothalonil fenarimol *harpin protein mancozeb + thiophanate methyl *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> *sulfur thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon trifloxystrobin
Winter Injury <i>(Abiotic)</i> p. 498	Symptoms are variable and include dieback and shriveling of branches and twigs; symptoms are most evident in late winter or early spring as growth resumes; however, they can develop in early summer as a sudden and “unexplained” dieback and collapse; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • maintain vigor; • prune and remove symptomatic tissues to minimize secondary invaders and opportunistic pests; 	No chemical control is suggested.

***Prunus* (Cherry, Flowering Cherry, Peach, Plum) cont'd**

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
X-disease (Prunus X-disease group of phytoplasmas) p. 400	X-disease is historically a serious problem for stone fruit in Connecticut but in recent years has been found in increasing frequency in landscape or backyard trees; hosts include peach, nectarine, sweet and sour cherry, and Japanese plum; the key reservoir host is chokecherry, <i>Prunus virginiana</i> ; trees with X-disease usually appear normal at the start of the growing season although some trees may exhibit branch and twig dieback due to increased sensitivity to winter injury or may have slightly smaller leaves; by midsummer, there is a sudden onset of symptoms; these may be on a single branch or the entire tree; leaves develop yellow or reddish, irregular water-soaked blotches and often roll upward longitudinally along the mid-vein; discolored areas become dry and brittle and the dead tissues drop out giving the leaf a tattered, shot-holed appearance; symptomatic leaves drop off, often leaving a characteristic cluster of leaves at the tip of the branches; trees with X-disease gradually decline since the disease is chronic and progressive due to the systemic distribution of the X-phytoplasma in the phloem; infected trees eventually die within 2-6 years depending upon the age of the tree at the time of infection; several species of phloem-feeding leafhoppers transmit this phytoplasma; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rogue and remove heavily infected trees; • maintain vigor; • remove chokecherry in the vicinity of stone fruits; 	No chemical control is suggested.

***Pseudotsuga* (Douglas-Fir)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Diplodia Blight [Sphaeropsis Tip Blight] <i>(Diplodia pinea)</i> p. 130	Tip blight results from infection of buds and shoots; infected buds and shoots usually stop growing before or during needle elongation and needles are frequently short; infected tissues are straw-colored; usually kills only current-season buds and shoots, but can cause significant dieback on trees under stress, especially under drought stress; black fruiting structures of the fungus may be visible on infected shoots; symptoms may be distributed uniformly throughout the canopy or concentrated in lower branches; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove blighted twigs and branches during dry weather in autumn; • maintain tree vigor with special attention to watering during periods of drought; • fungicide sprays can be applied at budbreak and repeated as necessary at label intervals until needles are fully expanded; 	copper sulphate pentahydrate *harpin protein mancozeb *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil

***Pseudotsuga* (Douglas-Fir) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Rhabdocline Needlecast <i>(Rhabdocline spp.)</i> p. 58	Yellow spots on one or both surfaces of 1-year-old needles first appear in late fall or early winter; spots gradually turn reddish-brown and can appear as distinct bands or encompass the entire needle; a diagnostic symptom is the sharp border between green and brown tissue; discolored needles are most conspicuous in early spring and heavily infected trees look scorched; in late spring, the epidermis of infected needles ruptures, usually in two longitudinal lines, and orangy-brown fruiting structures of the fungus can be seen with a hand lens; significant drop of infected needles occurs and symptoms are often most serious on lower branches where air circulation is poor; very heavy infections have been observed in landscape trees during the past few years; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • maintain tree vigor; • rogue and remove heavily infected trees; • pay attention to site, especially with regard to air circulation; • provide adequate spacing and maintain good weed control for optimum air circulation; • seed sources vary in susceptibility (e.g., highly susceptible- 'Lincoln'; moderately susceptible- 'Santa Fe'; least susceptible- 'Shuswap'); • fungicide sprays can be applied when new growth is ½ inch long and repeated 2-4 times at label intervals until needles are fully expanded or conditions are no longer favorable for disease; 	chlorothalonil chlorothalonil + fenarimol *copper hydroxide copper salts of fatty and rosin acids *harpin protein mancozeb *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl + chlorothalonil

***Pseudotsuga* (Douglas-Fir) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Swiss Needlecast <i>(Phaeocryptopus gaumanni)</i> p. 58	This needlecast recently reappeared in Connecticut after many years of absence; symptoms develop on first- or second-year needles and are usually evident in late winter and early spring; infected needles are yellow or mottled and gradually turn brown; when needles are examined with a hand lens, two bands of round, black fruiting bodies can be seen on either side of the midrib; green needles can also be infected and serve as a source of inoculum; Swiss needlecast is often confused with "sooty mold," which is a superficial, unsightly, but non-pathogenic fungus that grows on the honeydew or excrement of insects; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • maintain tree vigor; • rogue and remove heavily infected trees; • pay attention to site, especially with regard to air circulation; • fungicide applications can be made when new shoots are approximately 1-1½ inches long and again 3 weeks later; additional applications may be necessary in years with excessive rainfall; 	chlorothalonil chlorothalonil + fenarimol *harpin protein mancozeb *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl + chlorothalonil

***Pyracantha* (Firethorn)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Fire Blight <i>(Erwinia amylovora)</i> p. 376	Flowers wither and blacken; young twigs and branches die from the terminals back and appear as though “burned”; affected limbs frequently develop a characteristic shepherd's crook at the tip; dead leaves usually remain attached to the branch; sunken, discolored cankers may be evident on branches or the main trunk; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove infected branches at least 10-12 inches below visible symptoms when bark is dry; • disinfest tools between cuts; • avoid excessive nitrogen fertilization or vigor; • select cultivars with reported resistance (e.g., ‘Mojave,’ ‘Shawnee’); 	No chemical control is suggested.

***Pyracantha* (Firethorn) cont'd**

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Scab (<i>Venturia inaequalis</i> f. sp. <i>pyracanthae</i>) p. 88	Circular, olive-black, velvety spots with feathery, diffuse margins develop on leaves, fruit, and young fruit stems; heavy infections result in leaf yellowing and significant defoliation in midsummer; infected fruit often crack and drop prematurely;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune dead twigs and branches; • maintain vigor since repeated defoliation weakens trees; • resistant cultivars are available (e.g., <i>Pyracantha</i> 'Firey Cascade'; <i>P. crenatosessata</i>, 'Yunan Firethorn,' 'Shawnee,' 'Rutgers,' 'Santa Cruz Prostrata'); • chemical control is usually not necessary except for new transplants, young or specimen trees, or when defoliation has been heavy for several years; fungicide sprays can be applied at budbreak and repeated 2-3 times at label intervals; 	<p>chlorothalonil chlorothalonil + fenarimol *copper hydroxide copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + thiophanate methyl myclobutanil *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil</p>

***Pyrus* (Pear)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Fire Blight <i>(Erwinia amylovora)</i> p. 376	Flowers wither and blacken; young twigs and branches die from the terminals back and appear as though “burned”; affected limbs frequently develop a characteristic shepherd’s crook at the tips; dead leaves usually remain attached to the branch; sunken, discolored cankers may be evident on branches or the main trunk; symptoms often develop in a relatively short period of time; resistance is available, e.g., Bradford pear (<i>Pyrus calleryana</i> ‘Bradford’) is reported to be tolerant; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • avoid excessive nitrogen fertilization or vigor; • overwintering cankers should be pruned and removed during the winter; make cuts at least 10-12 inches below visible symptoms when bark is dry; • during the growing season, prune and remove infected branches as soon as they develop; make cuts at least 10-12 inches below visible symptoms when bark is dry; • disinfest tools between cuts; • recent studies with infected fruit trees have shown that the old method of cutting 8-10 inches below visible symptoms of growing-season blight strikes has certain limitations; new research has shown that bacteria can sometimes be found as far as 9 feet beyond visible symptoms on highly susceptible trees; they suggest that cuts on symptomatic shoots should be made back to 2-year or older wood and at least 8-12 inches below the visible symptoms; <p style="text-align: center;">(continued on next page)</p>	<ul style="list-style-type: none"> *copper hydroxide copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i>

***Pyrus* (Pear) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Fire Blight (Cont'd)		<ul style="list-style-type: none"> • these cuts often leave a 4-5 inch naked stub above the next leaf or branch, so this method has been called the “ugly stub” method; cuts should be made when the bark is dry; the presence of “ugly stubs” in the tree will flag infection sites for follow-up with winter pruning; • preventative copper sprays can be applied to the bark before growth emerges in spring; additional applications may be necessary to protect newly emerging shoots until flowering; select the appropriate product if harvesting fruit for consumption; 	
Leaf Blister <i>(Taphrina)</i> p. 4	Irregular, chlorotic blisters develop on upper leaf surfaces during late spring or summer; a whitish “bloom” is often visible on the undersurface of the blisters; infected leaves usually remain attached to the tree;	<ul style="list-style-type: none"> • maintain vigor; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen or newly transplanted trees, fungicide sprays can be applied before buds begin to swell in spring; 	chlorothalonil *harpin protein mancozeb

***Pyrus* (Pear) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Leaf Spot [Fabraea Leaf Spot] <i>(Diplocarpon mespili)</i> p. 78	Discrete, circular, dark-brown spots develop on leaves; when numerous, they coalesce and form large, dead blotches; fruiting structures of the fungus develop under the cuticle of lesions and give the spots a blister-like appearance; significant early leaf drop can occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation around the tree and avoid overhead watering; • maintain tree vigor; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as new growth emerges and repeated as necessary according to label directions; • select the appropriate fungicide if harvesting fruit for consumption; 	<ul style="list-style-type: none"> *copper hydroxide copper salts of fatty and rosin acids *harpin protein mancozeb *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl
Powdery Mildew <i>(Podosphaera)</i> p. 8	White to grayish, powdery growth develops on leaves; this is usually first evident on the upper leaf surfaces but can occur on both leaf surfaces; some premature leaf coloration can occur refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation around the tree; • spraying is usually not necessary since the disease develops mid to late in the season and has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; • select the appropriate fungicide if harvesting fruit for consumption; 	<ul style="list-style-type: none"> azoxystrobin fenarimol *harpin protein myclobutanil *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil triadimefon

***Pyrus* (Pear) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Scab <i>(Venturia pirina)</i> p. 88	Circular, olive-black, velvety spots with feathery, diffuse margins develop on leaves, fruit, and young fruit stems; heavy infections result in leaf yellowing and significant defoliation in midsummer; infected fruit often crack and occasionally drop; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • maintain tree vigor since repeated defoliation weakens trees; • chemical control is usually not necessary except for new transplants, young or specimen trees, or when defoliation has been heavy for several years; fungicide sprays can be applied at budbreak and repeated 2-4 times at label intervals; early-season sprays are very important; • select the appropriate fungicide if harvesting fruit for consumption; 	chlorothalonil chlorothalonil + fenarimol *copper hydroxide copper sulphate pentahydrate *harpin protein mancozeb mancozeb + thiophanate methyl methyl myclobutanil propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl

Quercus (Oak)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Anthracnose (<i>Apiognomonia</i>) p. 100	Irregular, necrotic spots that are tan and papery in appearance develop on newly emerging leaves in wet weather; spots are often so numerous that they coalesce and leaves appear blighted; some leaf distortion also occurs when margins are infected; as leaves reach full size they become resistant; heavily infected leaves drop and defoliation can occur; twigs with overwintering infections may die; white oak is most susceptible; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune and remove infected twigs; • maintain vigor; • fungicide sprays are usually not practical or necessary except for new transplants, young or specimen trees, or when defoliation has been heavy for several years; fungicide sprays can be applied at budbreak and repeated 2-3 times at label intervals; 	azoxystrobin chlorothalonil chlorothalonil + fenarimol copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil

Quercus (Oak) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Armillaria Root Rot (<i>Armillaria</i> spp. complex) p. 326	One of the most common diseases of oak in Connecticut; also called shoestring root rot and honey mushroom rot; this disease is difficult to identify since aboveground symptoms appear as general and progressive decline that leads to the eventual death of trees; trees can die singly or in groups; trees under environmental or site-related stresses are particularly susceptible; diagnostic signs of infection include black strands of the fungus called rhizomorphs (shoestrings) on the surface of the bark or at the base of infected trees, white fans of fungal growth with “mushroomy” odors under the bark, and the occasional growth of honey mushrooms at the base of infected trees in autumn; narrow, black lines are often evident in infected wood; the fungus can persist in stumps and large, woody roots for as long as 30 years;	<ul style="list-style-type: none"> • maintain tree vigor; • avoid any unnecessary stresses, esp. drought stress; • avoid planting susceptible trees in a site where this disease has been confirmed; • if replanting in the site, the stump and all woody roots greater than ½ inch in diameter should be removed; 	No chemical control is suggested.

Quercus (Oak) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Bacterial Wetwood and Slime Flux (<i>Bacteria and yeasts</i>) p. 384	This disease complex is usually not an important problem for landscape trees but it can cause unsightly and unpleasant conditions for homeowners; wet streaks are visible on the outer bark of the main trunk where liquids seep out of cracks or fissures in the bark; depending on the organisms responsible, the ooze can be bubbly and amber and have a foul odor or it can be colorless and have an "alcoholic," fermentative odor; oozing can be extensive at certain times of the year; the slime can be toxic to the cambium; when these tissues are killed, additional cracks can develop; some discoloration of the wood may occur but there are usually no symptoms in the canopy;	<ul style="list-style-type: none"> • maintain vigor; • wash off oozing liquid with a stiff spray of water; 	No chemical control is suggested.
Biscogniauxia (Hypoxylon) Canker (<i>Biscogniauxia</i>) p. 200	Initial symptoms are nonspecific and include yellowing or wilting of leaves and random branch dieback; the fungus is an opportunistic pathogen that readily attacks weak or stressed trees, especially heat- and drought-stressed trees; as it colonizes weakened branches or limbs, it decays the inner bark and sapwood and forms a tan or silvery-gray stroma; these are visible as the outer bark sloughs off and appear as characteristic smooth strips several feet long; stroma turn from tan to black with age;	<ul style="list-style-type: none"> • prune and remove infected twigs or branches; • maintain vigor; • avoid unnecessary stresses; 	No chemical control is suggested.

Quercus (Oak) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Bleeding Canker (<i>Phytophthora</i> spp.) p. 354	Primary symptoms include oozing of reddish-brown fluid from fissures or cracks in the bark; these are usually centered over diffuse cankers; infected inner bark, cambium, and sapwood appear distinctly reddish-brown; some dieback of branches and thinning of the canopy can occur; can result in tree death; quite prevalent in landscape trees in 2006 growing season;	<ul style="list-style-type: none"> maintain tree vigor by attention to irrigation, soil compaction; mildly infected trees have occasionally been reported to recover; rogue and remove heavily infected trees to reduce the potential of spread to nearby trees; recent trials have demonstrated anecdotal success with directed basal bark sprays and injections of mono- and di-potassium salts of phosphorous acid; 	*harpin protein mono- and di- potassium salts of phosphorous acid *QST 713 strain of <i>Bacillus subtilis</i>
Botryosphaeria Canker (<i>Botryosphaeria</i>) p. 120	Random dieback of branches and limbs; usually associated with sunken cankers in which black fruiting structures of the fungus may be visible; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> prune affected limbs back to healthy wood as soon as detected and when bark is dry; avoid wounding and unnecessary stress such as drought stress; maintain tree vigor; 	No chemical control is suggested.
Leaf Blister (<i>Taphrina caerulescens</i>) p. 4	Pale-green spots ¼ - ¾ inch in diameter appear on newly expanding leaves; spots expand and develop into blister-like bulges on the leaves; as the blisters age, they become necrotic; trees with heavy infections usually appear off-colored since the symptomatic leaves remain attached to the tree;	<ul style="list-style-type: none"> maintain vigor; spraying is usually not necessary; however, on specimen or newly transplanted trees, fungicide sprays can be applied before buds begin to swell in spring; 	chlorothalonil chlorothalonil + fenarimol *harpin protein mancozeb mancozeb + myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl + chlorothalonil

Quercus (Oak) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Powdery Mildew (<i>Erysiphe</i>) p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	azoxystrobin *harpin protein mancozeb + thiophanate methyl myclobutanil propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon

Quercus (Oak) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Scorch <i>(Xylella fastidiosa)</i> p. 386	<p>TO DATE, THIS DISEASE HAS NOT BEEN CONFIRMED IN CONNECTICUT; IT IS LISTED HERE FOR INFORMATION ONLY; leaves develop scorch symptoms in early to midsummer; leaf margins first appear chlorotic and discolor to drab green and then to brown; a distinctive reddish band often develops at the margin between symptomatic and green tissues; leaves usually remain attached to the tree; symptoms may appear on one or two branches and gradually increase from year to year; symptoms are often confused with abiotic scorch; with <i>Xylella</i>, symptoms first appear on older leaves and progress toward new growth; with abiotic scorch, symptoms usually first appear at tips of branches and move inward; definitive diagnosis requires laboratory tests; samples from any suspicious trees should be submitted for analysis;</p>	<ul style="list-style-type: none"> • maintain vigor; • prune symptomatic portions to reduce secondary invaders and opportunistic pests; 	No chemical control is suggested.

Quercus (Oak) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Tubakia Leaf Spot (Actinopelte Leaf Spot) (<i>Tubakia dryina</i>) p. 44	Symptoms are often confused with anthracnose; they appear in late summer and early fall; circular lesions about 1/4 -1/2 inch in diameter are initially water-soaked but then turn reddish-brown; spots may coalesce to form large, irregular blotches, usually surrounded by a chlorotic or yellow halo; premature leaf drop can occur; more prevalent during wet weather and on trees that are under stress, particularly nutritional stress (iron deficiency); very heavy in 2006 season;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune and remove infected twigs; • maintain vigor; • fungicide sprays are usually not practical or necessary except for new transplants, young or specimen trees, or when defoliation has been heavy for several years; fungicide sprays can be applied at budbreak and repeated 2-3 times at label intervals; 	copper salts of fatty and rosin acids *copper hydroxide elemental copper *harpin protein mancozeb propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil

Rhododendron (Azalea, Rhododendron)

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Armillaria Root Rot <i>(Armillaria spp. complex)</i> p. 326	Also called shoestring root rot and honey mushroom rot, this disease is difficult to identify since aboveground symptoms appear as general and progressive decline that leads to the eventual death of plants; plants can die singly or in groups; plants under environmental or site-related stresses are particularly susceptible; diagnostic signs of the infection include black strands of the fungus called rhizomorphs (shoestrings) on the surface of the bark or at the base of infected plants, white fans of fungal growth with “mushroomy” odors under the bark, and the occasional growth of honey mushrooms at the base of infected plants in autumn; the fungus can persist in stumps and large, woody roots for as long as 30 years;	<ul style="list-style-type: none"> • maintain vigor; • avoid any unnecessary stresses, esp. drought stress; • avoid planting susceptible trees in a site where this disease has been confirmed; • if replanting in the site, the stump and all woody roots greater than ½ inch in diameter should be removed; 	No chemical control is suggested.
Botryosphaeria Canker and Dieback <i>(Botryosphaeria)</i> p. 120	Brown to black, sunken cankers develop on stems; as they girdle stems, leaves turn dull green, wilt, and branches die; some cracking of bark may occur; in cross-section, the center of the stem is dark-brown and surrounding wood a lighter brown; easily confused with <i>Phytophthora</i> dieback, although with <i>Botryosphaeria</i> , small, blister-like, black fruiting bodies are sometimes visible in the cankered areas; plants under stress are most susceptible;	<ul style="list-style-type: none"> • prune and remove cankered limbs 4-6 inches below visible symptoms when bark is dry; • disinfest tools between cuts; • avoid wounds or injuries; • maintain vigor; • among cultivars reported to have resistance are ‘Boursalt,’ ‘Chinodes White,’ ‘Cunningham’s White,’ and ‘English Roseum’; 	No chemical control is suggested.

Rhododendron (Azalea, Rhododendron) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Botrytis Blight (<i>Botrytis cinerea</i>) p. 72	Flower clusters appear shriveled and brown; affected portions are often covered with gray, fuzzy, fungal growth; serious after periods of prolonged humidity, rain, or cloud cover; can result in some twig dieback;	<ul style="list-style-type: none"> • prune and remove infected twigs and blighted flower clusters; • maintain vigor; • fungicide sprays can be applied at budbreak in wet springs or when symptoms first appear; sprays can be repeated as necessary according to label directions; 	chlorothalonil *copper hydroxide copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + myclobutanil *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i> *sulfur thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil
Chlorosis (<i>Abiotic</i>) p. 490	Symptoms often develop on the newest growth, which generally appears pale-green or yellow; the veins of yellowed leaves frequently remain green; usually associated with an iron deficiency due to soil, site, or root health conditions (e.g., soil pH, root damage due to drought, excess moisture, or disease); refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • maintain plant vigor; • a soil test might help to determine the cause of the problem and may call for applications of chelated iron; 	No chemical control is suggested.

***Rhododendron* (Azalea, Rhododendron) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Crown Gall <i>(Agrobacterium tumefaciens)</i> p. 382	Galls ranging in size from ¼ inch to several inches in diameter develop on branches and roots; young galls appear white or cream-colored when cut in half; older galls darken to brown and have no recognizable internal structure (e.g., no organized vascular tissue);	<ul style="list-style-type: none"> • prune and remove young stem galls as soon as evident; • disinfest tools between cuts; • severely infected plants should be rogued and removed; • avoid mechanical injuries to neighboring plants using careful cultivation since the bacterium requires wounds to infect; • plant resistant species (refer to list of resistant species, Table 2); 	No chemical control is suggested.

***Rhododendron* (Azalea, Rhododendron) cont'd**

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Fungal Leaf Spots (<i>Phomopsis</i> , <i>Pseudocercospora</i> , <i>Septoria</i>) p. 24, 138, 146	Irregular or circular, brown, dead spots or patches develop over the leaves, particularly during wet weather; the size, shape, and color of these spots varies with the specific pathogen; for example, spots associated with <i>Pseudocercospora</i> are circular, have tan centers, and red or purple, highly defined margins; some yellowing of the leaves and premature leaf drop may also occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation and avoid overhead watering; • maintain vigor; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen plants, fungicides can be applied when new growth emerges and repeated as necessary according to label directions; 	<p>chlorothalonil *copper hydroxide copper salts of fatty and rosin acids ferbam *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + myclobutanil mancozeb + thiophanate methyl myclobutanil propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon</p>

Rhododendron (Azalea, Rhododendron) cont'd

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Gray Blight <i>(Pestalotiopsis)</i> p. 190	Symptoms usually develop on tissues that have been injured or damaged, usually from winter drying or sunscalding; infected tissues appear distinctly gray and there is often a sharp line delineating the infected from the healthy tissues; small, black, pinpoint fruiting structures of the fungus are visible in the infected tissues; heavily infected leaves can drop prematurely;	<ul style="list-style-type: none"> • maintain vigor; • avoid planting in open or windy sites; 	No chemical control is suggested.
Leaf Gall <i>(Exobasidium vaccinii)</i> p. 250	Especially problematic on azalea; portions of or entire leaves and flowers thicken and become fleshy; these swollen areas or galls are pale-green but can develop a rosy color; as galls age, they turn white due to the formation of spores of the fungus on the surface; galls eventually turn brown and dry out;	<ul style="list-style-type: none"> • pick and remove as many galls as possible before they turn white; • maintain vigor; • fungicides are registered for use but are usually not necessary; sprays can be applied when new growth emerges and repeated as necessary according to label directions; 	*copper sulfate copper salts of fatty and rosin acids *harpin protein mancozeb mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl + chlorothalonil triadimefon

***Rhododendron* (Azalea, Rhododendron) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Phytophthora Root Rot <i>(Phytophthora spp.)</i> p. 354	Infected plants generally exhibit poor vigor; leaves roll longitudinally along midveins, appear dull, olive-green, and wilted but usually remain attached to branches; branches and twigs shrivel; symptoms may be confined to individual branches or may develop progressively until the entire plant is involved; a distinctive cinnamon-brown discoloration may be evident when cuts are made into the wood at the root crown; frequently more serious on shrubs where excess water is a persistent problem (e.g., clay soils, low areas); definitive diagnosis usually requires laboratory tests;	<ul style="list-style-type: none"> • once infected, plants cannot be cured; • rogue and remove symptomatic plants; • avoid planting in poorly drained soils or improve drainage; • maintain vigor and avoid excessive irrigation; • some resistance has been identified (e.g., 'Caroline,' 'Professor Hugo de Vries,' 'Red Head'); • fungicides are not curative; healthy, uninfected plants adjacent to symptomatic plants can be protected with fungicides applied according to label directions; 	fosetyl-Al *harpin protein mefenoxam mono- and di- potassium salts of phosphorous acid phosphorous acid *QST 713 strain of <i>Bacillus subtilis</i>

**Phytophthora Tip
Dieback/Blight**
(*Phytophthora* spp.)
p. 354

Leaves and terminal buds begin to discolor; leaves turn brown and droop; a diagnostic V-shaped, water-soaked discoloration may be evident on the leaves, usually beginning at the point of petiole attachment to the leaf lamina; browning of the petiole often continues as the fungus-like organism moves into the twig; girdling cankers may form on twigs and branches and result in dieback; current season's growth is most susceptible;

- prune and remove affected tips below obvious symptoms;
- disinfest tools between cuts;
- avoid excessive vigor;
- fungicide sprays can be applied according to label directions when new shoots are growing; they are effective as protectants and have no curative action;

azoxystrobin
chlorothalonil
chlorothalonil +
fenarimol
*copper hydroxide
copper salts of fatty
and rosin acids
*harpin protein
mancozeb
mancozeb + copper
hydroxide
mancozeb +
myclobutanil
mefenoxam
*QST 713 strain of
Bacillus subtilis
thiophanate methyl
+ chlorothalonil

***Rhododendron* (Azalea, Rhododendron) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Powdery Mildew <i>(Erysiphe)</i> p. 8	Symptoms vary considerably with species and cultivar; on some cultivars, white to grayish, powdery growth typical of other powdery mildews is evident on leaves; this is usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; in other cases, symptoms are atypical and include pale-yellow spots with diffuse margins, purple to brown, circular patches, purplish-brown discolorations of veins, and necrotic blotches; symptoms usually develop fairly late in the season; some yellowing and premature leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	azoxystrobin copper salts of fatty and rosin acids *harpin protein mancozeb + copper hydroxide mancozeb + myclobutanil mancozeb + thiophanate methyl myclobutanil *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> *sulfur thiophanate methyl thiophanate methyl + chlorothalonil triadimefon

***Rhododendron* (Azalea, Rhododendron) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Winter Injury <i>(Abiotic)</i> p. 498	Browning of leaf tips or margins, rolling of leaves; dieback and shriveling of branches and twigs can be extensive; symptoms most evident in late winter or early spring as growth resumes; sub-lethal damage to the cambium may also occur and symptoms associated with this damage appear in early summer as a sudden, "unexplained" collapse of branches or entire plants; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove symptomatic tissues to minimize secondary invaders and opportunistic pests; • maintain vigor; • provide adequate moisture in the root zone before the ground freezes; • provide physical (e.g., burlap wraps) and/or chemical (e.g., applications of anti-transpirants) protection in wind-swept areas or in areas prone to extreme temperature fluctuations during the winter; 	No chemical control is suggested.

***Robinia* (Black Locust)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Canker <i>(Nectria spp.)</i> p. 176	Symptoms include progressive dieback of twigs and branches, usually first evident on lower limbs and proceeding up the tree; cankers appear as sunken areas of bark on branches or the main trunk; brightly colored orange or reddish-orange fruiting structures of the fungus are sometimes visible in the cankers;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs and branches as soon as evident; • cuts should be made below visible symptoms when bark is dry; • maintain vigor since drought-stressed or winter-injured trees are more vulnerable; • avoid mechanical injuries; • maintain vigor; 	No chemical control is suggested.
Powdery Mildew <i>(Erysiphe)</i> p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	*harpin protein myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon

Rosa (Rose)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Black Spot (<i>Diplocarpon rosae</i>) p. 80	Brown to black lesions with feathery, indistinct margins develop on leaves; spots can be up to ½ inch in diameter and can develop on both leaf surfaces; on highly susceptible cultivars, both symptomatic and non-symptomatic leaves turn yellow and drop prematurely, often in significant numbers; canes may develop purple spots and cankers on current growth; this disease can be severe during cool, wet weather; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove cankered and dead canes; • rake and remove fallen leaves; • avoid overhead irrigation and provide spacing for good air circulation; • maintain vigor; • resistance is available (e.g., highly resistant hybrid teas- 'Tropicana,' 'Mr. Lincoln,' 'David Thompson,' 'Coronado,' 'Peace'); however, strains of the fungus may influence individual disease reactions; • fungicide sprays can be applied as soon as new growth begins in spring and repeated as necessary according to label directions; sprays are often necessary throughout the entire growing season for control on highly susceptible cultivars; 	chlorothalonil chlorothalonil + fenarimol *copper hydroxide copper salts of fatty and rosin acids copper sulphate pentahydrate ferbam *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + myclobutanil mancozeb + thiophanate methyl myclobutanil propiconazole *QST 713 strain of <i>Bacillus subtilis</i> *sulfur thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil trifloxystrobin

Rosa (Rose) cont'd

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Botrytis Blight <i>(Botrytis cinerea)</i> p. 120	Symptoms appear on flowers, buds, canes, and growing tips after periods of cloudy, humid weather; on flowers and flower buds, small flecks or blister-like patches that develop into tan spots or large, tan patches appear on petals; stem cankers develop at pruning wounds or injuries and succulent growing tips wilt and die from girdling cankers; under conditions of high humidity and moisture, infected tissues are covered with the tan, fuzzy mass of the fungus; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove infected tips and canes; • avoid overhead irrigation and provide adequate spacing for air circulation; • remove spent flowers; • avoid unnecessary injuries; • maintain vigor; • fungicide sprays can be applied as soon as symptoms first appear and repeated as necessary; 	chlorothalonil chlorothalonil + fenarimol copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + thiophanate methyl *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil
Cankers <i>(Nectria, Phomopsis)</i> p. 176, 140	Slightly sunken, reddish-brown spots develop on canes; these lesions gradually enlarge, girdle, and kill the canes; affected tissues may turn tan to light-brown and, depending on the species of fungus, black fruiting bodies may be evident in longitudinal splits or evenly distributed throughout the cankered areas; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove infected canes below visible symptoms; • disinfest tools between cuts; • maintain vigor; 	No chemical control is suggested.

Rosa (Rose) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Crown Gall (<i>Agrobacterium tumefaciens</i>) p. 382	Galls ranging in size from ¼ inch to several inches in diameter develop on branches and roots; young galls appear white or cream-colored when cut in half; older galls darken to brown and have no recognizable internal structure (e.g., no organized vascular tissue); refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove young stem galls as soon as evident; • disinfest tools between cuts; • severely infected plants should be rogued and removed; • avoid mechanical injuries to neighboring plants using careful cultivation since the bacterium requires wounds to infect; • plant resistant species (refer to list of resistant species, Table 2); 	No chemical control is suggested.
Dieback (<i>Botryosphaeria</i>) p. 120	Brown to black, sunken cankers develop on canes; as they girdle stems, leaves turn dull green and wilt, and branches die; some cracking of bark may occur; in cross-section, the center of the stem is dark-brown and the surrounding wood a lighter brown; small, blister-like, black fruiting bodies are sometimes visible in the cankered areas; plants under stress are most susceptible;	<ul style="list-style-type: none"> • prune and remove cankered limbs 4-6 inches below visible symptoms when bark is dry; • disinfest tools between cuts; • avoid wounds or injuries; • maintain vigor; 	No chemical control is suggested.

Rosa (Rose) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Downy Mildew <i>(Peronospora sparsa)</i> p. 352	Symptoms can develop on all plant parts including leaves, stems, peduncles, calyxes, and petals; leaves develop purplish to dark-brown spots that are irregular in appearance; these spots are usually most obvious on the upper leaf surface but can be confused with phytotoxicity; extensive yellowing and leaf drop can occur when infection is heavy; under humid conditions, the fungus may be visible as fuzzy, purplish-brown growth on the undersurfaces of symptomatic leaves; purplish, sunken cankers can develop on canes; this disease is most serious during cool, wet weather; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove canes several inches below visible cankers; • rake and remove fallen leaves; • maintain vigor; • fungicide sprays can be applied on a preventative basis as soon as new growth emerges and repeated as necessary according to label directions; 	*copper hydroxide copper sulphate pentahydrate fosetyl-Al *harpin protein mancozeb *QST 713 strain of <i>Bacillus subtilis</i>

Rosa (Rose) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Powdery Mildew (<i>Podosphaera</i>) p. 8	Whitish-gray, powdery growth appears on leaves, young canes, and flower parts; symptoms usually don't appear until early to midsummer; if infections occur early in the season, tender canes may be killed by heavy infections; when young leaves are infected, some twisting and distortion may occur; heavily infected flower buds may fail to open and premature leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation; • resistance is available (e.g., hybrid teas 'Tropicana,' 'Mr. Lincoln,' 'Sonia,' 'Fragrant Cloud'); • highly susceptible cultivars can be sprayed with fungicides as soon as symptoms are evident and repeated as necessary; 	azoxystrobin chlorothalonil chlorothalonil + fenarimol *copper hydroxide copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein *horticultural oil mancozeb + copper hydroxide mancozeb + myclobutanil mancozeb + thiophanate methyl myclobutanil *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> *sulfur thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon

Rosa (Rose) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Rose Mosaic (<i>Virus complex</i>) p. 408	Symptoms are highly variable and include ringspots, chlorotic line patterns, mottles, and mosaics on leaves; symptoms also vary with cultivar, weather, and time of year; there is no obvious effect on flowering but infected plants often have reduced vigor and are prone to winter injury; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • maintain vigor; • remove heavily infected plants; 	No chemical control is suggested.
Rose Rust (<i>Phragmidium spp.</i>) p. 258	Symptoms can develop on leaves and any other green parts of the plant; small, orange pustules develop on both leaf surfaces in early spring; they gradually enlarge and by late summer or early fall they turn black and contain the spores for winter survival; heavy infections result in early defoliation;	<ul style="list-style-type: none"> • rake and remove infected leaves; • prune "rusted" canes back to healthy wood in spring prior to budbreak; • provide adequate spacing between plants to allow good air circulation; • avoid overhead irrigation; • maintain vigor; • highly susceptible cultivars can be sprayed with fungicides when new growth begins in spring or as soon as symptoms are evident and repeated as necessary; 	azoxystrobin *harpin protein mancozeb mancozeb + copper hydroxide mancozeb + myclobutanil myclobutanil propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl + chlorothalonil trifloxystrobin

Rosa (Rose) cont'd

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Winter Injury <i>(Abiotic)</i> p. 498	Symptoms include dieback of canes and death of entire plants; dieback can be extensive after some winters; symptoms are most evident in early spring as growth resumes; sub-lethal damage to the cambium may also occur and symptoms appear in early summer as a shriveling of newly developing shoots or as a sudden, "unexplained" collapse of canes; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove dead canes to minimize secondary invaders and opportunistic pests; • maintain vigor; • provide physical protection to the graft union in areas prone to extreme temperature fluctuations during the winter; 	No chemical control is suggested.

Salix (Willow)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Canker (<i>Botryosphaeria</i> , <i>Cytospora</i>) p. 120, 172	Twigs and branch tips wilt and die back; may be first confined to individual limbs but can encompass the entire tree; leaves usually droop and turn brown yet remain attached to the stem; discolored, brown cankers appear as flattened areas on killed stems or branches;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs or branches back to healthy wood when bark is dry; • avoid wounds and drought stress since the fungus is more aggressive on plants that have been weakened by drought or winter injuries; 	No chemical control is suggested.
Leaf Rust (<i>Melampsora</i> spp.) p. 284	Several species of fungi cause rust symptoms on willow; small, bright lemon-yellow spots appear on upper leaf surfaces, and orange pustules or blisters develop on upper leaf surfaces in late spring or summer; the lesions gradually darken in color; heavy infections result in premature leaf drop; these fungi overwinter on fallen willow leaves or, in some cases, in buds and twigs of infected trees; alternate hosts of these fungi include balsam fir and larch; in spring, spores develop on fallen willow leaves and infect emerging conifer needles; yellow pustules develop on these needles and spores produced on these infected needles infect willow leaves;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as new growth emerges in spring and repeated as necessary according to label directions; 	*harpin protein mancozeb *QST 713 strain of <i>Bacillus subtilis</i> triadimefon

Salix (Willow) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Powdery Mildew (<i>Erysiphe</i>) p. 8	Whitish-gray, powdery or felt-like growth appears on leaves; symptoms usually don't appear until early to midsummer; premature leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation; • highly susceptible cultivars can be sprayed with fungicides as soon as symptoms are evident and repeated as necessary; 	*harpin protein *horticultural oil mancozeb + copper hydroxide mancozeb + thiophanate methyl myclobutanil *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon

Salix (Willow) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
<p>Willow Blight (Complex of Black Canker, <i>Glomerella miyabeana</i> and Scab, <i>Venturia saliciperda</i>) p. 92</p>	<p>Symptoms of both diseases are very similar and most landscape trees are infected by both pathogens; Symptoms of scab include a rapid blighting of leaves and shoots; young leaves are killed as they emerge from the buds and the pathogen moves into the small twigs through the petioles; symptoms of black canker are similar but usually don't develop until later in the season; brown to black spots first appear on leaves in midsummer; a rapid blighting of leaves and shoots occurs and blackened lesions or cankers develop as the fungus readily moves from the petiole of infected leaves into the twig where girdling cankers are formed; cankers appear as discolored depressions in the bark and cause splitting; these cankers develop on larger-diameter wood than those associated with scab; blight kills highly susceptible trees by repeated defoliation and destruction of shoots; most species have some degree of susceptibility since both fungi are considered to be aggressive pathogens; willow blight is favored by wet weather;</p>	<ul style="list-style-type: none"> • prune and remove infected twigs or branches; • some resistance has been reported (<i>S. babylonica</i>, <i>S. pentandra</i>); • maintain vigor; 	<p>No chemical control is suggested.</p>

Sassafras (Sassafras)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Anthracnose (<i>Colletotrichum</i>) p. 114	Irregular, brown to reddish-brown (often papery) areas develop along and sometimes between veins and at leaf margins; symptoms are very similar to those associated with drought and heat stress; some defoliation may occur when infection is heavy; occasional tip dieback; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune dead twigs and branches; • chemical control is usually not necessary except for new transplants, young or specimen trees, or when defoliation has been heavy for several years; fungicide sprays can be applied at budbreak and repeated 2-3 times at label intervals; 	chlorothalonil *harpin protein mancozeb *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil

Sassafras (Sassafras) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Armillaria Root Rot (<i>Armillaria</i> spp. complex) p. 326	<p>Also called shoestring root rot and honey mushroom rot; this disease is difficult to identify since aboveground symptoms appear as general and progressive decline that leads to the eventual death of trees; trees can die singly or in groups; trees under environmental or site-related stresses are particularly susceptible; diagnostic signs of the infection include black strands of the fungus called rhizomorphs (shoestrings) on the surface of the bark or at the base of infected trees, white fans of fungal growth with “mushroomy” odors under the bark, and the occasional growth of honey mushrooms at the base of infected trees in autumn; narrow, black lines are often evident in infected wood; the fungus can persist in stumps and large, woody roots for as long as 30 years;</p>	<ul style="list-style-type: none"> • maintain tree vigor; • avoid any unnecessary stresses, esp. drought stress; • avoid planting susceptible trees in a site where this disease has been confirmed; • if replanting in the site, the stump and all woody roots greater than ½ inch in diameter should be removed; 	<p>No chemical control is suggested.</p>
Canker (<i>Botryosphaeria</i> , <i>Nectria</i>) p. 120, 176	<p>Symptoms include progressive dieback of twigs and branches, usually first evident on lower limbs and proceeding up the tree; cankers appear as sunken areas of bark on branches or the main trunk;</p>	<ul style="list-style-type: none"> • prune and remove symptomatic twigs and branches as soon as evident; • cuts should be made below visible symptoms when bark is dry; • maintain vigor since drought-stressed or winter-injured trees are more vulnerable; • avoid mechanical injuries; • maintain vigor; 	<p>No chemical control is suggested.</p>

Sassafras (Sassafras) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Powdery Mildew (<i>Erysiphe</i>) p. 8	Whitish-gray, powdery or felt-like growth appears on leaves; symptoms usually don't appear until early to midsummer; premature leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation; • highly susceptible cultivars can be sprayed with fungicides as soon as symptoms are evident and repeated as necessary; 	<ul style="list-style-type: none"> *harpin protein *horticultural oil mancozeb + copper hydroxide mancozeb + thiophanate methyl myclobutanil *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon
Verticillium Wilt (<i>Verticillium</i> spp.) p. 242	Flagging or wilting of individual limbs or portions of the canopy, usually in midsummer; leaves can be undersized and infected trees sometimes have heavy seed set; trees die slowly or suddenly, depending on the extent of infection and overall health of the tree; a distinctive olive-brown streaking may be evident in the wood of symptomatic branches or twigs; laboratory examination and culturing are usually required for definitive identification;	<ul style="list-style-type: none"> • prune and remove affected limbs as soon as symptoms are evident; • disinfest tools between cuts; • promote tree vigor; • avoid drought stress; • do not replant susceptible species in the area since the fungus is soilborne (refer to list of resistant species, Table 1); 	No chemical control is suggested.

***Sophora* (Japanese Pagoda-tree, Pagoda-tree)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Canker and Twig Blight <i>(Fusarium lateritium)</i> p. 186	Cankers result in twig dieback and subsequent thinning of the canopy; cankers are annual and often initiated at wounds; they are elliptical and tan, with purplish-brown margins that are readily distinguished from healthy tissues; cankers are often associated with freeze damage; peach-colored fruiting structures are often found erupting from lenticels within the cankers;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding; • maintain tree vigor; 	No chemical control is suggested.
Twig Blight <i>(Nectria cinnabarina)</i> p. 176	Random dieback of branches and limbs; usually associated with sunken cankers that are often covered with distinctive coral-colored or orange fruiting structures of the fungus; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs as soon as detected when bark is dry; • avoid wounding; • maintain tree vigor; 	No chemical control is suggested.
Verticillium Wilt <i>(Verticillium spp.)</i> p. 242	Flagging or wilting of individual limbs or portions of the canopy, usually in midsummer; leaves can be undersized and infected trees sometimes have heavy seed set; trees die slowly or suddenly, depending on the extent of infection and overall health of the tree; a distinctive olive-brown streaking may be evident in the wood of symptomatic branches or twigs; laboratory examination and culturing are usually required for definitive identification;	<ul style="list-style-type: none"> • prune and remove affected limbs as soon as symptoms are evident; • disinfest tools between cuts; • promote tree vigor; • avoid drought stress; • do not replant susceptible species in the area since the fungus is soilborne (refer to list of resistant species, Table 1); 	No chemical control is suggested.

***Sorbus* (Mountain Ash)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Cankers <i>(Cytospora, Fusicoccum)</i> p. 172	Progressive wilting and dieback of branches; sunken or swollen, discolored areas develop on twigs, branches, and limbs; as these cankers enlarge, they encircle and girdle the affected plant part and result in death of these tissues; small fruiting structures of the fungus can develop in the cankered areas; symptoms are more pronounced on trees weakened by environmental or site-related stresses;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs and branches when bark is dry; • maintain vigor; • avoid wounding or unnecessary stresses; 	No chemical control is suggested.

Sorbus (Mountain Ash) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Fire Blight (<i>Erwinia amylovora</i>) p. 376	Flowers wither and blacken; young twigs and branches die from the terminals back and appear as though "burned"; affected limbs frequently develop a characteristic shepherd's crook at the tips; dead leaves usually remain attached to the branch; sunken, discolored cankers may be evident on branches or the main trunk; symptoms often develop in a relatively short period of time; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • avoid excessive nitrogen fertilization or vigor; • overwintering cankers should be pruned and removed during the winter; make cuts at least 10-12 inches below visible symptoms when bark is dry; • during the growing season, prune and remove infected branches as soon as they develop; make cuts at least 10-12 inches below visible symptoms when bark is dry; • disinfest tools between cuts; • recent studies with infected fruit trees have shown that the old method of cutting 8-10 inches below visible symptoms of growing-season blight strikes has certain limitations; new research has shown that bacteria can sometimes be found as far as 9 feet beyond visible symptoms on highly susceptible trees; they suggest that cuts on symptomatic shoots should be made back to 2-year or older wood and at least 8-12 inches below the visible symptoms; 	*copper hydroxide copper salts of fatty and rosin acids copper sulphate pentahydrate *harpin protein mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i>

(continued on next page)

Sorbus (Mountain Ash) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Fire Blight (Cont'd)		<ul style="list-style-type: none"> • these cuts often leave a 4-5 inch naked stub above the next leaf or branch, so this method has been called the “ugly stub” method; cuts should be made when the bark is dry; the presence of “ugly stubs” in the tree will flag infection sites for follow-up with winter pruning; • preventative copper sprays can be applied to the bark before growth emerges in spring; additional applications may be necessary to protect newly emerging shoots until flowering; select the appropriate product if harvesting fruit for consumption; 	
Leaf Blotch (<i>Colletotrichum</i>) p. 114	Symptoms include blossom blight, leaf spots, leaf and shoot blights, cankers, dieback of twigs and branches, and tree death; large, irregular, necrotic areas develop on leaves and result in early defoliation; trees weakened by environmental and site-related stresses are more susceptible;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune any infected twigs and branches when bark is dry; • provide good air circulation; • maintain tree vigor; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied when new growth begins and repeated as necessary according to label directions; 	*harpin protein mancozeb mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl

Sorbus (Mountain Ash) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Leaf Spot <i>(Diplocarpon mespili)</i> p. 78	Discrete, circular, dark-brown spots develop on leaves; when numerous, they coalesce and form large, dead blotches; fruiting structures of the fungus develop under the cuticle of lesions and give the spots a blister-like appearance; significant early leaf drop can occur;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • provide good air circulation; • maintain tree vigor; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as new growth emerges in spring and repeated as necessary according to label directions; 	*harpin protein mancozeb mancozeb + copper hydroxide mancozeb + myclobutanil mancozeb + thiophanate methyl *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil

Sorbus (Mountain Ash) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Rusts <i>(Gymnosporangium</i> <i>spp.)</i> p. 262	Since several rust species attack this host, symptoms can vary; the most common rusts in the landscape are cedar-hawthorn (<i>G. globosum</i>) and quince (<i>G. clavipes</i>); distinctive yellowish-orange spots first appear on upper leaf surfaces in late May or June; as the fungus develops in the leaf, spots become noticeable on the undersurfaces; on close examination and depending on which species of fungus is responsible, rings of small, cup-like structures or long, tendrils of the fungus are visible; heavily infected leaves become chlorotic and often drop prematurely by mid-July; these rust fungi require other hosts (<i>Juniperus</i> spp.) in order to complete their life cycles; a detailed fact sheet is available upon request;	<ul style="list-style-type: none"> • for specimen trees, eliminate the alternate hosts (any red cedar or juniper species) within a one-mile radius, if possible; • resistant species are available (e.g., <i>M. baccata</i> 'Ellwangerina'; <i>M. floribunda</i> 'Henry Kohankie,' 'Ormiston Roy,' 'Red Baron'); a more extensive list is available upon request; • fungicide sprays can be applied when new growth is emerging in spring; this is usually when the gelatinous, orange telial horns are visible on the junipers (usually mid-May); sprays are repeated as necessary at label intervals; • select the appropriate fungicide if harvesting fruit for consumption; 	azoxystrobin chlorothalonil chlorothalonil + fenarimol copper salts of fatty and rosin acids fenarimol ferbam flutolanil *harpin protein mancozeb mancozeb + myclobutanil mancozeb + thiophanate methyl myclobutanil propiconazole *QST 713 strain of <i>Bacillus subtilis</i> *sulfur thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon trifloxystrobin

Sorbus (Mountain Ash) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Scab (<i>Venturia inaequalis</i>) p. 86	Circular, olive-black, velvety spots with feathery, diffuse margins develop on leaves, fruit, and young fruit stems; heavy infections result in leaf yellowing and significant defoliation in midsummer; infected fruit often crack and occasionally drop;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • maintain tree vigor since repeated defoliation weakens trees; • chemical control is usually not necessary except for new transplants, young or specimen trees, or when defoliation has been heavy for several years; fungicide sprays can be applied at budbreak and repeated 2-4 times at label intervals; early-season sprays are very important; 	copper sulphate pentahydrate *harpin protein mancozeb mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl

Spirea (Spirea)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Fire Blight (<i>Erwinia amylovora</i>) p. 376	While only an occasional problem, when infection does occur, disease can develop quite rapidly and destroy individual trees in a single season; flowers appear water-soaked, burned, and then shrivel but usually remain attached throughout the season; when new shoots are infected, they develop a distinctive “shepherd’s crook” and appear scorched or burned; blackened leaves cling to the branch and don’t fall off; cankers, identified as sunken, discolored areas on branches or the main trunk, may appear wet and oozing during wet weather in spring; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove infected branches at least 10-12 inches below visible symptoms when bark is dry; • disinfest tools between cuts; • avoid excessive nitrogen fertilization or vigor; 	No chemical control is suggested.
Powdery Mildew (<i>Podosphaera</i>) p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	azoxystrobin chlorothalonil *harpin protein *horticultural oil mancozeb myclobutanil *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon

Syringa (Lilac)

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Ascochyta Blight (<i>Ascochyta syringae</i>) p. 38	Initial symptoms develop in spring as newly emerging shoots appear blighted and shrivel, droop, and turn brown; foliar symptoms also develop in late summer and early autumn and appear as olive-green, water-soaked lesions; these vary from discrete spots to large, irregular lesions; can be confused with bacterial and Phytophthora blights; especially problematic during wet weather;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune and remove blighted shoots and cankered limbs; • fungicide sprays have questionable results but can be applied when new shoots emerge in spring and repeated as necessary according to label directions; 	chlorothalonil *harpin protein *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + chlorothalonil
Bacterial Blight (<i>Pseudomonas syringae</i> pv. <i>syringae</i>) p. 368	Leaves, shoots, and sometimes flower clusters shrivel and die; first symptoms are irregular to circular, black, water-soaked spots with occasional yellow halos; spots coalesce and leaves develop a blighted appearance; petioles and tender stems become infected, turn brown to black, and droop; elongate, black cankers often develop on current-season wood; blighted tissues usually persist on the tree; symptoms are very similar to frost injury and Phytophthora blight; often requires microscopic examination for identification;	<ul style="list-style-type: none"> • prune symptomatic leaves and shoots well below obvious symptoms as soon as possible; • disinfest tools between cuts; • maintain vigor but avoid excessive fertilization; • provide adequate spacing between plants for good air circulation; • protectant sprays can be applied as new growth emerges in spring and repeated as necessary according to label directions; 	*copper sulfate copper sulphate pentahydrate *elemental copper *harpin protein mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i>
Phytophthora Blight (<i>Phytophthora cactorum</i>) p. 354	Dark-brown, irregular lesions develop on leaves, shoots, and flower clusters; dark - brown lesions appear on petioles and new shoots resulting in a collapsed or blighted appearance; symptoms are very similar to bacterial blight; often requires microscopic examination for identification;	<ul style="list-style-type: none"> • prune symptomatic leaves and shoots well below obvious symptoms as soon as possible; • disinfest tools between cuts; • avoid overhead irrigation; • maintain vigor but avoid excessive fertilization; 	No chemical control is suggested.

Syringa (Lilac) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Powdery Mildew (<i>Erysiphe</i>) p. 8	Very heavy, white to grayish, powdery growth on leaves, usually most visible on the upper surfaces of leaves; develops fairly late in the season; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • spraying is usually not necessary since the disease has no significant impact on plant health; on specimen plants, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	azoxystrobin chlorothalonil *harpin protein *horticultural oil mancozeb + thiophanate methyl myclobutanil *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> *sulfur thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon
Witches' Broom (<i>Candidatus</i> <i>Phytoplasma fraxini</i>) p. 390	Numerous, slender shoots forming witches' brooms proliferate from random locations on branches; leaves on these shoots are usually chlorotic and undersized; brooms are frequently not winter-hardy; entire plants can die within a few years of forming witches' brooms; late-flowering species seem to be particularly susceptible; caused by the same phytoplasma responsible for Ash Yellows;	<ul style="list-style-type: none"> • prune and remove symptomatic limbs or entire plants; • maintain vigor; • avoid planting late-flowering species where this disease is prevalent; • insect vectors such as leafhoppers are involved in disease transmission but have not yet been identified; 	No chemical control is suggested.

Taxus (Yew)

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Armillaria Root Rot <i>(Armillaria spp. complex)</i> p. 326	Also called shoestring root rot and honey mushroom rot; this disease is difficult to identify since aboveground symptoms appear as general and progressive decline that leads to the eventual death of trees; trees can die singly or in groups; trees under environmental or site-related stresses are particularly susceptible; on conifers, excessive resin production at points of infections or at the bases of trees can be important symptoms of infection; the diagnostic black strands of the fungus called rhizomorphs (shoestrings) are usually not present on conifers; signs of the infection include white fans of fungal growth with “mushroomy” odors under the bark and the occasional growth of honey mushrooms at the base of infected trees in autumn; the fungus can persist in stumps and large, woody roots for as long as 30 years;	<ul style="list-style-type: none"> • maintain vigor; • avoid any unnecessary stresses, esp. drought stress; • avoid planting susceptible trees in a site where this disease has been confirmed; • if replanting in the site, the stump and all woody roots greater than ½ inch in diameter should be removed; 	No chemical control is suggested.
Botryosphaeria Canker <i>(Botryosphaeria)</i> p. 120	Random dieback of branches and limbs; usually associated with sunken cankers in which black fruiting structures of the fungus may be visible; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding and unnecessary stress such as drought stress; • maintain tree vigor; 	No chemical control is suggested.

***Taxus* (Yew) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Dieback <i>(Abiotic)</i> p. 502	Symptoms include unexplained dieback and collapse of new and established plants; early symptoms appear as yellowing of growing tips followed by general yellowing, wilting, collapse, and death of the entire plant; a "wet" decay or rot is often evident at the root/crown area; usually associated with unfavorable soil conditions that include acidic soil pH (4.0-5.4) and heavy, poorly-drained soils;	<ul style="list-style-type: none"> • maintain vigor; • pay attention to planting site and soil conditions since <i>Taxus</i> is particularly susceptible to wet soil; 	No chemical control is suggested.
Oedema <i>(Abiotic)</i> p. 502	Symptoms first appear as raised, water-soaked blisters on the undersides of needles; blisters eventually become corky and tan to rusty-brown; often misidentified as insects (e.g., scale); frequently associated with heavy, wet soils;	<ul style="list-style-type: none"> • maintain vigor; • avoid planting in wet or poorly-drained sites; 	No chemical control is suggested.
Root and Stem Rot <i>(Phytophthora)</i> p. 354	Infected plants generally exhibit poor vigor; needles appear dull, olive-green, and wilted but usually remain attached to branches; branches and twigs shrivel; symptoms may be confined to individual branches or may develop progressively until the entire plant is involved; a diagnostic cinnamon-brown discoloration may be evident when cuts are made into the wood at the root/crown area; frequently more serious on shrubs where excess water is a persistent problem (e.g., clay soils, low areas);	<ul style="list-style-type: none"> • plants cannot be cured once they are infected; • rogue and remove symptomatic plants; • avoid excessive irrigation and improve drainage; • maintain vigor; • healthy, uninfected plants adjacent to symptomatic plants can be protected with fungicide applications applied according to label directions; 	fosetyl-Al *harpin protein mefenoxam *QST 713 strain of <i>Bacillus subtilis</i>

***Thuja* (Arborvitae)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
“Black” Disease <i>(Unknown)</i>	Needles develop a distinctly shiny black appearance; symptoms can be randomly distributed throughout the plant and do not appear to be associated with site, age, or cultivar; possible suggestions for causes include nutrient deficiencies or toxicities and air pollutants;	<ul style="list-style-type: none"> • maintain vigor; 	No chemical control is suggested.
Botryosphaeria Canker <i>(Botryosphaeria)</i> p. 120	Random dieback of branches and limbs; usually associated with sunken cankers in which black fruiting structures of the fungus may be visible; problematic on trees weakened by other factors such as drought;	<ul style="list-style-type: none"> • prune affected limbs back to healthy wood as soon as detected and when bark is dry; • avoid wounding and unnecessary stress such as drought stress; • maintain tree vigor; 	No chemical control is suggested.
Botrytis Blight <i>(Botrytis cinerea)</i> p. 72	Affected tissues initially appear water-soaked and then turn brown; infections are identified by the gray, fuzzy, cottony growth of the fungus on the surface of needles and shoots; the fungus moves from the needles to the shoots and into the stems causing a twig blight; with the exception of weak trees, infections usually do not extend beyond the tips or current season’s growth and are often confined to tissues that have been damaged by frost; most symptomatic tissues drop off during the season;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs; • maintain vigor; • attention to planting site to avoid potential frost pockets; 	No chemical control is suggested.

***Thuja* (Arborvitae) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Diplodia Blight [Sphaeropsis Tip Blight] <i>(Diplodia pinea)</i> p. 130	Tip blight results from infection of buds and shoots; infected buds and shoots usually stop growing before or during needle elongation and needles are frequently short; infected tissues are straw-colored; usually kills only current-season buds and shoots, but can cause significant dieback on trees under stress, especially under drought stress; black fruiting structures of the fungus may be visible on infected shoots; symptoms may be distributed uniformly throughout the canopy or concentrated in lower branches; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove blighted twigs and branches during dry weather in autumn; • maintain tree vigor with special attention to watering during periods of drought; • fungicide sprays can be applied at budbreak and repeated as necessary at label intervals until needles are fully expanded; 	copper sulphate pentahydrate *harpin protein mancozeb *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil
Needle Browning and Shedding <i>(Abiotic)</i> p. 520	“Symptoms” develop as the older, inner branches turn brown and drop in the fall; this is a perfectly normal phenomenon similar to deciduous trees dropping leaves in the fall; however, when the previous growing season is stressful (due to drought or excess water), shedding can be more synchronous and more dramatic and heavier than usual;	<ul style="list-style-type: none"> • maintain vigor; 	No chemical control is suggested.

***Thuja* (Arborvitae) cont'd**

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Tip Blight (Abiotic)	Tips and whole sections of branches progressively turn brown and die; affected needles usually remain attached to the branches; symptoms are frequently distributed uniformly on the shrub and are most obvious in spring; since secondary fungi occasionally infect these dead tissues, microscopic examination is necessary to rule out fungal tip blights (see above);	<ul style="list-style-type: none"> • prune and remove as much of the affected portions of the shrub as practical; this helps to reduce problems associated with secondary invaders and opportunistic pests; • maintain vigor; 	No chemical control is suggested.
Twig Blights (<i>Kabatina</i> , <i>Pestalotiopsis</i> , <i>Phomopsis</i>) p. 146, 190	Tips and whole sections of branches progressively die and turn brown; affected needles usually remain attached to the branches; symptoms are frequently uniformly distributed over the shrub and are most obvious in spring or early summer; immature or newly expanding needles are most susceptible; upon close inspection, black fruiting bodies of these fungi are evident in browned tissues; microscopic examination is necessary to differentiate these causal fungi;	<ul style="list-style-type: none"> • prune and remove infected twigs and branches; • avoid overhead irrigation and excessive crowding; • severely infected plants should be rogued and removed; • maintain vigor; • fungicide sprays can be applied as new growth emerges in spring and repeated at label intervals until growth is fully expanded and mature; 	chlorothalonil *harpin protein mancozeb mancozeb + copper hydroxide *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil

***Thuja* (Arborvitae) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Winter Injury <i>(Abiotic)</i> p. 498	Browning, dieback, and shriveling of branches and twigs; symptoms can be extensive and are most evident in late winter or early spring as growth resumes; sub-lethal damage to the cambium may also occur and appears in early summer as a sudden, "unexplained" collapse; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • prune and remove symptomatic tissues to minimize secondary invaders and opportunistic pests; • maintain vigor; • provide adequate moisture in the root zone before the ground freezes; • provide physical (e.g., burlap wraps) and/or chemical (e.g., applications of anti-transpirants) protection in wind-swept areas or in areas prone to extreme temperature fluctuations during the winter; this is especially important for new transplants; 	No chemical control is suggested.

***Tilia* (Basswood, Linden)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Anthracnose <i>(Glomerella)</i>	Irregular, brown to reddish-brown areas develop along and sometimes between veins and at leaf margins; symptoms are very similar to those associated with drought and heat stress; some defoliation may occur when infection is heavy; occasional tip dieback;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune dead twigs and branches; • chemical control is usually not necessary except for new transplants, young or specimen trees, or when defoliation has been heavy for several years; fungicide sprays can be applied at budbreak and repeated 2-3 times at label intervals; 	copper salts of fatty and rosin acids *harpin protein mancozeb mancozeb + copper hydroxide propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil
Botryosphaeria Canker <i>(Botryosphaeria)</i> p. 120	Symptoms include progressive dieback of twigs and branches, usually first evident on lower limbs and proceeding up the tree; cankers appear as sunken areas of bark on branches or the main trunk;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs and branches as soon as evident; • cuts should be made below visible symptoms when bark is dry; • maintain vigor since drought-stressed or winter-injured trees are more vulnerable; • avoid mechanical injuries; • maintain vigor; 	No chemical control is suggested.

***Tilia* (Basswood, Linden) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Leaf Blotch <i>(Didymosphaeria)</i> p. 36	Irregular lesions with somewhat feathery margins first appear water-soaked then change to brown; symptoms are usually delayed and appear in midsummer; diseased leaves shrivel and drop prematurely; heavily infected trees are defoliated by September;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune dead twigs and branches; • chemical control is usually not necessary except for new transplants, young or specimen trees, or when defoliation has been heavy for several years; fungicide sprays can be applied at budbreak and repeated 2-3 times at label intervals; 	<ul style="list-style-type: none"> *copper hydroxide *harpin protein mancozeb + copper hydroxide propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl
Nectria Canker <i>(Nectria and Neonectria)</i> p. 176	Symptoms include progressive dieback of twigs and branches, usually first evident on lower limbs and proceeding up the tree; cankers appear as sunken areas of bark on branches or the main trunk; brightly colored coral or reddish-orange fruiting structures of the fungus may be visible in the cankers;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs and branches as soon as evident; • cuts should be made below visible symptoms when bark is dry; • maintain vigor since drought-stressed or winter-injured trees are more vulnerable; • avoid mechanical injuries; • maintain vigor; 	No chemical control is suggested.

***Tilia* (Basswood, Linden) cont'd**

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Powdery Mildew (<i>Erysiphe</i>) p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	copper sulphate pentahydrate *harpin protein *potassium bicarbonate propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil
Verticillium Wilt (<i>Verticillium</i> spp.) p. 242	Flagging or wilting of individual limbs or portions of the canopy, usually in midsummer; leaves can be undersized and infected trees sometimes have heavy seed set; trees die slowly or suddenly, depending on the extent of infection and overall health of the tree; a distinctive olive-brown streaking may be evident in the wood of symptomatic branches or twigs; laboratory examination and culturing are usually required for definitive identification;	<ul style="list-style-type: none"> • prune and remove affected limbs as soon as symptoms are evident; • disinfest tools between cuts; • promote tree vigor; • avoid drought stress; • do not replant susceptible species in the area since the fungus is soilborne (refer to list of resistant species, Table 1); 	No chemical control is suggested.

***Tsuga* (Hemlock)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Cytospora Canker <i>(Cytospora/Valsa)</i> p. 166	Symptoms include progressive dieback of twigs and branches, usually first evident on lower limbs and proceeding up the tree; cankers appear as sunken areas of bark on branches or the main trunk but are often very difficult to see; needle browning and drop may occur on infected, girdled branches;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs and branches as soon as evident; • cuts should be made at least 8-10 inches below visible symptoms when bark is dry; • maintain vigor since drought-stressed or winter-injured trees are more vulnerable; • take care in selecting planting site; • avoid mechanical injuries; 	No chemical control is suggested.
Dieback and Decline <i>(Abiotic)</i> p. 492	Needles yellow and brown and branch tips die back; this typically occurs in mid- to late summer but can appear in spring when new growth begins; symptoms are often most apparent on current-season needles but can occur on older needles and branches; significant needle drop can occur; no fruiting structures are evident in affected needles; symptoms can be random or uniformly distributed throughout the canopy; hemlocks are particularly sensitive to drought, high temperatures, and heavy shade;	<ul style="list-style-type: none"> • avoid drought stress and maintain tree vigor; • prune dead branches to avoid secondary invaders or opportunistic pests; • mulch to moderate soil temperatures; • avoid planting on rocky slopes or areas where root penetration into the soil is limited; • give root system a deep soaking before the ground freezes; 	No chemical control is suggested.

Tsuga (Hemlock) cont'd

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Needle Rust (<i>Melampsora</i>) p. 286	Several rust species infect hemlock; one species is autoecious and completes its life cycle on hemlock; another species requires members of <i>Populus</i> as alternate hosts; symptoms can develop on cones, needles, and green shoots; initial symptoms appear in late spring on newly emerged tissues; affected shoots are curled, slightly swollen, or twisted; bright orangy-yellow, powdery spores cover the affected tissues; infected shoots gradually turn brown and shrivel;	<ul style="list-style-type: none"> • maintain vigor; • prune dead twigs when necessary; • spraying is usually not necessary since the disease has no significant impact on plant health; on specimen plants, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	azoxystrobin *harpin protein mancozeb *QST 713 strain of <i>Bacillus subtilis</i> triadimefon

***Ulmus* (Elm)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Bacterial Wetwood and Slime Flux <i>(Bacteria and yeasts)</i> p. 384	This disease complex is usually not an important problem for landscape trees but it can cause unsightly and unpleasant conditions for homeowners; wet streaks are visible on the outer bark of the main trunk where liquids seep out of cracks or fissures in the bark; depending on the organisms responsible, the ooze can be bubbly, amber, and have a foul odor, or it can be colorless and have an “alcoholic,” fermentative odor; oozing can be extensive at certain times of the year; the slime can be toxic to the cambium; when these tissues are killed, additional cracks may develop; some discoloration of the wood may occur but there are usually no symptoms in the canopy;	<ul style="list-style-type: none"> • maintain vigor • wash off oozing liquid with a stiff spray of water; • do not insert pipes or drainage tubes to relieve pressure; 	No chemical control is suggested.
Black Spot <i>(Stegophora ulmea)</i> p. 96	Small, yellow spots first appear on upper leaf surfaces early in the season; these spots gradually darken and develop into raised, black spots with yellow halos; when numerous, the spots coalesce and can cause distortion; in wet years, lesions may also form on petioles and succulent stems resulting in a blighted appearance; severe infections can result in near-complete defoliation in early August; this disease is most problematic after wet spring weather and has been very heavy for the past few years;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • prune and remove symptomatic, blighted tips; • maintain vigor; • provide adequate spacing to allow good air circulation; • fungicide sprays can be applied at budbreak and repeated 2-4 times at label intervals; 	*harpin protein mancozeb mancozeb + copper hydroxide mancozeb + myclobutanil *QST 713 strain of <i>Bacillus subtilis</i>

***Ulmus* (Elm) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Canker <i>(Botryosphaeria)</i> p. 120	Bark of infected twigs appears water-soaked and develops slightly swollen or sunken lesions; inner bark becomes reddish-brown or blackened; small twigs are frequently girdled and killed; cankers on older branches can become perennial and are elliptical; more common on trees under stress from drought or winter injury;	<ul style="list-style-type: none">• maintain tree vigor;• prune and remove symptomatic twigs and branches back to sound wood when bark is dry;	No chemical control is suggested.

***Ulmus* (Elm) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Dutch Elm Disease <i>(Ophiostoma novo-ulmi)</i> p. 240	Symptoms of this historically important disease include “flagging” of individual branches or limbs in midsummer due to yellowing, wilting, and premature drop of leaves; progressive involvement of other parts of the crown continues from year to year since the pathogen is systemic in the tree; branches may die within a few weeks or over several years; diagnostic brown streaks may be visible in the sapwood of symptomatic twigs although their absence does not indicate lack of infection; disease is spread through root grafts and through the activities of two bark beetles, <i>Hylurgopinus rufipes</i> and <i>Scolytus multistriatus</i> ; laboratory examination and culturing of the fungus are usually required for definitive identification;	<ul style="list-style-type: none"> • prune and remove symptomatic limbs at least 5-10 feet below visible symptoms or vascular streaking; • promptly remove highly symptomatic trees and any dead elm wood in the vicinity (approx. 700 feet) to eliminate places for elm bark beetles to breed and acquire the pathogen; • control bark beetles; refer to the <i>Pesticide Guide Toward Integrated Pest Management for Connecticut Arborists</i> 2006 by K. Welch and T. Abbey for information on specific insecticides; • avoid root grafts; • maintain overall vigor; • resistant cultivars (e.g., ‘Valley Forge,’ ‘New Harmony,’ ‘Liberty’) and species (e.g., Siberian, Chinese) are available; • fungicides can be applied as injections when infections are recognized early (e.g., when no more than 5-10% of the canopy is symptomatic); 	<p>carbendazim copper sulphate pentahydrate *harpin protein propiconazole *QST 713 strain of <i>Bacillus subtilis</i> thiabendazole</p>

***Ulmus* (Elm) cont'd**

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Leaf Blister (<i>Taphrina</i>) p. 4	Slightly raised, thickened, yellow spots or blisters develop on leaves shortly after emergence; some leaf drop can occur when infection is heavy;	<ul style="list-style-type: none"> • maintain vigor; • spraying is usually not necessary; however, on specimen or newly transplanted trees, fungicide sprays can be applied before buds begin to swell in spring; 	<ul style="list-style-type: none"> *harpin protein mancozeb *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl + chlorothalonil
Powdery Mildew (<i>Erysiphe</i>) p. 8	White to grayish, powdery growth develops on leaves; usually most visible on the upper surfaces of leaves; usually develops fairly late in the season; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	<ul style="list-style-type: none"> chlorothalonil *harpin protein mancozeb + myclobutanil mancozeb + thiophanate methyl myclobutanil propiconazole *QST 713 strain of <i>Bacillus subtilis</i> *sulfur thiophanate methyl thiophanate methyl + chlorothalonil thiophanate methyl + flutolanil triadimefon

***Ulmus* (Elm) cont'd**

Disease (Pathogen/Cause)	Diagnostic Symptoms	Management	Materials
Yellows (<i>Candidatus</i> <i>Phytoplasma ulmi</i>) p. 390	Initial symptoms are epinasty, yellowing, and wilting of leaves throughout the crown of the tree; leaves can drop prematurely in midsummer; this is often followed by branch death; symptomatic trees can persist for several years or die within one year of first symptoms; root mortality is a key part of the disease syndrome; infected wood has a yellowy-butterscotch color and a unique wintergreen odor when freshly cut; phloem-feeding leafhoppers are thought to transmit the phytoplasma from tree to tree; this disease was formerly called "Elm Phloem Necrosis"; often confused with Dutch Elm Disease;	<ul style="list-style-type: none"> • rogue and remove highly symptomatic trees; • maintain vigor; • tolerant species are available (e.g., European and Asiatic species, other hybrids); 	No chemical control is suggested.

***Viburnum* (Viburnum)**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Bacterial Blight <i>(Pseudomonas syringae</i> pv. <i>syringae)</i> p. 368	Leaves, shoots, and sometimes flower clusters shrivel and die; first symptoms are irregular to circular, black, water-soaked spots with occasional yellow halos; spots coalesce and leaves develop a blighted appearance; petioles and tender stems become infected, turn brown to black, and droop; elongate, black cankers often develop on current-season wood; blighted tissues usually persist on the tree; symptoms are very similar to frost injury; particularly problematic during cool, wet spring weather; often requires microscopic examination for identification;	<ul style="list-style-type: none"> • prune symptomatic leaves and shoots well below obvious symptoms as soon as possible; • disinfest tools between cuts; • maintain vigor but avoid excessive fertilization; • protectant sprays can be applied as new growth emerges in spring and repeated as necessary according to label directions; 	<ul style="list-style-type: none"> *copper hydroxide *harpin protein *QST 713 strain of <i>Bacillus subtilis</i>
Botryosphaeria Canker <i>(Botryosphaeria)</i> p. 120	Wilting and dieback are first apparent on individual limbs but may encompass the entire shrub; leaves usually droop and brown yet remain attached to the stem; discolored cankers appear on killed stems or branches;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs and branches when bark is dry; • avoid wounds and drought stress since the fungus is more aggressive on plants that have been weakened by drought or winter injuries; 	No chemical control is suggested.

***Viburnum* (*Viburnum*) cont'd**

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Powdery Mildew <i>(Erysiphe)</i> p. 8	White to grayish, powdery growth on leaves, usually first evident on upper leaf surfaces but can occur on both surfaces of leaves; develops fairly late in the season; some premature fall coloration and leaf drop may occur; refer to fact sheet for more detailed information;	<ul style="list-style-type: none"> • rake and remove fallen leaves; • avoid excessive fertilization since tender, succulent leaves are more susceptible; • provide good air circulation around the tree; • spraying is usually not necessary since the disease has no significant impact on tree health; on specimen trees, fungicides can be applied as soon as symptoms are evident and repeated as necessary; 	chlorothalonil chlorothalonil + fenarimol copper sulphate pentahydrate *harpin protein mancozeb + myclobutanil myclobutanil *potassium bicarbonate *QST 713 strain of <i>Bacillus subtilis</i> thiophanate methyl thiophanate methyl + flutolanil triadimefon

Zelkova (Zelkova)

Disease <i>(Pathogen/Cause)</i>	Diagnostic Symptoms	Management	Materials
Nectria Canker <i>(Nectria spp.)</i> p. 176	Symptoms include progressive dieback of twigs and branches, usually first evident on lower limbs and proceeding up the tree; cankers appear as sunken areas of bark on branches or the main trunk; brightly colored coral or reddish-orange fruiting structures of the fungus may be visible in the cankers;	<ul style="list-style-type: none"> • prune and remove symptomatic twigs and branches as soon as evident; • cuts should be made below visible symptoms when bark is dry; • maintain vigor since drought-stressed or winter-injured trees are more vulnerable; • avoid mechanical injuries; • maintain vigor; 	No chemical control is suggested.
