



Woody Plant Disease Management Guide for Nurseries & Landscapes

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INTRODUCTION

This guide provides general information on symptoms and management approaches to common diseases of woody plants in residential plantings and commercial nurseries. It is intended to serve as an overview. Specific recommendations are included in separate publications and/or spray guides.

DISEASE IDENTIFICATION

It is essential to accurately identify the specific cause(s) of a plant problem in order to determine the correct treatment. Woody landscape ornamentals can succumb to various adverse factors, including diseases caused by infectious agents and symptoms caused by non-infectious agents. Plant diseases (biotic) are caused by microorganisms, such as fungi, fungus-like organisms (water molds), bacteria, nematodes, viruses, and phytoplasmas. Non-infectious problems (abiotic) may be attributed to unfavorable growing conditions such as low or excessive solar radiation, temperature extremes, improper soil pH, nutritional deficiencies or toxicities, and soil moisture deficits or surpluses. These conditions can result from natural occurrences, grower cultural practices, or a combination.

In many cases, plant problems may result from a combination of abiotic and biotic factors. For example, plants grown outside of their natural habitat (not native or adapted to Kentucky conditions) are more likely to become stressed; these stressful conditions can increase plant susceptibility and often are precursors to disease development. In other cases, wounds resulting from physical injury (e.g. due to equipment or hail) or pruning may provide entry points for pathogens, resulting in disease.

Diagnosing plant diseases involves close examination of plants for symptoms and signs. Symptoms are the external response of a plant to a problem and may include one or more of the following, regardless of the underlying cause:

- blight
- cankers or girdling
- dieback
- distortion of tissues
- galls
- leaf scorch
- leaf spot
- leaf drop, senescence
- stem/trunk & root decay
- stunted growth
- wilt
- yellowing/discoloration

Signs are the physical evidence of the causal organism that is responsible for the damage, such as fungal fruiting bodies or bacterial ooze.

Environmental factors and cultural practices, both present and past, are also important factors that can affect plant health, and therefore site history needs to be considered in making a diagnosis.

For assistance with diagnosis, refer to the resources listed at the end of this publication and/or contact a local county Extension agent.

DISEASE MANAGEMENT

Management of woody plant diseases usually combines preventative and curative practices, including a focus on plant health, sanitation, and fungicides or bactericides. Even when fungicides are warranted, following proper cultural management practices is critical and should be adopted regardless of whether the grower is following a no-spray, low-spray, organic, or conventional program.

EXCLUSION

Avoid introduction of pathogens into a planting:

- Purchase and plant only healthy material (transplants, seeds, tubers, and bulbs). Certified clean nursery stock is sometimes warranted.
- Carefully examine foliage, stems, roots, bulbs, and tubers for symptoms of disease or presence of pathogenic propagules before planting. Reject plant material appearing unthrifty or showing evidence of disease.
- Some plants may need to be quarantined before introducing them into production areas, especially in cases where invasive or regulated pathogens could potentially be present.
- Take cuttings for propagation only from healthy, vigorous stock plants.

PLANTING & CULTURAL PRACTICES

Proper care of trees and shrubs often prevents many nursery and landscape problems. Susceptibility to disease is influenced not only by current conditions, but also by conditions and care during previous seasons or years. Many problems can be avoided by following good cultural practices:

- Select plant species and cultivars tolerant to local heat and cold extremes. Native plants or those adapted to Kentucky conditions are less likely to succumb to stresses that predispose them to disease.
- Use disease resistant or tolerant cultivars whenever possible, especially if there has been a history of disease.

- Properly prepare planting sites based on the plant's growth requirements.
- Provide adequate spacing to allow for air circulation, taking into consideration plant size at full maturity. Poor air circulation can result in high humidity within plant canopies, prolonged leaf wetness, and soggy soils, which can be conducive to disease development and pathogen spread.
- Maintain plant vigor by promoting plant health; this will enable plants to better resist diseases and stress-related problems. Water plants during drought, fertilize according to soil test results, and mulch to maintain soil moisture and regulate soil temperatures.
- Follow good pruning practices to optimize tree or shrub callus formation.
- Avoid unnecessary wounding; protect trees and shrubs from mechanical injuries caused by equipment, vehicles, etc.

SANITATION

Some pathogens overwinter on fallen infected leaves, while others use nearby cultivated plants or weeds as overwintering reservoirs. Additionally, plant pathogens can be carried into plantings and spread by footwear, tools, equipment, moving water, blowing soil, and insect vectors. Proper sanitation is an important step in reducing populations of disease agents by eliminating these sources of inoculum (fungal spores, bacterial cells, and virus particles) that initiate disease (Refer to *Landscape Sanitation*, PPFS-GEN-04)

- Use sterile soil or soilless media for potting plants. Small quantities of soil can be sterilized using steam, a dry oven, or a microwave.
- Remove and destroy pruned plant parts, fallen leaves, and culled plants. Never leave diseased plant material in nurseries or landscapes.
- Do not compost diseased plant material, cuttings, or used soil and soilless media. Incomplete composting (internal temperatures below 160°F) may not kill disease propagules, resulting in their survival.
- Disinfect equipment (such as pruners, trowels, shovels, and containers) after they come into contact with diseased plant material or infested soil/soilless media, especially when bacteria, phytoplasmas, and/or viruses may be present. Bleach (10% solution), rubbing alcohol (70%), or a commercial greenhouse sanitizer can be used to disinfect tools or containers; rinse metal tools before storing to help prevent corrosion.
- Pass commercial nursery equipment through a central area where it can be washed to remove soil. For example, equipment may be parked on a bed of coarse rock or a steel grating set over a pit, so that contaminated

soil can be washed from equipment without washing or draining into the rest of the nursery.

- Restrict traffic from outdoor areas to indoor propagation areas. Use footbaths containing a germicidal agent at entrances to clean footwear.
- Divert surface water into ditches or culverts to prevent its movement from one nursery block to another.
- Select a clean source of irrigation water if city water is unavailable. Keep water from becoming contaminated with pests and pathogens. Contact a local county Extension agent for advice on recycling irrigation water.

CROP ROTATION

Rotate to tolerant or resistant plant species or cultivars to break pathogen life cycles. Some soilborne pathogens (*Phytophthora*, *Fusarium*, *Rhizoctonia*, *Sclerotinia*, etc.) can build-up and survive for long periods; in some cases, these pathogens may survive for many years, in soils.

PESTICIDES

Plants can be protected from disease using fungicides, bactericides, and/or nematicides; managing insects that vector disease (e.g. leafhopper, aphids, and thrips) with insecticides can be effective in some instances. Fungicides and bactericides are generally applied as preventatives, not curatives; they should be combined with cultural practices. Even after fungicide applications, damaged leaves often retain discoloration or visual damage as testimony to older infections

Most of the diseases listed in this publication do not require regular pesticide treatments for management. Use routine pesticide applications only when the plant is of high value and a particular disease is a known threat (has occurred in previous seasons, is present in nearby landscapes, is expected in an operation, or is especially devastating).

Before using any pesticide, check the product label to be sure both host and disease are listed; apply only as directed on the label. Familiarity with pesticide labels improves an applicator's ability to make decisions regarding pesticide formulations. Contact a local county Extension agent for current pesticide recommendations.

Foliar sprays. Small trees and shrubs may be sprayed with hand-pumped, bucket, hose-end, backpack, or small power sprayers. Large trees often must be sprayed with large spray machines for proper coverage.

Timing of pesticide applications varies by pathogen; each pathogen has its own optimal conditions for infection and colonization (for example, cool and moist or warm and wet). Diseases often are best controlled when fungicides and bactericides are applied before or soon after infection begins. It is, therefore, essential to have an understanding of conditions favoring disease so that protectant sprays can be applied prior to the occurrence of conducive conditions. Additional sprays might be needed during long periods of such conditions.

Coverage rates vary with pesticide formulations. When using broad spectrum, protectant fungicides, it is essential to cover every leaf, twig, and branch that may become infected by the pathogen. Systemic fungicides, on the other hand, are transported locally or throughout the plant, so complete coverage is less important.

Injections and implants. Control of diseases of certain trees is most effective by injecting fungicides into the sapstream at the trunk's base or on the flare roots. These applications are usually restricted to certified arborists. Injections are useful when sprays are not practical or effective, such as when the plant is too large or when the pathogen is confined to vascular tissue. Annual injections are not recommended, as the injury caused by injection is probably more damaging than the problem being addressed. Implants are less effective than injections and rarely are used.

Soil drench. Soilborne pathogens often require treatment with a fungicide or nematicide drench. These can be applied in bands directly to soil, in trenches before planting, or through drip irrigation. In some cases, systemic fungicides that translocate to roots and crowns can replace a soil drench.

Soil fumigation. General-purpose soil fumigants are designed to eradicate soil-inhabiting organisms including fungi, bacteria, nematodes, insects, plants, and seeds. Highly restricted materials usually are not available to residential or smaller commercial operations; only large commercial operations are prepared to manage this costly option.

Leaf, Bud, Flower & Twig Diseases

Disease/ hosts	Cause	Symptoms	Management
Abiotic			
Dieback & Decline			
Any woody ornamental	Abiotic; underlying causes can include drought, poor growing conditions, transplant shock, and root issues. (Note: dieback and leaf scorch can also have biotic causes; see root, stem/trunk, and vascular diseases.)	Leaves/needles prematurely senesce, die, and drop; sparse foliage in canopy; symptoms occur on one or more branches or over entire tree; small twigs and branches in the upper canopy may die back.	<ul style="list-style-type: none"> ▪ Select plant species/cultivars suitable for the growing site. ▪ Follow proper transplanting techniques at installation. ▪ Promote plant health and reduce stress by following good cultural practices (apply mulch, water during dry periods, maintain proper nutrition and pH). ▪ Avoid wounding trunk and roots (mowers, string trimmers, improper pruning cuts). ▪ Water during periods of low rainfall, but do not overwater. ▪ Sever girdling roots when present. ▪ Control damaging insects. ▪ Prune dead and dying branches to improve appearance. ▪ Avoid de-icing salt exposure and soil compaction; aerate soil in root zone if compaction is a problem. ▪ Protect plants from winter injury, especially if cultivar is not adapted to KY conditions. ▪ See PPFS-OR-W-17, ID-50, and ID-89.
Leaf Scorch Ash, elm, maple, pine, horse chestnut, poplar, and others		On broadleaf plants: brown, dead areas develop along leaf margins and/or between veins. On needled evergreens: needle tips turn brown.	
Bacterial			
Bacterial Blight			
Lilac	<i>Pseudomonas syringae</i> pv <i>syringae</i>	Brown spots develop on leaves and stems; enlarging spots can cause leaf distortion. Leaves die and drop prematurely. Infections in shoots result in wilt and blackened tissues; death of shoots and blossoms follow.	<ul style="list-style-type: none"> ▪ Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade). ▪ Avoid wetting foliage when irrigating plant, nearby plants, or lawn. ▪ Do not work with plants when wet. ▪ Apply copper or other bactericide (note: streptomycin products are labeled for commercial use only). ▪ Remove and destroy diseased plant material and debris.

Leaf, Bud, Flower & Twig Diseases

Disease/ hosts	Cause	Symptoms	Management
Bacterial			
Bacterial Blight / Bacterial Leaf Spot			
Viburnum	<i>Pseudomonas syringae</i> pv <i>viburni</i>	Angular-shaped, water soaked spots develop on leaves, eventually turning brown. Masses of bacterial cells and exudates on leaf surfaces gives foliage a shiny appearance. Developing leaves become distorted; shoots may dieback.	<ul style="list-style-type: none"> ▪ Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade). ▪ Avoid wetting foliage when irrigating plant, nearby plants, or lawn. ▪ Do not work with plants when wet. ▪ Apply copper or other bactericide (note: streptomycin products are labeled for commercial use only). ▪ Remove and destroy diseased plant material and debris.
Bacterial Leaf Spot			
Hydrangea	<i>Xanthomonas campestris</i>	Water-soaked spots become dark reddish-purple, enlarging and coalescing as disease progresses; entire leaves may die. Spots near veins have angular edges.	
Fungal			
Anthracnose			
Ash, maple, oak, redbud, sycamore/planetree, zelkova	Species of <i>Apiognomonia</i> , <i>Aureobasidium</i> , <i>Colletotrichum</i> , <i>Discula</i> , <i>Gnomonia</i> , <i>Gloeosporium</i> , <i>Kabatiella</i> , and others	Symptoms may include: failure to leaf-out in spring, dead spots or blotches on foliage (usually along leaf margins and/or veins), premature defoliation, and cankers causing twig death; more severe on lower and inner leaves/branches. Fungal fruiting structures may be visible as dark specks in symptomatic tissues (use a hand lens).	<ul style="list-style-type: none"> ▪ Plant resistant cultivars when available. ▪ Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade). ▪ Promote plant health and reduce stress by following good cultural practices (apply mulch, water during dry periods, maintain proper nutrition and pH). ▪ Avoid wetting foliage when irrigating plant, nearby plants, or lawn. ▪ Clean up and destroy fallen leaves throughout the growing season and in autumn. ▪ Prune and destroy diseased branches.
Birch	<i>Cryptocline betularum</i> , <i>Discula betulin</i> , and other species (Disease also known as birch leaf spot)	Small spots to large brown blotches or dark rings with light centers develop on leaves in the lower canopy; spots are often surrounded by a yellow border. Developing leaves may be distorted. Leaves turn yellow and drop prematurely.	<ul style="list-style-type: none"> ▪ Fungicides are often unnecessary; however, if disease has been severe previously, preventative fungicide applications may be warranted in early spring. Fungicide applications are not practical for large or tall trees. Refer to product label for details. ▪ See PPF5-OR-W-23.

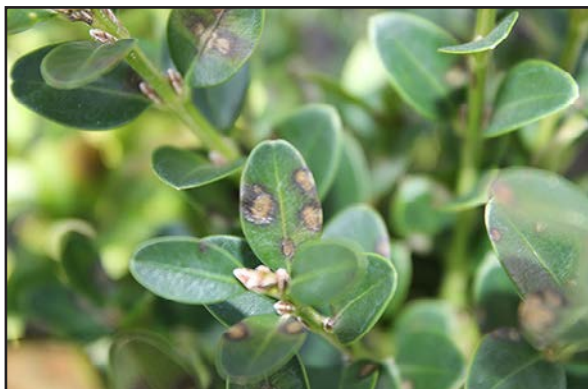
Leaf, Bud, Flower & Twig Diseases

Disease/ hosts	Cause	Symptoms	Management
Fungal			
Anthracnose (cont'd)			
Hydrangea	<i>Colletotrichum gloeosporioides</i>	Circular or irregular brown spots form on leaves and bloom clusters; centers may turn tan. Spots along veins appear angular.	<ul style="list-style-type: none"> ▪ Plant resistant cultivars when available. ▪ Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade). ▪ Promote plant health and reduce stress by following good cultural practices (apply mulch, water during dry periods, maintain proper nutrition and pH). ▪ Avoid wetting foliage when irrigating plant, nearby plants, or lawn. ▪ Clean up and destroy fallen leaves throughout the growing season and in autumn. ▪ Prune and destroy diseased branches. ▪ Fungicides are often unnecessary; however, if disease has been severe previously, preventative fungicide applications may be warranted in early spring. Fungicide applications are not practical for large or tall trees. Refer to product label for details. ▪ See PPFS-OR-W-23.
Rose	<i>Sphaceloma rosarum</i>	Leaf spots have red to purple borders; centers may turn brown or gray, and then drop out (shot-hole). Cane infections result in bright yellow cankers.	
Walnut	<i>Gnomonia leptostyla</i> (asexual stage: <i>Marssonina juglandis</i>) (Disease also known as brown leaf spot)	Dark spots first appear on leaves in the lower interior canopy. Spots range in size from very tiny to about 1/2 inch diameter; yellowing and premature leaf drop follow.	
Black Spot			
Rose	<i>Diplocarpon rosae</i>	Nearly circular black spots with feathery or irregular margins form on upper leaf surfaces. Individual spots may expand to 1/2 inch; coalescing spots produce larger irregular lesions. Yellow halos may form around spots; entire leaves turn yellow and drop prematurely. Defoliation weakens plants and reduces flower production and quality.	<ul style="list-style-type: none"> ▪ Plant resistant cultivars when available. ▪ Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade). ▪ Promote plant health and reduce stress by following good cultural practices (apply mulch, water during dry periods, maintain proper nutrition and pH). ▪ Avoid wetting foliage when irrigating plant, nearby plants, or lawn. ▪ Clean up and destroy fallen leaves throughout the growing season and in autumn. ▪ Prune and destroy diseased branches. ▪ Fungicides are often unnecessary; however, if disease has been severe previously, preventative fungicide applications may be warranted in early spring. Fungicide applications are not practical for large or tall trees. Refer to product label for details. ▪ See PPFS-OR-W-03 and ID-118.

Leaf, Bud, Flower & Twig Diseases


Disease/ hosts	Cause	Symptoms	Management
Fungal			
Boxwood Blight			
Boxwood	<i>Calonectria pseudonaviculata</i> (<i>Cylindrocladium buxicola</i>)	Light or dark brown circular spots with darker borders form on leaves, followed by rapid defoliation. Elongated, dark brown or black streak-like lesions appear on infected stems. This disease is aggressive, spreads rapidly, and is very destructive.	<ul style="list-style-type: none"> ▪ Plant only healthy boxwoods. ▪ Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade). ▪ Do not use overhead irrigation. Avoid wetting foliage when irrigating plant, nearby plants, or lawns. ▪ Avoid transmission of sticky spores by tools, clothing, equipment. ▪ Remove and destroy infected plants and leaf debris. ▪ If disease confirmed, apply preventative fungicides to neighboring healthy plants. Fungicides are not effective once plants become infected. <ul style="list-style-type: none"> - Commercial nurseries should apply preventative fungicides on a regular schedule. - Growers with valuable plantings may elect to follow a fungicide spray regime to suppress disease. ▪ See PPFS-OR-W-20.
Brown Rot (Monilinia Shoot Blight)			
Ornamental cherry and plum	<i>Monilinia</i> spp.	Infected blossoms wilt and turn brown but remain attached to twigs. Infections move into branches, causing girdling cankers and twig blight. Gummosis is common on twigs.	<ul style="list-style-type: none"> ▪ Remove and destroy infected twigs. ▪ Fungicides are often unnecessary; however, if disease has been severe previously, preventative fungicide applications may be warranted in early spring. Fungicide applications are not practical for large or tall trees. Refer to product label for details. ▪ See PPFS-FR-T-27.

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**BOXWOOD BLIGHT LEAF SPOTTING (LEFT);
BRANCH LESIONS AND DEFOLIATION (RIGHT)**

Leaf, Bud, Flower & Twig Diseases

Disease/ hosts	Cause	Symptoms	Management
Fungal			
Cedar Rusts (Cedar-apple, Cedar-hawthorn, Cedar quince)			
Crabapple, hawthorn, mountain ash, ornamental pear	<i>Gymnosporangium</i> spp. (Species depends on host)	Pale yellow spots form on upper leaf surfaces; later becoming yellow-orange, often with a reddish border and black dots (fungal fruiting bodies) in centers. Later, yellow spots develop on lower leaf surfaces; clusters of small orange-yellow, tubular fruiting bodies may form. Leaves yellow and drop prematurely. Fruit may exhibit similar symptoms/signs and/or distortion may occur. Pathogen requires alternate host to complete cycle.	<ul style="list-style-type: none"> ▪ Do not plant flowering crabapple, quince, or hawthorn near juniper. ▪ Manually remove cedar rust galls and rust-infected juniper twigs in early spring. ▪ Fungicides are often not necessary ; however, if disease has been severe previously, preventative fungicide applications may be warranted. Begin sprays in spring. Fungicide applications are not practical for large or tall trees. Refer to product label for details. ▪ See ID-68 (includes information on resistant cultivars; check with a local nursery for newly released cultivars) and PPFS-FR-T-05.
Cedar Rusts (Cedar-apple, Cedar-hawthorn, Cedar-quince)			
Juniper, red cedar	<i>Gymnosporangium</i> spp. (Species depends on host)	<p>Cedar apple and hawthorn rusts: Brown, round to irregular shaped galls (cedar apples) up to a 2-inch diameter form in leaf axils; slimy jelly-like, yellow-orange tendrils (spore horns) protrude from galls after rainy periods.</p> <p>Cedar-quince rust: perennial, spindle-shaped swellings develop on twigs and exude gelatinous, orange-brown mass of spores in spring. See above.</p>	

**FUNGAL SPORE-PRODUCING STAGES OF CEDAR-APPLE RUST (LEFT)
AND CEDAR-HAWTHORN RUST (RIGHT) ON JUNIPER**


Leaf, Bud, Flower & Twig Diseases

Disease/ hosts	Cause	Symptoms	Management
Fungal			
Cherry Leaf Spot			
Cherry and plum, ornamental	<i>Blumeriella jaapii</i> (formerly <i>Coccomyces hiemalis</i>)	Small purple spots appear on leaves, later turning brown. Fungal fruiting bodies on leaf undersides exude white spore masses when weather is wet. Spots may drop out leaving holes in foliage (shothole). Leaves turn yellow and drop prematurely.	<ul style="list-style-type: none"> ▪ Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade). ▪ Clean-up and destroy fallen leaves throughout the growing season and in autumn. ▪ Fungicides are often unnecessary; however, if disease has been severe previously, preventative fungicide applications may be warranted in early spring. Fungicide applications are not practical for large or tall trees. Refer to product label for details. ▪ See PPFS-FR-T-06.
Diplodia Tip Blight			
Pine (2- and 3-needled species, including Austrian, Scots, and mugo)	<i>Diplodia pinea</i>	Affects trees after they reach 10 to 12 years old and begin to bear cones. Newly emerging needles stop growing before they are fully expanded. Stunted needles eventually die and turn straw-colored. As additional needles are killed, branches in the lower canopy die. Excessive resin flows from infected twigs and branches; blighted needles may become trapped in this resin 'glue' and remain on trees.	<ul style="list-style-type: none"> ▪ Remove and destroy affected cones, twigs, and branches during dry weather in autumn. ▪ Fungicides are often unnecessary or tree size makes sprays impractical; however, if disease has been severe previously, preventative fungicide applications may be warranted in early spring. Fungicide applications are not practical for large or tall trees. Fungicides are not effective once disease becomes severe. Refer to product label for details. ▪ See PPFS-OR-W-21



DIPLODIA TIP BLIGHT STUNTED, STRAW-COLORED NEEDLES (LEFT) AND EXCESS RESIN FLOW (RIGHT).

Leaf, Bud, Flower & Twig Diseases

Disease/ hosts	Cause	Symptoms	Management
Fungal			
Dogwood Anthracnose			
Dogwood	<i>Discula destructiva</i>	Small, circular leaf spots with purple borders enlarge to irregularly-shaped tan blotches along leaf margins and veins. Leaves may cling to branches even through autumn. Sunken areas with dark-brown discoloration beneath bark develop on twigs and branches, resulting in shoot and branch dieback; infections to trunk result in tree death. (Not to be confused with spot anthracnose on dogwood.)	<ul style="list-style-type: none"> ▪ Plant resistant or tolerant cultivars when available. ▪ Do not transplant native trees from forests. ▪ Promote plant health and reduce stress by following good cultural practices (apply mulch, water during dry periods, maintain proper nutrition and pH of 5.5 to 6.8). ▪ Avoid wetting foliage when irrigating plant, nearby plants, or lawn. ▪ Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade). ▪ Prune diseased branches back to sound wood; destroy prunings. ▪ Clean-up and destroy fallen leaves. ▪ Apply protectant fungicides beginning at bud break. ▪ See PPFS-OR-W-06.
Downy Spot			
Hickory, walnut	<i>Microstroma juglandis</i>	As leaves expand in spring, a light green, spotty discoloration develops on upper leaf surfaces. Spots vary in size and may coalesce to create large angular lesions. White, fuzzy, fungal growth develops on leaf undersides.	<ul style="list-style-type: none"> ▪ Plant resistant cultivars when available. ▪ Select a sunny growing site with good air movement. ▪ Promote plant health and reduce stress by following good cultural practices. ▪ Rake and destroy fallen leaves throughout the growing season and in autumn. ▪ Prune and destroy diseased branches. ▪ Fungicides are often unnecessary; however, if disease has been severe previously, two or more preventative fungicide applications may be warranted in early spring. Fungicide applications are not practical for large or tall trees. Refer to product label for details.
<div style="display: flex; align-items: center;">  <div style="margin-left: 20px;"> <p>DOWNY SPOT ON HICKORY</p> </div> </div>			

Leaf, Bud, Flower & Twig Diseases

Disease/ hosts	Cause	Symptoms	Management
Fungal			
Frogeye Leaf Spot			
Crabapple	<i>Botryosphaeria obtusa</i>	Tiny, purplish specks enlarge to circular leaf spots 1/8 to 1/4 inch in diameter; centers become tan with dark brown to purplish margins; fungal fruiting bodies appear as tiny black specs in spot centers. Numerous leaf spots coalesce; leaves yellow and fall prematurely. See also <Black rot canker>.	<ul style="list-style-type: none"> ▪ Leaf spot phase does not cause severe damage, but infections can threaten stems and branches. ▪ Prune and destroy diseased/dead twigs and branches. ▪ Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade). ▪ Fungicides are often unnecessary; however, if disease has been severe previously, preventative fungicide applications may be warranted in early spring. Refer to product label for details. ▪ See PPFS-FR-T-03.
Gray Mold / Botrytis Blight			
Dogwood, hawthorn, hydrangea, peony, rose, and others	<i>Botrytis cinerea</i> <i>Botrytis paeoniae</i> (peony)	Tender tissues or those that are weakened/wounded/aged are most susceptible. Buds and flowers become blighted; infections move into twigs resulting in shoot blight. Tan to brown spots may occur on leaves. Tan, fluffy fungal growth covers infected tissues.	<ul style="list-style-type: none"> ▪ Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade). ▪ Practice strict sanitation, especially in commercial production. ▪ Avoid wetting foliage when irrigating. ▪ Clean-up and destroy fallen petals and leaves throughout the growing season and in autumn. ▪ In severe cases, apply fungicides. <p>See PPFS-GEN-19.</p>
Leaf Blister			
Maple, oak	<i>Taphrina carveri</i> (maple) <i>Taphrina caerulescens</i> (red oak group)	<p>Maple: Rounded, raised, blister-like spots appear on upper leaf surfaces with a corresponding depression on undersides. Blisters may be yellow, reddish-brown, grayish, or black-brown with lighter colored centers.</p> <p>Oak: Blisters are more clearly raised than on maple; colors change from yellow to reddish-brown to brown. Leaves often curl when blisters merge.</p> <p>Both: Leaves drop prematurely.</p>	<ul style="list-style-type: none"> ▪ Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade). ▪ Rake and destroy fallen leaves throughout the growing season and in autumn. ▪ Fungicides are often not necessary; however, if disease has been severe previously, a dormant fungicide application may be warranted before bud swell in spring. Fungicide applications are not practical for large or tall trees. Refer to product label for details.

Leaf, Bud, Flower & Twig Diseases

Disease/ hosts	Cause	Symptoms	Management
Fungal			
Leaf Blotch			
Horsechestnut	<i>Guignardia aesculi</i>	Water-soaked irregular areas turn reddish-brown; blotches may have yellow borders and encompass large portions of leaves; foliage may become curled and/or distorted. Tiny black specks (fungal fruiting bodies) develop within dead portions. Leaves drop prematurely.	<ul style="list-style-type: none"> ▪ Plant resistant cultivars when available. ▪ Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade). ▪ Promote plant health and reduce stress by following good cultural practices. ▪ Avoid wetting foliage when irrigating plant, nearby plants, or lawn. ▪ Prune and destroy diseased branches. ▪ Rake and destroy fallen leaves throughout the growing season and in autumn. ▪ Fungicides are often not necessary; however, if disease has been severe previously, preventative fungicide applications may be warranted in early spring. Fungicide applications are not practical for large or tall trees. Refer to product label for details.
Leaf Gall / Azalea Leaf Gall			
Azalea, rhododendron	<i>Exobasidium vaccinii</i>	Large fleshy galls develop on flowers and leaves; tissues become covered with white spores. Initial pale green or pinkish galls turn brown, shrink, and harden. More common on lower leaves, but may progress to upper branches.	<ul style="list-style-type: none"> ▪ Remove and destroy galls. ▪ Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade).

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AZALEA LEAF GALL (LEFT) AND HORSECHESTNUT LEAF BLOTCH (RIGHT)

Leaf, Bud, Flower & Twig Diseases

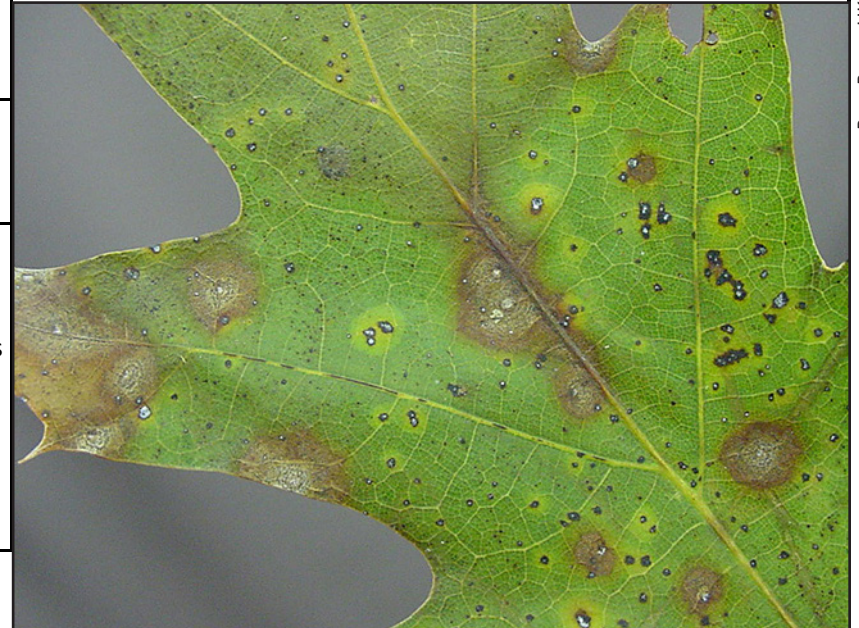
Disease/ hosts	Cause	Symptoms	Management
Fungal			
Leaf Spots			
Ash	<i>Mycosphaerella</i> spp.	Dark purple or yellow flecks to larger spots (up to 1/2 inch) develop on upper leaf surfaces. Coalescing spots cause entire leaflets to die.	<ul style="list-style-type: none"> ▪ Plant resistant cultivars when available. ▪ Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade). ▪ Promote plant health and reduce stress by following good cultural practices. ▪ Avoid wetting foliage when irrigating plant, nearby plants, or lawn. ▪ Rake and destroy fallen leaves throughout the growing season and in autumn. ▪ Prune and destroy diseased branches. ▪ Fungicides are often unnecessary; however, if disease has been severe previously, preventative fungicide applications may be warranted in early spring. Fungicide applications are not practical for large or tall trees. Refer to product label for details.
Ash, birch, dogwood, elm, lilac, magnolia, maple, oak, ornamental cherry, redbud, rhododendron, sweetgum	<i>Phyllosticta</i> spp. (Disease also known as bulls eye leaf spot)	Small (1/4 inch or less), roughly circular leaf spots have purple/red/dark brown borders with tan centers. Fruiting bodies appear as black specks within spots.	
Birch, catalpa, crabapple crepe myrtle, dogwood, holly, honey locust, hydrangea, lilac, maple, ornamental cherry, photinia, redbud, rhododendron, rose, sycamore, willow, and others	Species of <i>Alternaria</i> , <i>Cercospora</i> , <i>Entomosporium</i> , <i>Pestalotia</i> , <i>Phloeospora</i> , <i>Phoma</i> , <i>Phomopsis</i> , and others	Small, scattered, roughly circular or angular leaf spots may be tan, brown, yellow, or grey, with or without a darker margin. Spots may coalesce into larger irregularly shaped dead areas. Fungal structures forming within spots appear as tiny black specks. Leaves may yellow and drop prematurely.	



MYCOSPHAERELLA LEAF SPOT ON ASH

Leaf, Bud, Flower & Twig Diseases

Disease/ hosts	Cause	Symptoms	Management
Fungal			
Leaf Spots (cont'd)			
Birch	<i>Melampsorium betulinum</i>	Angular yellow leaf spots turn brown; yellow to orange rust pustules develop on leaf underside. Leaves turn brown and fall prematurely.	<ul style="list-style-type: none"> ▪ Plant resistant cultivars when available. ▪ Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade). ▪ Promote plant health and reduce stress by following good cultural practices. ▪ Avoid wetting foliage when irrigating plant, nearby plants, or lawn. ▪ Prune and destroy diseased branches. ▪ Rake and destroy fallen leaves throughout the growing season and in autumn. ▪ Fungicides are often not necessary; however, if disease has been severe previously, preventative fungicide applications may be warranted in early spring. Fungicide applications are not practical for large or tall trees. Refer to product label for details.
Boxwood, holly	<i>Macrophoma</i> spp.	Only affects leaves damaged by winter injury. Tiny black fruiting bodies appear on dying or dead straw-colored leaves.	
Cottonwood, poplar	<i>Melampsora</i> spp.	Small, yellow-orange pustules develop in late summer and early autumn on undersides of leaves.	
Hawthorn	<i>Fabraea maculata</i>	Tiny, irregular, often angular-shaped, reddish-brown to dark brown spots appear on upper and lower leaf surfaces. Spot centers may become dotted with dark fungal fruiting bodies.	
Hydrangea	<i>Pucciniastrum hydrangeae</i>	Yellow spots develop on upper leaf surfaces and brown-to-orange rust pustules develop on undersides.	
Oak	<i>Tubakia dryina</i> (Disease also known as Actinopelte leaf spot)	Dark brown or reddish-brown spots (1/4 to 1/2 inch diameter) with or without a yellow/dark brown halo appear on leaves late in summer. Spots may coalesce to encompass large areas of leaves. Infections on veins cause distal portions of leaves to die. Leaves drop prematurely. Twig cankers may form.	



TUBAKIA (ACTINOPELTE) LEAF SPOT ON OAK

Leaf, Bud, Flower & Twig Diseases

Disease/ hosts	Cause	Symptoms	Management
Fungal			
Leaf Spots (cont'd)			
Rose	<i>Phragmidium mucronatum</i> , <i>P. tuberculatum</i>	Yellow spots develop on upper leaf surfaces and reddish-brown to yellow-orange rust pustules develop on undersides; pustules may develop on canes. Leaves yellow and drop prematurely.	<ul style="list-style-type: none"> Plant resistant cultivars when available. Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade). Promote plant health and reduce stress by following good cultural practices. Avoid wetting foliage when irrigating plant, nearby plants, or lawn.
Walnut, hickory	<i>Mycosphaerella juglandis</i>	Small (maximum 1/4 inch diameter), angular spots form along veins and leaf tips; spots may eventually coalesce, giving leaves a scorched appearance. Leaves yellow and drop prematurely.	<ul style="list-style-type: none"> Rake and destroy fallen leaves throughout the growing season and in autumn. Prune and destroy diseased branches. Fungicides are often unnecessary; however, if disease has been severe previously, preventative fungicide applications may be warranted in early spring. Fungicide applications are not practical for large or tall trees. Refer to product label for details.
Needlecast / Needle Blight			
Pines (2- and 3-needled species, especially Austrian and mugo), Spruce (infrequently)	<i>Mycosphaerella pini</i> (formerly <i>Dothistroma septosporum</i>), <i>Naemacyclus</i> spp. (Disease also known as brown spot needle blight, <i>Dothistroma</i> needle blight, <i>Naemacyclus</i> needlecast, and <i>Lophodermium</i> needlecast)	Dark green spots on needles later become a distinctive brown or reddish color, sometimes encircling needles to form bands. As needles turn brown, black pimple-like fungal fruiting bodies may be visible. Blighted needles may drop prematurely or remain on trees. Symptoms develop on lower branches and progress upward.	<ul style="list-style-type: none"> Select plant species/cultivars suitable for the growing site and adapted to KY climates. Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade). Fungicides are often unnecessary; however, if disease has been severe previously, preventative fungicide applications may be warranted in early spring. Fungicide applications are not practical for large or tall trees. Refer to product label for timing sprays.



**MYCOSPHAERELLA (DOTHISTROMA)
NEEDLE BLIGHT ON SPRUCE**

Leaf, Bud, Flower & Twig Diseases

Disease/ hosts	Cause	Symptoms	Management
Fungal			
Needlecast / Needle Blight			
Spruce	<i>Rhizosphaera</i> spp., <i>Stigmina</i> spp.	Trees weakened by other factors are more susceptible. Scattered older needles turn purple to brown and eventually drop; symptoms begin on lower branches and progress upward. Fungal fruiting bodies protrude in rows through natural pores in needles (<i>Rhizosphaera</i> --tiny, raised, grayish bumps topped with white waxy caps; <i>Stigmina</i> -- tiny, brown-to-black, brush-like tufts).	<ul style="list-style-type: none"> Select plant species/cultivars suitable for the growing site and adapted to KY climates. Promote plant health and reduce stress by following good cultural practices. Preventative fungicide applications may be warranted; they are more effective when made annually each spring. <ul style="list-style-type: none"> Fungicides may be ineffective if applied inconsistently, when plant stress is too severe, or when disease is advanced. Fungicide applications are not practical for large or tall trees. Refer to product label for details. Colorado blue spruce is highly susceptible. See PPFS-OR-W-24.
Pine (2- and 3-needle pines, especially Austrian, Scots, Virginia, mugo, and red)	<i>Coleosporium asterum</i>	Conspicuous white to orange, blister-like, sack-shaped fungal structures appear on infected needles in spring. Disease may occasionally injure enough foliage to slow the growth of small trees, but normally does little damage.	<ul style="list-style-type: none"> Remove alternate hosts (goldenrod and aster) before August of each year to interrupt pathogen life cycle.
Needle Rust			
Pine (2- and 3-needle pines, especially Austrian, Scots, Virginia, mugo, and red)	<i>Coleosporium asterum</i>	Conspicuous white to orange, blister-like, sack-shaped fungal structures appear on infected needles in spring. Disease may occasionally injure enough foliage to slow the growth of small trees, but normally does little damage.	<ul style="list-style-type: none"> Remove alternate hosts (goldenrod and aster) before August of each year to interrupt pathogen life cycle.



PINE NEEDLE RUST

Leaf, Bud, Flower & Twig Diseases

Disease/ hosts	Cause	Symptoms	Management
Fungal			
Powdery Mildew			
Abelia, crabapple, crepe myrtle, dogwood, euonymus, honey locust, hydrangea, lilac, oak, photinia, service berry, tulip tree, rose, viburnum, and others	Species of <i>Erysiphe</i> , <i>Leveillula</i> , <i>Golovinomyces</i> , <i>Phyllactinia</i> , <i>Podosphaera</i> , <i>Sphaeotheca</i> , and others	White, tan, or gray powdery fungal growth covers surfaces of infected leaves, stems, buds, flowers, and fruit. Young expanding leaves and fruit may become distorted. In some cases, discolored spots or blotches may develop on foliage. Leaves drop prematurely. Tiny black fungal fruiting bodies 'pepper' mildewed surfaces late in the growing season.	<ul style="list-style-type: none"> Plant resistant cultivars when available. Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade). Fungicides are often unnecessary; however, if disease has been severe previously, preventative fungicide applications may be warranted at the first sign of disease. Fungicide applications are not practical for large or tall trees. Refer to product label for timing sprays. See PPFs-GEN-02 and PPFs-OR-W-06.
Scab			
Crabapple, pyracantha	<i>Venturia inaequalis</i> (crabapple) <i>Spiloceae pyracanthae</i> (pyracantha)	Olive-green to brown spots develop on upper and/or lower leaf surfaces; initially spots have indefinite, feathery edges, but margins become more distinct with time. Spots thicken and bulge upward. Heavily infected leaves become disfigured and/or turn yellow; premature leaf drop is common. Fruit spots are more distinctly outlined, turning dark brown to black, scabby, and cracked. Heavily infected fruit may drop prematurely.	<ul style="list-style-type: none"> Plant disease resistant cultivars when available. Rake and destroy fallen leaves throughout the growing season and in autumn. Remove diseased fruit from trees and ground. Fungicides are often unnecessary; however, if disease has been severe previously, preventative fungicide applications may be warranted in early spring. Refer to product label for details. See PPFs-FR-T-13.
Sooty Mold			
Many hosts, but commonly observed on holly, magnolia, pine, rhododendron, and tulip tree	Species of <i>Capnodium</i> , <i>Fumago</i> , <i>Scorias</i> , and others	Dark spored fungi grow in honeydew excretions deposited by aphids, scale, and other sucking insects; gives plant surfaces a black sooty appearance. Heavy sooty mold growth may shade tissues, causing them to yellow.	<ul style="list-style-type: none"> Manage insects that leave honey dew deposits. While unsightly, generally not a serious threat to plant health; may weather-off in time.


Leaf, Bud, Flower & Twig Diseases

Disease/ hosts	Cause	Symptoms	Management
Fungal			
Spot Anthracnose			
Dogwood	<i>Elsinoe corni</i>	Very small, reddish-purple, spots develop on flower bracts (petals); flowers may not open or be disfigured. Leaf spots are also very small, circular or angular, and dark purple; diseased tissue may drop out, leaving holes or ragged edges within spots.	<ul style="list-style-type: none"> Plant resistant cultivars when available. Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade). Promote plant health and reduce stress by following good cultural practices. Avoid wetting foliage when irrigating plant, nearby plants, or lawn. Rake and destroy fallen leaves throughout the growing season and in autumn.
Tar Spot			
Holly (English and American holly cultivars)	<i>Phacidium curtisii</i> , <i>Rhytisma curtisii</i> , <i>Coniothyrium ilicinum</i> , <i>Macroderma curtisii</i> , <i>Phytophthora ilicis</i>	Initial irregular yellow spots develop in winter or spring, turn reddish-brown, then black by autumn. Leaves may drop prematurely. Berries may also become infected.	<ul style="list-style-type: none"> Prune and destroy diseased branches. Fungicides are often not necessary; however, if disease has been severe previously, preventative fungicide applications may be warranted in early spring. Fungicide applications are not practical for large or tall trees. Refer to the product label for details. See PPFS-OR-W-06.
Maple	<i>Rhytisma</i> spp.	Black, raised spots with a yellow margin develop on upper leaf surfaces.	
Twig Blight			
Arborvitae, juniper, red cedar	<i>Phomopsis juniperovora</i> , <i>Kabatina juniperi</i>	Affects new growth. Twigs and needles distal to the infection site become light green, red brown, and finally, ashen grey. Fungal fruiting bodies (<i>Phomopsis</i> : pycnidia; <i>Kabatina</i> : acervuli) appear as black specks in diseased tissue. Small branches are generally girdled; infections that progress to a main branch result in cankers that generally do not completely girdle branches.	<p><i>Kabatina</i> and <i>Phomopsis</i></p> <ul style="list-style-type: none"> Select plant species/cultivars suitable for the growing site and adapted to KY climates. Prune dense foliage and increase plant spacing to improve air circulation. See PPFS-OR-W-11. <p><i>Kabatina</i> twig blight</p> <ul style="list-style-type: none"> Prune and destroy infected twigs and branches. Fungicide controls are not available. <p><i>Phomopsis</i> twig blight</p> <ul style="list-style-type: none"> Rogue and destroy infected hosts in young plantings. Prune and destroy infected shoots. Fungicides are often not necessary; however, if disease has been severe previously, preventative fungicide applications may be warranted throughout the growing season. Refer to product label for timing sprays.

Leaf, Bud, Flower & Twig Diseases

Disease/ hosts	Cause	Symptoms	Management
Fungal			
White Pine Blister Rust			
Pine	<i>Cronartium ribicola</i>	Indistinct chlorotic (pale green/yellow) spots form on needles. Spindle-shaped swellings form on branches and become cankers, often exuding large amounts of resin. Cankers enlarge annually and girdled branches die. Masses of yellow-orange spores erupt from cankers eventually. Dead needles on the affected branches turn red.	<ul style="list-style-type: none"> ▪ Do not plant pine near alternate hosts (currants and gooseberries). ▪ Plant resistant cultivars. ▪ Prune diseased branches at least 6 inches below visible symptoms.
Water Molds (Oomycetes, Fungus-like)			
Downy Mildew			
Rose	<i>Peronospora sparsa</i>	Symptoms may include: yellow spots becoming purple, red or black; grayish-brown spots between veins, becoming angular; premature leaf drop. White or gray downy fungal growth occurs on undersides of diseased leaves.	<ul style="list-style-type: none"> ▪ Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade). ▪ Avoid wetting foliage when irrigating plant, nearby plants, or lawn. ▪ Rake and destroy fallen leaves throughout the growing season and in autumn. ▪ Scheduled fungicide applications may be needed for high value or commercial crops when conditions favor disease.
Phytophthora Foliar Blight & Shoot Dieback			
Rhododendron, viburnum	<i>Phytophthora ramorum</i> ; <i>Phytophthora</i> spp.	Brown water-soaked spots form on leaves; leaves wilt and drop prematurely; shoots dieback due to stem cankers.	<ul style="list-style-type: none"> ▪ Promote plant health and reduce stress by following good cultural practices (e.g. apply mulch, water during dry periods, maintain proper nutrition and pH). ▪ Promote good air circulation (proper plant spacing, thinning, managing weeds, reduce shade).
Phytophthora Leaf Spot & Blight			
Mountain laurel	<i>Phytophthora</i> spp.	Irregular necrotic (brown) spots develop on leaves, especially near leaf tips. Disease progresses upward from lowest leaves, defoliating stems and causing them to die.	<ul style="list-style-type: none"> ▪ Rake and destroy fallen leaves throughout the growing season and in autumn. ▪ Prune and destroy diseased branches. ▪ Fungicides are available to commercial producers; apply as new lesions appear.

Leaf, Bud, Flower & Twig Diseases

Disease/ hosts	Cause	Symptoms	Management
Viruses			
Rose Rosette			
Rose	Rose Rosette Virus (RRV) (Spread by rose leaf curl eriophyid mite)	Symptoms are highly variable but commonly include one or more of the following: shoots with increased growth/rapid elongation, abnormal red discoloration, proliferation and clustering, shortened internodes; spiral pattern of cane growth; distorted or dwarfed leaves; overabundance of thorns; atypical flower coloration (such as mottling of otherwise solid-colored roses); deformed buds and flowers. Plants decline from disease or are ultimately killed by winter injury.	<ul style="list-style-type: none"> ▪ Do not purchase, plant, or propagate roses with symptoms. ▪ Remove multiflora roses within 100 yards of planting, when possible. ▪ Space plants so foliage does not come into contact with other roses. ▪ If disease is confirmed, remove and destroy symptomatic plants, including roots; remove and destroy any regrowth in landscapes. ▪ Attempts to control the vector are not practical. ▪ See PPF5-OR-W-16.
Abiotic			
Oak Dieback & Decline			
Oak, mainly those in red oak family	Multiple factors, including growing site, weather, and other unfavorable conditions	Leaves are sparse, undersized, and yellow; premature autumn coloration is common. Foliar symptoms are accompanied by a slow, progressive dieback of branches in the upper canopy. Epicormic sprouts (suckers or water sprouts) develop at the base of trees and/or from the trunk and larger branches.	<ul style="list-style-type: none"> ▪ Promote plant health and reduce stress by following good cultural practices (apply mulch, water during dry periods, maintain proper nutrition and pH). ▪ Avoid wounding trunk and roots (mowers, string trimmers, improper pruning cuts). ▪ Irrigate during dry periods. ▪ Avoid wounding trunk and roots (mowers, string trimmers, improper pruning cuts). ▪ Prune dead and dying branches to improve appearance. ▪ See PPF5-OR-W-19, PPF5-OR-W-04, ID-50, and ID-52.
		OAK DIEBACK AND DECLINE	

Branch & Trunk Diseases

Disease/ hosts	Cause	Symptoms	Management
Bacterial			
Bacterial Canker			
Ornamental cherry and plum, flowering peach	<i>Pseudomonas syringae</i> pv. <i>syringae</i>	Sunken patches (canker) develop on twigs, branches, and trunk. Heavy gummosis occurs along canker margins. Girdled branches dieback. Cambium tissues (under bark) at cankers turn brown. More common following cold injury and poorly drained sites.	<ul style="list-style-type: none"> ▪ Select plant species/cultivars suitable for the growing site and adapted to KY climates. ▪ Plant in well-drained soils. ▪ Protect against cold injury. ▪ Prune cankers when weather is dry; avoid working with wet plants. <ul style="list-style-type: none"> --Cut several inches below canker. --Sanitize tools between pruning cuts. ▪ Avoid summer and fall pruning.
Bacterial Wetwood / Slime Flux			
Ash, beech, birch, elm, oak, sycamore, tulip tree, and others	Species of <i>Bacillus</i> , <i>Clostridium</i> , <i>Enterobacter</i> , <i>Klebsiella</i> , <i>Pseudomonas</i> and others have been implicated	Foul-smelling, slimy liquid oozes and runs down trunks; seepage originates at cracks or wounds.	<ul style="list-style-type: none"> ▪ Select plant species/cultivars suitable for the growing site. ▪ Promote plant health and reduce stress by following good cultural practices (apply mulch, water during dry periods, maintain proper nutrition and pH). ▪ Avoid wounding trees (mowers, string trimmers, improper pruning cuts). ▪ Sanitize tools between pruning cuts. ▪ Inserting drain pipes is no longer recommended.
Fire Blight			
Cotoneaster, crabapple, hawthorn, ornamental pear, pyracantha, service berry	<i>Erwinia amylovora</i>	Blossoms collapse, leading to dark brown to purplish cankers on branches. Blighted shoots wilt and develop a bend at the growing point (shepherd's crook). Trunk and rootstock infections result in tree death.	<ul style="list-style-type: none"> ▪ Plant resistant species or cultivars when available. ▪ Avoid excessive fertilization. ▪ Prune cankers and blighted branches when trees are dormant (November to March). ▪ Apply copper to active cankers, twigs, and branches during late dormancy to help reduce overwintering populations of the bacterium; applications may not be practical for large or tall trees. ▪ Commercial growers may use disease predictive models to time antibiotic sprays during bloom (See PPFS-FR-T-07). ▪ See PPFS-FR-T-12.

Branch & Trunk Diseases

Disease/ hosts	Cause	Symptoms	Management
Fungal			
Black Knot			
Ornamental cherry and plum	<i>Dibotryon morbosum</i>	Small, light brown knots develop on branches; galls enlarge and become olive-green. Later, swellings develop into hard, brittle, black knots that continue to expand each year until girdled branches eventually die.	<ul style="list-style-type: none"> ▪ Remove and destroy knotted twigs when trees are dormant. --Prune at branch unions and at least 6 to 8 inches below knots. ▪ Trees with knots on major limbs or trunk should be removed. ▪ Apply fungicide beginning in early spring. --Sprays are only effective if knots have been eradicated. ▪ See PPFS-FR-T-04.
Cankers			
Arborvitae, boxwood, euonymus, oak, ornamental cherry, rhododendron, and others	Species of <i>Diaporthe</i> , <i>Fusarium</i> , <i>Hypoxyton</i> , <i>Leucostoma</i> , <i>Pestalotiopsis</i> , and <i>Phomopsis</i>	Sunken, elongated or dark areas develop on branches and trunks. Affected branches become girdled and dieback.	<ul style="list-style-type: none"> ▪ Select plant species/cultivars suitable for the growing site and adapted to KY climates. ▪ Plant resistant or tolerant cultivars when available (honeylocust tolerant cultivars include 'Shademaster and 'Imperial'). ▪ Avoid wounding trees (mowers, string trimmers, improper pruning cuts), and control borers.
Arborvitae, cypress	<i>Seiridium</i> spp.	Elongated, sunken cracked cankers form at the base of branches; affected branches turn yellow and then brown.	<ul style="list-style-type: none"> ▪ Promote plant health and reduce stress by following good cultural practices (apply mulch, water during dry periods, maintain proper nutrition and pH).
Ash, arborvitae, boxwood, dogwood, elm, forsythia, holly, juniper, lilac, magnolia, maple, oak, ornamental cherry, pyracantha, rhododendron, spruce, sweetgum, willow, and others	<i>Botryosphaeria dothidea</i> (Disease also known as canker and dieback)	Elongated, rough, sunken, dark areas develop at sites of wounds or natural openings in bark. Affected branches die.	<ul style="list-style-type: none"> ▪ Remove branch cankers by cutting at least 6 to 12 inches below the canker or to the nearest branch collar. Destroy prunings. ▪ Remove tree when trunk cankers expand to girdle, reduce tree vigor, or weaken tree structure. ▪ No chemical control measures are available. ▪ See PPFS-OR-W-01 and PPFS-OR-W-27.

Branch & Trunk Diseases

Disease/ hosts	Cause	Symptoms	Management
Fungal			
Cankers (cont'd)			
Ash, birch, boxwood, cottonwood, elm, juniper, maple, mountain laurel, ornamental cherry, poplar, spruce, willow, and others	<i>Cytospora</i> spp. (<i>Valsa</i> spp.) (Pathogen species are often host-specific)	Sunken or raised discolored yellow, orange-brown, or black lesions develop on small twigs or larger branches, resulting in girdling and death of branches. Killed branches are often covered with dried resin. Tiny, pimple-like fungal fruiting bodies develop in cankers.	<ul style="list-style-type: none"> ▪ Select plant species/cultivars suitable for the growing site and adapted to KY climates. ▪ Plant resistant or tolerant cultivars when available (honeylocust tolerant cultivars include 'Shademaster and 'Imperial'). ▪ Avoid wounding trees (mowers, string trimmers, improper pruning cuts), and control borers. ▪ Promote plant health and reduce stress by following good cultural practices (apply mulch, water during dry periods, maintain proper nutrition and pH).
Beech, birch, dogwood, elm, golden raintree, honey locust, maple, mimosa, oak, poplar, zelkova, and others	<i>Nectria</i> spp.	Elliptical, sunken lesions develop at nodes or wounds. Bright red, orange, or pink fungal structures appear as small cushions in cankers. Older cankers may have a target-like appearance due to repeated callus formation. Branches are girdled, fail to leaf-out in spring, and dieback.	<ul style="list-style-type: none"> ▪ Remove branch cankers by cutting at least 6 to 12 inches below the canker or to the nearest branch collar. Destroy prunings. ▪ Remove tree when trunk cankers expand to girdle, reduce tree vigor, or weaken tree structure. ▪ No chemical control measures are available. ▪ See PPFS-OR-W-01 and PPFS-OR-W-27.
Crabapple	<i>Botryosphaeria obtusa</i> (Black rot)	Cankers initially appear as slightly sunken reddish-brown areas on bark, often associated with old fire blight strikes, pruning wounds, or winter-injured tissue. Cankers may expand to several feet long and girdle limbs, resulting in branch death. See <Frog-eye leaf spot> for foliar symptoms.	



NECTRIA CANKER ON BEECH

Branch & Trunk Diseases

Disease/ hosts	Cause	Symptoms	Management
Fungal			
Cankers (cont'd)			
Elm, maple, oak, poplar, sycamore, and others	<i>Biscogniauxia</i> spp. (formerly <i>Hypoxylon</i> spp.)	Pathogen enters stressed trees through wounds and branch stubs. Initially, leaves wilt, yellow, and turn brown. Dieback follows as a result of girdling cankers. Trunk cankers result in tree death. Pathogen forms a cushion (stroma) between wood and bark of cankers; bark sloughs off revealing a white, brown, or black fungal mat covered with dusty spores.	<ul style="list-style-type: none"> ▪ Select plant species/cultivars suitable for the growing site and adapted to KY climates. ▪ Plant resistant or tolerant cultivars when available (honeylocust tolerant cultivars include 'Shademaster and 'Imperial'). ▪ Avoid wounding trees (mowers, string trimmers, improper pruning cuts), and control borers. ▪ Promote plant health and reduce stress by following good cultural practices (apply mulch, water during dry periods, maintain proper nutrition and pH). ▪ Remove branch cankers by cutting at least 6 to 12 inches below the canker or to the nearest branch collar. Destroy prunings.
Maple	<i>Eutypella parasitica</i>	Cankers are large, rough, and sunken with heavy callus around their margin; often occur around branch stubs. Under the bark, a tan to cream colored fungal mat can be observed. Black fruiting structures develop on cankers 5 years old or more. Affected limbs are eventually girdled and die.	<ul style="list-style-type: none"> ▪ Remove tree when trunk cankers expand to girdle, reduce tree vigor, or weaken tree structure. ▪ No chemical control measures are available. ▪ See PPFS-OR-W-01 and PPFS-OR-W-27.

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**HYPLOYLON CANKER FRUITING BODIES (LEFT);
EUTYPELLA CANKER ON SUGAR MAPLE (RIGHT)**

Branch & Trunk Diseases

Disease/ hosts	Cause	Symptoms	Management
Fungal			
Cankers (cont'd)			
Honeylocust	<i>Thyronectria austroamericana</i>	Elliptical reddish-brown to yellowish-tan cankers develop on trunks and branches; tissues beneath are stained a reddish color. Fungal fruiting bodies appear as dark specks in cankers. Foliage yellows and dies; girdled branches are killed.	<ul style="list-style-type: none"> ▪ Select plant species/cultivars suitable for the growing site and adapted to KY climates. ▪ Plant resistant or tolerant cultivars when available (honeylocust tolerant cultivars include 'Shademaster and 'Imperial'). ▪ Avoid wounding trees (mowers, string trimmers, improper pruning cuts), and control borers. ▪ Promote plant health and reduce stress by following good cultural practices (apply mulch, water during dry periods, maintain proper nutrition and pH).
Rose	Includes <i>Botryosphaeria ribis</i> , <i>Coniothyrium</i> spp., <i>Cryptosporrella umbrina</i> , <i>Cytosporrella umbrina</i> , <i>Leptosphaeria coniothyrium</i> , <i>Nectria</i> spp. (Diseases also called brown canker, cane canker, common canker, stem canker)	Depending on pathogen, cankers may appear as circular to elliptical raised spots that are pale yellow, red-purple, grayish, tan, or brown, often with darker margins. Fungal fruiting bodies may appear in cankers as tiny dark specks. Cankers expand and canes dieback.	<ul style="list-style-type: none"> ▪ Remove branch cankers by cutting at least 6 to 12 inches below the canker or to the nearest branch collar. Destroy prunings. ▪ Remove tree when trunk cankers expand to girdle, reduce tree vigor, or weaken tree structure. ▪ No chemical control measures are available. ▪ See PPFS-OR-W-01 and PPFS-OR-W-27.
Chestnut Blight			
Chestnut	<i>Cryphonectria parasitica</i> (formerly <i>Endothia parasitica</i>)	Reddish brown patches form on bark, then become sunken or swollen cankers; twigs, limbs, and eventually entire tree dies. Leaves on affected branches may remain attached after dying. Fungal fruiting bodies in cankers exude yellow-orange spore masses.	<ul style="list-style-type: none"> ▪ Plant resistant or tolerant cultivars when available (hybrids of Chinese chestnut) ▪ Prune to slow disease progress, but tree will continue to develop new cankers. ▪ Remove and destroy diseased tree.
Gall Rusts (Eastern & Western Gall Rusts)			
Pine (2- and 3-needled species)	<i>Cronartium quercuum</i> f.sp. <i>banksianae</i> , <i>Peridermium harknessii</i> (<i>Endocronartium harknessii</i>)	Spherical to elongate, woody galls form on branches and stems 6 to 12 months after infection. Galls enlarge annually until branches are girdled and die. Galls may be covered by orange spore masses in spring.	<ul style="list-style-type: none"> ▪ In nurseries, cull seedlings with stem swellings. ▪ In landscapes, remove branch galls and rogue heavily galled trees in early spring. ▪ Spray a single fungicide application when yellow pustules erupt through bark of galls.

Branch & Trunk Diseases

Disease/ hosts	Cause	Symptoms	Management
Fungal			
Phomopsis Gall			
American elm, azalea, forsythia, hickory, maple, oak, privet, viburnum	<i>Phomopsis</i> spp.	Knobby galls (up to 2 inches across) develop on twigs; girdled twigs become weak and eventually die. Easily confused with insect galls and crown gall.	<ul style="list-style-type: none"> ▪ Prune and destroy branches with galls.
Thousand Cankers			
Black walnut, butternut	<i>Geosmithia morbida</i>	Early symptoms include branch flagging, wilting, yellowing of leaves, and canopy dieback from the top down. On branches, 'thousands' of small cankers (3/4 to 1 inch in diameter) develop under bark. Rapid tree death ensues after initial infection. Tiny beetle exit holes and 'galleries' can be found on dead wood.	<ul style="list-style-type: none"> ▪ No cure exists. ▪ Remove diseased trees, and destroy all parts. ▪ Avoid off-site move of wood to prevent disease spread. ▪ See PPFS-OR-W-15.
Volutella Blight/Pseudonectria			
Boxwood	<i>Pseudonectria rouselliana</i> , <i>P. buxi</i> (formerly <i>Volutella buxi</i>)	Growth of individual branches is delayed or plants show poor vigor in spring. Sunken lesions (cankers) girdle stems and result in dieback. Bark may be loose and discolored around cankers. Leaves turn light green-yellow, change to red/bronze, and finally become straw or yellow/tan in color. Dead leaves cup upward and remain attached to branches even after branch death, although leaves may eventually drop. Salmon-colored fruiting structures (sporodochia) develop on lower surfaces of affected leaves and stems when conditions are wet.	<ul style="list-style-type: none"> ▪ Select plant species/cultivars suitable for the growing site. ▪ Plant in well-drained soil. ▪ Protect from drying winter winds and winter injury. ▪ In spring, remove and destroy old leaves lodged in branches (a strong stream of water applied during dry weather can help dislodge infected leaves). ▪ Prune infected branches back to healthy wood; destroy prunings. ▪ See PPFS-OR-W-26.

Branch & Trunk Diseases

Disease/ hosts	Cause	Symptoms	Management
Fungal			
Witch's Broom			
Hackberry	<i>Sphaerotheca phytophila</i> + eriophyid mite	Numerous thin, short, stubby twigs develop close together, but eventually die back. 'Brooms' develop from deformed buds.	<ul style="list-style-type: none"> No practical controls are available. Chinese hackberry (<i>Celtis sinensis</i>) is resistant.
Water Molds (Oomycetes, Fungus-like)			
Bleeding Canker			
Beech, birch, dogwood, maple, oak, sweetgum	<i>Phytophthora</i> spp.	Reddish-brown bleeding sap slowly oozes from cankers with well-defined margins. Bark becomes stained and water-soaked. Cambium tissues beneath bark become reddish-pink. Trees are girdled, resulting in sparse foliage, dieback, and ultimately tree death.	<ul style="list-style-type: none"> Select plant species/cultivars suitable for the growing site. Avoid wounding trees (mowers, string trimmers, improper pruning cuts). Promote plant health and reduce stress by following good cultural practices (apply mulch, water during dry periods, maintain proper nutrition and pH).
Other			
Lichens			
All trees and shrubs under stress	Composite organism of algae and fungi	Crusty leaf like organisms in a variety of colors (brown, gray, green, yellow, pink, or white), form on the bark of living trees. Lichens are not pathogenic; they are simply an indicator of poor growth or declining plants; they may be associated with abiotic stress, disease, or insect injury.	<ul style="list-style-type: none"> Promote plant health and reduce stress by following good cultural practices (apply mulch, water during dry periods, maintain proper nutrition and pH).



LICHEN ON MAGNOLIA BRANCH

Root & Lower Trunk Diseases

Disease/ hosts	Cause	Symptoms	Management
Abiotic			
White Pine Decline			
White pine	A complex of abiotic environmental and site-related factors	Established trees may turn yellow and appear unthrifty compared to healthy trees. Annual shoot growth is reduced and bark of individual branches appears wrinkled. Needles are shorter than normal, needle tips turn brown, and the overall tree canopy becomes sparse. Tree browning and death follow.	<ul style="list-style-type: none"> ▪ Select plant species/cultivars suitable for the growing site and adapted to KY climates. ▪ Provide a well-drained planting site with acidic soil and low clay content; avoid drought-prone sites. ▪ Avoid compacting soil, planting too deeply, and over mulching. ▪ Avoid wounding trees (mowers, string trimmers, improper pruning cuts) ▪ See PPFS-OR-W-22.
Bacterial			
Crown Gall			
Crabapple, euonymus, ornamental cherry, poplar, rose, Russian olive, walnut, willow, zelkova, and others	<i>Rhizobium</i> spp. (formerly <i>Agrobacterium</i> spp.)	New galls are white, fleshy callus growths; later become lumpy, rough, spherical to elongated tumors on roots, lower stems, and lower branches. Systemic infections (bacteria become distributed throughout plants) may result in gall formation on upper branches.	<ul style="list-style-type: none"> ▪ Do not plant susceptible hosts in sites where crown gall has been a problem. ▪ Pre-treat healthy cuttings or liners with bactericide specific for crown gall (commercial growers). ▪ See PPFS-GEN-01 for resistant plants. ▪ Prune out galls that appear on branches. ▪ Destroy infected plants when crowns become infected. ▪ See PPFS-GEN-01.
Fungal			
Black Root Rot			
Japanese and blue hollies, inkberry	<i>Berkeleyomyces basicola</i> (syn <i>Thielaviopsis basicola</i>)	Plants are slow-growing with poor vigor, followed by wilt, yellowing, death of leaves, and dieback. Dark brown to black lesions develop on roots, eventually expanding until the entire root system is affected and plants die.	<ul style="list-style-type: none"> ▪ Practice strict sanitation by disinfecting tools, equipment, and benches, destroying all infected plants regardless of severity, never using unsterilized soil or pots, and using disease-free stock plants. ▪ Plant only transplants with healthy white roots. ▪ Apply a preventative soil drench at planting if there is a history of disease. ▪ Monitor plants regularly. ▪ If disease is mild, promote plant health and reduce stress by following good cultural practices. ▪ If disease is severe, remove and destroy plants, including roots and soil ball; do not re-plant site with susceptible plants. ▪ See PPFS-OR-W-03.

Root & Lower Trunk Diseases

Disease/ hosts	Cause	Symptoms	Management
Fungal			
Butt Rots, Root & Butt Rots			
Oak, maple, pine, spruce, and others	Species of <i>Ganoderma</i> , <i>Grifola</i> , <i>Laetiporus</i> , <i>Phaeolus</i> , and others	Internal decay begins at tree base, moves up trunk, and results in dieback. Weakened trees become vulnerable to breakage. Fungal fruiting structures (such as bracket fungi or mushrooms) become visible on trunk or at tree base when decay is well-advanced..	<ul style="list-style-type: none"> ▪ Promote plant health and reduce stress by following good cultural practices (apply mulch, water during dry periods, maintain proper nutrition and pH). ▪ Avoid wounding trees (mowers, string trimmers, improper pruning cuts), and control borers. ▪ Prune dead and dying branches. ▪ Remove entire tree when it becomes a safety hazard. ▪ See ID-52.
Shoestring Root Rot / Armillaria Root Rot			
Hornbeam, maple, oak, pine, yew (<i>Taxus</i>), and zelkova are common KY hosts	<i>Armillaria</i> spp.	Trees dieback and decline. Dark brown rhizomorphs (thick strands of hyphae), resembling narrow 'shoestrings' form under bark and along decaying roots. Honey-colored mushrooms may develop under infected trees in autumn.	
White Pine Root Decline / Procerum Root Rot			
White pine	<i>Leptographium procerum</i>	Early symptoms include delayed bud break and reduced candle elongation in spring. As disease progresses, mature foliage begins to fade, droop, and turn brown; tree death occurs quickly. Resin is visible on bark at the tree base where a flattened canker develops. Wood beneath bark becomes discolored.	<ul style="list-style-type: none"> ▪ Select plant species/cultivars suitable for the growing site and adapted to KY climates. ▪ Choose well-drained planting sites. ▪ Control wood-boring insects that vector this disease. ▪ Remove and destroy infected trees. ▪ See PPFS-OR-W-22.

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ARMILLARIA SHOESTRING ROOT ROT MUSHROOMS (LEFT) AND RHIZOMORPHS (RIGHT)

Root & Lower Trunk Diseases

Disease/ hosts	Cause	Symptoms	Management
Water Molds (Oomycetes, Fungus-like)			
Phytophthora Crown & Collar Rot, Phytophthora Crown Canker, Basal Rot, Root rot			
Azalea, beech, dogwood, fir, hemlock, holly, juniper, ornamental cherry, pine, rhododendron, spruce, tulip tree, viburnum, yew (Taxus), and others	<i>Phytophthora</i> spp.	Slowly developing canker on lower trunk, along with root rot, result in foliar symptoms (such as reduced number and size, pale color, premature red or yellow, wilting, and curling) and dieback. May start on one side of a tree and progress until entire tree dies.	<ul style="list-style-type: none"> ▪ Select plant species/cultivars suitable for the growing site. ▪ Plant in well-drained soil or raised bed. ▪ Avoid wounding trees (mowers, string trimmers, improper pruning cuts.). ▪ For acid-loving plants (such as rhododendron), adjust soil pH prior to planting and maintain at desirable level. ▪ Control borers. ▪ Avoid overwatering. ▪ Prune dead and dying branches. ▪ Trees with cankers that encircle more than one-half the stem should be removed. ▪ Do not replant the site with susceptible plants for several years. ▪ See PPFS-OR-W-22.
Bacterial			
Bacterial Leaf Scorch			
Ash, elm, hackberry, London planetree, maple, mulberry, oak, sweetgum	<i>Xylella fastidiosa</i> (Spread by leafhoppers and treehoppers)	Trees may initially leaf-out, only to brown prematurely in late summer. Premature leaf browning, marginal necrosis, and defoliation occur annually as tree declines and eventually dies. Confirmation of diagnosis requires a laboratory test.	<ul style="list-style-type: none"> ▪ Promote plant health and reduce stress by following good cultural practices (apply mulch, water during dry periods, maintain proper nutrition and pH). ▪ Prune and destroy newly symptomatic branches to help prolong tree life (this will not eradicate the disease or pathogen). ▪ Remove and destroy severely infected trees. ▪ Managing insect vectors is usually not practical or effective. ▪ Foliar and injectable bactericides are available, but results have been inconsistent, nor do they provide a long-term solution. ▪ Replace infected trees with resistant hosts (see PPFS-OR-W-12).

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BACTERIAL LEAF SCORCH ON OAK

Vascular Wilt Diseases

Disease/ hosts	Cause	Symptoms	Management
Fungal			
Dutch Elm Disease			
Elm, zelkova	<i>Ophiostoma novo-ulmi</i> (formerly <i>Ceratocystis ulmi</i>) (Spread by European and native elm bark beetles)	Foliage in upper canopy wilts, yellows, and dies; followed by defoliation and death of affected branches. Dark streaks under the bark (vascular discoloration) develop in infected branches. Major limbs and, eventually, entire tree dies. Insect vector tunneling under the bark results in distinctive galleries.	<ul style="list-style-type: none"> ▪ Avoid planting susceptible species/cultivars. ▪ If symptoms are confined to small branches, prune well below damage, and destroy prunings. ▪ Sever root grafts between neighboring elms. ▪ Eliminate all dead or dying elm trees within 1,000 feet of the tree(s) to be protected. ▪ Apply a dormant spray (March or April) of insecticide for control of elm bark beetles. ▪ Commercial arborists can inject fungicide into the lower trunk and root flare for protection or therapy of high value trees. ▪ De-bark wood saved as firewood.
Laurel Wilt			
Sassafras, spicebush	<i>Raffaelea lauricola</i> (Spread by redbay ambrosia beetle)	Leaves suddenly and rapidly wilt, become discolored, and die. Dead leaves are reddish-brown and remain attached for about 2 weeks. Dark streaky staining develops under bark. Tiny circular holes due to insect tunneling are present on branches and trunk.	<ul style="list-style-type: none"> ▪ No management options are currently available. ▪ Remove and destroy infected tree(s). ▪ Avoid transport of wood products from susceptible hosts (such as firewood or debris) to other sites. ▪ See PPFS-OR-W-28.
Verticillium Wilt			
Catalpa, euonymus, golden raintree, maple, redbud, smoke tree, tulip tree, yellow wood, and others	<i>Verticillium dahliae</i>	Symptoms include sudden wilting and yellowing of leaves, leaf scorch, leaf death, stunting, sparse or undersized leaves, premature senescence, and death of all or part of tree (dieback/decline). Olive-green, brown, or black streaking is present in the sapwood of affected branches.	<ul style="list-style-type: none"> ▪ Plant resistant species or cultivars (see PPFS-OR-W-18). ▪ Select plant species/cultivars suitable for the growing site. ▪ Practice strict sanitation protocol. ▪ Prune and destroy infected branches; sanitize tools between pruning cuts. ▪ Promote plant health and reduce stress by following good cultural practices (apply mulch, water during dry periods, maintain proper nutrition and pH). ▪ Water during dry periods. ▪ Remove severely infected trees and shrubs. ▪ See PPFS-OR-W-18.

Vascular Wilt Diseases

Disease/ hosts	Cause	Symptoms	Management
Nematodes			
Pine Wilt Nematode / Pine Wood Nematode			
Pine, especially Scots and Austrian	<i>Bursaphelenchus xylophilus</i> (Spread by long horn beetles)	Needle color gradually fades, becomes grayish-green, then quickly turns brown starting at the top of the tree. Trees die within a few weeks or months while retaining their dead needles. Loss of resin flow occurs soon after infection. Disease vector is attracted to stressed trees.	<ul style="list-style-type: none"> Promote plant health and reduce stress by following good cultural practices (apply mulch, water during dry periods, maintain proper nutrition and pH). Submit samples from suspect trees to a county Extension office for confirmation. Trees with positive diagnosis should be removed to the ground; do not leave a stump. Destroy, bury, or chip diseased trees.
Phytoplasma			
Elm Yellows / Elm Phloem Necrosis			
Elm	<i>Phytoplasma</i> (Spread by white banded elm leafhopper, and possibly other insects)	Leaves yellow and petioles droop on scattered branches; symptoms spread throughout tree canopy. Entire trees may wilt and die suddenly. Inner bark (phloem) turns yellow followed by dark flecks.	<ul style="list-style-type: none"> Remove and destroy infected trees. Typically, elms resistant to Dutch elm disease are also resistant to elm yellows disease.

Other

Disease/ hosts	Cause	Symptoms	Management
Nematodes			
Soybean Cyst Nematode			
Soybean (does not infect woody ornamentals)	<i>Heterodera glycines</i>	Soybean cyst nematode is a quarantine pest in many states. It is found in fields previously in soybean production and also commonly associated with various nursery weeds.	<ul style="list-style-type: none"> To comply with clean stock certification requirements, nurseries shipping balled-and-burlapped plant material to certain states must obtain a state phytosanitary certificate verifying that the soil is free of soybean cyst nematode. See ID-110; contact a local Extension office for more information.

ADDITIONAL RESOURCES

GENERAL RESOURCES

- Diseases and Pests of Ornamental Plants (5th edition), Pirone, P.P. (John Wiley & Sons)
- Diseases of Trees and Shrubs (2nd edition), Sinclair, W.A., Lyon, H.H., and Johnson, W.T. (Cornell University Press)
- Diseases of Woody Ornamental Plants and Their Control in Nurseries, Jones, R.K. and Benson, D.M, eds. (American Phytopathological Society)
<https://my.apsnet.org/APSSStore/Product-Detail.aspx?WebsiteKey=2661527A-8D44-496C-A730-8CFEB6239BE7&iProductCode=42643>

UK DEPARTMENT WEBSITES

- Plant Pathology Extension Publications
<https://plantpathology.ca.uky.edu/extension/publications>
- Horticulture Department: Home Woody Plants
<https://www.uky.edu/hort/document-list-home-woody-plant>
- Horticulture Department: Nursery and Landscape Information for Commercial Growers
<https://www.uky.edu/hort/documents-list-commercial-landscape>

SPECIFIC DISEASES & PROBLEMS

- Bacterial Leaf Scorch of Shade Trees (PPFS-OR-W-12)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-12.pdf>
- Black Root Rot of Ornamentals (PPFS-OR-W-03)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-03.pdf>
- Black Spot of Rose (PPFS-OR-W-10)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-10.pdf>
- Boxwood Blight (PPFS-OR-W-20)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-20.pdf>
- Common Diseases of Spruce in Kentucky (PPFS-OR-W-24)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-24.pdf>
- Crown Gall (PPFS-GEN-01)
<https://plantpathology.ca.uky.edu/files/ppfs-gen-01.pdf>
- Diplodia Tip Blight of Pine (PPFS-OR-W-21)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-21.pdf>

- Dothistroma Needle Blight of Pine (PPFS-OR-W-25)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-25.pdf>
- Flowering Dogwood Diseases (PPFS-OR-W-06)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-06.pdf>
- How Dry Seasons Affect Woody Plants (ID-89)
<http://www2.ca.uky.edu/agcomm/pubs/id/id89/id89.pdf>
- Iron Deficiency of Woody Plants (ID-84)
<http://www2.ca.uky.edu/agcomm/pubs/ID/ID84/ID84.pdf>
- Laurel Wilt Disease & Redbay Ambrosia Beetle (PPFS-OR-W-28)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-28.pdf>
- Leaf Scorch and Winter Drying of Woody Plants (PPFS-OR-W-17)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-17.pdf>
- Mulch Mushrooms, Slime Molds & Other Saprophytes (PPFS-GEN-06)
<https://plantpathology.ca.uky.edu/files/ppfs-gen-06.pdf>
- Rose Rosette Disease (PPFS-OR-W-16)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-16.pdf>
- Shade Tree Anthracnose (PPFS-OR-W-23)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-23.pdf>
- Soybean Cyst Nematode: a Potential Problem for Nurseries (ID-110)
<http://www2.ca.uky.edu/agcomm/pubs/id/id110/id110.pdf>
- Stress and Decline in Woody Plants (ID-50)
<http://www2.ca.uky.edu/agcomm/pubs/id/id50/id50.pdf>
- Transplant Shock: Disease or Cultural Problem? (PPFS-OR-W-19)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-19.pdf>
- Tree Wounds—Invitations to Wood Decay Fungi (PPFS-OR-W-01)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-01.pdf>
- Twig Blights of Juniper (PPFS-OR-W-11)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-11.pdf>
- Verticillium Wilt of Woody Plants (PPFS-OR-W-18)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-18.pdf>

- Volutella Blight of Boxwood (PPFS-OR-W-26)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-26.pdf>
- “Wet Feet” of Ornamentals (PPFS-OR-W-04)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-04.pdf>
- What’s Wrong With My Taxus? (ID-52)
<http://www2.ca.uky.edu/agcomm/pubs/ID/ID52/ID52.pdf>
- When White Pines Turn Brown—Common Problems of White Pines in Kentucky (PPFS-OR-W-22)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-22.pdf>

DISEASE DIAGNOSIS

- Canker Sampling of Trees & Woody Ornamentals (PPFS-OR-W-27)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-27.pdf>
- Considerations for Diagnosis of Ornamentals in the Landscape (PPFS-GEN-15)
<https://plantpathology.ca.uky.edu/files/ppfs-gen-15.pdf>
- Diagnosis of “No Disease” (PPFS-GEN-11)
<https://plantpathology.ca.uky.edu/files/ppfs-gen-11.pdf>
- Fundamental Principles of Plant Pathology for Agricultural Producers (PPA-41)
<http://www2.ca.uky.edu/agcomm/pubs/ppa/ppa41/ppa41.pdf>
- KY Master Gardener Manual (chapters related to disease diagnosis)
 - Plant Diseases (Chapter 6) (PPA-46)
<http://www2.ca.uky.edu/agcomm/pubs/ppa/ppa46/ppa46.pdf>
 - Appendix to Master Gardener Chapter 6
https://plantpathology.ca.uky.edu/files/mg_ch6_appendix.pdf
 - Diagnosing Plant Problems (Chapter 7) (ID-194)
<http://www2.ca.uky.edu/agcomm/pubs/id/id194/id194.pdf>

- Sample Submission Protocol for Diagnosis of Thousand Cankers Disease in Walnut (PPFS-OR-W-15)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-15.pdf>
- Submitting Plant Specimens for Disease Diagnosis (PPFS-GEN-09)
<https://plantpathology.ca.uky.edu/files/ppfs-gen-09.pdf>

MANAGEMENT

- Fungicides for Management of Landscape Woody Ornamental Diseases (PPFS-OR-W-14)
<https://plantpathology.ca.uky.edu/files/ppfs-or-w-14.pdf>
- Greenhouse Sanitation (PPFS-GH-04)
<https://plantpathology.ca.uky.edu/files/ppfs-gh-04.pdf>
- Homeowner’s Guide to Fungicides (PPFS-GEN-07)
<https://plantpathology.ca.uky.edu/files/ppfs-gen-07.pdf>
- IPM for Select Deciduous Trees in Southeastern US Nursery Production
https://wiki.bugwood.org/IPM_book
- IPM for Shrubs in Southeastern US Nursery Production: Vol I
https://wiki.bugwood.org/IPM_Shrub_Book
- Landscape Sanitation (PPFS-GEN-04)
<https://plantpathology.ca.uky.edu/files/ppfs-gen-04.pdf>
- Relative Effectiveness of Various Chemicals for Disease Control of Ornamental Plants (PPFS-GEN-13)
<https://plantpathology.ca.uky.edu/files/ppfs-gen-13.pdf>
- Southeastern US Pest Control Guide for Nursery Crops and Landscape Plantings Landscape Plantings
<https://content.ces.ncsu.edu/southeastern-us-pest-control-guide-for-nursery-crops-and-landscape-plantings>
- The Role of Shearing in Disease Management of Diplodia Tip Blight
https://plantpathology.ca.uky.edu/files/managing_diplodia_tb.pdf

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