



WOODY PLANT DISEASE CONTROL GUIDE FOR KENTUCKY

by John Hartman, Mary Witt, Don Hershman, and Robert McNiel

Cultural Practices to Prevent Disease

Good care of trees and shrubs prevents many nursery and landscape problems. Because trees and shrubs live for many years, their susceptibility to disease is influenced not only by current climatic and environmental conditions but also by conditions and care during previous years. Adverse growing conditions, maltreatment, and lack of care favor many diseases. Many problems in nurseries and landscape plantings can be avoided by selecting proper plant materials, creating good planting sites, avoiding unnecessary wounding, providing routine care (including fertilization and timely watering and pruning), and using preventive disease and insect control measures as needed.

Woody plants may be stressed or grow poorly for a variety of reasons, some natural and some caused by people. In any case, these stressed plants are often susceptible to diseases that would otherwise not be a problem. Stresses are often alleviated or moderated by proper plant care. Several UK Cooperative Extension publications, available from your county Extension office, cover this topic.

Nursery and Landscape Hygiene

Careless hygiene can ruin one's investment in disease-free plants and clean soil. Soil-borne pathogenic fungi, bacteria, and nematodes are carried into the nursery or landscape and spread by footwear, implements, tools and machines, moving surface water, blowing soil, and plants. Nurseries are especially vulnerable to outbreaks of contagious diseases, so take extra precautions.

- Before planting, insist on clean stock. Do not order or accept stock likely to be infected with nematodes, crown gall bacteria, or highly destructive soil-borne fungi such as *Phytophthora*, *Thielaviopsis*, or *Verticillium*.
- Where practical, stabilize all open soil near the nursery and maintain windbreaks. Cover dirt roads with gravel or oil.
- Require equipment moving between nursery blocks to pass through a central area where soil is washed off. Equipment can be parked on a bed of coarse rock, and soil particles will be carried down through the stones. A steel grating over a pit is an even better arrangement for a permanent wash-down area.



- Wash boots and hand tools along with mechanical equipment.
- When roguing diseased plants or pruning diseased parts of plants, destroy or bury the discards.
- Divert surface water into ditches or culverts to prevent its movement from one nursery block to another.
- Remember that irrigation water can carry pests and pathogens. Select a clean source and keep it from becoming contaminated.
- Allow no direct traffic from outdoor areas to indoor propagation areas. Clean footwear with a germicidal agent such as LF-10 or Amphyl at entrances.
- When collecting cuttings in the field, inspect stock plants carefully and avoid any plants showing disease symptoms or abnormalities.
- Disinfect tools regularly when pruning to control disease or

when collecting cuttings. An easy, effective way to do so is to swab the cutting blades with denatured alcohol (mix 7 parts alcohol with 3 parts water). Chlorine bleach diluted 1:5 with water is also effective. A vial or other pocket-sized container will hold a cotton swab saturated with the disinfecting solution. Rinse tools in water at the end of the day to remove corrosive bleach or rubber-softening alcohol.

Using Fungicides and Bactericides

Most of the diseases listed in this publication do not require annual or regular chemical treatments for control. Exceptions include rose diseases and diseases of susceptible flowering crabapples. Consider routine chemical application for disease control only when the disease is a known threat (has occurred in previous seasons, is present in nearby landscapes, is expected in your operation, or is so devastating that routine prevention is essential) and when the plant being considered is irreplaceable.

Most fungicides and bactericides are protectants and must be on the plant before infection begins. Some fungicides are systemic types, however, and can eradicate new infections. Rainy, foggy weather favors most infections; therefore, apply protectant sprays before such weather conditions occur. Extra sprays may be needed during wet years, and few or no sprays may be needed during warm, dry, spring and summer weather.

Chemical Application

Methods and Equipment

Good injecting or spraying equipment and techniques are essential for successful control of diseases.

Injections and Implants. Techniques and materials have been developed for controlling specific diseases in certain trees by injecting fungicides into the sapstream at the trunk's base or on the flare roots. These systems are useful where sprays cannot be used. Much less chemical is needed, and it is all delivered into the tree not into the surrounding environment. Problems of uneven distribution of chemicals in the tree crown do sometimes occur, however, and each injection creates a wound that is a potential colonization site for decay fungi. In this regard, the smaller the injection, the better. If a problem requires annual injection, the injury caused by injection is probably more damaging than the problem being addressed.

Injector units using the Mauget system and similarly constructed units for injecting fungicides into trees (e.g., Alamo) consist of a small plastic cylinder containing fungicide attached to a short plastic tube inserted into a pre-drilled hole in the trunk. Installing injector units requires knowledge and practice. Accordingly, these are used by arborists, nursery operators, and horticulturists who have had a special training course.

An apparatus is also available for injecting liquid fungicides into the tree by gravity or under high pressure. Small holes are first bored into the tree trunk to the depth of the outer layers of sapwood. A special injector tap or screw is then inserted into the hole. A high-pressure hose is connected

at one end to the screw and at the other end to a hydraulic sprayer capable of building high pressures. The fungicide is then pumped into the tree at high pressure. Only experienced professional arborists should use such apparatus.

The Elm Research Institute can provide information about controlling Dutch elm disease using a low pressure system for injecting fungicide into elm trees. The arrangement of a series of T-shaped nozzles connected to one another with tubing is similar to the one used for the high pressure system described above.

Spraying Equipment. Small trees and shrubs can be sprayed with hand-pumped, bucket, hose-end, backpack, or small power sprayers. Large trees can only be properly sprayed with large spraying machines. Such machines are expensive and are mainly owned by commercial arborists and park and shade tree departments doing considerable tree work. Such sprayers include:

- **Hydraulic Sprayers** apply sprays to tall trees in a so-called solid stream; that is, the material leaves the nozzle much as water issues from a fire hose. The stream, forced out under great pressure, soon reaches a height, however, at which it breaks into a mist and drifts onto leaves and stems.

Smaller trees are sprayed with a hydraulic sprayer that breaks the liquid into a fine mist as soon as it leaves the nozzle, giving rapid and complete coverage. Most hand-held spray guns have nozzles that can be adjusted to accomplish both types of spraying.

- **Mist Blowers** (or air sprayers) use blasts of air to propel droplets of pesticide, in contrast to hydraulic sprayers which use water as the vehicle for the pesticide. With such machines, it is possible to cover more trees in a shorter time at far less cost. Using highly concentrated materials not only speeds up refilling time, but sharply reduces runoff or drip waste, which is a major component of lost pesticide for hydraulic applications.

Mist blowers come in several sizes and types. Some are more suitable for use on large shade trees, and others are better adapted for nursery plantings. Small motor-powered backpack mist blowers are now available for low-growing plant materials. Several companies manufacture spraying machines. Your local pesticide dealer has information on prices and specifications of spray equipment.

The object of spraying is to cover every leaf, twig, and branch that might become infected by a pathogen. Thorough coverage is especially essential when using protectant fungicides. For protection against infectious diseases, both leaf surfaces usually need to be covered. Because systemic fungicides are transported throughout the plant, complete coverage for them is less important. Because of concerns over drift of pesticides to neighboring property, sprayers capable of covering large trees should be used with caution.

Wetting, Spreading, and Sticking Agents

Wetting, spreading, and sticking agents (surfactants), often combined in commercial preparations as spreader-stickers, need to be used in some spray mixtures. They are particularly necessary when pesticides are applied to hard-to-

wet broadleaf evergreens or conifers. Follow directions on labels of commercial preparations.

The fungicide label usually indicates any restrictions in selection of compatible surfactants. The following are surfactants commercially available for tank mixing: Biofilm Spreader-Sticker, Chevron Spray Sticker, Chevron Spreader, Citowett (spreader-sticker), Multifilm L (spreader), Nu-film P (spreader-sticker), Nu-Film 17 (spreader-sticker), Ortho X-77 (spreader), Pinolene (sticker), Spray Stay (spreader-sticker), Sure Spred (spreader), Surfactant 11 (spreader), and Triton B-1956 (spreader).

Materials Used to Control Diseases of Woody Plants

(Follow label instructions.)

Fungicides are listed in this section, alphabetically by common chemical name followed by trade name and fungicide or bactericide uses and remarks.

benomyl — Benomyl WP; Fungicide with some systemic properties; effective against many diseases. Tolerant strains of Botrytis, rose powdery mildew, and the apple scab fungus now occur. Do not use benomyl alone. Rather alternate or tank mix with other fungicides. Ineffective against Pythium, Phytophthora, and similar fungi. Benlate, a product containing benomyl, is not labeled for landscape use, though other benomyl forms are.

bordeaux mixture — Bordeaux mixture, Bordo, Copper Bordo; Equal parts by wt. copper sulfate (bluestone) + hydrated lime in water; most effective if freshly mixed but dried Bordeaux preparations are available. Some species of Ilex may be injured by copper. Proportions of chemical in the mixture can vary and are often expressed as pounds of copper sulfate, pounds of hydrated lime, and gallons of water.

captan — Captan Fungicide, Captan, Orthocide, Captan Dust; General protectant fungicide used for foliage diseases. Sometimes used for control of damping-off fungi.

chlorothalonil — Daconil 2787, Bravo 720; Broad-spectrum fungicide for control of foliage diseases including conifer needle diseases.

copper (fixed) — [see also Bordeaux mixture] Basic Copper Sulfate, Tribasic copper sulfate, Basi-Cop, Microcop, Copper 53 Fungicide, T-B-C-S 53, copper oxychloride sulfate; General protectant fungicide. May be phytotoxic to new spring growth, especially Ilex spp.

copper hydroxide — Kocide 101, 606, DF, Champion; General protectant fungicide. May be phytotoxic.

copper sulfate pentahydrate — Phyton 27; Fungicide for Dutch elm disease control via injection.

dodemorph acetate — Milban; For commercial greenhouse use only; controls powdery mildew.

etrizazole (ethazole) — Terrazole, Truban; Soil drench fungicide useful against Pythium, Phytophthora damping-off, and root rot.

fenarimol — Rubigan AS; Locally systemic fungicide for control of powdery mildew and apple scab.

ferbam — Carbamate T&O, Carbamate WDG, Ferbam,

Karbam Black; General protectant fungicide. May leave black residue on flowers and foliage.

folpet — Phaltan, Folpet; Rose and garden fungicide.

fosetyl-AI — Aliette; Foliar and soil drench fungicide used for systemic control of Pythium and Phytophthora diseases.

funginex — Triforine; Rose disease control fungicide.

Gallex — For therapeutic treatment of crown gall.

Galltrol-A, Norbac-84 (Agrobacterium radiobacter strain 84) — A preventive biocontrol of crown gall.

iprodione — Chipco 26019; Broad spectrum, locally systemic fungicide.

mancozeb — F-45, Fore, Mancozeb, Penncozeb, Protect T/O; General protectant fungicide for foliar diseases.

maneb — Dithane M-22, Maneb, Manex, Blitex, Chem Neb; General protectant fungicide for foliar diseases.

MBC phosphate — Lignasan BLP, Elmosan, Elm-Noculate, Correx, Elmpro, Fungisol; Soluble systemic fungicide injected for Dutch elm disease control.

metalaxyl — Subdue 2E Subdue II; Systemic soil drench fungicide used to control Pythium and Phytophthora diseases.

pentachloronitrobenzene — Terraclor, PCNB; Fungicide used principally to control Rhizoctonia using soil drench applications or incorporated into soil in dry form. May suppress root development in cuttings.

piperalin — Pipron; Powdery mildew fungicide for roses.

propamocarb — Banol; For control of Phytophthora root rots of container plants.

propiconazole — Banner, BannerMaxx, Alamo, Immunex; Locally systemic fungicide effective for anthracnose, scab, powdery mildew, and rust diseases. Alamo is injected for Dutch elm disease and oak wilt control.

streptomycin — Ag-Strep, Agrimycin, Phytomycin, Antibiotic spray powder, Streptomycin spray, Streptomycin WP, Streptomycin C 17; Antibiotic effective against bacteria but not fungi. Ineffective at low temperature. May cause phytotoxicity at high rates during hot weather. Effectiveness is favored by slow drying conditions. Not recommended for urban landscape situations.

sulfur — Sulfur dust, wettable, Thiolux, Liquid lime-sulfur; Elemental sulfur is a fungicide for powdery mildew; lime-sulfur can serve as both fungicide and insecticide and is phytotoxic on Viburnum.

thiabendazole — Arbotect 20-S; Systemic fungicide injected for Dutch elm disease and for sycamore anthracnose control.

thiophanate-methyl (dimethyl 4, 4-o-phenylenebis-[3,thioallophanate]) — Cleary's 3336, Fungo-Flo, Fungo DF, Domain FL, 3336 WP, Topsin M; Systemic fungicide having properties similar to benomyl.

triadimefon — Bayleton, Strike; Systemic fungicide for control of powdery mildew, rust diseases, some leaf spots, and flower blights.

vinclozolin — Ornalin, Curalan DF; For control of Botrytis diseases.

ziram — Ziram; General protectant fungicide.

Fungicide Mixtures

chlorothalonil + fenarimol — Two Some; Combination protectant and locally systemic fungicide controlling a wide range of diseases.

ethzole + thiophanate methyl — Banrot; Broad-spectrum fungicide for control of root rot diseases of container-grown plants.

thiophanate-methyl + mancozeb — Zyban, Duosan; Broad spectrum systemic and protectant fungicide combination.

Soil Fumigation

General-purpose soil fumigants are designed to eradicate essentially all soil organisms including fungi, bacteria, nematodes, soil insects, plants, and seeds. Commonly used materials are methyl bromide, chloropicrin, sodium methyldithiocarbamate, and mixtures containing two or more active ingredients. Consider using a general-purpose fumigant for rehabilitation of high value soil infested with damaging populations of nematodes or root disease fungi.

Soil fumigation suggestions:

1. Soil fumigation is most effective when soil is warm and moderately moist, like summer or early autumn.
2. Cultivate soil at least 12 in. deep, providing a uniform loose texture. Remove roots and other non-rotted plant debris.
3. Work the soil to seedbed condition to achieve effective sealing of the surface by a roller or cultipacker after injection of the chemical.
4. Inject the chemical 6 to 8 in. deep or half the depth of topsoil.
5. Carefully adhere to minimum waiting periods before planting as indicated on product labels.
6. It may be necessary to aerate the soil by cultivation.
7. Be aware of potential side effects, such as toxic bromide residues and increases in soluble salts and nitrogen caused by some fumigants.
8. Follow all label directions.

Nematode Control

Soil-borne nematodes can be controlled using nematocidal fumigants like chlorinated hydrocarbon compounds applied before planting. Follow guidelines listed previously for soil fumigation.

Fenamifos and oxamyl are useful for postplanting nematode control treatments on a wide variety of woody plants. These chemicals also control some insect pests. These nematicides can also be used for preplant treatments. Consult manufacturers' instructions.

Uses for Soil Fumigants & Nematicides

(Follow label instructions.)

Fumigants, fumigant mixtures, and nematicides are listed in this section, alphabetically by common chemical name followed by trade name and fumigant or nematicide uses and remarks.

chlorinated hydrocarbons (some formulations are mixed with chloropicrin) — Telone C-17; Fumigant. Controls nematodes, soil insects, some soilborne diseases, and many weeds. Apply in spring or fall when soil temperature is above 40°F. Plant when fumigant odor is gone or follow label instructions.

chloropicrin (some formulations are mixed with chlorinated hydrocarbons or methyl bromide) — Chlor-O-Pic, Picfume, Larvabrome, Nemex, Telone II; General soil fumigant. Corrosive to metal; water or plastic seal necessary. Apply only when soil temperature is 60°F or higher. Aerate soil by cultivation until odor is gone before planting — 2 to 4 weeks minimum.

fenamifos — Nema-cur; Nematicide with systemic action. Protects ornamentals against the major nematode genera.

methyl bromide (some formulations are mixed with chloropicrin) — Brom-0-Gas, Dowfume MC-2, Dowfume MC-33, Brozone, Nemaster; General soil fumigant; odorless, therefore usually mixed with small amounts of chloropicrin to impart odor. Applied under plastic tarp or by injection followed by tarp application. Soil must be 50°F or above. Leaves bromide residue in soil. Be aware that this chemical is being gradually phased out over concerns that it facilitates atmospheric ozone depletion.

oxamyl — Vydate; Systemic insecticide-nematicide; has broad-spectrum nematocidal activity when applied to soil; is unique in functioning as a nematicide when applied to foliage of certain plants. Fruit nursery plant applications.

sodium methyldithiocarbamate — Vapam, Busan 1020; General soil fumigant; applied by injection or as drench. Also used to prevent root-graft transmission of Dutch elm disease.

Woody Plant Disease Control

ALL SPECIES

Anthracnose and leaf spots

Control: Sprays are usually not needed. Provide the growing site with good air movement and sunlight penetration by pruning and spacing. Rake up and destroy fallen infected leaves in autumn. If disease has been severe the previous year and cool, wet conditions are expected in spring, spray with bordeaux mixture, chlorothalonil, chlorothalonil + fenarimol, copper (fixed), mancozeb, mancozeb + thiophanate-methyl, maneb, propiconazole, or thiophanate-methyl. Repeat 2 to 3 times at 10- to 14-day intervals, beginning at bud break. NOTE: Read the fungicide label to be sure that the specific plant and disease are listed. The plant and disease list for each fungicide is different.

Dieback, decline

Control: Keep trees well-watered, especially from May to July. Prune out dead and dying branches. Prevent decline by routine care and tree placement to avoid salt exposure and soil compaction. Sever girdling roots as needed. Control defoliating insects. Aerate compacted soil in root zone.

Powdery mildew

Control: Provide growing site with good air movement and sunlight penetration by pruning and spacing. Apply

benomyl, dodemorph, fenarimol, propiconazole, thiophanate-methyl, triadimefon, wettable sulfur, ziram, or mancozeb + thiophanate-methyl weekly beginning when disease symptoms first appear. Check fungicide labels for specific plants cleared.

Root and cutting rot of propagation and overwintering stock

Control: Provide good sanitation, clean plant materials and growing media, and good soil drainage. Fungicide drenches, where labelled for specific crops, may be used. For water molds, use products containing metalaxyl, fosetyl-Al, or ethazole. For Rhizoctonia or other fungi, use benomyl, PCNB, thiophanate-methyl, or iprodione.

Storage mold of nursery stock

Control: Maintain cold storage near freezing. Apply captan or benomyl in the field or just before nursery stock is packed.

Verticillium wilt

Control: Practice strict nursery hygiene. It is difficult to disinfest contaminated soil even using soil fumigation. Rogue out infected nursery plants. In the landscape, prune out infected branches, or remove badly infected plants. Fertilize and water landscape plants. Replace with Verticillium wilt resistant plants, e.g., Betula spp., Buxus spp., Cercidiphyllum japonicum, Carpinus spp., Cornus spp., Crataegus spp., Ginkgo biloba, Fagus spp., Gleditsia triacanthos, Ilex spp., Juglans spp., Liquidambar styraciflua, Malus spp., Morus spp., Platanus spp., Pyracantha spp., Quercus spp., Pyrus spp., Salix spp., Sorbus aucuparia, Tilia spp., and needled evergreens.

ACER (maple)

Anthracnose

Control: See suggestions under ALL SPECIES.

Fungal cankers

Control: Fertilize and water as needed to provide good growing conditions for maintaining plant health. Avoid injuries. Remove and destroy cankered branches or excise trunk cankers when bark is dry.

Phyllosticta and other leaf spots

Control: See suggestions under ALL SPECIES.

Taphrina leaf blister

Control: Sprays usually not needed. A single dormant application of lime sulfur will control this disease.

Verticillium wilt

Control: See suggestions under ALL SPECIES. Norway maples tolerant or resistant to Verticillium wilt include: 'Columnare Compacta', 'Jade Glen', and 'Parkway'.

AESCULUS (horsechestnut, buckeye)

Abiotic scorch

Control: Provide adequate water.

Guignardia leaf blotch, leaf spots

Control: Destroy fallen leaves in autumn. Spray with chlorothalonil, chlorothalonil + fenarimol, or mancozeb 2 to

4 times at 10- to 14-day intervals beginning when buds open. Weather conditions and severity of disease determine number of applications needed. The following species and varieties are reported to be resistant to leaf blotch: Aesculus arguta, A. glabra var. monticola, A. glabra var. sargentii, A. parviflora, and A. parviflora var. serotina.

AMELANCHIER (serviceberry)

Powdery mildew

Control: See suggestions under ALL SPECIES.

Rust

Control: See suggestions under MALUS.

BETULA (birch)

Leaf rust, leaf spots

Control: Rake up and destroy fallen leaves.

BUXUS (boxwood)

Macrophoma and other leaf spots

Control: Use sanitation measures as for canker. Fertilize and protect from winter injury to maintain vigor. Sprays not needed.

Nematodes

Control: Apply soil insecticide/nematicide fenamifos.

Pseudonectria canker

Control: Plant in well-drained soil and protect from drying winter winds. Prune infected branches back to healthy wood. In spring, if possible, remove and destroy old leaves lodged in branches (a strong stream of water helps).

CARYA (hickory)

Fungal leaf spots

Control: Rake up and destroy fallen leaves. Sprays are usually not necessary. If disease has been severe, see suggestions under ALL SPECIES.

CASTANEA (chestnut)

Blight, Endothia (Cryphonectria) parasitica

Control: Prune away and destroy cankered limbs. Cankers in landscape trees can be treated with a soil-water paste held in place with plastic. Treated cankers will begin remission. American chestnut is extremely susceptible; Chinese chestnut is tolerant.

CATALPA

Fungal leaf spots

Control: Rake up and destroy fallen leaves. Sprays are usually not necessary. If disease has been severe, see suggestions under ALL SPECIES. Spray as leaves are unfolding, when leaves reach full size, and 2 weeks later.

Verticillium wilt

Control: See suggestions under ALL SPECIES.

CELTIS (hackberry)

Witches' broom, caused by Sphaerotheca

phytophila and eriophyid mites

Control: No practical control for affected trees. *C. sinensis* (Chinese hackberry) is resistant.

CERCIS (redbud)

Botryosphaeria canker

Control: Prune and destroy affected branches when foliage is dry. Control borers and avoid other injuries. Provide water during dry periods.

Verticillium wilt

Control: See suggestions under ALL SPECIES.

CORNUS (dogwood)

Botrytis flower and leaf blight

Control: Disease is serious only in wet years. If wet weather occurs during bloom, spray once with thiophanate-methyl or iprodione.

Discula anthracnose (lower branch dieback)

Control: Prune diseased branches back to sound wood and destroy them. Remove epicormic shoots along trunk and limbs. Rake up and destroy fallen leaves. Avoid trimmer and mower wounds and other unnecessary injuries. Maintain vigor by applying mulch; water during dry periods. Do not transplant dogwood trees from the wild. Resistant dogwoods include: *C. kousa*, *C. racemosa*, *C. canadensis*. For fungicide suggestions, see under ALL SPECIES, and begin applications at bud break.

Fungal twig blights and cankers

Control: Prune diseased branches back to sound wood and destroy them. Maintain vigor by mulching; water during dry periods.

Phytophthora crown canker

Control: Avoid mechanical injuries, especially to the lower trunk and roots. Remove discolored wood down to heartwood if necessary and healthy wood for 1.5 inches around the edge of the canker. Control borers and treat all borer wounds like cankers. Trees with cankers that encircle more than one half the stem should be removed and the area not replanted with dogwoods for several years unless the soil is fumigated. Where losses have occurred in nurseries, fumigate the soil before planting. Provide good soil drainage. Metalaxyl, used as a soil drench, will suppress crown canker.

Powdery mildew

Control: See suggestions under ALL SPECIES.

Septoria and other fungal leaf spots, spot anthracnose

Control: Sprays ordinarily are not necessary. If disease was severe the previous year and spring conditions are wet, see fungicides suggested under ALL SPECIES, and apply sprays at budbreak and 10 and 20 days later.

COTONEASTER

Fire blight

Control: See suggestions under MALUS.

The following are reported to be resistant or tolerant to fire blight: *C. adpressus praecox*, *C. adpressus praecox* 'Boer', *C. apiculatus*, *C. bacillaris*, *C. dielsiana* var. *elegans*, *C. distica*, *C. francheti*, *C. harroviana*, *C. microphylla*, *C. neweryensis*, *C. nitens*, *C. salicifolius repandens* 'Emerald Spray', *C. simonsi*.

CRATAEGUS (hawthorn)

Fabraea leaf spot

Control: Destroy or compost fallen leaves. Spray as suggested under ALL SPECIES when leaf buds open and repeat 10 and 20 days later. Additional applications may be necessary during wet seasons. Plant resistant hawthorns such as cockspur (*C. crusgalli*), Washington (*C. phaenopyrum*), Toba (*C. mordenensis* cv. Toba), or Lavalley's (*C. lavalleyi*).

Fire blight

Control: See suggestions under MALUS. Do not use streptomycin on *C. mollis*.

Rusts, caused by Gymnosporangium spp.

Control: Eliminate nearby red cedar and common juniper to whatever extent practical. Spray with triadimefon, chlorothalonil, mancozeb + thiophanate-methyl, or chlorothalonil + fenarimol. Begin spray schedule when orange rust masses develop on cedars (April through May). Make 3 or 4 applications at 7- to 10-day intervals. The Washington thorn (*C. phaenopyrum*) and the cockspur thorn (*C. crus-galli*) are resistant.

ELEAGNUS (Russian olive)

Canker, dieback

Control: Prune out and destroy infected branches.

EUONYMUS

Crown gall

Control: Pretreat cuttings or liners with Galltrol-A or Norbac 84. Destroy heavily infected plants. Prune out and destroy galls on savable plants. Disinfest tools between cuts. Apply Gallex to exposed galls. Plant crown gall-resistant plants in the following genera: *Berberis*, *Buxus*, *Carpinus*, *Catalpa*, *Cedrus*, *Cephalotaxus*, *Cryptomeria*, *Fagus*, *Ginkgo*, *Ilex*, *Koeleruteria*, *Larix*, *Liriodendron*, *Magnolia*, *Mahonia*, *Nyssa*, *Picea*, *Pinus*, *Pseudolarix*, *Tamarix*, *Taxodium*, *Tilia*, and *Tsuga*. *Euonymus alatus* is resistant.

Powdery mildew

Control: See suggestions under ALL SPECIES. Apply fungicide weekly beginning when disease symptoms first appear.

FORSYTHIA

Phomopsis gall

Control: Prune out affected branches.

FRAXINUS (ash)

Anthracnose and other leaf spots

Control: See suggestions under ALL SPECIES.

GLEDITSIA (honeylocust)

Leaf spots

Control: Rake up and destroy fallen leaves.

Powdery mildew

Control: No need to control this disease.

Thyronectria canker

Control: Avoid injuries; alleviate stressful growing conditions. Cultivars ‘Shademaster’, ‘Holka’, and ‘Imperial’ are thought to be more tolerant.

ILEX (holly)

Black root rot

Control: Practice strict nursery hygiene and sanitation. Exclude the pathogen from the nursery by using disease-free stock plants. Avoid use of unsterilized agricultural soils. Promote good plant growth. *I. aquifolium* and *I. cornuta* are said to be resistant.

Fungal leaf spots

Control: Rake up and destroy fallen leaves.

JUGLANS (walnut, butternut)

Fungal leaf spots

Control: Destroy fallen leaves. Spray as suggested under ALL SPECIES 3 times at 2-week intervals, starting when leaves begin to unfold.

JUNIPERUS (juniper, red cedar)

Cedar-apple, cedar-hawthorn, and cedar-quince rusts, caused by *Gymnosporangium spp.*

Control: Do not plant near flowering crabapple, hawthorn, quince, and similar plants. Manual removal of galls and infected twigs in early spring may be practical where infection is light. Use disease-resistant varieties such as:

Juniperus ashei;
J. chinensis—‘Ames’, ‘Blue Mountain’, ‘Blue Point’, ‘Columnaris Hetzii’, ‘Femina’, ‘Fortunei’, ‘Fountain’, ‘Grey Owl’, ‘Hetzii’, ‘Japonica’, ‘Keteleeri’, ‘Leeana’, ‘Maney’, ‘Mas’, ‘Mountbatten’, ‘Oblonga’, ‘Pedula’, ‘Perfecta’, ‘Pfitzeriana’, ‘Pfitzeriana Compacta’, ‘Pfitzeriana Glauca’, ‘Plumosa Aurea’, ‘Pyrimidalis’, ‘Robusta Green’, ‘sargentii’, ‘sargentii ‘Variegata’, ‘sargentii ‘Wateri’, ‘Winter Green’;
J. communis—‘Aurea’, ‘Aureo-spica’, ‘Cra Covia’, var. *depressa*, *depressa* ‘Aurea’, ‘Hibernica’, ‘Oblonga Pendula’, ‘Saxatilis’, ‘Saxatilis Pallas’, ‘Suecica’, ‘Suecica Nana’;
J. horizontalis—‘Admirabilis’, ‘Adpressa’, ‘Argenteus’, ‘Depressa’, ‘Douglasii’, ‘Eximius’, ‘Filicinus’, ‘Glomerata’, ‘Lividus’, ‘Petraea’, ‘Plumosa’, ‘Variegata’, ‘Wiltonii’;
J. procumbans;
J. rigida;
J. sabina—‘Broadmoor’, ‘Fastigiata’, ‘Knap Hill’, ‘Skandia’, ‘var. *tamariskifolia*’;
J. scopulorum—‘Medora’, ‘Moonglow’, ‘Sparkling Sky-rocket’, ‘Wichita Blue’;
J. squamata—‘Albo-variegata’, var. *fargesii*, ‘Meyerii’, ‘Wilsonii’;

J. virginiana—‘Aurea’, ‘Berg’s Rust Resistant’, ‘Blue Fountain’, ‘Globosa’, ‘Hillspire’, ‘Kosteri’, ‘Pseudocupressus’, ‘Primidalis’, ‘Tripartita’, ‘Venusta’.

Kabatina tip blight (the most damaging tip blight in Kentucky)

Control: Prune out infected shoots. Chemical controls have not been developed. Plant disease-tolerant cultivars such as:

Juniperus chinensis—‘Ames’, ‘Aurea Gold Coast’, ‘Columnaris Hetzii’, ‘Hetzii Glauca’, ‘Keteleeri’, ‘Maney’, ‘Mountbatten’, ‘Perfecta’, ‘Pfitzeriana’, ‘Pfitzeriana aurea’, ‘Robusta Green’, var. *sargentii* ‘Viridis’, ‘sargentii ‘Glauca’, ‘Saybrook Gold’, ‘Spartan’, ‘Winter Green’;
J. communis—‘Hornbrookii’, ‘Hibernica’;
J. horizontalis—‘Bar Harbor’, ‘Marcellus’;
J. procumbens—‘Nana’, ‘Variegata’;
J. sabina—var. *tamariskifolia*;
J. scopulorum—‘Sutherland’;
J. virginiana—‘Blue Fountain’, ‘Prostrata Glauca’.

Phomopsis tip blight

Control: If possible, prune out and destroy infected shoots. Avoid overhead irrigation. Rogue and destroy infected plants when disease is first seen in young plantings. Spray with mancozeb, thiophanate-methyl, or mancozeb + thiophanate-methyl plus a spreader-sticker at 2-week intervals throughout the growing season.

Use disease-resistant junipers such as:

Juniperus chinensis—‘Femina’, ‘Hetzii’, ‘Iowa’, ‘Keteleeri’, ‘Pfitzeriana’, ‘Pfitzeriana aurea’, ‘Robusta’, var. *sargentii*, ‘sargentii ‘Glauca’, ‘Saybrook Gold’, ‘Shoosmith’, ‘Spartan’;
J. communis—‘Ashfordii’, ‘Aureo-spica’, var. *depressa*, ‘Hibernica’, ‘Hulkjaerhus’, ‘Prostrata aurea’, ‘Repanda’, var. *saxatilis*, ‘Suecica’;
J. conferta—‘Blue Pacific’, ‘Emerald Sea’
J. horizontalis—‘Blue Mat’, ‘Depressa’, ‘Depressa aurea’, ‘Douglasii’, ‘Prince of Wales’, ‘Procumbens’;
J. sabina—‘Broadmoor’, ‘Knap Hill’, ‘Skandia’;
J. scopulorum—‘Silver King’, ‘Campbellii’;
J. squamata—var. *fargesii*, ‘Meyerii’, ‘Prostrata’, ‘Pumila’;
J. virginiana—‘Tripartita’.

KALMIA (mountain laurel)

Fungal leaf spots

Control: Hand pick infected leaves and prune infected shoots; destroy or compost fallen leaves. If disease has been severe, spray as suggested under ALL SPECIES at budbreak and again 10 and 20 days later.

KOELREUTERIA (goldenrain tree)

Nectria canker

Control: Prune back to sound wood. Fertilize and water to maintain vigor.

Verticillium wilt

Control: See suggestions under ALL SPECIES.

LIRIODENDRON (tulip poplar)

Verticillium wilt

Control: See suggestions under ALL SPECIES.

Powdery mildew

Control: No need to control this disease.

MAGNOLIA

Leaf spots

Control: If disease has been severe, spray as suggested under ALL SPECIES.

MALUS (apple, flowering crabapple)

See list of disease-resistant varieties and cultivars below.

Fire blight

Control: Avoid use of high nitrogen fertilizer. Cut out cankers and blighted branches between November and March when tree is dry, making cuts below the visible limits of infection. Unless done when symptoms are first just visible, pruning cuts done April through October have little value in fire blight control and in fact may spread the disease. Once symptoms are obvious, allow tree defenses to stop the spread of disease. Remove worthless pear, apple, quince, and similar plants from the vicinity. Use MARYBLYT computer program to time sprays in the nursery during bloom. Otherwise, spray with streptomycin when 25 percent of blossoms are open and again when 75 percent of blossoms are open. To prevent injury, if temperatures are above 65°F, use fixed copper instead of streptomycin. Avoid use of streptomycin in urban landscapes.

Rust, caused by Gymnosporangium spp.

Control: Eliminate nearby red cedar and common juniper where possible, or remove and destroy cedar rust galls and rust-infected juniper twigs. Spray with fenarimol, propiconazole, chlorothalonil + fenarimol, triadimefon, mancozeb, or mancozeb plus thiophanate-methyl. Make 3 applications at 10-day intervals beginning when orange rust masses develop on junipers (April through May).

Powdery mildew

Control: Provide a sunny, well-ventilated planting site. Use disease-resistant types. Prune away shading vegetation. For fungicide suggestions, see under ALL SPECIES.

Scab

Control: Rake up and destroy all fallen leaves and fruits in the fall. During the growing season, spray: chlorothalonil, fenarimol, propiconazole, chlorothalonil + fenarimol, mancozeb, thiophanate-methyl, or mancozeb + thiophanate-methyl at pink bud and at petal-fall, plus 2 more applications at 10-day intervals to control primary infections. Apply before rain if possible, and extend the schedule during rainy seasons. Use disease-resistant crabapples.

Frogeye leaf spot (black rot)

Control: Eliminate dead twigs and branches.

The following flowering crabapple cultivars are moderately to highly resistant to powdery mildew, scab, fire blight leaf spot, and rust (see also U.K. CES publication ID-68 “The Flowering Crabapple”):

‘Adams’, bacatta ‘Jackii’, ‘Beverly’, ‘Bob White’, ‘Candied Apple’, ‘Christmas Holly’, ‘David’, ‘Donald Wyman’, ‘Henningii’, ‘Jewelberry’, ‘Liset’, ‘Mary Potter’, ‘Molten Lava’, ‘Ormiston Roy’, ‘Profusion’, ‘Red Jewel’, ‘Red Splendor’, ‘Robinson’, sargentii, ‘Sentinel’, ‘Silver Moon’, ‘Strawberry Parfait’, ‘Sugar Tyme’, ‘Velvet Pillar’, ‘White Angel’, ‘White Cascade’, ‘Winter Gold’, hunnanensis ‘Veitchii’, zumi ‘Calocarpa’.

PICEA (spruce)

Cytospora canker

Control: Remove and destroy all diseased branches (do not prune in wet weather); disinfest tools between cuts. Chemical control measures are not available.

Rhizosphaera needlecast

Control: Sprays are normally not needed. This disease is most often found on trees weakened by other factors. Chlorothalonil applications in early and late June may help.

PIERIS (andromeda)

See RHODODENDRON diseases.

PINUS (pine)

Gall rusts of 2- and 3-needle pines (eastern gall rust, western gall rust)

Control: In nurseries, cull seedlings with stem swellings. In plantations, cut off branch galls and rogue heavily galled trees in early spring. Apply mancozeb or triadimefon once when yellow pustules erupt through bark on galls.

White pine decline, a non-infectious disease

Control: No control for established trees. Provide a planting site having acid soil with little clay. Avoid soil compaction and tree injuries. Remedial sulfur applications to acidify soil may benefit trees.

White pine root decline, a fungal disease

Control: Remove and destroy infected trees. Choose well-drained planting sites. Control wood boring insect vectors of this disease.

Needlecast diseases of 2- and 3-needle pines

Control: In nurseries, spray with chlorothalonil, ferbam, or mancozeb plus a spreader-sticker monthly from mid-April through October. Avoid planting highly susceptible strains of Scots pine such as Spanish and French Green.

In plantations and landscapes: Plant on slopes when possible. Space trees and control weeds for good air circulation around low branches. Avoid susceptible varieties of Scots pine; if in doubt, use long-needle varieties. Rogue heavily infected source trees. Trim off and destroy lowest branches to promote air circulation. If disease occurs, spray four times at monthly intervals beginning July 1 (Lophodermium needle cast) or mid-April through June (for

brown spot needle blight or Naemacyclus needle cast). Use chlorothalonil, mancozeb, ferbam, or bordeaux mixture sprays.

Needle rust of 2- and 3-needle pines (Coleosporium)

Control: Goldenrod and aster plants are alternate hosts. In plantations, mow or otherwise control these weeds annually before August.

Diplodia tip blight of 2- and 3-needle pines

Control: Prune and destroy affected cones, twigs, and branches during dry weather in autumn. Spray with thiophanate-methyl at bud break, as candles are beginning to elongate, and when needles are emerging from needle sheaths. Use a spreader-sticker.

Pine wilt nematode

Control: Remove and destroy affected trees.

PLATANUS (plane tree and sycamore)

Anthracnose

Control: Prune out infected twigs and branches. Rake up and destroy fallen leaves. See fungicide suggestions listed for ALL SPECIES. Make a first application before trees break bud, a second at bud break, and a third when leaves are expanding. Trees can also be protected by thiabendazole injections.

POPULUS (poplar, aspen, cottonwood)

Fungal cankers

Control: Mulch and water trees as needed. Avoid wounding. Prune out and destroy infected branches during dry weather. Destroy severely affected trees. Do not plant Lombardy poplars. The Japan poplar, *Populus maximowczii*, is reported to have some resistance to cankers.

Leaf rust

Control: Spray triadimefon in early summer just before disease is expected and again 2 weeks later.

PRUNUS (cherry, flowering cherry, peach, flowering almond)

Black knot

Control: Prune away and destroy knotted twigs, and excise knots on large limbs when trees are dormant. Spray with thiophanate-methyl when dormant and at pink bud, full bloom, and 3 weeks later.

Crown gall

Control: See EUONYMUS disease control. For galls on established trees, use Gallex according to label instructions.

Coccomyces leaf spot

Control: Rake up and destroy fallen leaves. Spray with propiconazole or captan at petal fall, plus 2 more applications at 2-week intervals, plus a single application after fruit drop if needed.

Monilinia shoot blight (brown rot)

Control: Prune out and destroy infected twigs if possible.

Spray with captan, chlorothalonil, vinclozolin, or propiconazole as blossoms open and again 10 days later.

PYRACANTHA (firethorn)

Fire blight

Control: See under MALUS fire blight control.

Scab

Control: Spray with benomyl plus a spreader-sticker; chlorothalonil, thiophanate-methyl, mancozeb, mancozeb + thiophanate-methyl, or chlorothalonil + fenarimol at full bloom and 2 and 4 weeks later. The Yunan firethorn, *P. crenato-sessata*, is reported to be resistant. Hybrids resistant to both scab and fire blight include 'Apache', 'Fiery Cascade', 'Mohave', 'Navaho', 'Pueblo', 'Shawnee', 'Teton'.

PYRUS (pear)

Fire blight

Control: See MALUS fire blight control. The Bradford, Aristocrat, and other flowering pear cultivars are susceptible to the disease yet not normally heavily infected.

QUERCUS (oak)

Anthracnose

Control: See anthracnose under ALL SPECIES.

Dieback, decline

Control: Keep trees well-watered, especially through dry periods from May through July. Control of defoliating insects is important for prevention of dieback and decline. Alleviate soil compaction in the root zone. Prune out dead and dying branches to improve tree's appearance.

Taphrina leaf blister

Control: Spray once before bud swell with mancozeb, chlorothalonil, or chlorothalonil + fenarimol.

Actinopelte leaf spot

Control: Normally, there is no need to control this disease. Rake up and destroy fallen leaves. Propiconazole sprays may help.

Armillaria shoestring root rot

Control: This disease most frequently affects trees weakened by other agents. No control.

Bacterial leaf scorch, Xylella

Control: No effective control.

Powdery mildew

Control: Usually there is no need to control this disease.

Bacterial wetwood

Control: See under ULMUS.

RHODODENDRON (azalea, rhododendron)

Azalea gall

Control: Pick and destroy galls.

Botryosphaeria canker and dieback

Control: Prune and destroy infected parts disinfecting tools carefully between cuts. Avoid adverse growing conditions, i.e., drought, freezing, etc. Hybrids reported to be resistant include: 'Boursalt', 'Chionoides White', 'Cunningham's White', 'English Roseum', 'Le Bar's Red', 'Roseum 2', 'Sweet Simplicity', 'Wissahickon'.

Phytophthora dieback

Control: Avoid planting near lilacs. Prune and destroy infected twigs. Reduce shade if possible. As new leaves appear, spray with mancozeb or chlorothalonil + fenarimol, making 2 applications 10 to 14 days apart. Applications of metalaxyl (soil drench) or fosetyl-Al may help.

Fungal leaf spots

Control: Hand pick infected leaves if possible. Spray at budbreak and 10 and 20 days later with thiophanate-methyl, ferbam, or mancozeb.

Root rot and wilt, caused by Phytophthora and other fungi

Control: Plant only in soils with good drainage. Avoid overwatering. Adjust soil Ph to between 4.0 and 4.5 by amending with acid peat or sulfur. Apply soil drench fungicides such as propamocarb, metalaxyl, ethazole, or ethazole + thiophanate-methyl.

ROSA (rose)

Black spot

Control: Spray with chlorothalonil, folpet, fenarimol, ferbam, maneb, captan, mancozeb, propiconazole, ziram, or mancozeb + thiophanate-methyl at 7- to 14-day intervals beginning as leaves expand. Shorten intervals during wet weather. Some rose varieties are sensitive to chlorothalonil.

Resistant hybrid tea roses include: 'Carla', 'Cayenne', 'Duet', 'Electron', 'First Prize', 'Granada', 'Miss All American Beauty', 'Mister Lincoln', 'Pascali', 'Peace', 'Pink Peace', 'Portrait', 'Pristine', 'Proud Land', 'Sutter's Gold', 'Tiffany', 'Tropicana'.

Resistant floribunda/grandiflora roses include: 'Angel Face', 'Betty Prior', 'Carousel', 'Europeana', 'First Edition', 'Gene Boerner', 'Ivory Fashion', 'Montezuma', 'Pink Parfait', 'Prominent', 'Queen Elizabeth', 'Razzle Dazzle', 'Red Gold', 'Rose Parade', 'Sonia', 'Sun Sprite', 'The Fairy'.

Crown gall

Control: See under EUONYMUS disease control.

Powdery mildew

Control: See suggestions under ALL SPECIES. Select fungicides that also control black spot.

Brown canker, stem canker, graft canker

Control: Prune out and destroy infected canes.

SYRINGA (lilac)

Bacterial blight

Control: Prune out and destroy dead twigs.

Powdery mildew

Control: See under ALL SPECIES powdery mildew control. Resistant lilacs (non-vulgaris types) include: *S. diversifolia*, *S. emodi*, *S. julianae*, *S. meyeri*, *S. mycrophylla*, *S. mycrophylla superba*, *S. oblata* var. *dilatata*, *S. patula*, *S. persica*, *S. reflexa*, *S. reticulata*, *S. swegiflexa*, *S. sweginzowii*, *S. villosa*, *S. yunnanensis*.

THUJA (arborvitae)

Tip blights

Control: See under JUNIPERUS tip blight disease control.

ULMUS (elm)

Dutch elm disease

Control: Where infected elms are allowed to grow nearby, the chances of preserving a susceptible elm are poor. Effective control is best done on a community-wide basis.

1. Eliminate, if possible, all potential beetle-breeding elm material within 1,000 feet of trees to be protected. This material includes diseased, weak, recently cut, killed, or broken elm trees or parts of trees including firewood. Such material should be burned, buried, or debarked, and the bark burned or buried. This sanitation is most important in and immediately adjacent to trees to be protected. Without sanitation, the other suggestions listed here are not very helpful.

2. Make dormant application (March or April) of methoxychlor or chlorpyrifos insecticide for control of elm bark beetles.

3. Prune out DED-infected branches. Pruning is sometimes effective if symptoms are detected while confined to a small branch and the large branch bearing the small one is immediately removed.

4. Inject Arbotect 20-S, Lignasan (Correx, Elmpro), Fungisol, or Phytan 27 into the lower trunk and root flare for protection or therapy. Follow manufacturer's instructions for application. Combine eradication pruning (step 3) with therapeutic treatments. These should be made as soon as symptoms are seen, but will seldom be effective in trees that became infected the previous year or that show symptoms in more than 5 percent of the crown. Fungicide injections made the year before may protect trees from the disease.

5. Prevent root graft transmission of DED by applying vapam to the soil in 3/4" x 18" holes 6 inches apart midway between diseased and healthy trees at a rate of 1/4 cup of dilute solution (1 part Vapam to 3 parts water) per linear foot. Seal by tamping. This treatment should also prevent root graft transmission of phloem necrosis. If phloem necrosis is involved, treat at two sites: one between diseased tree and nearest healthy tree and one between first and second healthy trees. Digging a trench 18 inches deep and a few inches wide between trees will accomplish the same as vapam treatments.

6. The herbicide cacodylic acid can be used to kill diseased elm trees which attract and "trap" bark beetles. The beetles fail to mature in such trees and are then lost as a vector source.

In general, native elms are susceptible to Dutch elm disease and phloem necrosis; elms of European origin vary in

susceptibility to Dutch elm disease; elms of Asiatic origin are resistant. The yellows pathogen normally is not a problem in European and Asiatic elms. The following can be grown: Chinese elm (*U. parvifolia*), Scots elm (*U. glabra*), Buisman elm (*U. hollandica* 'Christine Buisman'), and Groeneveld elm (*U. hollandica* 'Groeneveld'). Additional resistant cultivars such as 'Lobel', 'Dodoens', 'Plantyn', 'Clusius', and 'Columella' are available. Hybrid clones with Asian or European parentage 'Dynasty', 'Frontier', 'Homestead', 'Jacan', 'New Horizon', 'Ohio', 'Pathfinder', 'Pioneer', 'Prospector', 'Regal', 'Sapporo Autumn Gold', 'Thompson', and 'Urban' Elm have been bred for disease resistance. 'American Liberty', 'Independence', and 'Washington' American elms are considered tolerant to DED but not to elm yellows. Consult nursery catalogs for a full account of the characteristics of disease-resistant elms.

Disease-resistant elms in the vicinity of susceptible trees must be included in sanitation programs since elm bark beetles breed in dead or dying parts of all kinds of elms.

Yellows, also known as phloem necrosis

Control: See controls listed for Dutch elm disease.

Bacterial wetwood and slime-flux

Control: Install drainpipes to keep fluid from running down the bark. Pipes can be of threaded metal or stiff plastic. If plastic is used, coat the inside of the hole with grafting wax before fitting the tube, and seal at the surface with grafting wax. Plastic can be cut to desired length after fitting.

VIBURNUM

Powdery mildew

Control: See ALL SPECIES powdery mildew control. Resistant types include *V. burkwoodii* 'Mowhawk' and *V. carlcephalum* 'Cayuga'.

Additional References

Jones, R.K., ed. Diseases of Woody Ornamental Plants and Their Control in Nurseries. North Carolina State University Cooperative Extension Service.

Pirone, P.P. Diseases and Pests of Ornamental Plants. John Wiley & Sons.

Sinclair, W.A., Lyon, H.H., and Johnson, W.T. Diseases of Trees and Shrubs. Cornell University Press.

Educational programs of the Kentucky Cooperative Extension Service serve all people regardless of race, color, age, sex, religion, disability, or national origin. Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture, C. Oran Little, Director of Cooperative Extension Service, University of Kentucky College of Agriculture, Lexington, and Kentucky State University, Frankfort. Issued 7-89; Revised/Printed 7-96, 2000 copies; 10000 copies to date.