Fungicide Inventory and Disease Control Spray Programs for Woody Ornamentals

by Malcolm C. Shurtleff and Gary W. Simone

“What fungicides should I stock?” is a common question. There is no easy answer since this depends on the type of disease, what plants need protection, the area of the country you live in, and whether you also operate a nursery and/or turfgrass business. There is no one fungicide that controls all diseases on all plants. Also, we do not know what pesticides the federal EPA will classify in the general and restricted use categories.

Table 1 lists the most helpful plant disease control materials, common trade names, and principal uses. Soil fumigants and nematicides have been omitted from this discussion, since they are complete subjects in themselves.

Table 1. Fungicide Inventory for Woody Ornamentals

<table>
<thead>
<tr>
<th>Material and Common trade names</th>
<th>Uses and remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>benomyl</td>
<td>Broad-spectrum fungicide with systemic (curative) properties. Effective against many fungus leaf spots and blights, blights, rots, scab, powdery mildews, Botrytis blights, plus turf and soil-borne diseases. Ineffective against water mold fungi (e.g., Pythium and Phytophthora) and rusts.</td>
</tr>
<tr>
<td>Bordeaux mixture</td>
<td>Broad-spectrum, long-lasting fungicide now used mostly as a dormant spray and on conifers. May “scorch” foliage of some plants (e.g., holly, maples) in cold damp weather. Most effective if freshly mixed.</td>
</tr>
<tr>
<td>cycloheximide</td>
<td>Antibiotic fungicide for controlling certain powdery mildews, rusts and turfgrass diseases. Plant injury may occur at high temperatures.</td>
</tr>
<tr>
<td>Botran (dicloran)</td>
<td>Useful in controlling Botrytis blights. Also controls certain storage molds, e.g., Sclerotinia, Penicillium, and Rhizopus.</td>
</tr>
<tr>
<td>Captafol</td>
<td>Long-lasting protective fungicide closely related to captan and folpet. Controls various fungus leaf spots, anthracnoses, and scabs. Some people develop an allergic skin rash after contacting captafol.</td>
</tr>
<tr>
<td>cycloheximide</td>
<td>Acti-dione PM, Acti-dione TGF, Actispray</td>
</tr>
<tr>
<td>Bactolin</td>
<td>For therapy of crown gall and olive knot by direct application (as “paint”) to galls on established plants.</td>
</tr>
<tr>
<td>Botran</td>
<td>Botran</td>
</tr>
<tr>
<td>Bordeaux mixture</td>
<td>Acme and Patterson’s Bordeaux Mixture, Copper Hydro Bordo, Bor-dox, Pratt Bordeaux Mix, Black Leaf Bordeaux Powder, Bordo Mixture</td>
</tr>
<tr>
<td>Bordeaux mixture</td>
<td>Difolatan 4 Flowable</td>
</tr>
</tbody>
</table>

1 Presented by the senior author at the International Society of Arboriculture Convention in St. Louis, Mo. August 10, 1976.

2 Extension plant pathologist and graduate extension assistant, respectively, Department of Plant Pathology, University of Illinois at Urbana-Champaign. The authors greatly appreciate assistance from the following individuals who kindly supplied their suggested spray programs and/or reviewed the manuscript: R.J. Campana, S.H. Davis, Jr., E.B. Himelick, F.F. Laemmlen, O.C. Maloy, I.C. Mc-Swan, Dan Neely, L.P. Nichols, P.C. Pecknold, G.W. Petersen, A.H. McCain, W.A. Sinclair, R.J. Stipes, D.F. Schoeneweiss, and G.L. Worf.
captan
Captain 50-W and 80-W, Orthocide 50 Wettable, Captan 80% Wettable, Powder, Captan 80 Spray-Dip, Captain Garden Spray

chlorothalonil
Daconil 2787, Bravo 6F, Exotherm Termil, Diamond 76%, Tennessee Copper Sulfate, Ortho Copper, Microcop, Tri-Basic Copper Sulfate, Cyprex 65W Fruit Fungicide, Carbamat, Karban Black, Ferbam Fungicide

Copper
(1) basic copper sulfate
Basic Copper Sulfate, Ortho Copper 53 Fungicide, Basi-Cop, Microcop, Tri-Basic Copper Sulfate, Tennessee Copper Sulfate, Spraycop T-B-C-S 53

(2) basic chlorides
Coprantol, C-O-C-S, Aceto copper Chloride, Copper Oxochloride, Kaurtal (3) oxides
Kuprite, Kocide 101, Cupric Oxide, Copper Oxide, Cuprous Oxide, Brown Copper Oxide, Cuprocide

(4) miscellaneous
Copper Oleate, GH-41 Copper Resinate, Tri-Cop, For-Cop 80, Copper Carbonate, Zinc Coposil Fungicide (5) liquid, i.e. emulsifiable
TC-90, Oxy Cop, Copoloid, Cicit cop 4E, Carmel GH-41 Greenhouse Fogging
diazoben
Dexon
dinocap
Karathane WD, Miller's Garden Karaspray
dodine
Cyprex 65W Fruit Fungicide

ethazol
Terrazole, Truban, Koban

ferbam
Ferbam, Fermate Ferbam Fungicide, Carbamat, Karban Black, Ferbam Fungicide

folpet
Phaltan, Folpet, Rose and Garden Fungicide

mancozeb
(or maneb and zinc ion)
Dithane M-45, Manzate 200, Sup’r-Flo Maneb Flowable, For, Fore Lawn Fungicide, Pratt Lawn & Garden Fungicide

maneb
Maneb, Dithane M-22, Manzate Maneb Fungicide, Black Leaf Maneb, Aceto Amazine Maneb 80 WP, Agsco Blitex, Tersan LSR, Sears Lawn Fungicide, Maneb Garden Fungicide

parinol
Parnon

PCNB
PCNB, Terracil, Fungiclor, Pearson’s Green Lawn Fungicide, Lawn Disease Control

piperalin
Pipron

dodine
Cyprex 65W Fruit Fungicide

ethazol
Terrazole, Truban, Koban

ferbam
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piperalin
Pipron

Diazoben
Dexon

Dinocap
Karathane WD, Miller’s Garden Karaspray

Long-lasting protective fungicide with good eradicant properties. Effective against many fungus leaf spots and blights, scabs, and anthracnose diseases.

A systemic soil and turf fungicide, usually applied as a drench to control seedling blights, damping-off, and root rots caused by water molds (Pythium, Phytophthora, etc.). Koban is used on turfgrasses.

General, safe, protectant fungicide effective against fungus leaf spots and blights, rusts and scabs. Ferbam leaves an unsightly black residue on foliage, flowers and fruit.

A relative of captan and captafol and used for many of the same foliar diseases. Gives fair control of many powdery mildews.

General protectant fungicide for controlling a wide range of fungus leaf spots and blotsches, scabs, rots, rusts, and anthracnoses. Does not control powdery mildews.

Broad-spectrum foliar fungicide for use on woody and nonwoody ornamentals and turf. Has the same uses as does mancozeb and zineb. Maneb may be more injurious to certain kinds of plant foliage than mancozeb or zineb.

Liquid fungicide for control of powdery mildews of certain ornamentals, e.g., crabapples, roses, and non-bearing apples.

Long-lasting soil and turf fungicide especially effective against sclerotia-forming fungi (e.g., Rhizoctonia, Sclerotium, Sclerotinia, Botrytis). Often combined with diazoben, ethazol, captan, Polyram, or other fungicide. Applied as a drench or incorporated into soil in a dry form. May suppress root development in certain cuttings.

Protectant-eradicant fungicide for control of certain powdery mildews (e.g., catalpa, lilac, rose).
Polyram

Polyram streptomycin compounds
Agrimycin 17, Ag-Strep, Streptomycin Spray, Agri-Strep, Phytomycin, Agri-mycin 100 and 500, Antibiotic Spray Powder, Streptomycin Wettable Powder

sulfur compounds
(including liquid lime-sulfur)
Sulfur, Magnetic, Sulfuron, Microfine, Corosul, Kolodust, Kolofog, Lime-Sulfur Solution

thiophanate compounds
Topsin M, Zyban, Banrot, Cleary 3336, Chipco Spot Kleen, Fungo

thiram
Tersan 75, Thiram, Thylate, Thiuram 75, Turftox, Arasan, Fungisan, Thiramad

zineb
Dithane Z-78, Zineb, Zineb Garden Fungicide, Oxy Casonil, Black Leaf Sheen, Science Zineb Fungicide

Greenfield Rose and Ornamental Disease Control contains Pipron and maneb.

General protectant fungicide similar to mancozeb, maneb and zineb in range of effectiveness. Often combined with PCNB (Polyram PCNB Dust).

Anti-bacterial antibiotic effective against fire blight and other bacterial diseases. Ineffective at low temperatures. Effectiveness is impaired if mixed with other pesticides. Gives best control when applied during slow-drying conditions (e.g., night). Agri-mycin 100 and 500 contain the antibiotic oxytetracycline (Terramycin).

Old-time combination fungicide-insecticide-miticide. Controls powdery mildews, rusts, and many leaf spots, blights, scabs, and rots. May injure plants in hot dry weather. Lime-sulfur is more phytotoxic than other sulfurs and will discolor paint. It is primarily used as a dormant spray.

A broad-spectrum systemic fungicide, closely related to benomyl, not yet cleared for use on woody ornamentals. Used as a turf fungicide and as a foliar spray to control powdery and downy mildews, Botrytis blights, numerous leaf and fruit spots, scabs and rots of ornamentals and fruit crops. Zyban and Banrot are used as a soil drench or dry soil mix to control soil-borne fungi of bedding and container-grown plants.

General protectant fungicide for control of fungus leaf spots and blottches, scabs, and rusts. Used as a seed protectant and turf fungicide. Arasan 42-S is also sold as a deer, rodent and bird repellent.

General protectant fungicide for control of fungus leaf spots, blights and blotches, scabs, rots, and anthracnoses. Will not control powdery mildews.

Table 2 should be used as a guide for selecting and applying appropriate fungicides to control specific diseases. It is not intended as a spray program to be followed in all areas of the United States each year. Adapt the spray programs to those suggested by the Cooperative Extension Service for your state.

Many diseases cause slight damage to the plant; their control is only "cosmetic." Learn which diseases are most damaging in your area and concentrate your spray program on those which annually cause the greatest injury.

The disease control materials suggested in Table 2 are those registered for specific uses by the Pesticide Regulation Division of the federal Environmental Protection Agency (EPA), as of February, 1976, when the last update was received plus new EPA registrations received from chemical manufacturers up to October 15, 1976. There are other effective fungicides available to control many of the diseases listed. These products can only be recommended in the future if they are registered by the federal EPA. For the latest plant disease control registrations check with the Extension Plant Pathologist at your land-grant university.

Fungicides, like other pesticides, are generally formulated for sprays as flowables (F), emulsifiable concentrates (EC), and most commonly as wettable powders (WP).

The concentration of fungicide is expressed as a weight per unit volume or as a percent of the commercial product. For example, a fifty percent wettable powder (50% WP) is half active ingredient (a.i.) and half inert material—emulsifying agent, carrier, surfactant, and other diluents. Liquid formulations generally indicate the number of pounds of active ingredient per gallon (lbs. a.i./gal.) on the label. All rates in Table 2 are product rates, not a.i. rates, unless specifically stated otherwise.

The actual amount of material to be applied depends on the concentration of the chemical (a.i.) in the preparation. A manufacturer may sell the same fungicide in a half dozen or more formulations where the percentage of a.i. may vary from 2 to 80 percent or more. Amounts indicated in Table 2 are approximate. Be sure to read and follow the manufacturer's directions on the container label.

Most fungicide spray applications are designed to protect against infection. This requires the material to uniformly and thoroughly cover
susceptible parts before disease occurs. Rainy, foggy or very humid weather greatly favors infection of practically all pathogens. Whenever possible, spray programs should be altered to provide maximum protection during moist periods. The spray recommendations in Table 2 will provide acceptable control under weather conditions with about an inch of rain per week or less during periods of active growth. Extra sprays may be required during wet seasons, while fewer or no applications may be needed in years when the weather in spring, early summer and autumn is unusually dry.

Suggested fungicides in Table 2 are listed by coined names or representative trade names. Mention of a trade name or proprietary product does not constitute warranty of the product and does not imply approval of this material to the exclusion of comparable products that may be equally suitable.

### Table 2. Chemical Control of Diseases of Woody Ornamentals

<table>
<thead>
<tr>
<th>Plant &amp; Disease</th>
<th>Rate per Application and Remarks</th>
<th>Suggested fungicides</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALDER Powdery mildew</td>
<td>100 gal. (lbs.)1</td>
<td>ALDER Powdery mildew</td>
</tr>
<tr>
<td></td>
<td>Benomyl, 50% WP</td>
<td>½</td>
</tr>
<tr>
<td></td>
<td>Sulfur, 95% WP</td>
<td>2-3</td>
</tr>
<tr>
<td>AMERICAN HORNBEAM</td>
<td>See Cherry</td>
<td>AMERICAN HORNBEAM</td>
</tr>
<tr>
<td>Cedar rusts</td>
<td>Ferbam, 76% WP</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Thiram, 65-75% WP</td>
<td>1½-2</td>
</tr>
<tr>
<td></td>
<td>Zineb, 75% WP</td>
<td>1½-2</td>
</tr>
<tr>
<td></td>
<td>Mancozeb, 80% WP</td>
<td>1½-2</td>
</tr>
<tr>
<td>APPLE</td>
<td>See Crabapple</td>
<td>APPLE</td>
</tr>
<tr>
<td></td>
<td>ARBORVITAE</td>
<td>ARBORVITAE</td>
</tr>
<tr>
<td></td>
<td>Phomopsis needle and twig</td>
<td>Phomopsis needle and twig</td>
</tr>
<tr>
<td></td>
<td>Benomyl, 50% WP</td>
<td>½-1</td>
</tr>
<tr>
<td>ARBUTUS See Madrone</td>
<td></td>
<td>ARBUTUS See Madrone</td>
</tr>
<tr>
<td>ASH Anthracnose, fungus leaf spots</td>
<td>Copper</td>
<td>1½-2</td>
</tr>
<tr>
<td></td>
<td>Zineb, 75% WP</td>
<td>½-1</td>
</tr>
<tr>
<td></td>
<td>Benomyl, 50% WP</td>
<td>½-1</td>
</tr>
<tr>
<td>AZALEA See Rhododendron</td>
<td></td>
<td>AZALEA See Rhododendron</td>
</tr>
<tr>
<td>BARBERRY Bacterial leaf spot and twig blight</td>
<td>Copper</td>
<td>See label</td>
</tr>
<tr>
<td>BUTTERSWEET Powdery mildew</td>
<td>Benomyl, 50% WP</td>
<td>½-1</td>
</tr>
<tr>
<td>BOXELDER See Maple</td>
<td>BOXELDER See Maple</td>
<td>BOXELDER See Maple</td>
</tr>
<tr>
<td>BOXWOOD Canker, fungus leaf blights or spots</td>
<td>Copper</td>
<td>See label</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIRCH Leaf blister</td>
<td>Copper</td>
<td>See label</td>
</tr>
<tr>
<td></td>
<td>Liquid lime-sulfur</td>
<td>2 gal.</td>
</tr>
<tr>
<td>ANTHRACNOSE Copper</td>
<td>Zineb, 75% WP</td>
<td>1½-2</td>
</tr>
<tr>
<td>BUTTERFLY Rust</td>
<td>Zineb, 75% WP</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Mancozeb, 80% WP</td>
<td>1½-2</td>
</tr>
<tr>
<td>BASSWOOD See Linden</td>
<td></td>
<td>BASSWOOD See Linden</td>
</tr>
<tr>
<td>BIRCH Leaf blight</td>
<td>Copper</td>
<td>See label</td>
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<td>2 gal.</td>
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<td></td>
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<td>1½-2</td>
</tr>
<tr>
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<td></td>
<td>BASSWOOD See Linden</td>
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<td>Copper</td>
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<td>1½-2</td>
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<td>2</td>
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<td>See label</td>
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<td></td>
<td>Liquid lime-sulfur</td>
<td>2 gal.</td>
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<td>ANTHRACNOSE Copper</td>
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<td>1½-2</td>
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<td>BUTTERFLY Rust</td>
<td>Zineb, 75% WP</td>
<td>2</td>
</tr>
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<td>Mancozeb, 80% WP</td>
<td>1½-2</td>
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<td></td>
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<td>2 gal.</td>
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<td>1½-2</td>
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<td>2</td>
</tr>
<tr>
<td></td>
<td>Mancozeb, 80% WP</td>
<td>1½-2</td>
</tr>
<tr>
<td>Disease / Infection</td>
<td>Treatment</td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------</td>
<td></td>
</tr>
<tr>
<td>Phytophthora root rot</td>
<td>Ethazol, 30-35% Diazoben See label Drench soil around roots at 14-day intervals during April-May and again in September-October.</td>
<td></td>
</tr>
<tr>
<td>CHERRY, PEACH, PLUM, AMOND, MAYDAY-TREE, CHERRY PLUM, CHERRY-LAUREL</td>
<td>Black knot</td>
<td>Drench soil around roots at 14-day intervals during April-May and again in September-October.</td>
</tr>
<tr>
<td>BUCKEYE Horsechestnut</td>
<td>See label</td>
<td>See label</td>
</tr>
<tr>
<td>BUTTERNUT See Walnut</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BUTTONBUSH Powdery mildew</td>
<td>Benomyl, 50% WP ½-1</td>
<td>Make several weekly sprays. Start when disease first appears.</td>
</tr>
<tr>
<td>BUTTONWOOD See Sycamore</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAMELLIA Sclerotinia flower blight</td>
<td>PCNB, 75% WP Benomyl, 50% WP</td>
<td>See label Drench soil surface in early November to early January. Apply 1 cup in 1 gal. water to thoroughly cover 100 sq. ft. (100 lb./450 gal./acre).</td>
</tr>
<tr>
<td>Sooty mold</td>
<td>Sooty mold fungi grow in honeydew secreted by aphids, scale and other insects. Spray in spring and summer for insect control.</td>
<td></td>
</tr>
<tr>
<td>Phytophthora root rot</td>
<td>Ethazol, 30-35% Diazoben See label Apply as drench around plants to saturate the soil. Repeat at 4- to 12-week intervals during spring and autumn.</td>
<td></td>
</tr>
<tr>
<td>CATALPA Powdery mildew</td>
<td>Piperalin ¼</td>
<td>Spray when disease first appears. Repeat 10 to 14 days later.</td>
</tr>
<tr>
<td>CHAMAEHY-PARIS Phytophthora root rots (Pacific Northwest)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liquid-lime-sulfur</td>
<td>2 gal.</td>
<td>old leaves cleaned up and before new growth starts; 10 to 14 days later; when growth is half complete; in autumn when fall growth has ceased.</td>
</tr>
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<td>CHERRY, PEACH, PLUM, AMOND, MAYDAY-TREE, CHERRY PLUM, CHERRY-LAUREL</td>
<td>Black knot</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
22.5% WP  ½ Apply Acti-dione only to non-bearing cherry trees.
Sulfur, 95% WP  2-3
Acti-dione PM See label

Rust
Ferbam, 76%  2
WP
Zineb, 75% WP  1½-2

Scab, fungus
leaf spots,
shot-hole
Benomyl, 50%  ½-1
WP
Sulfur, 95% WP  5-10
Captan, 50%  2
WP
Ferbam, 76%  2
WP
Zineb, 75% WP  1½-2

CONIFERS
See Pine

COTONEASTER

Fire blight
Streptomycin See label
formulations
Bordeaux mixture 2-6-100

Scab
Benomyl, 50%  ½-1
WP
Dodine, 65%  ½-1
WP
Fungus
leaf spots
Maneb, 80%  1½-2
WP
Zineb, 75% WP  1½-2

CRABAPPLE,
APPLE

Cedar rusts
(Apple, hawthorn, quince)
Ferbam, 76%  2
WP
Maneb, 80% WP  1½-2
Mancozeb, 80% WP  1½-2
Thiram, 65-75% WP  1½-2
Zineb, 75% WP  1½-2
Polyram, 80% WP  1½-2

Scab
Zineb, 75% WP  1½-2
Benomyl, 50% WP  ½-1
Sulfur, 95% WP  6-8
Dodine, 65% WP  ½-1
Captan, 50% WP  2
Maneb, 80% WP  1½-2
Mancozeb, 80% WP  1½-2

Spray several times, about 10 days apart. Start about 2 weeks after petal-fall.
Spray 3 times, 10 to 14 days apart, starting at petal-fall.

80% WP  1½-2
Polyram, 80% WP  1½-2
Dikar, 80% WP  2
Folpet, 50% WP  1½-2
Captatol 1½-2 pts.

Fire blight
Streptomycin See label
formulations
Copper See label

Powdery
mildew
Benomyl, 50% WP  ½-1
Sulfur, 95% WP  6-8
Karathane, 22.5% WP  ½

CRAPE-
MYRTLE
Fungus leaf
spots or blotch,
black spot,
tip blight
Copper See label
Zineb, 75% WP  1½-2
Maneb, 80% WP  1½-2
Mancozeb, 80% WP  1½-2

Powdery
mildew
Benomyl, 50% WP  ½-1
Karathane, 22.5% WP  ½
Sulfur, 95% WP  2-3
Acti-dione PM See label
Lime-sulfur See label
CURNANT,
ALPINE
Anthracnose
and fungus
leaf spots
Benomyl, 50% WP  ½-1
Ferbam, 76% WP  2
Maneb, 80% WP  1½-2
Mancozeb, 80% WP  1½-2
Zineb, 75% WP  1½-2

CYPRESS
Coryneum blight, canker
Bordeaux mixture 4-4-50

DGWOOD
Fungus leaf
spot or blotch,
anthracnose,
flower

Apply during bloom at 5- to 7-day intervals. Do not use streptomycin on C. racemifolia; may substitute bordeaux if temperature is above 65 deg. F.

Spray as new growth appears and flower buds start to open. Repeat 3 or 4 more times at 10-day intervals.
Spray as new growth appears. Repeat 4 more times, 7 to 10 days apart. Thorough coverage of new growth is essential.

Spray when 20 to 25% of blossoms are open and repeat at 5- to 7-day intervals during bloom. Then apply weekly for 5 or 6 weeks. Best control when spraying at night.

Spray when disease first appears or as leaves start to expand. Repeat 2 or 3 times, 10 apart.
Make several applications, 2 to 3 weeks apart. Start when new growth appears in the spring.
Make several spring and autumn sprays. Start when disease is first seen. Apply lime-sulfur once, just as the buds are breaking open.

Spray 2 or 3 times, 10 to 14 days apart. Start at leaf emergence or when leaves are nearly expanded.

Apply in early spring and late fall at 7- to 10-day intervals.
<table>
<thead>
<tr>
<th>Disease / Disorder</th>
<th>Control Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black leaf blight</td>
<td>Benomyl, 50% WP</td>
</tr>
<tr>
<td></td>
<td>Maneb, 80% WP</td>
</tr>
<tr>
<td></td>
<td>Mancozeb, 80% WP</td>
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<td></td>
<td>Zineb, 75% WP</td>
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<tr>
<td></td>
<td>Captan, 50% WP</td>
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<td>Folpet, 50% WP</td>
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<td>Copper</td>
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<tr>
<td></td>
<td>Powdery mildew</td>
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<td></td>
<td>Benomyl, 50% WP</td>
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<tr>
<td></td>
<td>Sulfur, 95% WP</td>
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<tr>
<td>Douglas-fir</td>
<td>Copper</td>
</tr>
<tr>
<td>Needle cast</td>
<td>See label</td>
</tr>
<tr>
<td>ELM</td>
<td>Benomyl, 50% WP</td>
</tr>
<tr>
<td>Anthracnose,</td>
<td>Sulfur, 95% WP</td>
</tr>
<tr>
<td>black leaf spot,</td>
<td>Copper</td>
</tr>
<tr>
<td>other fungus</td>
<td>Zineb, 75% WP</td>
</tr>
<tr>
<td>leaf spots,</td>
<td>Maneb, 80% WP</td>
</tr>
<tr>
<td>twig blight</td>
<td>Mancozeb, 80% WP</td>
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<tr>
<td></td>
<td>Ferbam, 76% WP</td>
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<tr>
<td>Dutch elm disease</td>
<td>Copper</td>
</tr>
<tr>
<td>Metham (Vapam Soil Fumigant) + Methoxychlor + Lignasan BLP 2A</td>
<td></td>
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<tr>
<td>Nectria canker</td>
<td>Copper</td>
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<tr>
<td>(Pacific Northwest)</td>
<td>See label</td>
</tr>
<tr>
<td>Euonymus</td>
<td>Maneb, 80% WP</td>
</tr>
<tr>
<td>Leaf spots</td>
<td>Maneb, 80% WP</td>
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<tr>
<td></td>
<td>Mancozeb, 80% WP</td>
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<td></td>
<td>Zineb, 75% WP</td>
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<tr>
<td></td>
<td>Captan, 50% WP</td>
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<tr>
<td></td>
<td>Folpet, 50% WP</td>
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<td>Mancozeb, 80% WP</td>
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<td></td>
<td>Zineb, 75% WP</td>
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<td></td>
<td>Chlorothalonil, 75% WP</td>
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<td></td>
<td>Fire blight</td>
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<td></td>
<td>Streptomycin</td>
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<td></td>
<td>See label</td>
</tr>
</tbody>
</table>

**Notes:**
- **Acti-dione PM** See label
- **Karathane, 22.5% WP** ½ 1
- **Sulfur, 95% WP** 4 6
- **EVERGREENS** See Juniper, Pine, Yew
- **FIRETHORN** See Pyracantha
- **FORSYTHIA** Leaf spots
- **GARDENIA** Canker
- **HAWTHORN, RED HAW** Leaf blight or spots, scab, other fungus
- **Leaf spots** Ferbam, 76% WP
- **Powdery mildew** Karathane, 22.5% WP
- **Powdery mildew** Actidione
- **Cedar rusts** Thiram, 65-75% WP
- **Fire blight** Streptomycin
- **Fire blight** See label formsulations

**Elliptical Sprays:**
- Apply at budbreak and just before flower bracts are fully expanded. Repeat 2 or 3 more times about 2 weeks apart.
- Spray when mildew first appears. Repeat 7 to 10 days later if needed.
- Spray 3 or 4 times, 10 to 14 days apart. Start when new growth appears.
- So soil treatment when disease first appears to prevent transmission by root grafts. Follow label directions.
- For protective and/or therapeutic treatment. Should be applied by a trained arborist. Inject 2 gal. of solution per 4 in. of tree diameter (measured at breast height) into root flare or trunk, using multiple injection sites. Spring application at half-to-full leaf stage is preferred; or at first sign of disease.
- Spray in October and 2 or 3 times in spring, starting when new growth appears.
- Spray at budbreak or at first sign of disease. Spray 2 or 3 times at 7- to 10-day intervals.
- Apply at budbreak and repeat at 7- to 10-day intervals as needed.
- Mix ½ lb. of ferbam with 100 pounds of sand for cutting bed.
- Spray cuttings and plants at 7- to 10-day intervals in wet weather.
- Apply at first sign of disease; repeat 2 or 3 times 7 to 10 days apart.
- Apply 4 sprays at 7- to 10-day intervals, starting as new growth appears. Extend the schedule during rainy seasons.
- Spray as new growth appears and flower buds start to open. Repeat 3 or 4 times at 7- to 10-day intervals.
HEATHER
(Calluna)
Botrytis blight
Benomyl, 50% WP ¼-1 Drench when symptoms appear; repeat if Botrytis re-appears.

Phytophthora root rot
Ethazol, 30-35% See label Drench soil around plants at 2- to 4-week intervals during spring and autumn rainy periods.
Diazoben

HIBISCUS
Powdery mildew
Sulfur, 95% WP 2-3 Apply at first sign of disease and repeat 2 or 3 times at weekly intervals.

HICKORY
Anthracnose, fungus leaf spot or blotch, scab, spot anthracnose
Benomyl, 50% WP ¼-1 Spray 3 or 4 times, 7 to 10 days apart, starting when the buds break open.
Zineb, 75% WP 1½-2
Mancozeb, 80% WP 1½-2
Maneb, 80% WP 1½-2
HOLLY
Fungus leaf spots, tar spot, anthracnose, spot anthracnose
Benomyl, 50% WP ¼-1 Apply 3 or 4 sprays at 10- to 14-day intervals. Start as leaves begin to unfold. Some holly species and cultivars are sensitive to copper materials in cold damp weather.
Zineb, 75% WP 1½-2
Mancozeb, 80% WP 1½-2
Maneb, 80% WP 1½-2
Copper See label

Leaf and twig blight, algae
Copper See label Spray 3 or 4 times, 10 days apart. Start with the first autumn rains.
Zineb, 75% WP 1½-2

Powdery mildew
Sulfur, 95% WP 2-3 Apply at first disease appearance. Repeat at 7-day intervals as needed.

HONEYSUCKLE
Herpetosidium leaf blight
Mancozeb, 80% WP 1½-2 Apply several sprays 7 to 10 days apart. Start when new growth appears.
Maneb, 80% WP 1½-2
Powdery mildew

Spray 2 or more times at weekly intervals. Start when disease first appears.

Benomyl, 50% WP ¼-1
Sulfur, 95% WP 2-3
Acti-dione PM See label HORSECHESTNUT, BUCKEYE
Leaf blight, fungus leaf spot or blight, anthracnose
Benomyl, 50% WP ¼-1
Zineb, 75% WP 1½-2
Mancozeb, 80% WP 1½-2
Maneb, 80% WP 1½-2
Dodine, 65% WP 1-2

HYDRANGEA
Fungus leaf spots, rust
Zineb, 75% WP 1½-2
Ferbam, 76% WP 2

Powdery mildew
Benomyl, 50% WP ¼-1 Spray 3 times, 7 to 10 days apart. Start when new growth appears.
Karathane, 22.5% WP ½
Sulfur, 95% WP 2-3
Botrytis blight
Benomyl, 60% WP ¼-1
Botran, 50% WP 1-1½

JUNEBERRY
See Amelanchier

JUNIPER, REDCEDAR
Rusts
Zineb, 75% WP 1½-2
Ferbam, 76% WP 2

Acti-dione See label Phomopsis canker or twig blight
Benomyl, 50% WP 1-1½

Cercospora needle blight
Copper See label Spray 2 or more times at weekly intervals. Start when disease first appears.

KALANCHOÉ
Powdery mildew
Benomyl, 50% WP ¼-1 Spray several times at 7- to 10-day intervals. Start when disease first appears.
LAUREL
See Mountain-laurel

LILAC

Powdery mildew
Benomyl, 50% WP ½-1
Sulfur, 95% WP 4-6
Karathane, 22.5% WP ½-1

Bacterial and Phytophthora blights
Copper

Spray several times at 7- to 10-day intervals. Start when disease first appears. If using benomyl, apply at 3-week intervals.

Sulfur, 95% WP
Karathane, 22.5% WP

LILAC

Powdery mildew
Benomyl, 50% WP ½-1

Anthracnose, fungus leaf spots, leaf blight, spot anthracnose
Copper

Spray just after budbreak and again 10 and 20 days later.

Benomyl, 50% WP ½-1

MADRONE (Arbutus)

Hendersonula canker
Zineb, 75% WP plus 1
Ferbam, 76% WP 1

Fungus leaf spots
Captan, 50% WP 2
Zineb, 75% WP ½-2
Maneb, 80% WP ½-2
Mancozeb, 80% WP ½-2
Thiram, 65-75% WP ½-2
Dodine, 65% WP ½-2

MAGNOLIA

Powdery mildews
Benomyl, 50% WP ½-1
Actidione PM See label

MAPLE, BOXELDER

Anthracnose, fungus leaf spots, leaf blight or blotch, leaf scab, tar spot, leaf blister
Copper

See label

Spray 3 times, 10 to 14 days apart, starting as the buds begin to open.

Zineb, 75% WP ½-2
Mancozeb, 80% WP ½-2
Maneb, 80% WP ½-2

Zineb, 75% WP ½-2

MAYDAY-TREE
See Cherry

MOUNTAIN-ASH

Leaf blight, scab, fungus leaf spots
Benomyl, 50% WP ½-1
Mancozeb, 80% WP ½-2
Zineb, 75% WP ½-2

Rust
Zineb, 75% WP ½-2

Fire blight
Streptomycin formulations
Copper
See label

MOUNTAIN-LAUREL, LAUREL (Kalmar)

Fungus leaf spots, leaf blight
Benomyl, 50% WP 1
Copper

See label

Spray 3 times starting at budbreak. Repeat 10 and 20 days later.

Ferbam, 76% WP 2

MULBERRY

Bacterial blight
Bordeaux mixture 5-5-100

NEW JERSEY TEA (Ceanothus)

Powdery mildew
Benomyl, 50% WP ½-1

OAK

Anthracnose, fungus leaf spots and

See label

Spray once in October and 2 or 3 times in spring starting when growth commences.

Usually not needed except in rainy seasons. Apply several sprays at 7- to 10-day intervals.

Spray when mildew first appears. Repeat 10 days later.

Spray when disease is first noticed and repeat 10 to 14 days later.

Spray 2 to 4 times, 14 days apart, starting as the leaf buds open.

Spray when 20 to 25 percent of blossoms are open and again at full bloom.

Apply 4 or 5 sprays, 10 days apart, starting as flower buds open.

Spray 2 or 3 times, 7 to 10 days apart. Start when disease first appears.

Spray 2 or 3 times, 7 to 10-day intervals. Start when new growth appears in spring.

Spray 3 times starting at budbreak. Repeat 10 and 20 days later.

Apply at budbreak and repeat at 7-day intervals during moist periods.

Apply several sprays at 7- to 10-day intervals.

Spray 2 or 3 times, 7 to 10-day intervals. Start when disease first appears.

Spray 2 or 3 times, 7 to 10-day intervals. Start when new growth appears in spring.

Spray just after budbreak and again 10 and 20 days later.

Spray 2 or 3 times at 7- to 10-day intervals. Start when new growth appears in spring.

Spray 2 to 3 times at 7- to 10-day intervals. Start when new growth appears in spring.

Spray just after budbreak and again 10 and 20 days later.

Spray 2 or 3 times, 7 to 10 days apart. Start when disease appears.

Spray 2 or 3 times, 7 to 10-day intervals. Start when new growth appears in spring.
and blights, spot anthracnose, leaf blotch, leaf blister

Copper
Zineb, 75% WP 1½-2
Captan, 50% WP 2-4
Benomyl, 50% WP 1
Dodine, 65% WP 1½-2
Mancozeb, 80% WP 1½-2

Oak Wilt
2,4,5-T ³
4 lbs. a.i./gal. oil

Apply to deep girdle and axe cuts in roots to runoff before 50% wilt of tree develops. Treatment kills infected trees and prevents spread to healthy oaks.

Metham (Vapam Soil Fumigant)

Soil treatment when disease first appears to prevent transmission to healthy oaks by root grafts. Follow label directions.

PEACH
See Cherry
PEAR
Fire blight
Streptomycin formulations

Spray when 20 to 25% of blossoms are open and repeat at 5- to 7-day intervals during bloom. Then apply weekly for 5 or 6 weeks. Best control when spraying at night.

Scab
Several fungicides
Leaf spot
Benomyl, 50% WP ½-1
Ferbam, 76% WP 2
Mancozeb, 80% WP 1½-2
Dodine, 65% WP ½-1
Zineb, 75% WP 1½-2

PECAN
Scab, fungus leaf spots, leaf blotch and sooty spot anthracnose, anthracnose
Benomyl, 50% WP ½-1
Zineb, 75% WP 1½-2
Maneb, 80% WP 1½-2
Mancozeb, 80% WP 1½-2
Dodine, 65% WP 1½-2

Apply 4 to 6 sprays, 10 to 14 days apart. Start when buds begin to open. Thorough coverage is required. Follow manufacturer's directions.

WP
Copper ½-1
Polyram, 80% WP 2
Du-Ter, 47.5% WP ½

Powdery mildew
Benomyl, 50% WP ½-1
Du-Ter, 47.5% WP ½-½

PHOTINIA
Powdery mildew
Benomyl, 50% WP ½-1
Sulfur, 95% WP 2-3

PINE
Dothistroma needle blight
Copper See label

Spray twice: when new needles are just emerging and again when new needles are fully expanded.

Scirrhia brown spot needle blight
Copper See label
Mancozeb, 80% WP 1½-2
Maneb, 80% WP 1½-2
Chlorothalonil Daconil 2787 1½-2
Bravo 6F 3 qts.

Lophodermium needle cast or blight
Mancozeb, 80% WP 1½-2
Maneb, 80% WP 1½-2
Chlorothalonil Daconil 2787 2½
Bravo 6F 2½ pts.
Copper See label
Diplodia tip blight
Copper See label
Benomyl, 50% WP 1

Fusiform rust (nurseries in southern states)
Ferbam, 76% WP 2

Sclerotodris canker
Chlorothalonil Bravo 6F ½ qts.

Spray as new growth appears in spring. Repeat at 2- to 3-week intervals until early July; then monthly until early September.
Slrococcus tip blight and Phoma spp. (West Coast only)
Chlorothalonil Bravo 6F 1 qt. Start spraying in early November and repeat at 2- to 4-week intervals during the autumn and winter rainy period.

Annosus root and butt rot
Borax, 97% (dry, powdered) 1 lb./50 sq. ft. of stump surface Cover fresh cut stump surface immediately after falling tree. Sprinkle liberally and evenly.

Cylindrocladium blight
Benomyl, 50% WP ½ Apply as a soil drench to seedling beds at 2- to 4-week intervals.
Ferbam, 76% WP 2

Damping-off
Ethazol, 30-35% PCNB See label Drench around plants in nursery beds at 2- to 4-week intervals. Drench nursery beds of southern pines prior to seedling. Follow with 0.5 inch of water.

Cover fresh cut stump surface immediately after falling tree. Sprinkle liberally and evenly. Apply as a soil drench to seedling beds at 2- to 4-week intervals. Drench around plants in nursery beds at 2- to 4-week intervals. Drench nursery beds of southern pines prior to seedling. Follow with 0.5 inch of water.

Spray about a week before rust is expected and again 10 to 14 days later. Apply several weekly sprays when spots first appear on the lower leaves. Apply at first sign of disease. Repeat 2 or 3 times at 5- to 10-day intervals. Spray several times at 10-day intervals during the spring rainy period. Spray several times at 7- to 10-day intervals. Start when disease first appears.

Rainbow mixture 2-6-100

Chlorothalonil Bravo 6F
Annosus root and butt rot
Borax, 97%
(Cylindrocladium blight)

Benomyl, 50%
Ferbam, 76%

Apply as a soil drench to seedling beds at 2- to 4-week intervals.

Apply several times at 10-day intervals starting at budbreak.

Rust, scab, fungus leaf spots
Maneb, 80% WP 1½-2
Mancozeb, 80% WP 1½-2
Ferbam, 76% WP 2
Zineb, 75% WP 1½-2

REDBUD
Cercospora and other fungus leaf spots
Captan, 50% WP 2
Maneb, 80% WP 1½-2
Zineb, 75% WP 2

Rust, scab, fungus leaf spots
Maneb, 80% WP
Mancozeb, 80% WP
Ferbam, 76% WP
Zineb, 75% WP

REDCEDAR
See Juniper
RED HAW
See Hawthorn
RHODODENDRON, AZALEA
Ovulinia petal or flower blight of azalea
Benomyl, 50% WP
Zineb, 75% WP
Mancozeb, 80% WP
Thiram, 65-75% WP

Spray 4 times: just before blossoms open, petal-fall, 2 weeks and 4 weeks later.

Spray when 20 to 25% of the blossoms are open; repeat when 75% of blossoms are open. Do not use streptomycin on quince.

Spray as flowers open. Then apply benomyl at 5-day intervals, zineb, mancozeb, and thiram 3 times weekly during the bloom period.

Spray several times at 7- to 10-day intervals. Start when new growth appears or right after bloom. Zineb, maneb, mancozeb, and ferbam are effective against rusts.

RUST, SCAB, FUNGUS LEAF SPOTS
Maneb, 80% WP 1½-2
Mancozeb, 80% WP 1½-2
Ferbam, 76% WP 2
Zineb, 75% WP 1½-2

POWDERY MILDEW
Benomyl, 50% WP
Sulfur, 95% WP
Karathane, 22.5% WP

Spray several times at 7- to 10-day intervals. Start when disease first appears.

Spray several times at 7- to 10-day intervals. Start when new growth appears or right after bloom. Zineb, maneb, mancozeb, and ferbam are effective against rusts.
<table>
<thead>
<tr>
<th>Disease</th>
<th>Sprays</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stem gall</strong></td>
<td>Zineb, 75% WP 1½, Ferbam, 76% WP 2</td>
</tr>
<tr>
<td><strong>Bud and twig blight, dieback</strong></td>
<td>Copper See label Make 3 sprays, 7 to 10 days apart, starting at budbreak.</td>
</tr>
<tr>
<td><strong>Root and crown rot or wilt</strong></td>
<td>Ethanol, 30-35% See label Diazoben See label Apply as drench around plants to saturate the soil. Repeat at 4- to 12-week intervals during spring and autumn.</td>
</tr>
<tr>
<td><strong>Cutting rot</strong></td>
<td>Benomyl, 50% WP ¾ Mix 1 part benomyl with 39 parts of root-inducing hormone powder by weight. Treat cutting ends with mixture before &quot;sticking&quot; in rooting medium. Then drench soil as for Root and crown rot or wilt (above). Apply as for Root and crown rot or wilt (above).</td>
</tr>
<tr>
<td><strong>ROSE</strong></td>
<td>Botrytis blight Benomyl, 50% WP ½ Apply to flowers at 7- to 10-day intervals during moist weather.</td>
</tr>
<tr>
<td></td>
<td>Black spot, cane blights or cankers, spot anthracnose, anthracnose, fungus leaf spots Chlorothalonil, 75% WP 1½-2, Folpet, 50% WP 1½-2, Maneb, 80% WP 1½-2, Mancozeb, 80% WP 1½-2, Polyram, 80% WP 1½-2, Benomyl, 50% WP 1, Zineb, 75% WP 1½-2, Powdery mildew Benomyl, 50% WP ½-1, Folpet, 50% WP ½-1, Maneb, 80% WP ½-1, Karathane, 22.5% WP ½, Sulfur, 95% WP 2-3</td>
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<tr>
<td><strong>SHADDBUSH</strong></td>
<td>See Amelanchier</td>
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<tr>
<td><strong>SPRUCE</strong></td>
<td>See Pine</td>
</tr>
<tr>
<td><strong>SUMAC</strong></td>
<td>Fungus leaf spots Maneb, 80% WP 1½-2, Sulfur, 95% WP 4-6 Apply when disease is first seen. Repeat as needed at 7- to 10-day intervals during wet periods.</td>
</tr>
<tr>
<td><strong>SYCAMORE, PLANETREE, BUTTONWOOD</strong></td>
<td>Anthracnose, fungus leaf spots, leaf blight Benomyl, 50% WP 1 Copper See label Mancozeb, 80% WP 1½-2, Maneb, 80% WP 1½-2, Dodine, 65% WP 1, Captanol 2 pts., Zineb, 75% WP 1½-2, Powdery mildew Benomyl, 50% WP ½-1, Sulfur, 95% WP 2-3, TAXUS See Yew</td>
</tr>
<tr>
<td><strong>VIBURNUM</strong></td>
<td>Powdery mildew Benomyl, 50% WP ½-1, Sulfur, 95% WP 1½, Karathane, 22.5% WP ½, WALNUT, BUTTERNUT Anthracnose, yellow leaf blotch, fungus leaf spots or blights Benomyl, 50% WP ½-1, Sulfur, 95% WP 1½-2, Mancozeb, 80% WP 1½-2, Maneb, 80% WP 1½-2, Bacterial blight (of Persian or English walnut) Copper See label Streptomycin formulations See label Spray 3 times: when flowering starts, at full bloom, and at petal-fall.</td>
</tr>
</tbody>
</table>
WILLOW
Tar spot, leaf blight or scab, black canker, spot anthracnose
Copper See label Spray 3 times, 10 days apart, starting as the buds open.
Zineb, 75% WP 1½-2 Zineb, maneb and mancozeb also control rust.
Mancozeb, 80% WP 1½-2
Maneb, 80% WP 1½-2
Dodine, 65% WP ½-1
Powdery mildew and rust
Sulfur, 95% WP 4½-5½ Apply 2 or more times, 7 to 10 days apart. Start when disease first appears.

WITCH HAZEL
Powdery mildew
Benomyl, 50% WP ½-1 Spray 2 or more times, 7 to 10 days apart. Start when disease appears.

YEW (Taxus)
Phytophthora root rot
Ethazol, See label Drench soil around plants at 2- to 4-week intervals during April-May and again in September-October.
30-35% See label
Diazoben

Twig blight
Bordeaux mixture 4-4-100 Apply when new growth emerges. Repeat twice more at 7- to 10-day intervals.

ALL TREES AND SHRUBS
Seed decay, damping-off, seedling blights
Thiram, 50-75% WP Apply 2 oz./lb. of seed. If damping-off occurs, drench seedbed (4 T./gal.) when first seen. Follow label directions.
Captan, 50-75% WP

Mylone, DMTT See label Apply as a soil drench 2 to 3 weeks prior to planting in nursery beds.
Diazoben See label Apply as a soil drench after plants are set; repeat at 2- to 4-week intervals.

Wood rots or decays
Thiram, 75% WP 1% Apply thinly in an asphalt or other non-fortified tree wound preparation.
Copper naphthenate 3.3-10.0% See label
Benomyl, 50% WP ¼t./gal.
Sodium o-phenylphenate 2%

The rates given are based on hydraulic application. If using a mistblower, follow label directions.

2Copper fungicides include bordeaux mixture (usually 4-4-100 or 8-8-100) and fixed or neutral copper compounds.
2Lignasan BLP has not been adequately tested in most states by specialists in the area of tree pathology, and hence cannot be fully recommended at this time.
3Do not use 2,4,5-T around the home, recreational areas, pond or ditch banks, or similar sites.
4Recommended for the leaf-blight stage of anthracnose only.

Additional Comments:
1. The vigor of unthrifty and undernourished woody ornamentals, commonly susceptible to a variety of diseases and environmental stresses, can often be greatly improved by periodic applications of fertilizer and timely watering. Soil tests are always suggested prior to feeding, especially if a soil (or lawn) fertilization program has been in effect. In general, a 10-10-10 (NPK) fertilizer at the rate of 2 to 4 lbs. per inch of trunk diameter at breast height can be applied in a series of holes evenly distributed in the ground beneath the tree and extending well beyond the drip line.

2. Proper selection of planting site, planting and spacing, pruning, winter protection, control of other diseases and pests, and avoidance of unnecessary wounding will aid in control of a wide range of diseases.

Prune during dry weather, sterilizing tools frequently between cuts using a fresh 10% solution of liquid household bleach, 70% alcohol, or formaldehyde. When pruning or removing diseased wood, paint the newly exposed inner bark and sapwood with a germicidal or fungicidal coating. Shellac is useful for diseases caused by bacteria, such as fire blight. Follow the shellac with a tree wound paint containing benomyl (Benlate) fungicide 50% WP at the rate of 1 gram in 5,000 grams (or 2 2/3 oz. in 100 gal.). This mixture, although harmless to living bark, is toxic to spores of such canker-producing fungi as Cytospora (Valsa), Ceratocystis and Botryosphaeria. Some tree pathologists believe that the application of wound paints is primarily for “cosmetic effect.”

3. Wetting, spreading, and sticking agents (surfactants), are often added to spray mixes
when spraying hard-to-wet foliage such as that of conifers, broadleaf evergreens, boxwood, and roses. A few commercial spreader-stickers available for tank mixing include Biofilm Spreader-Sticker, Chevron Spray Sticker, Citowatt, and Nu-Film P and 17. Commercial spreaders include Chevron Spreader, Multifilm L, Ortho X-77, Pinolene, Sure Spred, Surfactant II, and Triton B-1956.

The fungicide label usually indicates any restrictions in selection of compatible surfactants. Use these commercial preparations according to label directions. The addition of excess wetting or spreading agent may cause excess runoff and result in a poor spray deposit.

4. Winter drying (leaf scorch) of broadleaf evergreens (e.g. magnolia, rhododendron, etc.) can often be prevented by applying an antidesiccant such as Folicote, Foli-Guard, Vapor Guard, or Wilt Pruf NCF, according to label directions. Apply to the upper surfaces of leaves in late November or early December and repeat again in mid-winter.

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Noise is perhaps mankind's most widespread social irritant, and also the most insidious. Ever since the days when Julius Caesar banned chariots from the streets of Rome at night, man has attempted to control noise. Suburban noise, resulting from increased vehicular traffic has been a major concern of highway engineers and property owners who live adjacent to main thoroughfares. Researchers measuring sound levels at 48 locations in Buffalo, New York have found some suburban areas to be almost as noisy as downtown locations during the rush-hour. Individual attempts have often been made to control this noise, with some success, but the process has been rather haphazard, and more concerted efforts are needed. It has been known for many years that plant materials have some ability to absorb, and diffuse sound, thereby reducing noise levels; also solid barriers of earth concrete or wood are known to reduce noise transmission, when properly placed. Experiments by the authors in 1972, using combinations of belts of tall trees and earthen dykes or land firms, gave indications that the loudness of sounds could be reduced by half over distances from 45 to 140 meters when a barrier consisting of trees and land form was interposed between the noise source and receiver. More recently experiments in residential areas of the city in 1975 have shown that significant reductions are possible by the proper use of plant materials and barriers, and in many cases the devices used may be both attractive and relatively inexpensive.

RECOMMENDATIONS

1. To reduce noise from suburban automobiles and light trucks to an acceptable level where the residence is at least 25 meters from the centerline of the roadway, plant one or two continuous rows of dense shrubs as close to the curb as possible, and one or two continuous rows of dense trees behind the shrubs. One or both plantings should be of evergreens for year-round protection.

2. Where immediate relief from traffic noise is desired, erect an earthen dike, masonry wall, or solid wooden fence. The height should be sufficient to screen the noise source from view at the location to be protected. Landscaping should be included to provide additional protection, when the trees become larger, and to decrease the reflection from the hard wall surface back across the street.

3. Where the residence is less than about 20 meters from the centerline of the roadway, both trees and a solid barrier are necessary, as in recommendations 1 and 2.