"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><strong>benomyl</strong>&lt;br&gt;Benlate Benomyl&lt;br&gt;Turf Fungicide, Tersan 1991&lt;br&gt;Benomyl (DuPont New Systemic Fungicide), Benomyl Turf Fungicide Granules, Rockland&lt;br&gt;Benomyl Fungicide, Patterson's Systemic Fungicide&lt;br&gt;Science Benomyl Systemic Fungicide, Miller's Benomyl Systemic Fungicide, ProTurf Fertilizer Plus DSB&lt;br&gt;Fungicide, Lignasan BLP</td>
<td>Broad-spectrum fungicide with systemic (curative) properties. Effective against many fungus leaf spots and blights, blights, rots, scabs, 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><strong>bordeaux mixture</strong>&lt;br&gt;Acme and Patterson's Bordeaux Mixture, Copper Hydro Bordo, Bor-dox, Pratt Bordeaux Mix, Black Leaf Bordeaux Powder, Bordo Mixture</td>
<td>Broad-spectrum, long-lasting fungicide now used mostly as a dormant spray and on conifers. May &quot;scorch&quot; foliage of some plants (e.g., holly, maples) in cold damp weather. Most effective if freshly mixed.</td>
</tr>
<tr>
<td><strong>cycloheximide</strong>&lt;br&gt;Acti-dione PM, Acti-dione TGF, Actispray</td>
<td>Antibiotic fungicide for controlling certain powdery mildews, rusts and turfgrass diseases. Plant injury may occur at high temperatures.</td>
</tr>
<tr>
<td><strong>Botran (dicloran)</strong>&lt;br&gt;Botran</td>
<td>Useful in controlling Botrytis blights. Also controls certain storage molds, e.g., Sclerotinia, Penicillium, and Rhizopus.</td>
</tr>
<tr>
<td><strong>captan</strong>&lt;br&gt;Difolan 4 Flowable</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 captan.</td>
</tr>
<tr>
<td><strong>cycloheximide</strong>&lt;br&gt;Acti-dione PM, Acti-dione TGF, Actispray</td>
<td>For therapy of crown gall and olive knot by direct application (as &quot;paint&quot;) to galls on established plants.</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. McSwan, 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, Captain 80% Wettable Powder, Captain 80 Spray-Dip, Captain Garden Spray

chlorothalonil
Daconil 2787, Bravo 6F, Exotherm Termil, Diamond 76% Chlorothalonil

copper
(1) basic copper sulfate
Basic Copper Sulfate, Ortho Copper 53 Fungicide, Basi-Cop, Microcop, Tri-Basic Copper Sulfate, Tennessee Copper Sulfate, Spraycop 530, T-B-C-S 53

(2) basic chlorides
Copranto1, C-O-C-S, Aceto Copper Chloride, Copper Oxychloride, Kaurital (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, Copoiloid, Citecop 4E, Carmel GH-41 Greenhouse Fogging
diazoben
Dexon
dinocap
Karathane WD, Miller’s Garden Karaspray
dodine
Cyprex 65W Fruit Fungicide
dazocen
(or maneb and zineb) Dithane M-45, Manzate 200, Sup’r-Flo Maneb Flowable, For, Fore Lawn Fungicide, Pratt Lawn & Garden Fungicide
dodine
Cyprex 65W Fruit Fungicide
ethazol
Terrazole, Truban, Koban
dodine
Cyprex 65W Fruit Fungicide
dazocen
(or maneb and zineb) Dithane M-45, Manzate 200, Sup’r-Flo Maneb Flowable, For, Fore Lawn Fungicide, Pratt Lawn & Garden Fungicide
ferbam
Ferbam, Fermate Ferbam Fungicide, Carbamate, Karbam Black, Ferbam Fungicide
folfpet
Phaltan, Folpet, Rose and Garden Fungicide
mancozeb
Maneb, Dithane M-22, Manzate Maneb Fungicide, Black Leaf Maneb, Aceto Amazine Maneb 80 WP, Agsco Bitex, Tersan LSR, Sears Lawn Fungicide, Maneb Garden Fungicide
parinol
Parnon
PCNB
PCNB, Terraclor, Fungiclor, Pearson’s Green Lawn Fungicide, Lawn Disease Control
piperalin
Pipron
Shurtleff and Simone: Disease Control Sprays

Broad-spectrum protectant fungicide that controls many fungus leaf spots and blights, rots, scabs, and anthracnoses. Will not control powdery mildews and rusts. Used with PCNB or Terraclor (Soil Treater) for control of damping-off and seedling blights.

These materials, divided into five categories, are substitutes for Bordeaux mixture. They control the same range of diseases without leaving an unsightly deposit. Copper fungicides also give control of some bacterial diseases, e.g., fire blight of pome fruits and bacterial blight of lilac and Persian walnut. They are generally much more compatible with other pesticides than Bordeaux and often less toxic to tender foliage in cold, damp weather.

Broad-spectrum protectant fungicide effective against many fungus leaf spots, blights, scabs, rots, Botrytis blights, and rusts. Exotherm Termil is used in greenhouses to control Botrytis and other blights.

These materials, divided into five categories, are substitutes for Bordeaux mixture. They control the same range of diseases without leaving an unsightly deposit. Copper fungicides also give control of some bacterial diseases, e.g., fire blight of pome fruits and bacterial blight of lilac and Persian walnut. They are generally much more compatible with other pesticides than Bordeaux and often less toxic to tender foliage in cold, damp weather.

Long-lasting protectant 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, rots and scabs. Ferbam leaves an unsightly black residue on foliage, flowers and fruit.

A relative of captan and captanol 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 blotches, 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, Sclerotina, 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).
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 blotsches, 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.

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 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.

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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

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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 disease</th>
<th>Application and Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suggested fungicides</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ALDER**
Powdery mildew
Benomyl, 50% WP
Sulfur, 95% WP

**AMERICAN CHERRY**
(Shadbush, Serviceberry, Juneberry)
Cedar rusts
Ferbam, 76% WP
Thiram, 65-
75% WP
Zineb, 75% WP
Mancozeb, 80% WP

**APPLE**
See Crabapple

**ARBORVITAE**
Phomopsis needle and twig

**BLIGHT**
Benomyl, 50% WP

Only new growth is susceptible. Spray whenever new growth appears. Spray after shearing or wet weather and repeat at 10- to 14-day intervals until new growth has matured.

**Coryneum twig blight**
(Pacific Northwest)
Copper

See label Spray at least monthly during autumn and winter rainy seasons.

**ARBUTUS**
See Madrone

**ASH**
Anthracnose, fungus leaf spots
Copper
Zineb, 75% WP
Benomyl, 50% WP

**AZALEA**
See Rhododendron

**BAMBOO**
Bacterial leaf spot and twig blight
Copper

**BASSWOOD**
See Linden

**BIRCH**
Leaf blister
Copper
Liquid lime-sulfur

**ANTHRACNOSE**
Copper
Zineb, 75% WP
Benomyl, 50% WP

**RUST**
Zineb, 75% WP
Mancozeb, 80% WP

**BUTTERCUP**
Powdery mildew
Benomyl, 50% WP

**BOXELDER**
See Maple

**BOXWOOD**
Canker, fungus leaf blights or spots
Copper

**See label**
Apply 4 times: dormant after

**CACTUS**
(Rose, Gabardine)
Copper

**CAMELLIA**
Botrytis, mildew
Copper

**CEDAR**
Canker, fungus leaf blights or spots
Copper

**See label**
Apply when buds begin to open. Repeat 10 to 14 days later. Zineb also controls rust.

**CITHAREX**
Copper

**CITRUS**
See Orange

**CLAYTONIA**
Copper

**COBALT**
Copper

**CORNELL**
Copper

**CUCURBITA**
Powdery mildew
Benomyl, 50% WP

See label Apply 4 times: dormant after
Liquid-lime-sulfur 2 gal. 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.

Phytophthora root rot Ethazol, 30-35% Diazoben See label
Drench soil around roots at 14-day intervals during April-May and again in September-October.

BUCKEYE See Hordhestnut

BUTTERNUT See Walnut

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

BUTTONWOOD See Sycamore

CAMELLIA Sclerotinia flower blight PCNB, 75% WP Benomyl, 50% WP See label

Sooty mold Suggested insecticide

Phytophthora root rot Ethazol, 30-35% Diazoben See label

Catalpa Powdery mildew Piperalin ¼

Chamaecyparis Phytophthora root rots (Pacific Northwest)
<table>
<thead>
<tr>
<th>Disease</th>
<th>Insecticide/Chemical</th>
<th>Rate</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rust</td>
<td>Ferbam, 76% WP</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Zineb, 75% WP</td>
<td>1½-2</td>
<td></td>
</tr>
<tr>
<td>Scab, fungus</td>
<td>Acti-dione PM</td>
<td>See label</td>
<td></td>
</tr>
<tr>
<td>leaf spots,</td>
<td>Sulfur, 95% WP</td>
<td>2-3</td>
<td></td>
</tr>
<tr>
<td>shot-hole</td>
<td>Captan, 50% WP</td>
<td>1½-2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ferbam, 76% WP</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Zineb, 75% WP</td>
<td>1½-2</td>
<td></td>
</tr>
<tr>
<td>Scab</td>
<td>Sulfur, 95% WP</td>
<td>5-10</td>
<td></td>
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<tr>
<td></td>
<td>Captan, 50% WP</td>
<td>2</td>
<td></td>
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<tr>
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<td>Ferbam, 76% WP</td>
<td>2</td>
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<td>1½-2</td>
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<tr>
<td>CONIFERS</td>
<td>See Pine</td>
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</tr>
<tr>
<td>Scab</td>
<td>Benomyl, 50% WP</td>
<td>½-1</td>
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<tr>
<td></td>
<td>Dodine, 65% WP</td>
<td>½-1</td>
<td></td>
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<tr>
<td>Scab</td>
<td>Maneb, 80% WP</td>
<td>1½-2</td>
<td></td>
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<tr>
<td></td>
<td>Zineb, 75% WP</td>
<td>1½-2</td>
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<tr>
<td>CRABAPPLE, APPLE</td>
<td>Bordeaux mixture</td>
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<tr>
<td>Scab</td>
<td>Benomyl, 50% WP</td>
<td>½-1</td>
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<tr>
<td>Scab</td>
<td>Sulfur, 95% WP</td>
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<td></td>
<td>Dodine, 65% WP</td>
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<td>Scab</td>
<td>Zineb, 75% WP</td>
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<td></td>
</tr>
</tbody>
</table>

Apply Acti-dione only to non-bearing cherry trees.

Spray several times, about 10 days apart. Start about 2 weeks after petal-fall.

Spray about 3 times, 10 to 14 days apart, starting at petal-fall.

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.

Apply in spring as buds start to swell and repeat 2 to 3 weeks later.

Spray several times 10 to 14 days apart. Commence at budbreak.

Spray as new growth appears and flower buds start to open. Repeat 3 or 4 more times at 10-day intervals.

Apply Acti-dione only to non-bearing cherry trees.

Spray several times, about 10 days apart. Start about 2 weeks after petal-fall.

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.

Spray when disease first appears or as leaves start to expand. Repeat 2 or 3 times, 10 apart.

Make several spring and autumn sprays. Start when disease is first seen. Apply lime-sulfur once, just as the buds are breaking open.

Spray 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.

Apply in spring as buds start to swell and repeat 2 to 3 weeks later.

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.

Spray when disease first appears or as leaves start to expand. Repeat 2 or 3 times, 10 apart.

Apply in early spring and late fall at 7- to 10-day intervals.
and leaf blight
Benomyl, 50% WP
Maneb, 80% WP
Mancozeb, 80% WP
Zineb, 75% WP
Captan, 50% WP
Folpet, 50% WP
Copper

Powdery mildew
Benomyl, 50% WP
Sulfur, 95% WP
DOUGLAS-FIR

Needle cast
Copper

ELM
Anthracnose, black leaf spot, other fungus
leaf spots, twig blight
Sulfur, 95% WP
Copper
Zineb, 75% WP
Mancozeb, 80% WP
Ferbam, 76% WP

Dutch elm disease
Metham (Vapam Soil Fumigant)
+ Methoxychlor
+ Lignasan BLP

Nectria canker
(Pacific Northwest)
Copper

EUONYMUS
Leaf spots
Maneb, 80% WP
Mancozeb, 80% WP

Zineb, 75% WP
Powdery mildew
Acti-dione PM
Karathane, 22.5% WP
Sulfur, 95% WP
EVERGREENS
See Juniper, Pine, Yew
FIRETHORN
See Pyracantha

FORSYTHIA
Leaf spots
Maneb, 80% WP
Zineb, 75% WP
Copper
GARDENIA
Cankor
Karathane, 76% WP

Leaf spots
Ferbam, 76% WP
Copper
Powdery mildew
Karathane, 22.5% WP

HAUROWN, RED HAW
Leaf blight or spots, scab, other fungus
leaf spots
Polyram, 80% WP
Captan, 50% WP
Benomyl, 50% WP
Maneb, 80% WP
Mancozeb, 80% WP
Zineb, 75% WP
Dodine, 65% WP
Acti-dione
Cedar rusts
Thiram, 65-75% WP
Zineb, 75% WP
Maneb, 80% WP
Mancozeb, 80% WP
Chlorothalonil, 75% WP
Fire blight
Streptomycin

Spray 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.

Spray 3 times, 10 to 14 days apart. Start when the leaf buds break open.

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.

Spray in October and 2 or 3 times in spring, starting when new growth appears.

Apply at first evidence of disease. Repeat at 7- to 10-day intervals.

Apply at budbreak and repeat at 7- to 10-day intervals as needed.

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.

Spray when 20 to 25% of blossoms are open and at 5-
HEATHER
(Calluna)
Botrytis blight
Benomyl, 50% WP ½-1
Drench when symptoms appear; repeat if Botrytis reappears.

Phytophthora root rot
Ethazol, 30-35% See label
Diazobenz See label

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 ½-1
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 ½-1
Zineb, 75% WP 1½-2
Mancozeb, 80% WP 1½-2
Maneb, 80% WP 1½-2
Copper See label

Leaf and twig blight, algae
Copper Zineb, 75% WP 1½-2
Powdery mildew Sulfur, 95% WP 2-3

HONEYSUCKLE
Herpetosandium leaf blight
Mancozeb, 80% WP 1½-2
Maneb, 80% WP 1½-2
Powdery mildew

SHURLEFF AND SIMONE: DISEASE CONTROL SPRAYS

HEATHER (Calluna)
Botrytis blight
Benomyl, 50% WP ½-1
Drench when symptoms appear; repeat if Botrytis reappears.

Phytophthora root rot
Ethazol, 30-35% See label
Diazobenz See label

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 ½-1
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 ½-1
Zineb, 75% WP 1½-2
Mancozeb, 80% WP 1½-2
Maneb, 80% WP 1½-2
Copper See label

Leaf and twig blight, algae
Copper Zineb, 75% WP 1½-2
Powdery mildew Sulfur, 95% WP 2-3

HONEYSUCKLE
Herpetosandium leaf blight
Mancozeb, 80% WP 1½-2
Maneb, 80% WP 1½-2
Powdery mildew

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

BOTRYTIS BLIGHT
Benomyl, 50% WP ½-1
Sulfur, 95% WP 2-3
Acti-dione PM See label

HYPOCHEST NUT, BUCKEYE
Leaf blight, fungus leaf spot or blotch, anthracnose
Benomyl, 50% WP ½-1
Zineb, 75% WP 1½-2
Mancozeb, 80% WP 1½-2
Maneb, 80% WP 1½-2
Codine, 65% WP 1-2

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

Powdery mildew
Benomyl, 50% WP ½-1
Karathan, 22.5% WP ½
Sulfur, 95% WP 2-3
Botrytis blight
Benomyl, 60% WP ½-1
Botran, 50% WP 1-1½

JUNEBERRY
See Amelanchier

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

Powdery mildew
Benomyl, 50% WP ½-1
Karathan, 22.5% WP ½
Sulfur, 95% WP 2-3
Botrytis blight
Benomyl, 60% WP ½-1
Botran, 50% WP 1-1½

JUNIPER
Spray when disease first appears or after June 1; repeat twice more at 2- to 3-week intervals.

KALANCHOE
Powdery mildew
Benomyl, 50% WP ½-1
Spray several times at 7- to 10-day intervals. Start when disease first appears.

Cercospora needle blight
Copper See label

Spray several times at 10- to 14-day intervals. Keep new growth protected. See Arbor vitae.

Phomopsis canker or twig blight
Benomyl, 50% WP 1

Spray susceptible junipers 4 times, 10 to 20 days apart, starting about mid-summer. Acti-dione is applied in spring before galls become orange and jelly-like.

KALANCHOE
Spray when disease first appears at 10- to 14-day intervals. Start when disease first appears.

Acti-dione PM See label

Leaf and twig blight, algae
Copper Zineb, 75% WP 1½-2

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

Cercospora needle blight
Copper See label

Spray when disease first appears or after June 1; repeat twice more at 2- to 3-week intervals.

KALANCHOE
Powdery mildew
Benomyl, 50% WP ½-1

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

LILAC
Powdery mildew
Benzylmethylen, 50% WP
Sulfur, 95% WP
Karathane, 22.5% WP
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.

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

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

MADRONE (Arbutus)
Hendersonula canker
Zineb, 75% WP
Ferbam, 76% WP
Fungus leaf spots
Captan, 50% WP
Zineb, 75% WP
Maneb, 80% WP
Mancozeb, 80% WP
Thiram, 65-75% WP
Dode, 65% WP
MAGNOLIA
Powdery mildew
Benomyl, 50% WP
Actidione PM

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

MAPLE, BOXELDER
Anthracnose, fungus leaf spots
Copper

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

MAYDAY-TREE
See Cherry

MOUNTAIN-Ash
Leaf blight, scab, fungus leaf spots
Benomyl, 50% WP
Mancozeb, 80% WP
Zineb, 75% WP
Rust
Zineb, 75% WP

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

NEW JERSEY TEA (Ceanothus)
Powdery mildew
Benomyl, 50% WP

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

OAK
Anthracnose, fungus leaf spots

Make several sprays 7 to 10 days apart. Start when disease appears.
and blights, spot anthracnose, leaf blotch, leaf blister

Copper See label
Zineb, 75% WP 1Vi-2
Capture, 50% WP 2-4
Benomyl, 50% WP 1
Dorle, 65% WP 1
Mancozeb, 80% WP 1Vi-2

Oak Wilt

2,4,5-T3

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) See label

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

See label

Spray 3 times: just before buds open, when leaves are half grown, and 10 to 14 days later.

Scab

Several fungicides

Copper
Benomyl, 50% WP ½-1
Ferbam, 76% WP 2
Mancozeb, 80% WP 1Vi-2
Dorle, 65% WP ½-1
Zineb, 75% WP 1Vi-2

PECAN

Scab, fungus leaf spots, leaf blotch and scorch, spot anthracnose, anthracnose

Benomyl, 50% WP ½-1
Zineb, 75% WP 1Vi-2
Mancozeb, 80% WP 1Vi-2
Dorle, 65% WP 1Vi-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

Deothistroma needle blight
Copper See label
Spray twice: when new needles are just emerging and again when new needles are fully expanded.

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

Lophodermium needle cast or blight
Mancozeb, 80% WP 1½-2
Mane, 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

Scleroderma canker
Chlorothalonil Bravo 6F 1½ qts.

Spray as new growth appears in spring. Repeat at 2- to 3-week intervals until early July; then monthly until early September.
<table>
<thead>
<tr>
<th>Disease</th>
<th>Treatment</th>
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| **Stroccoccus 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  
Ferbam, 76% WP  
Apply as a soil drench to nursery beds at 2- to 4-week intervals. |
| **Damping-off**  
Ethanol, 30-35% | See label  
Drench around plants in nursery beds at 2- to 4-week intervals. Drench nursery beds of southern pines prior to seeding. Follow with 0.5 inch of water. |
| **PLANETREE**  
See Sycamore  
PLUM  
See Cherry  
POPLAR  
Leaf rusts | Zineb, 75% WP  
Spray about a week before rust is expected and again 10 to 14 days later. |
| **Yellow leaf blister**  
Zineb, 75% WP  
Mancozeb, 80% WP  
Maneb, 80% WP | 2  
Apply several weekly sprays when spots first appear on the lower leaves. |
| **Powdery mildew**  
Sulfur, 95% WP | 4½-5½  
Apply at first sign of disease. Repeat 2 or 3 times at 5- to 10-day intervals. |
| **PRIVET**  
Anthracnose, leaf spot, twig blight  
Ferbam, 76% WP  
Benomyl, 50% WP | 2  
Spray several times at 10-day intervals, starting in mid-spring. |
| **PYRACANTHA (Firethorn) Fire blight Streptomycin formulations Copper** | See label  
Spray when 20 to 25% of blossoms are open and repeat at 5- to 7-day intervals during bloom. |
| **Scab**  
Benomyl, 50% WP  
Folpet, 50% WP  
Dodiene, 85% WP  
**QUINCE**  
Fire blight Bordeaux mixture | ½-1  
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 blooms are open. Do not use streptomycin on quince. |
| **Rust, scab, fungus leaf spots**  
Maneb, 80% WP  
Mancozeb, 80% WP  
Ferbam, 76% WP  
Zineb, 75% WP | 1½-2  
Apply several times at 10-day intervals starting at budbreak.  
Apply at budbreak and repeat several times at 10-day intervals during the spring rainy period. |
| **Pyracantha**  
Ovulina petal or flower blight of azalea  
Benomyl, 50% WP  
Zineb, 75% WP  
Mancozeb, 80% WP  
Thiram, 65-75% WP | ½  
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 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. |
and stem gall
Zineb, 75% WP 1½
Ferbam, 76% WP 2
Bud and twig blight, dieback
Copper See label
Root and crown rot or wilt (Phytophthora cinnamomi and other fungi)
Ethazol, 30-35% See label
Diazoben See label
Cutting rot
Benomyl, 50% WP
Ethazol, 30-35% See label
ROSE
Botrytis blight
Benomyl, 50% WP ½
Botran, 50-75% WP See label
Zineb, 75% WP 1
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 1½-2
Karathane, 22.5% WP ½-1
Sulfur, 95% WP 2-3
Actidione See label
Parinol See label
Pipealrin See label
SHADBUSH
See Amelanchier
PRUCE
See Pine
SUMAC
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.
SYCAMORE,
PLANETREE,
BUTTONWOOD
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
VIBURNUM
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
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.
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, maneb and mancozeb also control rust.
Zineb, 75% WP 1½-2
Mancozeb, 80% WP 1¾-2
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 (Pacific Northwest)
Ethazol, 30-35% See label Drench soil around plants at 2- to 4-week intervals during April-May and again in September-October.
Diazoben See label

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
Captan, 50-75% WP
Mylone, DMTT See label
Diazoben See label

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% Apply as a soil drench after plants are set; repeat at 2- to 4-week intervals.
Benomyl, 50% WP ½t./gal.
Sodium o-phenylphenate 2%

1 The rates given are based on hydraulic application. If using a mistblower, follow label directions.
2 Copper fungicides include bordeaux mixture (usually 4-4-100 or 8-8-100) and fixed or neutral copper compounds.
3 Lignasan 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.
4 Do not use 2,4,5-T around the home, recreational areas, pond or ditch banks, or similar sites.

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.


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 firm, 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.