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 blotches, 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>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>Bacthcin</td>
<td>For therapy of crown gall and olive knot by direct application (as &quot;paint&quot;) to galls on established plants.</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>
</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
Captan 50-W and 80-W, Orthocide 50 Wettable, Captan 80% Wettable Powder, Captan 80 Spray-Dip, Captan 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
Coprantol, C-O-C-S, Aceto copper Chloride, Copper Oxochloride, 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, Copoloid, Citcops 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
Ferbarn, Femate Ferbam Fungicide, Carbamate, Karbam 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, Fore, Fore Lawn Fungicide, Pratt Lawn & Garden Fungicide

maneb
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, Fungicolor, Pearson’s Green Lawn Fungicide, Lawn Disease Control

piperalin
Pipron

protectant

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

Shurtell and Simone: Disease Control Sprays
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 rot 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 blotches, 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 and blotches, scabs, and rusts. 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 100 gal.</th>
<th>Suggested fungicides</th>
<th>Application and Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALDER Powdery mildew</td>
<td>Benomyl, 50% WP</td>
<td>Sulfur, 95% WP</td>
<td>½</td>
</tr>
<tr>
<td>ALMOND Cedar rusts</td>
<td>Ferbam, 76% WP</td>
<td>Thiram, 65-75% WP</td>
<td>Sulfur, 95% WP</td>
</tr>
<tr>
<td>AMELANCHIER Leaf blister</td>
<td>Copper</td>
<td>Liquid</td>
<td>Lime-sulfur</td>
</tr>
<tr>
<td>BOXELDER Canker, fungus leaf blights or spots</td>
<td>Copper</td>
<td>Zineb, 75% WP</td>
<td>Mancozeb, 80% WP</td>
</tr>
<tr>
<td>BOXWOOD Bacterial leaf spot and twig blight</td>
<td>Copper</td>
<td>Zineb, 75% WP</td>
<td>Benomyl, 50% WP</td>
</tr>
</tbody>
</table>

Coryneum twig blight (Pacific Northwest)

Copper

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

ARBUSCUS See Madrone

ASH Anthracnose, fungus leaf spots

Copper

Zineb, 75% WP

Benomyl, 50% WP

½-1

AZALEA See Rhododendron

BARBERRY Bacterial leaf spot and twig blight

Copper

See label Spray 2 or 3 times, 10 days apart, beginning when new leaves appear.

BASSWOOD See Linden

BIRCH Leaf blister

Copper

Liquid

Anthracnose

Copper

Zineb, 75% WP

Benomyl, 50% WP

Rust

Zineb, 75% WP

Mancozeb, 80% WP

½-1

Buttersweet Powdery mildew

Benomyl, 50% WP

½-1

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

BOXELDER See Maple

BOXWOOD Canker, fungus leaf blights

Copper

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  Apply as drench around plants to saturate the soil. Repeat at 4- to 12-week intervals during spring and autumn.

BUCKEYE  See Horsechestnut

BUTTONBUSH  Powdery mildew  Benomyl, 50% WP  ½-1  Make several weekly sprays. Start when disease first appears.

BUTTONWOOD  See Sycamore

CAMELLIA  Sclerotinia flower blight  PCNB, 75% WP Benomyl, 50% WP  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).

Sooty mold  Suggested insecticide  Sooty mold fungi grow in honeydew secreted by aphids, scale and other insects. Spray in spring and summer for insect control.

Phytophthora root rot  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.

CATALPA  Powdery mildew  Piperailin  Benomyl, 50% WP  Sulfur, 95% WP Fungus leaf spots  Copper  1/4  ½-1  2-3  See label  If severe, spray when leaves are unfolding, leaves reach full size, and 2 weeks later.

CHAMAECY-PARIS  Phytophthora root rots (Pacific Northwest)  Ethazol, 30-35% Diazoben  See label  Drench soil around roots at 14-day intervals during April-May and again in September-October.

CHERRY, PEACH, PLUM, AMOND, MAYDAY-TREE, CHERRY PLUM, CHERRY-LAUREL

Black knot  Dodine, 65% WP  Zineb, 75% WP Mancozeb, 80% WP Ferbam, 76% WP Benomyl, 50% WP  ½-1  1 ½-2  2  2  ½-1

Brown rot, blossom and twig blight  Benomyl, 50% WP  Captan, 50% WP  Sulfur, 95% WP  ½-1  2  5-10

Leaf blotter or curl, plum pockets, witches'-broom  Captan, 50% WP  Liqulid lime-sulfur Ferbam, 76% WP Dodine, 65% WP Copper  ½-1  2  ½-1

Coccomyces leaf spot, blight, or shot-hole  Benomyl, 50% WP Dodine, 65% WP Acti-dione Captan, 50% WP  ½-1  ½-1  2

Perennial canker  Ferbam, 76% WP Benomyl, 50% WP  ½-1

Powdery mildew  Benomyl, 50% WP Karathane,  ½-1

Spray as buds begin to swell. Repeat at pink bud, full bloom, 10 and 20 days later.

Spray when first blossoms open, during full bloom, and again at petal-fall. Thorough coverage is required.

Spray once in late fall or just before buds swell in early spring. Dodine is cleared for use only on peaches for leaf leaf curl in the western states.

Spray 3 or 4 times, 2 weeks apart. Start as buds are opening. Apply Acti-dione only to non-bearing cherry trees.

Delay pruning until buds open in spring. Spray just after pruning.

Spray when mildew first appears. Repeat once or twice at 7- to 10-day intervals.
**Shurtleff and Simone: Disease Control Sprays**

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| **22.5% WP** | ½ | Apply Acti-dione only to non-bearing cherry trees. |
| **Sulfur, 95% WP** | 2-3 | Spray several times, about 10 days apart. Start about 2 weeks after petal-fall. |
| **Acti-dione PM** | See label | Spray about 3 times, 10 to 14 days apart, starting at petal-fall. |

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

**Scab, fungus**
- **leaf spots, shot-hole**
  - **Benomyl, 50% WP** | ½-1 |
  - **Sulfur, 95% WP** | 5-10 |
  - **Captan, 50% WP** | 2 |
  - **Ferbam, 76% WP** | 2 |
  - **Zineb, 75% WP** | 1½-2 |
- **CONIFERS** See Pine
- **COTONEASTER** See label

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

**Scab**
- **Benomyl, 50% WP** | ½-1 |
- **Dodine, 65% WP** | ½-1 |
- **Fungus leaf spots**
  - **Maneb, 80% WP** | 1½-2 |
  - **Zineb, 75% WP** | 1½-2 |
- **CRABAPPLE, APPLE**
  - **Cedar rusts** (Apple, hawthorn, quince)
    - **Ferbam, 76% WP** | 2 |
    - **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 |

**80% WP** | 1½-2 |
- **Polyram, 80% WP** | 1½-2 |
- **Dikar, 80% WP** | 2 |
- **Folpet, 50% WP** | 1½-2 |
- **Captanol** | 1½-2 pts. |

**Fire blight**
- **Streptomycin formulations** See label
- **Copper** See label

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

**CRABAPPLE, APPLE**
- **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

**DOGWOOD**
- **Fungus leaf spot or blotch, anthracnose, spot anthracnose, flower**
- **Mixture** 4-4-50

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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.  
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.  
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.
and leaf blight
Benomyl, 50% WP ½-1
Maneb, 80% WP 1½-2
Mancozeb, 80% WP 1½-2
Zineb, 75% WP 1½-2
Captan, 50% WP 2
Folpet, 50% WP 1½-2
Copper See label

Polyram, 80% WP 1½-2
Benomyl, 75% WP 1½-2

Copper See label

DOUGLAS-FIR
Needle cast
Copper See label

EML
Anthracnose, black leaf spot, other fungus
leaf spots, twig blight
Sulfur, 95% WP 2-3
Copper See label
Zineb, 75% WP 1½-2
Mancozeb, 80% WP 1½-2
Ferbam, 76% WP 2

ELM
Anthracnose, black leaf spot, other fungus
leaf spots, twig blight
Sulfur, 95% WP 2-3
Copper See label
Zineb, 75% WP 1½-2
Mancozeb, 80% WP 1½-2
Ferbam, 76% WP 2

Dutch elm disease
Metham (Vapam Soil Fumigant) See label
+ Methoxychlor See label
+ Lignasan BLP 2A See label

Nectria canker
(Pacific Northwest)
Copper See label

EUONYMUS
Leaf spots
Maneb, 80% WP 1½-2
Mancozeb, 80% WP 1½-2

Acti-dione PM See label
Karathane, 22.5% WP ½-1
Sulfur, 95% WP 4-5

EVERGREENS
See Juniper, Pine, Yew

FIRETHORN
See Pyracantha

FORSYTHIA
Leaf spots
Maneb, 80% WP 1½-2
Zineb, 75% WP 1½-2
Copper See label

GARDENIA
Canker
Grodan, 76% WP See label

Leaf spots
Ferbam, 76% WP 1½
Copper See label

Powdery mildew
Karathane, 22.5% WP ½

HAUCTION, RED HAW
Leaf blight or spots, scab, other fungus
leaf spots
Polyram, 80% WP 1½-2
Captan, 50% WP 2
Benomyl, 50% WP ½-1
Maneb, 80% WP 1½-2
Mancozeb, 80% WP 1½-2
Zineb, 75% WP 1½-2
Dodine, 65% WP ½
Acti-dione See label

Cedar rusts
Thiram, 65-75% WP 1½-2
Zineb, 75% WP 1½-2
Maneb, 80% WP 1½-2
Mancozeb, 80% WP 1½-2
Chlorothalonil, 75% WP 1½-2

Fire blight
Streptomycin See label
formulations

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.

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

Apply just before budbreak to prevent inoculation by elm bark beetles.

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.

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.

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.

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, See label
30-35% Diazoben 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 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 ½-1 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
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 Herpobasidium 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
Benomyl, 50% WP ½-1
Sulfur, 95% WP 2-3
Acti-dione PM See label

HORSECHESTNUT, 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
Dodine, 65% WP 1-2

HYDRANGEA Fungus leaf spots, rust
Zineb, 75% WP 1½-2 Spray 3 times, 7 to 10 days apart. Start when new growth appears.
Ferbam, 76% WP 2

Powdery mildew
Benomyl, 50% WP ½-1 Spray several times, 7 to 10 days apart. Start when disease first appears.
Karathane, 22.5% WP ½
Sulfur, 95% WP 2-3

BOTRYTIS BLIGHT Benomyl, 50% WP ½-1
Botran, 50% WP 1½-2

JUNEBERRY See Amelanchier

JUNIPER, REDCEDAR Rusts
Zineb, 75% WP 1½-2 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.
Acti-dione See label
Ferbam, 76% WP 2

Phomopsis canker or twig blight
Benomyl, 50% WP ½-1

Cercospora needle blight
Copper See label

KALANCHOË 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
Benomyl, 50% WP 1/1-1
Sulfur, 95% WP 4-6
Karathane, 22.5% WP 1/1-1
Bacterial and Phytophthora blights
Copper See label
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 See label
Benomyl, 50% WP 1/1-1
Powdery mildew
Benomyl, 50% WP 1/1-1
Sulfur, 95% WP 2-3
MADRONÉ (Arbutus)
Hendersonula canker
Zineb, 75% WP plus 1
Ferbam, 76% WP 1
Fungus leaf spots
Captan, 50% WP 2
Zineb, 75% WP 1 1/4-2
Maneb, 80% WP 1 1/4-2
Mancozeb, 80% WP 1 1/4-2
Thiram, 65-75% WP 1 1/4-2
Dodine, 65% WP 1/4-2
MAGNOLIA
Powdery mildews
Benomyl, 50% WP 1/1-1
Acti-dione PM See label
MAPLE, BOXELDER
Anthracnose, fungus leaf spots, leaf blight
Copper See label
Spray 2 or 3 times at 7-to-10 day intervals. Start when new growth appears in spring.

NEW JERSEY TEA (Ceanothus)
Powdery mildew
Benomyl, 50% WP 1/1-1
Oak Anthracnose, fungus leaf spots and blight or blotch, leaf scab, tar spot, leaf blister
Copper See label
Zineb, 75% WP 1 1/4-2
Mancozeb, 80% WP 1 1/4-2
Maneb, 80% WP 1 1/4-2
Nectria canker (Pacific Northwest)
Copper See label
Spray once in October and 2 or 3 times in spring starting when growth commences.

MAYDAY-TREE
See Cherry
MOUNTAIN-ASH
Leaf blight, scab, fungus leaf spots
Benomyl, 50% WP 1/1-1
Mancozeb, 80% WP 1 1/4-2
Zineb, 75% WP 1 1/4-2
Rust
Zineb, 75% WP 1 1/4-2
Fire blight
Streptomycin formulations
Copper See label
Spray 2 to 4 times, 14 days apart, starting as the leaf buds open.

MOUNTAIN-LAUREL, LAUREL (Kalmia)
Powdery mildew
Fungus leaf spots
Benomyl, 50% WP 1
Copper See label
Spray several times starting at budbreak. Repeat 10 and 20 days later.

OAK
Anthracnose, fungus leaf spots and
and blights, spot anthracnose, leaf blotch, leaf blister

<table>
<thead>
<tr>
<th>Product</th>
<th>Concentration</th>
<th>Application Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td>See label</td>
<td>Spray 3 times: just before buds open, when leaves are half grown, and 10 to 14 days later.</td>
</tr>
<tr>
<td>Zineb, 75% WP</td>
<td>1½-2</td>
<td>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.</td>
</tr>
<tr>
<td>Captan, 50% WP</td>
<td>2-4</td>
<td>Soil treatment when disease first appears to prevent transmission to healthy oaks by root grafts. Follow label directions.</td>
</tr>
<tr>
<td>Benomyl, 50% WP</td>
<td>1</td>
<td>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.</td>
</tr>
<tr>
<td>Dodine, 65% WP</td>
<td>1½-2</td>
<td>See Scab under Crab-apple.</td>
</tr>
<tr>
<td>Mancozeb, 80% WP</td>
<td>1½-2</td>
<td>Spray 2 or 3 times, 10 days apart, starting at budbreak.</td>
</tr>
<tr>
<td>Oak Wilt 2,4,5-T</td>
<td>4 lbs. a.i./gal. oil</td>
<td>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.</td>
</tr>
</tbody>
</table>

PEACH

<table>
<thead>
<tr>
<th>Product</th>
<th>Concentration</th>
<th>Application Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metham (Vapam Soil Fumigant)</td>
<td>See label</td>
<td>Spray twice: when new needles are just emerging and again when new needles are fully expanded.</td>
</tr>
</tbody>
</table>

PEAR

Fire blight

<table>
<thead>
<tr>
<th>Product</th>
<th>Concentration</th>
<th>Application Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Streptomycin formulations</td>
<td>See label</td>
<td>Spray when mildew is first seen. Repeat at 10- to 14-day intervals.</td>
</tr>
</tbody>
</table>

Scab

<table>
<thead>
<tr>
<th>Product</th>
<th>Concentration</th>
<th>Application Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benomyl, 50% WP</td>
<td>½-1</td>
<td>Spray once or twice, 30 days apart, starting when new needles are half-grown. If rainy, spray at 2-week intervals.</td>
</tr>
<tr>
<td>Ferbam, 76% WP</td>
<td>2</td>
<td>Spray 4 times, 2 to 3 weeks apart, starting about mid-summer when the new needles are full-grown.</td>
</tr>
<tr>
<td>Mancozeb, 80% WP</td>
<td>1½-2</td>
<td>Spray seedlings at 5-day intervals after emergence; continue to about July 1.</td>
</tr>
<tr>
<td>Maneb, 80% WP</td>
<td>1½-2</td>
<td></td>
</tr>
<tr>
<td>Chlorothalonil</td>
<td>See label</td>
<td></td>
</tr>
<tr>
<td>Daconil 2787</td>
<td>2½</td>
<td></td>
</tr>
<tr>
<td>Bravo 6F</td>
<td>2½ pts.</td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td>See label</td>
<td></td>
</tr>
<tr>
<td>Diplodia tip blight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Copper</td>
<td>See label</td>
<td></td>
</tr>
<tr>
<td>Benomyl, 50% WP</td>
<td>1</td>
<td>Spray as new growth appears in spring. Repeat at 2- to 3-week intervals until early July; then monthly until early September.</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Product</th>
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<th>Application Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benomyl, 50% WP</td>
<td>½-1</td>
<td>Apply 4 to 6 sprays, 10 to 14 days apart. Start when buds begin to open. Thorough coverage is required. Follow manufacturer's directions.</td>
</tr>
<tr>
<td>Zineb, 75% WP</td>
<td>1½-2</td>
<td></td>
</tr>
<tr>
<td>Maneb, 80% WP</td>
<td>1½-2</td>
<td></td>
</tr>
<tr>
<td>Mancozeb, 80% WP</td>
<td>1½-2</td>
<td></td>
</tr>
<tr>
<td>Dodine, 65%</td>
<td>See label</td>
<td></td>
</tr>
</tbody>
</table>

Sclerotodrris canker

<table>
<thead>
<tr>
<th>Product</th>
<th>Concentration</th>
<th>Application Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorothalonil</td>
<td>1½ qts.</td>
<td></td>
</tr>
</tbody>
</table>
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.

*Borax, 97% (dry, powdered)*  
Cover fresh cut stump surface immediately after falling tree. Sprinkle liberally and evenly.

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

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 seeding. Follow with 0.5 inch of water.

**PLANETREE**  
See Sycamore  
**PLUM**  
See Cherry  
**POPLAR**  
**Leaf rusts**  
Zineb, 75% WP  
2  
Spray about a week before rust is expected and again 10 to 14 days later.

Yellow leaf blister  
Zineb, 75% WP  
Mancozeb, 80% WP  
Manebe, 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  
1  
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  
Doddine, 65% WP  
½-1  
Spray 4 times: just before blossoms open, petal-fall, 2 weeks and 4 weeks later.

**QUINCE**  
Fire blight  
Bordeaux mixture  
2-6-100  
Spray when 20 to 25% of the blossoms are open; repeat when 75% of blossoms are open. Do not use streptomycin on quince.

**Rust, scab, fungus leaf spots**  
Manebe, 80% WP  
Mancozeb, 80% WP  
Ferbam, 76% WP  
Zineb, 75% WP  
½-2  
½-2  
2  
1½-2  
Apply several times at 10-day intervals starting at budbreak.

**REDBUD**  
Cercospora and other fungus leaf spots  
Captan, 50% WP  
Manebe, 80% WP  
2  
1½-2  
Zineb, 75% WP  
2  
Apply at budbreak and repeat several times at 10-day intervals during the spring rainy period.

**RHODODENDRON, AZALEA**  
Ovulinia petal or flower blight of azalea  
Benomyl, 50% WP  
Zineb, 75% WP  
Mancozeb, 80% WP  
Thiram, 65-75% WP  
1  
1  
1  
½-1  
Spray as flowers open. Then apply benomyl at 5-day intervals, zineb, mancozeb, and thiram 3 times weekly during the bloom period.

**Powdery mildew**  
Benomyl, 50% WP  
Sulfur, 95% WP  
Karathane, 22.5% WP  
Fungus leaf spots, rusts  
Zineb, 75% WP  
Manebe, 80% WP  
Mancozeb, 80% WP  
Benomyl, 50% WP  
Ferbam, 76% WP  
½-1  
3-6  
½-1  
½-1  
½-2  
½-2  
½-2  
½-1  
Spray several times at 7- to 10-day intervals. Start when disease first appears.

**Leaf, flower**  
½-1  
Spray several times at 7- to 10-day intervals. Start when new growth appears or right after bloom. Zineb, manebe, 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 cinamomoni 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
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
Folpet, 50% WP  1½-2
Karathane, 22.5% WP  1½-1
Sulfur, 95% WP  2-3
Acti-dione See label
Parinol See label
Piperalin See label
SERVICEBERRY,

SHADDBUSH
See Amelanchier

SPRUCE
See Pine

SUMAC
Fungus leaf spots
Maneb, 80% WP  1½-2
Sulfur, 95% WP  4-6

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
Caphafol 2 pts.
Zineb, 75% WP  1½-2
Powdery mildew
Benomyl, 50% WP
Sulfur, 95% WP  2-3
TAXUS
See Yew

VIBURNUM
Powdery mildew
Benomyl, 50% WP
Sulfur, 95% WP  1½
Karathane, 22.5% WP  ½

WALNUT,
BUTTERNUT
Anthracnose, yellow leaf blotch, fungus leaf spots or blights
Benomyl, 50% WP
Sulfur, 95% WP  1½
Karathane, 22.5% WP  ½

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 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, 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 Apply 2 oz./lb. of seed. If damping-off occurs, drench seedbed (4 T./gal.) when first seen. Follow label directions.
Captain, 50-75% WP
Mylan, 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% WP ½t./gal.
Benomyl, 50% WP
Sodium o-phenylphenate 2%

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 fungicidal 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 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.