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FUNGICIDE INVENTORY AND DISEASE CONTROL SPRAY PROGRAMS FOR WOODY ORNAMENTALS¹

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"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

Material and Common trade names	Uses and remarks
cycloheximide Acti-dione PM, Acti-dione TGF, Actispray	Antibiotic fungicide for controlling certain powdery mildews, rusts and turfgrass diseases. Plant injury may occur at high temperatures.
Bacticin Bacticin	For therapy of crown gall and olive knot by direct application (as
benomyl Benlate Benomyl Fungicide, Tersan 1991 Turf Fungicide, Bonide Benomyl (DuPont New Systemic Fungicide), Benomyl Turf Fungicide Granules, Rockland Benomyl Fungicide, Patterson's Systemic Fungicide, Science Benomyl Systemic Fungicide, Miller's Benomyl Systemic Fungicide, ProTurf Fertilizer Plus DSB Fungicide, Lignasan BLP	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., <i>Pythium</i> and <i>Phytophthora</i>) and rusts.
bordeaux mixture Acme and Patterson's Bordeaux Mixture, Copper Hydro Bordo, Bor-dox, Pratt Bordeaux Mix, Black Leaf Bordeaux Powder, Bordo Mixture	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.
Botran (dicloran) Botran	Useful in controlling Botrytis blights. Also controls certain storage molds, e.g., <i>Sclerotinia</i> , <i>Penicillium</i> , and <i>Rhizopus</i> .
captafol Difolatan 4 Flowable	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.

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captan

Captan 50-W and 80-W, Orthocide 50 Wettable, Captan 80% Wettable Powder, Captan 80 Spray-Dip, Captan Garden Spray

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.

chlorothalonil

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

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.

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

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.

(2) *basic chlorides*

Coprantol, 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, Copoloid, Citcop 4E, Carmel GH-41 Greenhouse Fogging

diazoben

Dexon

Soil and turf fungicide that controls *Pythium*, *Phytophthora*, and other water molds. Often mixed with PCNB for control of damping-off, seedling blights, and cutting rots. Light-sensitive.

dinocap

Karathane WD, Miller's Garden Karaspray

Powdery mildew fungicide and mite suppressant. May "scorch" foliage in hot weather.

dodine

Cyrex 65W Fruit Fungicide

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

ethazol

Terrazole, Truban, Koban

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 turf-grasses.

ferbam

Ferbam, Fermate Ferbam Fungicide, Carbamate, Karbam Black, Ferbam Fungicide

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.

folpet

Phaltan, Folpet, Rose and Garden Fungicide

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

mancozeb

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

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

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

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.

parinol

Parnon

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

PCNB

PCNB, Terraclor, Fungiclor, Pearson's Green Lawn Fungicide, Lawn Disease Control

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.

piperalin

Pipron

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

	Greenfield Rose and Ornamental Disease Control contains Pipron and maneb.	
Polyram Polyram	General protectant fungicide similar to mancozeb, maneb and zineb in range of effectiveness. Often combined with PCNB (Polyram PCNB Dust).	
streptomycin compounds Agrimycin 17, Ag-Strep, Streptomycin Spray, Agri-Strep, Phytomycin, Agri-mycin 100 and 500, Antibiotic Spray Powder, Streptomycin Wettable Powder	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).	
sulfur compounds (including liquid lime-sulfur) Sulfur, Magnetic, Sulfuron, Microfine, Corosul, Kolodust, Kolofog, Lime-Sulfur Solution	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.	
thiophanate compounds Topsin M, Zyban, Banrot, Cleary 3336, Chipco Spot Kleen, Fungo	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.	
thiram Tersan 75, Thiram, Thylate, Thiuram 75, Turftox, Arasan, Fungisan, Thiramad	General protectant fungicide for control of fungus leaf spots and blotches, scabs, rots, and rusts. Used as a seed protectant and turf fungicide. Arasan 42-S is also sold as a deer, rodent and bird repellent.	
zineb Dithane Z-78, Zineb, Zineb Garden Fungicide, Oxy Casonil, Black Leaf Sheen, Science Zineb Fungicide	General protectant fungicide for control of fungus leaf spots, blights and blotches, scabs, rots, rusts, and anthracnoses. Will not control powdery mildews.	

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

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

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

Plant & disease	Rate per 100 gal. Suggested fungicides (lbs.) ¹	Application and Remarks
ALDER Powdery mildew Benomyl, 50% WP Sulfur, 95% WP	1/2 2-3	Spray 2 or more times, 7 to 10 days apart. Start when disease first appears.
ALMOND See Cherry		
AMELANCHIER (Shadbush, Serviceberry, Juneberry)		
Cedar rusts Ferbam, 76% WP Thiram, 65-75% WP Zineb, 75% WP Mancozeb, 80% WP	2 1 1/2-2 1 1/2-2 1 1/2-2	Spray 3 times at 10-day intervals, starting when new growth appears in the spring.
APPLE See Crabapple		
ARBORVITAE Phomopsis needle and twig		

blight

Benomyl, 50% WP

1

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) ²
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

See label
1 1/2-2

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

1/2-1

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 lime-sulfur

See label
2 gal.

Spray once before buds swell in early spring.

Anthracnose

Copper
Zineb, 75% WP

See label
1 1/2-2

Spray twice, 10 to 14 days apart, starting at budbreak.

Rust

Zineb, 75% WP
Mancozeb, 80% WP

2
1 1/2-2

Spray several times at 10-day intervals. Start about a week before rust normally appears.

BUTTERSWEET

Powdery mildew

Benomyl, 50% WP

1/2-1

Make 2 or more weekly sprays. Start when disease first appears.

BOXELDER

See Maple

BOXWOOD

Canker, fungus leaf blights or spots

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.	Ethazol, 30-35% Diazoben	See label See label	Drench soil around roots at 14-day intervals during April-May and again in September-October.
Phytophthora root rot			CHERRY, PEACH, PLUM, AMOND, MAYDAY-TREE, CHERRY PLUM, CHERRY-LAUREL		
Ethazol, 30-35% Diazoben	See label See label	Apply as drench around plants to saturate the soil. Repeat at 4- to 12-week intervals during spring and autumn.	Black know Dodine, 65% WP		Spray as buds begin to swell. Repeat at pink bud, full bloom, 10 and 20 days later.
BUCKEYE See Horsechestnut			Zineb, 75% WP Mancozeb, 80% WP	1/2-1 1 1/2-2	
BUTTERNUT See Walnut			Ferbam, 76% WP	2	
BUTTONBUSH Powdery mildew			Benomyl, 50% WP	1/2-1	
Benomyl, 50% WP	1/2-1	Make several weekly sprays.	Brown rot, blossom and twig blight Benomyl, 50% WP	1/2-1	
Sulfur, 95% WP	2-3	Start when disease first appears.	Captan, 50% WP	2	Spray when first blossoms open, during full bloom, and again at petal-fall. Thorough coverage is required.
BUTTONWOOD See Sycamore			Sulfur, 95% WP	5-10	
CAMELLIA Sclerotinia flower blight			Leaf blister or curl, plum pockets, witches'-broom Captan, 50% WP	2	Spray <i>once</i> in late fall or just <i>before</i> buds swell in early spring. Dodine is cleared for use <i>only</i> on peaches for leaf leaf curl in the western states.
PCNB, 75% WP Benomyl, 50% WP	See label 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).	Liquid lime-sulfur Ferbam, 76% WP	2 gal.	
Sooty mold			Dodine, 65% WP	1/2-1	
Suggested insecticide		Sooty mold fungi grow in honeydew secreted by aphids, scale and other insects. Spray in spring and summer for insect control.	Copper	See label	
Phytophthora root rot			Coccomyces leaf spot, blight, or shot-hole Benomyl, 50% WP	1/2-1	Spray 3 or 4 times, 2 weeks apart. Start as buds are opening. Apply Acti-dione <i>only</i> to non-bearing cherry trees.
Ethazol, 30-35% Diazoben	See label See label	Apply as drench around plants to saturate the soil. Repeat at 4- to 12-week intervals during spring and autumn.	Dodine, 65% WP	1/2-1	
CATALPA Powdery mildew			Acti-dione Captan, 50% WP	See label 2	
Piperain Benomyl, 50% WP	1/4 1/2-1	Spray when disease first appears. Repeat 10 to 14 days later.	Perennial canker Ferbam, 76% WP	2	
Sulfur, 95% WP	2-3		Benomyl, 50% WP	1/2-1	
Fungus leaf spots			Powdery mildew Benomyl, 50% WP	1/2-1	Spray when mildew first appears. Repeat once or twice at 7- to 10-day intervals.
Copper	See label	If severe, spray when leaves are unfolding, leaves reach full size, and 2 weeks later.	Karathane,		
CHAMAECY-PARIS Phytophthora root rots (Pacific Northwest)					

22.5% WP	½	Apply Acti-dione <i>only</i> to non-bearing cherry trees.	80% WP	1½-2	
Sulfur, 95% WP	2-3		Polyram, 80% WP	1½-2	
Acti-dione PM	See label		WP	2	
Rust			Dikar, 80% WP	2	
Ferbam, 76% WP	2	Spray several times, about 10 days apart. Start about 2 weeks after petal-fall.	Folpet, 50% WP	1½-2	
Zineb, 75% WP	1½-2		Captafol	1½-2 pts.	
Scab, fungus leaf spots, shot-hole			Fire blight		
Benomyl, 50% WP	½-1	Spray about 3 times, 10 to 14 days apart, starting at petal-fall.	Streptomycin formulations	See label	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.
Sulfur, 95% WP	5-10		Copper	See label	
Captan, 50% WP	2				
Ferbam, 76% WP	2		Powdery mildew		
Zineb, 75% WP	1½-2		Benomyl, 50% WP	½-1	Spray when disease first appears or as leaves start to expand. Repeat 2 or 3 times, 10 apart.
CONIFERS			Sulfur, 95% WP	6-8	
See Pine			Karathane, 22.5% WP	½	
COTONEASTER			CRAPE-MYRTLE		
Fire blight			Fungus leaf spots or blotch, black spot, tip blight		
Streptomycin formulations	See label	Apply during bloom at 5- to 7-day intervals. Do <i>not</i> use streptomycin on <i>C. racemifolia</i> ; may substitute bordeaux if temperature is above 65 deg. F.	Copper	See label	Make several applications, 2 to 3 weeks apart. Start when new growth appears in the spring.
Bordeaux mixture	2-6-100		Zineb, 75% WP	1½-2	
Scab			Maneb, 80% WP	1½-2	
Benomyl, 50% WP	½-1	Apply in spring as buds start to swell and repeat 2 to 3 weeks later.	Mancozeb, 80% WP	1½-2	
Dodine, 65% WP	½-1		Powdery mildew		
Fungus leaf spots			Benomyl, 50% WP	½-1	Make several spring and autumn sprays. Start when disease is first seen. Apply lime-sulfur <i>once</i> , just as the buds are breaking open.
Maneb, 80% WP	1½-2	Spray several times 10 to 14 days apart. Commence at budbreak.	Karathane, 22.5% WP	½	
Zineb, 75% WP	1½-2		Sulfur, 95% WP	2-3	
CRABAPPLE, APPLE			Acti-dione PM	See label	
Cedar rusts			Lime-sulfur	See label	
(Apple, hawthorn, quince)			CURRENT, ALPINE		
Ferbam, 76% WP	2	Spray as new growth appears and flower buds start to open. Repeat 3 or 4 more times at 10-day intervals.	Anthracnose and fungus leaf spots		
Maneb, 80% WP	1½-2		Benomyl, 50% WP	½-1	Spray 2 or 3 times, 10 to 14 days apart. Start at leaf emergence or when leaves are nearly expanded.
Mancozeb, 80% WP	1½-2	Ferbam, 76% WP	2		
Thiram, 65-75% WP	1½-2		Maneb, 80% WP	1½-2	
Zineb, 75% WP	1½-2		Mancozeb, 80% WP	1½-2	
Polyram, 80% WP	1½-2		Zineb, 75% WP	1½-2	
Scab			CYPRESS		
Zineb, 75% WP	1½-2	Spray as new growth appears. Repeat 4 more times, 7 to 10 days apart. Thorough coverage of new growth is essential. Captafol (Difolatan 4F) is applied to apple and crabapple as a single application before bloom for control of primary scab. See label.	Coryneum blight, canker		
Benomyl, 50% WP	½-1		Bordeaux mixture	4-4-50	Apply in early spring and late fall at 7- to 10-day intervals.
Sulfur, 95% WP	6-8		DOGWOOD		
Dodine, 65% WP	½-1		Fungus leaf spot or blotch, anthracnose, spot anthracnose, flower		
Captan, 50% WP	2				
Maneb, 80% WP	1½-2				
Mancozeb,					

and leaf blight

Benomyl, 50% WP ½-1 Spray at budbreak and just before flower bracts are fully expanded. Repeat 2 or 3 more times about 2 weeks apart.

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

Powdery mildew

Benomyl, 50% WP ½-1 Spray when mildew first appears. Repeat 7 to 10 days later if needed.

Sulfur, 95% WP 2-3

DOUGLAS-FIR**Needle cast**

Copper See label Spray 3 or 4 times, 10 to 14 days apart. Start when new growth appears.

ELM**Anthracnose, black leaf spot, other fungus leaf spots, twig blight**

Sulfur, 95% WP 2-3 Spray 3 times, 10 to 14 days apart. Start when the leaf buds break open.

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

Methoxychlor + Lignasan BLP^{2A} See label 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.

Nectria canker

(Pacific Northwest) Copper See label Spray in October and 2 or 3 times in spring, starting when new growth appears.

EUONYMUS**Leaf spots**

Maneb, 80% WP 1½-2 Apply at budbreak or at first sign of disease. Spray 2 or 3

80 WP 1½-2 times at 7- to 10-day intervals.

Zineb, 75% WP 1½-2

Powdery mildew

Acti-dione PM See label Apply at first evidence of disease. Repeat at 7- to 10-day intervals.

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

Zineb, 75% WP 1½-2

Copper See label

GARDENIA**Canker**

Ferbam, 76% WP See label Mix ½ lb. of ferbam with 100 pounds of sand for cutting bed.

Leaf spots

Ferbam, 76% WP 1½ Spray cuttings and plants at 7- to 10-day intervals in wet weather.

Copper See label

Powdery mildew

Karathane, 22.5% WP ½ Apply at first sign of disease; repeat 2 or 3 times 7 to 10 days apart.

2

½

HAWTHORN,**RED HAW****Leaf blight or spots, scab,****other fungus****leaf spots**

Polyram, 80% WP 1½-2 Apply 4 sprays at 7- to 10-day intervals, starting as new growth appears. Extend the schedule during rainy seasons.

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

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

See label

Cedar rusts

Spray as new growth appears and flower buds start to open.

Repeat 3 or 4 times at 7- to 10-day intervals.

Maneb, 80% WP 1½-2

Mancozeb, 80% WP 1½-2

Chlorothalonil, 75% WP 1½-2

See label

Streptomycin formulations See label

Spray when 20 to 25% of blossoms are open and at 5-

times at 7- to 10-day intervals.

Repeat 3 or 4 times at 7- to 10-day intervals.

Spray when 20 to 25% of blossoms are open and at 5-

LAUREL

See

Mountain-laurel

LILAC**Powdery mildew**

Benomyl, 50% WP	½-1	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	4-6	
Karathane, 22.5% WP	½-1	

Bacterial and Phytophthora blights

Copper	See label	Spray 2 or 3 times at 7- to 10-day intervals. Start when new growth appears in spring.
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LINDEN,**BASSWOOD****Anthracnose, fungus leaf spots, leaf blight, spot anthracnose**

Copper	See label	Spray just after budbreak and again 10 and 20 days later.
Benomyl, 50% WP	½-1	

Powdery mildew

Benomyl, 50% WP	½-1	Spray when mildew first appears. Repeat 10 days later.
Sulfur, 95% WP	2-3	

MADRONE*(Arbutus)***Hendersonula canker**

Zineb, 75% WP plus	1	Spray when disease is first noticed and repeat 10 to 14 days later.
Ferbam, 76% WP	1	

Fungus leaf spots

Captan, 50% WP	2	Usually not needed except in rainy seasons. Apply several sprays at 7- to 10-day intervals.
Zineb, 75% WP	1½-2	

Maneb, 80% WP 1½-2

Mancozeb,

80% WP 1½-2

Thiram, 65-

75% WP 1½-2

Dodine, 65%

WP ½-2

MAGNOLIA**Powdery mildews**

Benomyl, 50% WP	½-1	Spray 2 or 3 times, 7 to 10 days apart. Start when disease first appears.
Acti-dione 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	1½-2	
Mancozeb, 80% WP	1½-2	

Maneb, 80% WP 1½-2

Nectria canker*(Pacific**Northwest)*

Copper	See label	Spray once in October and 2 or 3 times in spring starting when growth commences.
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MAYDAY-TREE

See Cherry

MOUNTAIN-ASH**Leaf blight, scab, fungus leaf spots**

Benomyl, 50% WP	½-1	Spray 2 to 4 times, 14 days apart, starting as the leaf buds open.
Mancozeb, 80% WP	1½-2	

Zineb, 75% WP 1½-2

Rust

Zineb, 75% WP	1½-2	Apply 4 or 5 sprays, 10 days apart, starting as flower buds open.
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Fire blight

Streptomycin formulations	See label	Spray when 20 to 25 percent of blossoms are open and again at full bloom.
Copper	See label	

MOUNTAIN-**LAUREL,****LAUREL***(Kalmia)***Fungus leaf spots, leaf blight**

Benomyl, 50% WP	1	Spray 3 times starting at budbreak. Repeat 10 and 20 days later.
Copper	See label	

Ferbam, 76%

WP 2

MULBERRY**Bacterial blight**

Bordeaux mixture	5-5-100	Apply at budbreak and repeat at 7-day intervals during moist periods.
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NEW JERSEY**TEA***(Ceanothus)***Powdery mildew**

Benomyl, 50% WP	½-1	Make several sprays 7 to 10 days apart. Start when disease appears.
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OAK**Anthracnose, fungus leaf spots and**

**and blights,
spot
anthracnose,
leaf blotch,
leaf blister**

Copper	See label	Spray 3 times: just <i>before</i> buds open, when leaves are half grown, and 10 to 14 days later.
Zineb, 75% WP	1½-2	
Captan, 50% WP	2-4	
Benomyl, 50% WP	1	
Dodine, 65% WP	1	
Mancozeb, 80% WP	1½-2	
Oak Wilt 2,4,5-T ³	4 lbs. a.i./ gal. oil	

Metham (Vapam Soil Fumigant)	See label	Soil treatment when disease first appears to prevent transmission to healthy oaks by root grafts. Follow label directions.
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PEACH

See Cherry

PEAR

Fire blight

Streptomycin formulations	See label	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.
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Scab

Several fungicides	See Scab under Crab-apple.
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Leaf spot

Benomyl, 50% WP	½-1	Spray 2 or 3 times, 10 days apart, starting at budbreak.
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 scorch,

spot

anthracnose,

anthracnose

Benomyl, 50% WP	½-1	Apply 4 to 6 sprays, 10 to 14 days apart. Start when buds begin to open. Thorough coverage is required. Follow manufacturer's directions.
Zineb, 75% WP	1½-2	
Maneb, 80% WP	1½-2	
Mancozeb, 80% WP	1½-2	
Dodine, 65%		

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

Powdery

mildew

Benomyl, 50% WP	½-1	Spray when mildew is first seen. Repeat at 10- to 14-day intervals.
Du-Ter, 47.5% WP	¼-½	

PHOTINIA

Powdery

mildew

Benomyl, 50% Wp	½-1	Spray several times at 10- to 14-day intervals. Start when new leaf growth or disease first appears.
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.
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Scirrhia brown

spot needle

blight

Copper	See label	Spray once or twice, 30 days apart, starting when new needles are half-grown. If rainy, spray at 2-week intervals.
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	Spray 4 times, 2 to 3 weeks apart, starting about mid-summer when the new needles are full-grown.
Maneb, 80% WP	1½-2	
Chlorothalonil		
Daconil 2787	2½	
Bravo 6F	2½ pts.	
Copper	See label	

Diplodia

tip blight

Copper	See label	Spray twice, 10 to 14 days apart. Start as buds open.
Benomyl, 50% WP	1	

Fusiform rust

(nurseries in southern states)

Ferbam, 76% WP	2	Spray seedlings at 5-day intervals after emergence; continue to about July 1.
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Scleroderma

canker

Chlorothalonil		Spray as new growth appears in spring. Repeat at 2- to 3-week intervals until early July; then monthly until early September.
Bravo 6F	1½ qts.	

Sirococcus 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% 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.
PCNB See label

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 2 Apply several weekly sprays when spots first appear on the lower leaves.
Mancozeb, 80% WP 2
Maneb, 80% WP 2

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

Anthraxnose, leaf spot, twig blight

Ferbam, 76% WP 2 Spray several times at 10-day intervals, starting in mid-spring.
Benomyl, 50% WP 1

PYRACANTHA
(Firethorn)

Fire blight

Streptomycin formulations See label Spray when 20 to 25% of blossoms are open and repeat at 5- to 7-day intervals during bloom.
Copper See label

Scab

Benomyl, 50% WP 1
Folpet, 50% WP 2
Dodine, 65% WP ½-1

QUINCE

Fire blight

Bordeaux mixture 2-6-100 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 1½-2 Apply several times at 10-day intervals starting at budbreak.
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 Apply at budbreak and repeat several times at 10-day intervals during the spring rainy period.
Maneb, 80% WP 1½-2
Zineb, 75% WP 2

REDCEDAR

See Juniper

RED HAW

See Hawthorn

RHODODENDRON, AZALEA

Ovulinia petal or flower blight of azalea

Benomyl, 50% WP ½ Spray as flowers open. Then apply benomyl at 5-day intervals, zineb, mancozeb, and thiram 3 times weekly during the bloom period.
Zineb, 75% WP 1
Mancozeb, 80% WP 1
Thiram, 65-75% WP 1

Powdery mildew

Benomyl, 50% WP ½-1 Spray several times at 7- to 10-day intervals. Start when disease first appears.
Sulfur, 95% WP 3-6
Karathane, 22.5% WP ½-1

Fungus leaf spots, rusts

Zineb, 75% WP 1½-2 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.
Maneb, 80% WP 1½-2
Mancozeb, 80% WP 1½-2
Benomyl, 50% WP ½-1
Ferbam, 76% WP ½-1
Leaf, flower ½-1

and stem gall

Zineb, 75% WP 1½ Spray just *before* budbreak and continue as for Fungus leaf spots.
 Ferbam, 76% WP 2

Bud and twig blight, dieback

Copper See label Make 3 sprays, 7 to 10 days apart, starting at budbreak.

Root and crown rot or wilt

(*Phytophthora cinnamomi* and other fungi)

Ethazol, See label Apply as drench around plants
 30-35% See label to saturate the soil. Repeat at
 Diazoben See label at 4- to 12-week intervals during spring and autumn.

Cutting rot

Benomyl, 50% WP Mix 1 part benomyl with 39 parts of root-inducing hormone powder by weight. Treat cutting ends with mixture before "sticking" in rooting medium. Then drench soil as for Root and crown rot or wilt (above).
 Ethazol, 30-35% See label Apply as for Root and crown rot or wilt (above).

ROSE**Botrytis blight**

Benomyl, 50% WP ½ Apply to flowers at 7- to 10-day intervals during moist weather.

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 Spray at 7- to 10-day intervals, starting when new growth appears. Shorten spray interval to 5 or 7 days during rainy weather.
 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 Spray at 7- to 10-day intervals, starting when new growth appears. Thorough coverage
 Folpet, 50% WP 1½-2 Thorough coverage is required
 Karathane, 22.5% WP ½-1
 Sulfur, 95% WP 2-3

Acti-dione See label
 Parinol See label
 Piperalin See label

SERVICEBERRY,**SHADBUSH**

See Amelanchier

SPRUCE

See Pine

SUMAC**Fungus****leaf spots**

Maneb, 80% WP 1½-2 Apply when disease is first seen. Repeat as needed at 7-
 Sulfur, 95% WP 4-6 to 10-day intervals during wet periods.

SYCAMORE, PLANETREE, BUTTONWOOD Anthracnose⁴, fungus leaf spots, leaf blight

Benomyl, 50% WP 1 Spray 3 times, 10 days apart, starting *just before* budbreak.
 Copper See label Thorough coverage is required
 Mancozeb, 80% WP 1½-2
 Maneb, 80% WP 1½-2
 Dodine, 65% WP 1
 Captafol 2 pts.
 Zineb, 75% WP 1½-2

Powdery mildew

Benomyl, 50% WP ½-1 Spray 2 or 3 times, 7 to 10 days apart, starting when disease first appears.
 Sulfur, 95% WP 2-3

TAXUS

See Yew

VIBURNUM**Powdery mildew**

Benomyl, 50% WP ½-1 Spray 2 or more times, 7 to 10 days apart. Start when disease first appears. Some viburnums are sensitive to sulfur.
 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 Spray 3 or 4 times at 2-week intervals, starting when the leaves begin to unfold. Thorough coverage is required.
 Dodine, 65% WP ½-1
 Zineb, 75% WP 1½-2
 Mancozeb, 80% WP 1½-2
 Maneb, 80% WP 1½-2

Bacterial blight

(of Persian or English walnut)

Copper See label Spray 3 times: when flowering starts, at full bloom, and at petal-fall.
 Streptomycin See label formulations

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.
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WITCH HAZEL

Powdery mildew

Benomyl, 50% WP	½-1	Spray 2 or more times, 7 to 10 days apart. Start when disease appears.
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YEW (*Taxus*)

Phytophthora root rot

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

Twig blight

Bordeaux mixture	4-4-100	Apply when new growth emerges. Repeat twice more at 7- to 10-day intervals.
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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%	
Benomyl, 50% WP	½t./gal.	
Sodium o-phenylphenate	2%	

²Copper fungicides include bordeaux mixture (usually 4-4-100 or 8-8-100) and fixed or neutral copper compounds.

^{2A}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.

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

¹The rates given are based on hydraulic application. If using a mistblower, follow label directions.

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.

Cook, D.I. and D.F. Van Haverbeke. 1976. **Residential traffic noise control using three-shrub-barrier combinations.** p. 112-116. *In* Shelterbelts on the Great Plains. Proc. Symp. Denver, Colo., Apr. 1976, Great Plains Agric. Council. Publ. 78, 218 p.

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.