

## Control of Ornamental Diseases

Chuan Hong, Extension Plant Pathologist, Hampton Roads AREC

A home garden is a unique ecosystem, completely different from an ornamental nursery. Making a beautiful home garden does not necessarily mean having to spray fungicides on a preventive schedule as most nurserymen do. Instead, disease control can be achieved in most home gardens by using the following preventive strategies: (1) grow relatively disease-free plant species, (2) select resistant ornamental varieties, (3) buy healthy plant materials from accredited nurseries and garden centers, (4) fertilize and irrigate plants as needed to grow strong plants, (5) remove diseased and dead plants and plant parts (leaves, shoots, etc.) from the garden regularly to reduce disease pressure to the minimum, and (6) use biorational products such as detergents and essential oils to control powdery mildews. The application of fungicides should be considered as a last option and fungicide labels must be followed carefully when chemical control is performed. Fungicides also should be used based on disease diagnosis because some fungicides may work for a specific group of diseases but not others. In addition, repeated use of the same chemical may induce the target pathogen to develop fungicide resistance. Thus, we highly recommend alternating different mode-of-action products when possible.

### Index of Ornamental Plants and Their Diseases

The index is arranged alphabetically by the scientific name of host plant with its common name in parenthesis if different. Diseases that are common and usually require control treatments are in italics.

- Abies (Fir)** Botrytis blight, Cytospora canker, oedema, *Phytophthora root/crown rot*
- Acer (Maple)** *Anthracnose*, bacterial scorch, bacterial wetwood, *Botrytisphaeria dieback*, Cytospora canker, Ganoderma root rot, leaf spot, Nectria canker, Phomopsis dieback, *purple-eye leaf spot*, tar spot, Valsa canker, *Verticillium wilt*, *zonate leaf spot*
- Aconitum (Monkshood)** Southern blight
- Aegopodium (Goutweed)** leaf spot
- Aesculus (Buckeye)** Guignardia blotch
- Agave (Century plant)** crown rot
- Ageratum (Floss flower)** Southern blight
- Ailanthus (Tree-of-heaven)** Fusarium stem/root rot
- Ajuga (Bugleweed)** Phomopsis dieback, *Phytophthora root rot*, *Pythium root rot*, Rhizoctonia root/crown rot, root knot nematode, *Southern blight*, viral disease, web blight
- Albizia (Mimosa)** Fusarium wilt
- Alcea (Hollyhock)** root knot nematode, *rust*
- Amelanchier (Service berry)** rust, Entomosporium leaf spot
- Anemone** foliar nematode, *Phytophthora root rot*
- Antirrhinum (Snapdragon)** *Cercospora leaf spot*, downy mildew, *Phytophthora root/crown rot*, *Pythium root rot*, Rhizoctonia stem rot, *rust*, *Verticillium wilt*, viral diseases
- Aquilegia (Columbine)** *Pythium root rot*
- Arctostaphylos (Bearberry)** *Pythium root rot*, *Phytophthora root rot*
- Arisaema (Jack-in-the-pulpit)** rust
- Armeria (Sea thrift)** web blight
- Aronia (Chokeberry)** *Pythium root rot*
- Artemisia (Dusty miller)** Rhizoctonia root/stem rot
- Asclepias (Milkweed)** anthracnose
- Asclepias tuberosa (Butterfly weed)** Rhizoctonia stem rot
- Aster** *powdery mildew*, rust
- Astilbe** *Pythium root rot*
- Aucuba** anthracnose, *Botrytisphaeria dieback*, leaf spot, Phomopsis dieback, ring nematode
- Bamboo** *Pythium root rot*
- Bedding plants** damping-off
- Begonia** anthracnose, Botrytis blight, Fusarium stem rot, *powdery mildew*, *Rhizoctonia root/stem rot*, root knot nematode
- Berberis (Barberry)** *Phytophthora root rot*
- Bergenia** *Pythium root rot*
- Betula (Birch)** *anthracnose*, *Botrytisphaeria dieback*, Botrytis blight, red heart, Septoria leaf spot

## 4-2 Home Ornamentals: Control of Ornamental Diseases

- Buddleia (Butterfly bush)** Phytophthora root rot, Rhizoctonia root rot  
**Buxus (Boxwood)** Botrytisphaeria dieback, *boxwood decline*, lesion nematode, Macrophoma leaf spot, volutella blight  
**Cactus** Pythium root rot  
**Caladium** Pythium root rot  
**Calibrachoa (Million bells)** Phytophthora crown rot, Rhizoctonia root rot, Southern blight  
**Calocedrus (Incense cedar)** Seiridium canker  
**Camellia** anthracnose, Botrytisphaeria dieback, *leaf/flower gall*, leaf spot, oedema, *petal/flower blight*, *Phytophthora root rot*, Pythium root rot, viral disease  
**Campanula (Bellflower)** Fusarium crown rot  
**Campsis (Trumpet vine)** anthracnose  
**Canna (Canna lily)** lesion nematodes, Pythium root rot  
**Carpinus (Hornbeam)** Pythium root rot  
**Carya (Hickory)** downy leaf spot, Gnomonia leaf spot, phomopsis gall, powdery mildew, zonate leaf spot  
**Caryopteris (Bluebeard)** Phytophthora stem/root rot, Pythium root rot  
**Catalpa** bacterial wetwood, *Verticillium wilt*  
**Catharanthus (Madagascar periwinkle)** black root rot, Botrytis blight, *Phytophthora blight*, Pythium root rot, Rhizoctonia stem/root rot  
**Cattleya (Orchid)** bacterial brown spot  
**Cedrus (Cedar)** Armillaria root rot, *Phomopsis needle/twig blight*  
**Celosia (Cockcomb)** Pythium root rot, Rhizoctonia root rot  
**Cercis (Redbud)** Botrytisphaeria dieback, botrytis blight, Fusarium canker, leaf spot, *Verticillium wilt*  
**Chamaecyparis (Falsecypress)** Phytophthora root rot, Seiridium canker, web blight  
**Chionanthus (Fringe tree)** leaf spot  
**Chrysanthemum (Daisy)** *Pythium root rot*, web blight  
**Chrysogonum (Goldenstar)** Southern blight  
**Cladastris (Yellow wood)** anthracnose  
**Clematis** leaf spot, Phytophthora root rot  
**Clivia (Kaffir lily)** leaf spot, Southern blight  
**Coleus** Botrytis blight, downy mildew  
**Consolida (Larkspur)** Pythium root rot, Rhizoctonia crown/root rot  
**Coreopsis (Tickseed)** Botrytis blight, Rhizoctonia root/stem rot, rust, viral disease  
**Cornus (Dogwood)** *anthracnose*, Armillaria root rot, Botrytisphaeria dieback/canker, *Botrytis blight*, *Discula anthracnose*, Fusarium canker, leaf spot, phomopsis dieback, *powdery mildew*, Pythium root rot, *Septoria leaf spot*, *spot anthracnose*, viral disease  
**Corylus (Filbert)** eastern filbert blight  
**Cosmos (Mexican aster)** Botrytis blight, Phomopsis stem canker, powdery mildew, white smut  
**Cotinus (Smoke bush)** anthracnose, *Verticillium wilt*  
**Cotoneaster** leaf spot, Phytophthora root rot, web blight  
**Crassula (Jade plant)** oedema, Pythium root rot  
**Crataegus (Hawthorn)** Cercospora leaf spot, *Entomosporium leaf spot*, rust  
**Cryptomeria (Japanese cedar)** needle blight, *Phomopsis twig blight*, Phytophthora root rot  
**Cupressocyparis (Leyland Cypress)** phytophthora root rot  
**Cupressus (Cypress)** Botrytisphaeria dieback, Kabatina dieback, tip blights, Phytophthora root rot, *Seiridium canker*  
**Cyclamen** Fusarium wilt  
**Cymbidium (Orchid)** viral disease  
**Dahlia** crown gall, *powdery mildew*  
**Daphne** anthracnose, Phytophthora root/stem rot  
**Davidia (Dove tree)** Phomopsis dieback  
**Delosperma (Ice plant)** Pythium root rot  
**Dendranthema (Chrysanthemum)** bacterial leaf spot, *Botrytis blight*, *Mycosphaerella ray blight*, Phytophthora root rot, *powdery mildew*, *Pythium root/stem rot*, Rhizoctonia root rot, *Septoria leaf spot*, *leaf rust*, *Verticillium wilt*  
**Dianthus (Carnation)** *Alternaria leaf spot*, *Botrytis blight*, Fusarium stem rot, *powdery mildew*, Rhizoctonia stem rot, rust  
**Digitalis (Foxglove)** black root rot, Fusarium root rot, Pythium root rot  
**Dracaena** Fusarium blight, Pythium root rot

- Echinacea (Coneflower)** aster yellows, foliar nematodes, Pythium root rot, viral disease  
**Elaeagnus (Autumn olive)** Phytophthora root rot  
**Epiphyllum (Cereus)** oedema  
**Epipremnum (Pothos)** Phytophthora stem rot  
**Erica (Heather)** Phytophthora root rot  
**Eucalyptus** anthracnose, Botrytisphaeria dieback, crown gall, Fusarium canker, Phomopsis dieback, *Phytophthora root rot*, powdery mildew, Pythium root rot  
**Euonymus** *powdery mildew*  
**Euphorbia (Spurge)** anthracnose, Botrytisphaeria dieback canker  
**Euphorbia pulcherima (Poinsettia)** bacteria blight, bacterial leaf spot, Botrytis blight, *powdery mildew*, *Pythium root rot*, scab  
**Eustoma (Lisianthus)** Botrytis blight, Fusarium root/stem rot  
**Exacum (Persian violet)** viral disease  
**Fagus (Beech)** anthracnose, Botrytisphaeria canker, Hypoxylon canker, viral disease  
**Fatsia** leaf spot  
**Ficus (Fig)** anthracnose, Phytophthora root rot  
**Ficus benjamina (Weeping fig)** anthracnose, Phomopsis gall  
**Forsythia** Botrytisphaeria dieback, crown gall, Phomopsis gall, Phytophthora root rot, ringer nematodes, Sclerotinia twig blight, web blight  
**Fraxinus (Ash)** *anthracnose*, ash yellows, Botrytisphaeria canker, *rust*  
**Gaillardia (Blanket flower)** *Pythium root rot*, white smut  
**Galium (Sweet woodruff)** Rhizoctonia stem/root rot, Southern blight  
**Gardenia** anthracnose  
**Gerbera (African daisy)** Pythium root rot  
**Gladiolus** *Botrytis leaf blight*, *Curvularia leaf blight*, *Fusarium yellows*, *Penicillium corm rot*, Rhizoctonia corm rot  
**Gleditsea (Honeylocust)** Botrytisphaeria canker, Thyronectria canker  
**Gloxinia (Sinningia)** viral disease  
**Gomphrena (Globe amaranth)** leaf spot  
**Gypsophila (Baby's breath)** bacterial soft rot  
**Hamamelis (Witchhazel)** Botrytisphaeria dieback, leaf spot, powdery mildew  
**Hedera helix (English ivy)** anthracnose, bacterial leaf spot, oedema, Phyllosticta leaf spot, Phytophthora root rot, Pythium root rot, Rhizoctonia root rot  
**Helianthemum (Rock rose)** Botrytis blight  
**Helianthus (Sunflower)** Alternaria leaf/stem spot  
**Helichrysum (Strawflower)** Fusarium stem rot  
**Helleborus (Hellebore)** black leaf spot, Botrytis blight, Pythium root rot, Rhizoctonia root rot, Southern blight  
**Hemerocallis (Daylily)** anthracnose, *rust*, *leaf streak*, Southern blight  
**Heuchera (Coral bells)** Pythium root rot  
**Hibiscus** *Phytophthora root rot*, Pythium root rot, viral disease  
**Hibiscus syriacus (Rose-of-Sharon)** leaf spot  
**Hosta** *anthracnose*, Botrytis blight, leaf spot, root rot, *soft rot*, *Southern blight*, virus X  
**Hydrangea** anthracnose, Armillaria root rot, bacterial leaf spot, *Botrytis blight*, Cercospora leaf spot, *Phytophthora root rot*, *Pythium root rot*, *powdery mildew*  
**Hypericum (St Johnswort)** Phytophthora stem/root rot, *rust*, Rhizoctonia root rot  
**Iberis (Candytuft)** anthracnose, Pythium root rot  
**Ilex (Holly)** *anthracnose*, bacterial blight, *black root rot*, Botrytisphaeria dieback, leaf spot, root knot nematodes, oedema, Phomopsis dieback, *Phytophthora root rot*, Pythium root rot, Rhizoctonia root rot, *rust*, tar spot, web blight  
**Ilex glabra (Inkberry)** *black root rot*, *Phytophthora root rot*  
**Impatiens** *Alternaria leaf spot*, bacterial fasciation, Botrytis blight, *Fusarium crown rot*, *powdery mildew*, *Pythium root/stem rot*, Rhizoctonia root/stem rot, root knot nematodes, Verticillium wilt, viral diseases  
**Ipomoea (Morning glory)** rust, white rust  
**Iris** *Botrytis blight*, *Heterosporium leaf spot*, *soft rot*  
**Juniperus (Juniper)** Kabatina tip blight, Pestalotia dieback, *Phytophthora root rot*, Pythium root rot, *rust*  
**Juniperus virginiana (Eastern red cedar)** Cercospora blight, Kabatina tip blight, Pestalotia blight, *Phomopsis tip blight*, *rust*

#### 4-4 Home Ornamentals: *Control of Ornamental Diseases*

**Kalmia (Mountain laurel)** Botryspaeria dieback, *Cercospora leaf spot*  
**Lagerstroemia (Crape myrtle)** leaf spot, *powdery mildew*, sooty mold  
**Lamiastrum (Yellow archangel)** Rhizoctonia root/stem rot, Southern blight  
**Laurus nobilis (Bay laurel)** Cercospora leaf spot  
**Lavandula (Lavender)** Phytophthora root rot, Pythium root rot  
**Leucothoe (Drooping leucothoe)** Botryspaeria dieback, Cylindrocladium leaf spot, Phyllosticta leaf spot, Phytophthora root rot  
**Lewisia** soft rot  
**Liatris (Gayfeather)** Sclerotinia stem rot  
**Ligustrum (Privet)** anthracnose, Cercospora leaf spot, Phytophthora root rot  
**Lilium (Lily)** anthracnose, Botrytis blight, Pythium root rot  
**Limonium (Statice)** Phytophthora root rot, Pythium root rot, Rhizoctonia root rot  
**Liquidambar (Sweet gum)** Cercospora leaf spot, Endothia canker, Sphaeropsis gall  
**Liriodendron (Tulip tree)** powdery mildew  
**Liriope (Lilyturf)** anthracnose, foliar nematodes, Mycosphaerella leaf spot, Phytophthora root rot, viral disease  
**Lobelia** Pythium root rot, viral disease  
**Lobularia (Sweet alyssum)** Rhizoctonia stem rot  
**Lonicera (Honeysuckle)** Botryspaeria dieback, Botrytis blight, *Herpobaisidium leaf blight*, powdery mildew  
**Lupinus (Lupine)** anthracnose, brown spot, Pythium root rot  
**Lysimachia (Loosestrife)** Rhizoctonia root/stem rot, *Southern blight*  
**Magnolia** bacterial leaf spot, *powdery mildew*  
**Malus (Crabapple)** Coniothyrium leaf spot, *fire blight*, *frog-eye leaf spot*, *powdery mildew*, *rust*, *scab*  
**Malva (Mallow)** rust  
**Metasequoia (Dawn redwood)** *Dothiorella canker*, needle blight  
**Microbiota decussata (Russian arborvitae)** Phytophthora root rot  
**Morus (Mulberry)** berry blight  
**Myosotis (Forget-me-not)** web blight  
**Myrica (Bayberry)** Botryspaeria dieback, Phytophthora root rot  
**Myrica cerifera (Waxmyrtle)** anthracnose, Botryspaeria dieback, Phytophthora root rot, Septoria leaf spot  
**Nandina (Heavenly bamboo)** Cercospora leaf spot, Phytophthora root rot, Pythium root rot  
**Nelumbo (Water lily)** Cercospora leaf spot  
**Nerium oleander (Oleander)** bacterial gall  
**Nyssa sylvatica (Black gum)** anthracnose, Botryspaeria dieback, leaf spot  
**Ocimum basilicum (Basil)** Alternaria leaf spot, Fusarium root rot  
**Oenanthe javanica (Water celery)** Fusarium crown rot  
**Ophiopogon (Mondo grass)** anthracnose  
**Oxalis (Wood sorrel)** rust  
**Oxydendrum arboreum (Sourwood)** leaf spots  
**Pachysandra** leaf spot, Pythium root rot, Southern blight, *Volutella blight*  
**Paeonia (Peony)** Botrytis blight, Cercospora leaf spot, *Cladosporium leaf/stem blotch*, Rhizoctonia root rot  
**Parthenocissus (Boston ivy)** Phyllosticta leaf spot  
**Paxistima** Phytophthora root rot  
**Pelargonium (Geranium)** bacterial blight, bacterial leaf spot, bacterial wilt, *Botrytis blight*, oedema, *Pythium root rot/black-leg*, Rhizoctonia root rot, *rust*, viral disease  
**Petunia** Botrytis blight, *Fusarium root/crown rot*, *Phytophthora root/crown rot and foliage blight*, *Pythium root/crown rot*, Rhizoctonia root/stem root, viral disease  
**Phalaris (Canarygrass)** web blight  
**Phlox** bacterial leaf spot, black root rot, Colletotrichum stem canker, *powdery mildew*, Pythium root rot, southern blight, viral disease, web blight  
**Photinia (Japanese photinia red-tip)** bacterial blight, Botryspaeria canker, *Entomosporium leaf spot*, *powdery mildew*, Armillaria root rot  
**Physocarpus (Ninebark)** powdery mildew, Rhizoctonia root rot  
**Picea (Spruce)** Cytospora canker, Phytophthora root rot, Pythium root rot, needle blight, tip blight  
**Pieris (Japanese pieris)** Botryspaeria dieback, Phomopsis canker, Phytophthora root rot

- Pinus (Pine)** Armillaria root rot, Atropellis twig canker, Cenangium dieback, Cytospora canker, *Diplodia tip blight*, Dothistroma needle blight, Eastern gall rust, Fusiform rust, needle cast, needle rust, Phacidiopycnis canker, Phytophthora root rot, *pine-wood nematodes*
- Pistacia (Pistache)** Verticillium wilt
- Platanus (Sycamore)** anthracnose, bacterial scorch, Botryphaeria dieback, *powdery mildew*
- Platycodon (Balloon flower)** Rhizoctonia crown rot
- Polygonatum (Solomon seal)** Penicillium rot
- Populus (Poplar)** Botryphaeria canker, leaf spot
- Portulaca (Purslane)** Rhizoctonia stem rot
- Potentilla (Cinquefoil)** foliar nematodes
- Pratia** Southern blight
- Prunus (Flowering apricot/cherry/peach/plum)** bacterial blossom blight, bacterial leaf spot, bacterial shot hole, bacterial scorch, black knot, blossom blight/brown rot, *Cytospora canker*, Nectria canker, peach leaf curl, Phomopsis canker, white rot
- Prunus laurocerasus (Cherry laurel)** anthracnose, bacterial leaf spot, bacterial shot hole, Botryphaeria dieback, Phomopsis dieback, leaf spots, Phytophthora root rot, Pythium root rot, zonate leaf spot
- Pseudotsuga (Douglas fir)** Botryphaeria canker, Swiss needle cast
- Pyracantha (Firethorn)** Botryphaeria dieback, *fire blight*, Phomopsis dieback, *scab*
- Pyrus calleryana (Flowering pear)** Botryphaeria canker, Entomosporium leaf spot, *fire blight*, rust
- Quercus (Oak)** anthracnose, Armillaria root rot, bacterial scorch, *bacterial wetwood*, Botryphaeria canker, Cydrocladium root rot, Discula anthracnose, Hypoxylon canker, *leaf blister*, Phomopsis dieback, *powdery mildew*, rust, smooth patch, spot anthracnose, *Tubakia leaf spot*
- Ranunculus (Buttercup)** bacterial blight, web blight
- Rhaphiolepis (Indian hawthorn)** Entomosporium leaf spot
- Rhododendron (Azalea)** anthracnose, Armillaria root rot, *Botryphaeria dieback*, Botrytis blight, *Cercospora leaf spot*, Colletotrichum leaf spot, *leaf and flower gall*, lesion nematodes, oedema, Pestalotia leaf spot, *petal blight*, Phomopsis dieback, Phyllosticta leaf spot, *Phytophthora dieback*, *Phytophthora root/stem rot*, *powdery mildew*, *web blight*
- Rosa (Rose)** anthracnose, *black spot*, Botryphaeria dieback, Botrytis blight, *crown gall*, *downy mildew*, Phomopsis canker, *powdery mildew*, Pythium root rot, rose rosette disease, viral disease
- Rosmarinus (Rosemary)** Botrytis blight, crown gall, *Phytophthora root rot*, Pythium root rot
- Rudbeckia (Black-eyed Susan)** Pythium root rot, Rhizoctonia stem rot, *Septoria leaf spot*, downy mildew
- Salix (Willow)** Armillaria root rot, *Botryphaeria dieback*, Botrytis blight, black canker, Cercospora leaf spot, *crown gall*, rust, scab, white rot
- Salvia** bacterial leaf spot, downy mildew, Pythium root rot, Rhizoctonia stem rot
- Santolina (Lavender cotton)** Rhizoctonia root rot
- Scabiosa (Pincushion flower)** Botrytis blight
- Schefflera (Umbrella tree)** oedema, Pythium root rot
- Schlumbergera (Thanksgiving cactus)** oedema, Pythium root rot
- Sedum (Stone crop)** anthracnose, bacterial soft rot, bacterial stem rot, Diplodia stem rot, leaf spot, Phytophthora stem rot, Pythium root rot, Rhizoctonia root/stem rot, root knot nematodes, web blight
- Sequoia (Redwood)** Cercospora needle blight, Phomopsis needle blight
- Setcreasia (Purple heart)** leaf spot
- Solidago (Goldenrod)** rust
- Spiraea** leaf spot
- Styrax (Silverbell)** leaf spots
- Syngonium (Nepthytis)** bacterial leaf spot
- Syringa (Lilac)** anthracnose, *bacterial blight*, *Botrytis blight*, Cercospora leaf spot, *Phytophthora root rot*, *powdery mildew*
- Tagetes (Marigold)** Alternaria blight, Botrytis blight, crown gall, Fusarium stem/root rot, Pythium root rot, Rhizoctonia stem rot
- Taxus (Yew)** Botryphaeria dieback, *Phytophthora root rot*
- Teucrium (Germander)** Rhizoctonia root rot, Southern blight
- Thuja (Arborvitae)** Armillaria root/stem rot, *Cytospora canker*, Kabatina tip blight, *Phomopsis twig/needle blight*, *Phytophthora root rot*, Pythium root rot, Seiridium twig canker, web blight
- Thymus (Thyme)** Pythium root rot
- Tilia (Linden)** spot anthracnose, white rot

## 4-6 Home Ornamentals: Control of Ornamental Diseases

**Tradescantia virginica (Spiderwort)** Southern blight  
**Tsuga (Hemlock)** Armillaria root rot, damping-off, rust  
**Tulipa (Tulip)** *Botrytis blight*, Fusarium basal rot  
**Ulmus (Elm)** *bacterial wetwood*, *bacterial leaf scorch*, Botryospheria canker, Cytospora canker, *Dutch elm disease*, *Verticillium wilt*  
**Verbena (Vervain)** *powdery mildew*, Pythium root rot  
**Veronica (Speedwell)** Phytophthora root rot  
**Viburnum (Snowball bush)** spot anthracnose, bacterial scorch, Botryospheria dieback, Botrytis blight, phoma leaf spot, Phytophthora root rot, Rhizoctonia root rot  
**Vinca minor (Periwinkle)** oedema, *Phoma dieback*, *Phomopsis dieback*, Phyllosticta stem rot/leaf spot, Pythium root rot, Rhizoctonia root/stem rot, Southern blight  
**Viola (Pansy)** anthracnose, *black root rot*, *Botrytis blight*, Cercospora leaf spot, *Phytophthora root/crown rot*, *Pythium root/crown rot*  
**Weigela** Phytophthora root rot, Pythium root rot  
**Wisteria** Botryospheria dieback  
**Xanthoceras sorbifolium (Yellowhorn)** Botrytis blight  
**Yucca** bacterial soft rot, Mycosphaerella leaf spot  
**Zephyranthes (Rain lily)** *anthracnose*  
**Zinnia** *Alternaria blight*, bacterial leaf spot, Botrytis stem canker, *powdery mildew*, Pythium root rot

**Table 4.1 - General Guideline for Fungicide Selection**

Disease	Common Name	Trade Name	Manufacturer
<b>Oomyceteous diseases</b>			
Phytophthora root rot	Fosetyl-Al	Monterey Aliette	Monterey
Pythium root/crown rot	Phosphorous acid	AGRI-FOS	Monterey
Downy mildew	Fosetyl-Al	Monterey Aliette	Monterey
Phytophthora blight/ dieback	Phosphorous acid	AGRI-FOS	Monterey
	Copper hydroxide	Copper Fungicide	Hi-Yield
	Copper salts	LIQUI-COP	Monterey
		Liquid Copper Fungicide	Bonide
		Copper Fungicide	Dragon
<b>Fungal</b>			
Black root rot	Thiophanate-methyl	Halt Systemic Fungicide	Ferti-lome
Cylindrocladium root rot		Lawn Fungus Control	Scotts
		Systemic Fungicide	Green Light
		Systemic Fungicide 3336 WP	Dragon
Rhizoctonia root/stem rot	Pentachloronitrobenzene	Turf & Ornamental Fungicide	Hi-Yield
Sclerotinia root rot		Terraclor	Southern Agriculture
Southern blight			Insecticides
Botrytis blight	Thiophanate-methyl	Halt Systemic	Ferti-lome
Diplodia tip blight		Lawn Fungus Control	Scotts
		Systemic Fungicide	Green Light
Kabatina dieback		Systemic Fungicide 3336 WP	Dragon
Phomopsis dieback			
Phomopsis needle blight			
Sclerotinia stem rot			
Tip blight			

**Table 4.1 - General Guideline for Fungicide Selection (cont.)**

Disease	Common Name	Trade Name	Manufacturer	
<b>Fungal (cont.)</b>				
Powdery mildew	Potassium bicarbonate	Remedy	Bonide	
		Sulfur	Garden Fungicide	Safer
	Sulfur	Sulfur 90W	Monterey	
		Sulfur Plant Fungicide	Bonide	
		Wettable Dusting Sulfur	Hi-Yield	
		Wettable or Dusting Garden Sulfur	Dragon	
		Neem oil	Powdery mildew killer Ready To Use	Green Light
	Neem oil	Triple Action Ready-To-Use	Ferti-lome	
		Joboba oil	E-Rase RTU	Monterey
	Myclobutanil	Myclobutanil	F-Stop Lawn Fungicide	Ferti-lome
			Fung-Away systemic Granules	Green Light
			Immunox 3-in-1	Spectracide
			Immunox Fungicide	
			Immunox Lawn Disease Spray	
			Immunox Lawn Disease Control Granules	
			Immunox Multi-Purpose Fungicide	
			Immunox Plus Insect and Disease Control	
Triforine	Triforine	Rose Pride – Rose & shrub Disease Control	Ortho	
		Orthenex-Garden Insect & Disease Control		
Rust	Myclobutanil	F-Stop Lawn Fungicide	Ferti-lome	
		Fung-Away systemic Granules	Green Light	
		Immunox 3-in-1	Spectracide	
		Immunox Fungicide		
		Immunox Lawn Disease Spray		
		Immunox Lawn Disease Control Granules		
		Immunox Multi-Purpose Fungicide		
		Immunox Plus Insect and Disease Control		
	Triadimefon	Triadimefon	Fung-Away Fungicide	Green Light
			Fung-Away Systemic Lawn Spray	
			Fung-Away Systemic Lawn Spray	
Hose-End Concentrate				
Triadimefon	Triadimefon	Lawn Fungicide Granules	Hi-Yield	

## 4-8 Home Ornamentals: Control of Ornamental Diseases

**Table 4.1 - General Guideline for Fungicide Selection (cont.)**

Disease	Common Name	Trade Name	Manufacturer	
<b>Fungal (cont.)</b>				
Rust (cont.)	Triforine	Rose Pride – Rose & Shrub Disease Control	Ortho	
		Orthenex-Garden Insect & Disease Control		
	Tebuconazole	Disease Control for Roses, Flowers, and Shrubs	Bayer	
		All-In-One Rose and Flower Care		
Alternaria leaf spot	Propiconazole	Infuse	Bonide	
Anthracnose		Lawn Disease Control	Ortho	
Black spot (rose)	Chlorothalonil	Liquid Systemic Fungicide	Ferti-lome	
Cercospora leaf spot		Broad Spectrum Liquid Fungicide	Ferti-lome	
Curvularia leaf blight		Daconil	Hi-Yield	
Cylindrocladium leaf spot		Daconil 2787	Dragon	
Entomosporium leaf spot		Fungicide Disease Control	Garden Tech	
Gnomonia leaf spot		Fung-Onil Multi-Purpose Fungicide	Bonide	
Heterosporium,		Garden Disease Control	Ortho	
Leaf streak (daylily)		Multipurpose Fungicide	Tiger Brand	
Macrophoma leaf spot	Mancozeb	Mancozeb Disease Control	Dragon	
Mycosphaerella leaf spot		Mancozeb Flowable	Bonide	
Phyllosticta leaf spot		Maneb	Maneb Garden Fungicide	Hi-Yield
Purple-eye leaf spot	Captan	Captan	Bonide	
Scab		Captan Wettable Powder	Dragon	
Septoria leaf spot	Copper hydroxide	Copper Fungicide	Hi-Yield	
Spot anthracnose	Copper salts	LIQUI-COP	Monterey	
Volutella blight		Liquid Copper Fungicide	Bonide	
Web blight		Copper Fungicide	Dragon	
Zonate leaf spot		Thiophanate-methyl	Halt Systemic	Ferti-lome
Leaf/flower gall	Chlorothalonil	Lawn Fungus Control	Scotts	
		Systemic Fungicide	Green Light	
		Systemic Fungicide 3336 WP	Dragon	
		Tebuconazole	Disease Control for Roses, Flowers, and Shrubs	Bayer
		All-In-One Rose and Flower Care		
		Broad Spectrum Liquid Fungicide	Ferti-lome	
		Daconil	Hi-Yield	
		Daconil	Garden Tech	
		Daconil 2787	Dragon	
		Fungicide Disease Control	Garden Tech	
Fung-Onil Multi-Purpose Fungicide	Bonide			
Garden Disease Control	Ortho			
Multipurpose Fungicide	Tiger Brand			
	Tebuconazole	Advanced Garden Disease Control	Bayer	

**Table 4.1 - General Guideline for Fungicide Selection (cont.)**

Disease	Common Name	Trade Name	Manufacturer
<b>Fungal (cont.)</b>			
Leaf/flower gall (cont.)	Mancozeb	Mancozeb Disease Control	Dragon
		Mancozeb	Bonide
Flower/petal blight	Myclobutanil	F-Stop Lawn Fungicide	Ferti-lome
		Fung-Away systemic Granules	Green Light
		Immunox 3-in-1	Spectracide
		Immunox Fungicide	
		Immunox Lawn Disease Spray	
		Immunox Lawn Disease Control Granules	
		Immunox Multi-Purpose Fungicide	
		Immunox Plus Insect and Disease Control	
	Chlorothalonil	Broad Spectrum Liquid Fungicide	Ferti-lome
		Daconil	Hi-Yield
		Daconil	Garden Tech
		Daconil 2787	Dragon
		Fungicide Disease Control	Garden Tech
		Fung-Onil Multi-Purpose Fungicide	Bonide
Garden Disease Control	Ortho		
<b>Bacterial</b>			
Fire blight	Copper	Copper Spray or Dust	Bonide
	Copper hydroxide	Copper Fungicide	Hi-Yield
	Copper salts	LIQUI-COP	Monterey
Soft rot		Liquid Copper Fungicide	Bonide
		Copper Fungicide	Dragon
	Copper oxinate	Copper Soap	Concern
	Fosetyl-Al	Monterey Aliette	Monterey
	Streptomycin sulfate	Fire Blight Spray	Bonide Ferti-lome
Crown gall	Purchase healthy plants		
<b>Nematode</b> - No nematicide available for homeowner use.			
<b>Viral</b> - No chemicals for control of viral diseases.			



## **Diseases of Landscape Trees**

*Mary Ann Hansen, Extension Plant Pathologist, Virginia Tech*

Many landscape tree diseases can be managed effectively by cultural control methods and/or with fungicides or other chemicals. Trees should be maintained in the best possible vigor by a regular fertilization and watering program as needed to help prevent disease from occurring. (See Additional Comments 1 and 2 at the end of this section.) Fungicides should be used only when a destructive disease is a known threat. Few diseases require regular spray schedules on a yearly basis. For example, anthracnose control should be elected during prolonged damp weather in late winter and early spring. Most fungicides are designed primarily to be protective; that is, they must be applied before the fungus is deposited on the plant surface to prevent infection. They are ineffective when applied to established lesions. Fungicides should be re-applied when washed off by rain following their application. The addition of a spreader (surfactant)-sticker to the fungicide suspension often enhances disease control.

Pruning may be used either as a horticultural practice or for removing diseased or dead plant tissues. The disinfecting of tools used in these activities cannot be overemphasized. Many disease organisms are spread by careless workers who do not use disinfectants. Pruning tools should be dipped between cuts in rubbing alcohol or in a household bleach solution made by combining 1 part of bleach and 9 parts of water; the solution is more effective when a little soap is added as a wetting agent. A wound paint or spray, preferably one fortified with a disinfecting agent, may then be applied. Recent research indicates that wound paint preparations may not be effective in excluding wood-rotting organisms (see Additional Comment 3 at the end of this section); they may, however, be helpful in preventing infection by certain canker-causing organisms. In all cases, diseased tree parts of all kinds (whole trees, limbs, leaves, etc.) should be removed and, if possible, burned or buried. This eliminates or reduces the source of inoculum.

Many decline problems are attributable directly to 1) chemical exposure (spillage of toxicants near roots or growth of roots into soil treated with soil-sterilant herbicides, de-icing salts, excessive rates of turf herbicides, excessive rates of fertilizer, etc.); 2) mechanical injury (building, sidewalk or driveway construction, lawnmower injury at tree base, etc.); 3) poor cultural practices (deep planting, pruning, or mulching method; inadequate or excessive soil moisture or fertilizer; lack of winter protection; etc.); and 4) girdling roots. Girdling roots, especially ones that partially girdle the trunks, have been recognized as a major cause of landscape tree decline. Often the problem with an abnormally shaped root system starts in the nursery and is magnified over time after the tree is transplanted to the landscape. Trees purchased from nurseries should be carefully examined for depth of flare roots and for encircling roots before transplanting. Trees that were already planted too deeply in the nursery should have excess soil removed and/or be planted higher in the planting hole. Encircling roots should be loosened or severed to prevent continued circular growth after transplanting.

Trees weakened by the above stresses are predisposed to attack by pathogens that normally are of little or no consequence. Insect attack is also commonly observed in declining landscape trees, and some species serve as vectors or carriers of important pathogens. Therefore, in the control of landscape tree diseases, one should seriously consider a total maintenance program.

Many problems of landscape trees can be prevented by proper selection of planting materials. Competent horticultural counsel should be sought and considered at the planning stage; resistance to diseases, pests, and other stresses should be involved in all decision-making during the landscape design planning process. It is often wise to use as many native trees as possible, since native species often have more resistance to endemic pathogens than exotic species. Refer to electronic fact sheets on problem-free trees and shrubs for Virginia at the following websites: <http://www.ext.vt.edu/pubs/plantdiseasefs/450-237/450-237.html> and <http://www.ext.vt.edu/pubs/plantdiseasefs/450-236/450-236.html>.

## 4-12 Home Ornamentals: Diseases of Landscape Trees

**Table 4.2 - Fungicide Use**

Tree And Disease	Fungicide, Rate, and Remarks
<b>Ash</b> ( <i>Fraxinus</i> ) Anthracnose ( <i>Gloeosporium</i> )	Apply fungicide sprays at label rates, beginning at budbreak or first sign of disease. Collect and either burn or bury fallen leaves to reduce overwintering of inoculum. Fungicide options include: <ul style="list-style-type: none"> <li>• Chlorothalonil (Daconil Weather Stik, Daconil Ultrex, Fertilome Landscape &amp; Garden Fungicide): repeat at 7- to 14-day intervals.</li> <li>• Chlorothalonil + thiophanate methyl (Spectro 90 WDG): repeat at 7- to 21-day intervals.</li> <li>• Mancozeb (Dithane DF Rainshield, Mancozeb DG, Dithane T/O Rainshield, Pentathlon LF, or Protect T/O): repeat at 7- to 10-day intervals.</li> <li>• Thiophanate methyl (Cleary 3336, Fertilome Halt): repeat applications at 7- to 14-day intervals. Rotation with other products is recommended to prevent resistance development in the pathogen population.</li> <li>• Thiophanate methyl + mancozeb (Zyban WSB): repeat at 7-day intervals.</li> </ul>
Ash Rust ( <i>Puccinia</i> )	By the time symptoms are noticed, control is generally not warranted. However, if fungicide control is desired, application of the following fungicides at label rates can be made in early spring: <ul style="list-style-type: none"> <li>• Mancozeb (Dithane DF Rainshield, Mancozeb DG, Dithane T/O Rainshield, Pentathlon LF, or Protect T/O): repeat at 7- to 10-day intervals.</li> <li>• Myclobutanil (Eagle 40WP, Eagle 20EW, Systhane WSP): repeat applications at 10- to 14-day intervals. Rotation with other products is recommended to prevent resistance development in the pathogen population.</li> <li>• Thiophanate methyl (Cleary 3336, Fertilome Halt): repeat applications at 7- to 14-day intervals. Rotation with other products is recommended to prevent resistance development in the pathogen population.</li> </ul>
<b>Beech</b> ( <i>Fagus</i> ) and <b>Birch</b> ( <i>Betula</i> ) Anthracnose	Follow directions for anthracnose of ash.
Canker (various fungi)	Prune affected branches below the canker and destroy cankered branches by burning or burying.
<b>Buckeye</b> ( <i>Aesculus</i> ) Leaf Spot and Blotch ( <i>Guignardia</i> )	Same as for control of anthracnose of ash.
<b>Catalpa</b> ( <i>Catalpa</i> ) Verticillium Wilt ( <i>Verticillium</i> )	Verticillium wilt on this and other tree species is normally not manageable with fungicides. Some research has shown that high-nitrogen applications will aid in recovery; specific recommendations cannot be made, and personal discretion must be followed. Replace trees that have died from this disease with immune species. See comments for Verticillium wilt of maple.
<b>Cherry</b> ( <i>Prunus</i> ) Cankers (various fungi)	Ornamental cherries are susceptible to a variety of fungal canker diseases and, for that reason, may not be the best choice for landscape plantings. Symptoms include swollen, sunken, or cracked areas on the bark. Dieback occurs above the canker. Fungicides are generally not effective for control of canker diseases. Pruning out affected branches below cankers back to healthy wood is the only recommended control. If cankers occur on the trunk, trees cannot be saved.
<b>Chestnut</b> ( <i>Castanea</i> ) Canker ( <i>Cryphonectria</i> )	Excise cankers at least 1 inch beyond visibly stained bark tissues. A fungicide-amended wound dressing applied to the wound may be helpful in disease control. See Additional Comment 3 at the end of this section.

**Table 4.2 - Fungicide Use (cont.)**

Tree And Disease	Fungicide, Rate, and Remarks
<b>Crabapple (<i>Malus</i>)<sup>1</sup></b> Cedar-apple Rust ( <i>Gymnosporangium juniperi-virginianae</i> )	Apply fungicides at label rates, beginning at budbreak or first sign of disease. Fungicide options include: <ul style="list-style-type: none"> <li>· Mancozeb (Dithane DF Rainshield, Mancozeb DG, Dithane T/O Rainshield, Pentathlon LF, or Protect T/O): repeat at 7- to 10-day intervals.</li> <li>· Myclobutanil (Eagle 40WP, Eagle 20EW, Systhane WSP): repeat applications at 10- to 14-day intervals. Rotation with other products is recommended to prevent resistance development in the pathogen population.</li> <li>· Thiophanate methyl (Cleary 3336, Fertilome Halt): repeat applications at 7- to 14-day intervals. Rotation with other products is recommended to prevent resistance development in the pathogen population.</li> <li>· Thiophanate methyl + mancozeb (Zyban WSB): repeat applications at 14-day intervals.</li> <li>· Trifloxystrobin (Compass): repeat applications at 7- to 14-day intervals.</li> <li>· Bacillus subtilis (Serenade, Rhapsody): repeat applications at 3- to 7-day intervals.</li> </ul>
Fire Blight ( <i>Erwinia</i> )	Prune out affected branches at least 6 inches below discolored wood and destroy or bury. It is best to prune in late summer when bacteria are no longer active. Disinfest pruning tools with rubbing alcohol or a solution of 1 part bleach to 9 parts water between cuts. Spray a registered copper product at label rates; use only one spray before budbreak. Alternatively, spray streptomycin (Agrimycin 17 or Fertilome Fire Blight Spray) at label rates, using no more than 5 applications, starting at 20% to 30% bloom, every 10 to 14 days. Serenade or Rhapsody can also be used for fire blight control. See instructions under cedar-apple rust.
Powdery Mildew ( <i>Podosphaera</i> )	Apply fungicides at label rates, beginning at budbreak or first sign of disease. Fungicide options include: <ul style="list-style-type: none"> <li>· Chlorothalonil (Daconil Weather Stik, Daconil Ultrex, Fertilome Landscape &amp; Garden Fungicide): repeat applications at 7- to 14-day intervals. Applications made during bloom may damage flowers.</li> <li>· Jojoba oil (E-Rase): make repeated applications when new mildew infections are observed.</li> <li>· Myclobutanil (Eagle 40WP, Eagle 20EW, Systhane WSP): repeat applications at 10- to 14-day intervals. Rotation with other products is recommended to prevent resistance development in the pathogen population.</li> <li>· Neem oil (Garden-Safe Fungicide): repeat applications at 7- to 14-day intervals.</li> <li>· Potassium bicarbonate (First Step, Remedy): repeat applications at 7- to 10-day intervals.</li> <li>· Sulfur (Lilly Miller Sulfur Dust, Sulfur Dust, Sulfur Plant Fungicide): repeat at 5 to 10-day intervals.</li> <li>· Thiophanate methyl (Cleary 3336, Fertilome Halt): repeat applications at 7- to 14-day intervals. Rotation with other products is recommended to prevent resistance development in the pathogen population.</li> <li>· Thiophanate methyl + mancozeb (Zyban WSB): repeat applications at 7-day intervals.</li> <li>· Trifloxystrobin (Compass): repeat applications at 7- to 14-day intervals.</li> <li>· Bacillus subtilis (Serenade, Rhapsody): repeat applications at 3- to 7-day intervals through second cover.</li> </ul>
Scab ( <i>Venturia</i> )	Apply fungicides at label rates, beginning at budbreak or first sign of disease. Fungicide options include: <ul style="list-style-type: none"> <li>· Mancozeb (Dithane DF Rainshield, Mancozeb DG, Dithane T/O Rainshield, Pentathlon LF, or Protect T/O): repeat at 7 to 10-day intervals.</li> <li>· Myclobutanil (Eagle 40WP, Eagle 20EW, Systhane WSP): repeat applications at 10- to 14-day intervals. Rotation with other products is recommended to prevent resistance development in the pathogen population.</li> <li>· Thiophanate methyl (Cleary 3336, Fertilome Halt): repeat applications at 7- to 14-day intervals. Rotation with other products is recommended to prevent resistance development in the pathogen population.</li> <li>· Thiophanate methyl + mancozeb (Zyban WSB): repeat applications at 7-day intervals.</li> <li>· Bacillus subtilis (Serenade, Rhapsody): repeat applications at 7- to 10-day intervals.</li> </ul>

<sup>1</sup> Many cultivars of crabapple are available, and many have resistance to one or more of the diseases listed here. When planting new cultivars, choose ones with resistance to as many of these diseases as possible.

## 4-14 Home Ornamentals: Diseases of Landscape Trees

**Table 4.2 - Fungicide Use (cont.)**

Tree And Disease	Fungicide, Rate, and Remarks
<b>Conifers</b> Needle Casts (various fungi)	<p>Collect and either bury or burn fallen twigs and needles in autumn. Needle casts are caused by many different fungi. Generally, a broad-spectrum fungicide, applied at label rates in a series of applications as needles are emerging in the spring, will adequately control needle-cast fungi.</p> <ul style="list-style-type: none"> <li>• Calcium hydroxide + copper sulfate (Bordeaux mixture): apply when new growth starts, as needles emerge from the sheath, and when needles are 2/3 mature length.</li> <li>• Chlorothalonil (Daconil Weather Stik, Daconil Ultrex, Fertilome Landscape &amp; Garden Fungicide): for most needle cast diseases, an application at budbreak, followed by applications at 3- to 4-week intervals until needles are fully elongated, will control the disease.</li> <li>• Copper hydroxide (Cupro 2005 T/N/O, Kocide 2000 T/N/O): apply at first sign of disease and repeat at 7- to 14-day intervals. Copper hydroxide should NOT be tank mixed with Aliette or phytotoxicity may occur. The spray solution should also have a pH of &gt;6.5 to avoid phytotoxicity.</li> <li>• Mancozeb (Dithane DF Rainshield, Mancozeb DG, Dithane T/O Rainshield, Pentathlon LF, or Protect T/O): begin applications in spring or early summer and repeat after heavy rains and at 2-week intervals.</li> </ul>
<b>Dawn Redwood</b> <i>(Metasequoia)</i> Dothiorella Canker <i>(Dothiorella)</i>	<p>Prune affected branches below the canker and destroy cankered branches by burning or burying.</p>
<b>Dogwood</b> <i>(Cornus)</i> Bacterial Wetwood (various bacteria)	<p>See elm section.</p>
Discula Anthracnose <i>(Discula destructiva)</i>	<p>This disease develops rapidly and may kill the tree. It is especially serious at cool temperatures, high moisture, higher elevations, and near water sources. Understory trees are more prone to attack. Plant landscape trees in full sun. Trees should be maintained carefully, employing the best management procedures: mulching, watering, fertilizing with a balanced NPK formulation, removing suckers (water sprouts), and avoiding lawnmower injuries, etc. Fungicide applications appear to be essential in high-hazard areas. (See options below.) Propiconazole (Banner Maxx) fungicide is the preferred fungicide. Breeding efforts are ongoing, but to date only one cultivar with resistance to Discula anthracnose has been developed ('Appalachian Spring'). This cultivar does NOT have resistance to another serious disease of dogwood, powdery mildew. The kousa dogwood (<i>Cornus kousa</i> = Korean, Chinese, or Japanese) is resistant but not immune to Discula anthracnose; however, it may harbor fungal inoculum that can perpetuate the disease cycle on flowering dogwoods. Hybrids of kousa and flowering dogwood with varying levels of resistance to both Discula anthracnose and powdery mildew are also available ('Stellar' series).</p> <p>Apply fungicides at label rates, beginning at budbreak or first sign of disease. Fungicide options include:</p> <ul style="list-style-type: none"> <li>• Chlorothalonil (Daconil Weather Stik, Daconil Ultrex, Fertilome Landscape &amp; Garden Fungicide): repeat applications at 7- to 14-day intervals.</li> <li>• Mancozeb (Dithane DF Rainshield, Mancozeb DG, Dithane T/O Rainshield, Pentathlon LF, Protect T/O): repeat applications at 7- to 10-day intervals.</li> <li>• Neem oil (Garden Safe Fungicide): repeat applications at 7- to 14-day intervals.</li> <li>• Propiconazole (Banner Maxx, Fertilome Liquid Systemic Fungicide, Fungonil Lawn &amp; Garden Disease Control): repeat applications at 14- to 28-day intervals.</li> </ul>
Powdery Mildew <i>(Oidium)</i>	<p>Although powdery mildew diseases of many plant species are primarily a cosmetic problem, powdery mildew of dogwood can severely stunt the tree. Cultivars of both flowering dogwood and kousa dogwood with resistance to powdery mildew are available. For fungicide control, see the fungicide list under powdery mildew of crabapple.</p>

**Table 4.2 - Fungicide Use (cont.)**

Tree And Disease	Fungicide, Rate, and Remarks
Septoria Leaf Spot ( <i>Septoria</i> )	<p>Septoria leaf spot generally occurs in late summer and control is usually not warranted. If the disease occurs earlier in the season, the following fungicides can be used for control, beginning at the first sign of disease:</p> <ul style="list-style-type: none"> <li>• Azoxystrobin (Heritage): repeat applications at 7- to 28-day intervals. Follow label instructions on the total number of sprays allowed per season to avoid fungicide resistance in the pathogen population.</li> <li>• Chlorothalonil (Daconil Weather Stik, Daconil Ultrex, Fertilome Landscape &amp; Garden Fungicide): repeat at 7- to 14-day intervals.</li> <li>• Copper hydroxide (Kocide 2000 T/N/O, Cupro 2005 T/N/O): repeat applications at 7- to 14-day intervals. See notes about phytotoxicity under needle casts of conifers.</li> <li>• Mancozeb (Dithane DF Rainshield, Mancozeb DG, Dithane T/O Rainshield, Pentathlon LF, Protect T/O): repeat at 7- to 10-day intervals.</li> <li>• Myclobutanil (Eagle 40WP, Eagle 20EW, Systhane WSP): repeat applications at 10- to 14-day intervals. Rotation with other products is recommended to prevent resistance development in the pathogen population.</li> <li>• Thiophanate methyl (Cleary 3336, Fertilome Halt): repeat applications at 7- to 14-day intervals. Rotation with other products is recommended to prevent resistance development in the pathogen population.</li> <li>• Thiophanate methyl + mancozeb (Zyban WSB): repeat at 7-day intervals.</li> </ul>
Spot Anthracnose ( <i>Elsinoe corni</i> )	<p>This disease is a distinct disease from <i>Discula</i> anthracnose. Spot anthracnose is not fatal to the tree. It is present to some degree every year, but is more severe in wet springs. Spots are tiny and don't enlarge. The fungus attacks leaves and "flowers" (bracts) but not branches. Sanitation, i.e. removal of fallen leaves, may help if the tree is isolated. Fungicides can also be used for control. Apply one of the following fungicides at label rates beginning when buds begin to open. Repeat three times: when bracts have fallen, four weeks after bract fall, and in late summer after flower buds form.</p> <ul style="list-style-type: none"> <li>• Chlorothalonil (Daconil Weather Stik, Daconil Ultrex, Fertilome Landscape &amp; Garden Fungicide)</li> <li>• Mancozeb (Dithane DF Rainshield, Mancozeb DG, Dithane T/O Rainshield, Pentathlon LF, Protect T/O)</li> <li>• Thiophanate methyl + mancozeb (Zyban WSB)</li> </ul>
<b>Douglasfir</b> ( <i>Pseudotsuga</i> )	
Swiss Needle Cast ( <i>Phaeocryptopus</i> )	See control recommendations for needle casts of conifers.
<b>Elm</b> ( <i>Ulmus</i> ) Bacterial Leaf Scorch ( <i>Xylella</i> )	<p>A bacterial disease limited to the xylem (wood), causes leaf scorch, a slow decline, and ultimately tree death. Means of spread and disease control are currently under investigation. Leafhoppers and treehoppers are known vectors; however, insecticides have not proven effective in control. Preliminary research has indicated that micro-injections of OTC (oxytetracycline) are helpful in symptom remission; however, OTC does not cure the tree of the bacteria and is generally not a practical control measure for most homeowners. Pruning out affected branches on trees that are not yet severely affected may help slow disease progression. Branches should be pruned back as far as possible. The bacterium has a wide host range, but some trees not known to be affected include linden, black gum, buckeye, zelkova, willow oak (other oaks are very susceptible), hackberry, tulip tree, and maples other than red maple. These species can be considered as replacement trees.</p>

**Table 4.2 - Fungicide Use (cont.)**

Tree And Disease	Fungicide, Rate, and Remarks
Bacterial Wetwood (Slime Flux) (various bacteria)	Bacterial wetwood is a condition that typically does not cause serious harm to the tree. Many tree species, including elm, oak, dogwood, and probably most other hardwood species, can be affected; conifers are sometimes affected. Often a rancid or stinky odor emanates from affected tissue due to fatty acids produced by a complex of microorganisms. Generally, the external signs on bark include vertical light or dark streaks with seeping liquids, wet or dried when observed. The word "wetwood" is derived from the wet appearance of cross-sections of affected wood. This disease really has no practical management either preventively or therapeutically, although some have drilled holes at oblique angles with or without insertion of copper pipes to allow alleviation of built-up pressure and drainage of the flux away from the bark in affected areas. Stinging insects or other pests that are sometimes attracted to the fluxing sites may need to be controlled. Fluxing in oak trees may become more severe in trees that have undergone high stress situations (climatic extremes) and may disappear when such stressors are gone. Note: In oaks, bacterial wetwood is sometimes confused with Ramorum blight, which is not currently known to occur in Virginia. See section on OAK.
Black Leaf Spot ( <i>Gnomonia</i> )	Collect and either burn or bury fallen leaves. Mancozeb (=Dithane T/O Rainshield, Dithane DF Rainshield, or Mancozeb DG) at label rates may be applied at budbreak and 1 to 2 times thereafter at 10- to 14-day intervals.
Dutch Elm Disease (DED) ( <i>Ophiostoma novo-ulmi</i> )	<p><b>An integrated program</b> for susceptible elms is strongly recommended in American elm trees for maximum protection against DED. PREVENTION is the critical key to disease management. This integrated program consists of (1) sanitation—prompt removal and destruction of diseased trees by burning or burial, (2) chemical or mechanical severance of root graft unions between diseased and healthy trees, and (3) prompt removal at the trunk of individual branches with new and restricted (5% or less of crown involvement) beetle-transmitted infections. Systemic fungicides have undergone preliminary trials for prevention and cure of DED. Even though promising results have been reported following applications in preventive (before contraction of disease) and curative (after contraction of disease) situations, research has not adequately revealed the (1) degree and completeness of disease control, (2) extent of translocation within the sapwood and therefore extent of internal protection of therapy, (3) residual life, (4) optimum dosage per individual trees of varying sizes and configurations, and related information. In high hazard situations where fungicide injection is the only recourse available for disease management, injection is elected for use. Injections are made in flare roots. When administered to symptomatic elms, systemic fungicides should be applied in American elm trees <b>before</b> the removal of diseased branches (radical surgery as a supplemental component). Treatment administered after crown involvement exceeds 5% may not be effective. Virginia Cooperative Extension recommends the administration only of scientifically proven systemics as a component part of its integrated DED control package, as outlined herein, <b>but not as a substitute for it</b>. These compounds are to be used by trained arborists or others acquainted with the identification of DED and injection techniques.</p> <p>1. 3-Year Treatment For Preventive and Therapeutic Management of DED: Inject 12.0 fl oz thiabendazole (Arbotect 20-S) in 6.0 gal of water for each 5 inches of trunk diameter. Inject into any exposed root flares, as near to the ground as possible, once every 3 years. The maximum diameter of the injection holes should be about 1/4 inch. 1-1/2 to 2 injection holes (ports) per inch of trunk diameter are recommended. Do not use this treatment if trees are less than 10 inches in diameter. When a tree shows more than 5% crown symptoms, treatment may not be effective. Treatment should be used in conjunction with an insect control and sanitation program (pruning of diseased limbs) in order to obtain best results. Be sure to flush injection holes with water following fungicide injection; several liters are desirable. This promotes faster and better wound closure.</p> <p>2. Propiconazole (Alamo), also registered for use on Dutch elm disease, has shown remarkable preventive and curative properties. For macroinjection or infusion, Alamo should be used preventively at the rate of 6-10 ml/ DBH inch or curatively at the rate of 10-20 ml/DBH inch or whatever is indicated on the current label. Label dosages for prevention and therapy should be followed. Dilution in water can be variable.</p>

**Table 4.2 - Fungicide Use (cont.)**

Tree And Disease	Fungicide, Rate, and Remarks
Dutch Elm Disease (DED) ( <i>Ophiostoma novo-ulmi</i> ) (cont.)	<p>Frequency of Alamo treatment required is not clearly known at this time, but research indicates that the 6-ml rate should protect trees for 24 months; the 10-ml rate for 36 months. Curative treatments should be repeated every 12-36 months. Also, we emphasize that preventive injection is much preferable to therapeutic (curable) injection; extent of disease can often be misinterpreted or underestimated on the basis of percentage of crown symptoms. Severely affected trees may not respond to treatment. Alamo is also registered for use in microinjectors. Injectors are placed on flare roots. Injection holes should be flushed with water as previously mentioned for Arbotect or any other injectant.</p> <p><b>Please Note:</b> New products, including EPA-registered fungicides, for the control of Dutch elm disease appear occasionally on the market. Many of them have not been tested objectively and scientifically in reputable laboratories where rigid standards of evaluation are employed. Beware of products not tested or recommended by Virginia Cooperative Extension. It is important to inquire if doubts arise.</p>
<p><b>Hawthorn</b> (<i>Crataegus</i>) Cedar-quince Rust (<i>Gymnosporangium clavip</i>)</p>	<p>Spray with chlorothalonil (Daconil Weather Stik, Daconil Ultrex), azoxystrobin (Heritage), or chlorothalonil + thiophanate methyl (Spectro 90 WDG) at label rates at pre-bloom stage. Sprays applied after bloom are not effective for this disease.</p>
<p><b>Hickory</b> (<i>Carya</i>) Leaf Spot (<i>Microstroma</i>)</p>	<p>Collect and either burn or bury diseased leaves. Fungicides generally are not warranted.</p>
<p><b>Honeylocust</b> (<i>Gleditsia</i>) Cercospora Leaf Spot (<i>Cercospora</i>)</p>	<p>See fungicide recommendations for Septoria leaf spot of dogwood.</p>
<p><b>Horse Chestnut and Buckeye</b> (<i>Aesculus</i>) Leaf Blotch and Other Leaf Spots (<i>various fungi</i>)</p>	<p>Same as for control of anthracnose of ash.</p>
<p><b>Leyland Cypress</b> (<i>x Cupressocyparis leylandii</i>) Canker (<i>Seiridium</i>, <i>Botryosphaeria</i>)</p>	<p>Trees are predisposed to these diseases by drought stress. In some cases, decline can be reversed in the early stages of disease by alleviating water stress with adequate irrigation. Prune out affected branches below cankers (look for cracked, swollen or sunken bark with resin droplets) and remove or destroy them by burning or burying. Dip pruning tools in rubbing alcohol or a solution of 1 part bleach to 9 parts water between cuts to avoid spreading the pathogen. Fungicides are generally NOT effective for control of these diseases in landscape trees.</p>
<p><b>Magnolia</b> (<i>Magnolia</i>) Leaf Scorch, Winter Injury</p>	<p>Apply foliar anti-transpirant such as Moisturin, Wilt Pruf, or other according to manufacturer's recommendations.</p>
<p>Sooty Mold (<i>various fungi</i>)</p>	<p>Sooty mold fungi appear as a black coating on the leaf surface on several different trees and shrubs, including magnolia and holly. Sooty molds do not parasitize the leaves; they simply grow on the honeydew substance secreted by certain insects, such as aphids and scales. To prevent the growth of sooty mold, treat for the insect that is secreting the honeydew. For magnolia, refer to the section on control of magnolia scale in the "Insects of Trees and Shrubs" section.</p>
<p><b>Maple</b> (<i>Acer</i>) Anthracnose (<i>Kabatella</i>, <i>others</i>)</p>	<p>This disease is common in spring, but is generally harmless except in very wet springs. When weather is conducive to disease development, the fungicides recommended for anthracnose of ash can be used for control.</p>

**Table 4.2 - Fungicide Use (cont.)**

Tree And Disease	Fungicide, Rate, and Remarks
Maple (Acer) (cont.) Scorch	Scorch, the "burning" of leaf margins, occurs commonly in early spring or summer due to moisture stress. Supplemental watering and mulching often alleviate or prevent the problem. Anti-transpirants have proven helpful. Bacterial leaf scorch has also been found to cause leaf scorch in red maple. See bacterial leaf scorch of elm section for details.
Verticillium Wilt ( <i>Verticillium</i> )	Some research indicates that a vigorous nitrogen (ammonium sulfate) fertilization, above that which the tree and/or turf might ordinarily receive in a standard maintenance program, may enhance recovery. We cannot offer a specific recommendation; the consumer must choose a regimen at his/her discretion. Avoid replanting susceptible species in infested soil. Refer to Additional Comment 4 for a list of tree species immune to Verticillium wilt.
Zonate Leaf Spot ( <i>Cristulariella</i> )	Collect and either burn or bury diseased leaves. If zonate leaf spot appears early in the season, which is sometimes seen in Norway or red maple, a broad-spectrum fungicide, such as mancozeb (Mancozeb DG, Dithane T/O Rainshield, or Dithane DF Rainshield), can be used at label rates, starting at the first sign of disease. Usually this disease appears later in the season and does not warrant control.
Mimosa ( <i>Albizia</i> ) Mimosa Wilt ( <i>Fusarium</i> )	This disease is a vascular wilt disease for which there are no chemical controls. The fungal pathogen has a very narrow host range. Replace trees that have died from this disease with species other than mimosa.
Mountain Ash ( <i>Sorbus</i> )	
Cytospora Canker ( <i>Cytospora</i> )	Remove and destroy cankered branches by burning or burying.
Oak ( <i>Quercus</i> ) Anthracnose ( <i>Apiognomonina</i> )	Normally, this disease is not deemed serious enough to recommend fungicidal treatment. However, if fungicide control is desired, refer to recommendations for anthracnose of ash.
Bacterial Leaf Scorch ( <i>Xylella</i> )	The same organism that causes elm leaf scorch causes bacterial leaf scorch in oak. Refer to comments for bacterial leaf scorch of elm.
Bacterial Wetwood	See elm section.
Chlorosis	Chlorosis (yellowing) is a common problem in the Virginia highlands on pin oak ( <i>Quercus palustris</i> ) and in other oak species in other areas of the state. It should be noted that ANY macro- or micro-element in short supply might interfere with chlorophyll synthesis, leading to chlorosis. Commonly, however, on pin oak, the problem is elevated soil pH (in the neutral, pH 7.0, or higher (alkaline) range due to limestone or other alkalifying agent). To control this problem, soil pH must be lowered (soil must be acidified) by some agent, such as an acid-producing fertilizer, addition of sulfur, aluminum sulfate or other acidic compound. For exact dosage, report the soil pH to an extension soil scientist. On sites where soil is difficult to amend, some have achieved success with foliar applications of iron chelate. Trunk implantation devices (capsules, "Medicaps," etc.) have been successful in some situations also. The best result, however, is to adjust soil pH. Consult an Extension soil scientist for specific recommendations. Note that chlorosis may also result from root abnormalities, such as girdling roots, or from poor drainage. For example, willow oaks or other oak species planted in parking lot islands in heavy clay soil may show severe chlorosis even when the soil pH is correct.
Endothia Canker ( <i>Endothia</i> )	Endothia gyrosa, causal agent of pin oak blight, may also be pathogenic to other species of oak. Remove cankered branches at the trunk or at the major adjoining branch and destroy by burning or burying. Avoid wounding of any kind, especially lawnmower injuries and trimming of lateral branches of the pin oak. Keep pin oaks well watered. Provide nutrients on a regular basis as needed.
Leaf Blister ( <i>Taphrina</i> )	This disease rarely causes significant stress to trees. Preventive spray is generally not needed. The pathogen infects leaves early in the spring and repeat infections do not occur. By the time symptoms are noticed, it is too late for effective control.
Powdery Mildew ( <i>Sphaerotheca</i> )	This disease rarely causes significant stress to oak trees; preventive sprays are generally not needed.

**Table 4.2 - Fungicide Use (cont.)**

Tree And Disease	Fungicide, Rate, and Remarks
Ramorum Blight (Sudden Oak Death) ( <i>Phytophthora ramorum</i> )	This disease is not known to occur on oaks in Virginia at this time. If symptoms of bleeding areas are seen on oak bark, the problem is most likely bacterial wetwood. Refer to the description of bacterial wetwood in the elm section.
Tubakia Leaf Spot ( <i>Tubakia</i> )	This disease rarely causes significant stress to trees; preventive sprays are generally not needed.
<b>Pear</b> ( <i>Pyrus</i> )	A special note on Bradford (Callery) pear: This species is prone to breakage during wind or ice storms. Although it has resistance to fire blight, dieback due to this disease may occur in severe fire blight years. Pruning out affected branches 6 inches below obvious cankers usually provides adequate control. Dip pruning tools in rubbing alcohol or a solution of 1 part bleach to 9 parts water between cuts. Bradford pear is also very sensitive to deep planting and poor drainage. The tree responds to these conditions by turning black (foliage and branches) throughout the tree. These symptoms could be confused with fire blight, but fire blight generally affects only a few individual branches at a time on this species.
<b>Pine</b> ( <i>Pinus</i> ) Diplodia Tip Blight ( <i>Diplodia</i> )	Clubbed shoot tips, which serve as a source of fungal inoculum, should be pruned back to healthy wood. Austrian and other 2-needled pines are especially susceptible to this disease. In some cases, cankers form on branches. Such branches should be pruned back to healthy wood. On highly susceptible species, such as Austrian pine, the disease may progress to kill the whole tree in the absence of early intervention. Fungicide options include: <ul style="list-style-type: none"> <li>• Calcium hydroxide + copper sulfate (Bordeaux mixture): apply when new growth starts, as needles emerge from the sheath, and when needles are 2/3 mature length.</li> <li>• Chlorothalonil (Daconil Weather Stik, Daconil Ultrex, Fertilome Landscape &amp; Garden Fungicide): apply at budswell and repeat at 10- to 14-day intervals.</li> <li>• Thiophanate methyl (Cleary 3336, Fertilome Halt): begin applications in spring when new growth starts. Make a second application just before needles emerge from the sheath and a third application 7 days later. Thorough coverage is necessary for optimal disease control.</li> </ul>
Eastern White Pine (various disorders)	Eastern white pine ( <i>Pinus strobus</i> ), known commonly as “white pine,” is a tree that is particularly sensitive to a wide array of stresses. It is easily injured by insufficient or excess soil moisture, and many trees do not adapt to landscapes where soil profiles have been disturbed, where the soil is heavy and/or compacted, or where other soil problems exist. White pine is also sensitive to chemical toxicants, such as certain herbicides, deicing salt, and air pollutants. Most of these stresses result in overall browning, yellowing, and/or stunting of the needles. Individual cases must be examined to be diagnosed.
Needle Casts (various fungi)	See Conifers section.
Needle Rust ( <i>Coleosporium</i> )	This disease rarely causes significant stress to trees; preventive sprays are generally not needed.
Pine Wilt (Japanese Black Pine, esp.) ( <i>Bursaphelenchus</i> )	Symptoms include sudden wilting and death of entire trees. It is believed that trees in decline attract beetles that carry a nematode which colonizes the water-conducting system. Remove affected trees. No chemical controls are available.
Seasonal Needle Drop	Conifers are often referred to as “evergreens”, however, conifers are not really “evergreen” because they regularly lose the oldest needles when those needles are 2 or more years old. Many conifers lose their oldest needles gradually and the discoloration and loss of these needles goes unnoticed. White pines, however, are especially prone to losing the oldest needles all at once in the fall. The innermost needles turn yellow all over the tree and may remain on the tree for some time before they drop, resulting in a striking inner yellowing of the tree. This phenomenon often leads homeowners to believe the trees are dying. Seasonal needle drop is a normal occurrence in pines and other conifers. It may be more noticeable some years than others, but it is no cause for concern.

## 4-20 Home Ornamentals: Diseases of Landscape Trees

**Table 4.2 - Fungicide Use (cont.)**

Tree And Disease	Fungicide, Rate, and Remarks
White Pine Root Decline (Procerum Root Disease) ( <i>Leptographium</i> )	The fungus, <i>Leptographium (Verticicladiella) procerum</i> , is the suspected causal agent, but may not be the sole contributory stress factor. Pales weevils are believed to introduce the fungus to the tree or provide entry ports for the fungus. These weevils breed in stressed trees or in the stumps of trees that have been cut down. Therefore, complete removal and burning of dying trees, including stumps, is recommended. If stumps are not removed, insecticide treatment of stumps is recommended. Refer to information on stump control of pales weevil in the "Insects of Trees and Shrubs" section of this guide. White pine should NOT be used as a replacement plant.
<b>Plane-tree</b>	See sycamore.
<b>Plum</b> ( <i>Prunus</i> ) Black Knot ( <i>Dibotryon</i> )	Galls turn black in the second year after infection when the fungus produces fruiting bodies and spores on the bark surface. Prune out galled branches and remove or destroy them while they are still the color of the bark and before spores have formed. Avoid planting ornamental plums near stands of wild cherries, which are very susceptible to the disease.
<b>Poplar</b> ( <i>Populus</i> ) Canker (various fungi)	Remove and destroy cankered branches by burning or burying. Avoid the use of Lombardy or other susceptible species and cultivars.
<b>Redbud</b> ( <i>Cercis</i> ) Botryosphaeria Dieback ( <i>Botryosphaeria</i> )	This disease causes sections of the tree to die back. Prune out affected branches back to healthy wood (where entire cut surface appears creamy white). Dip pruning tools in rubbing alcohol or a solution of 1 part bleach to 9 parts water between cuts. Botryosphaeria infections often follow drought stress. Water trees deeply during drought.
<b>Spruce</b> ( <i>Picea</i> ) Cytospora Canker ( <i>Cytospora</i> ) Rhizosphaera Needle Cast ( <i>Rhizosphaera</i> )	Remove and destroy cankered branches by burning or burying. Prevent drought or other stresses, which predispose trees to this disease.  Fungicide options include: <ul style="list-style-type: none"> <li>• Calcium hydroxide + copper sulfate (Bordeaux mixture): apply when new needles are 1/2 to 1 inch long. Repeat when needles are full length.</li> <li>• Chlorothalonil (Daconil Weather Stik, Daconil Ultrex, Fertilome Landscape &amp; Garden Fungicide): make first application in spring when new growth is 1/2 to 2 inches in length. Repeat applications at 3- to 4-week intervals until conditions no longer favor disease.</li> </ul>
<b>Sweetgum</b> ( <i>Liquidambar</i> ) Bleeding Canker ( <i>Botryosphaeria</i> )	This disease appears as small bleeding lesions on the bark. Stress, especially drought stress, predisposes trees to the disease. Removing stress factors by watering during drought, etc., can allow trees to recover. There are no chemical controls.
<b>Sycamore</b> ( <i>Platanus</i> ) Anthracnose ( <i>Apiognomonina</i> )	Anthracnose can be severely disfiguring and possibly debilitating to this species during repeated long, moist, cool springs. Follow fungicide recommendations for anthracnose of ash. If sprays are undesirable because of the tree's location or size, Arbotect 20S injections done in late summer are highly effective; see the 3X rate used in elm for management of Dutch elm disease, or follow the label dosage. Anthracnose must not be confused with bacterial leaf scorch caused by the bacterium, <i>Xylella fastidiosa</i> . Anthracnose lesions tend to follow leaf veins, whereas symptoms of bacterial scorch appear along leaf margins.
Bacterial Leaf Scorch ( <i>Xylella</i> )	See elm section.
<b>Walnut</b> ( <i>Juglans</i> ) Anthracnose ( <i>Gnomonia</i> )	Follow directions for control of anthracnose of ash.
<b>Willow</b> ( <i>Salix</i> ) Crown Gall ( <i>Agrobacterium</i> )	If desired for cosmetic purposes, galls on larger trees may be removed surgically, and a wound paint applied to the wound. Disinfect tools between cuts. Galls should be removed during late fall or mid-summer when sap flow is minimal.
Fungal Cankers (various fungi)	Willows are susceptible to a variety of fungal canker diseases. Symptoms appear as discolored or cracked bark with dieback above the canker. Fungicides are generally not effective for control. Prune out cankered branches back to healthy wood and destroy them by or burying.

## **Additional Comments**

1. The vigor of unthrifty and undernourished trees, commonly susceptible to various environmental stresses, often can be greatly improved by periodic applications of nutrients. Soil tests are always recommended prior to fertilizer application, especially if a soil fertilization program has already been in effect. In general, a 10-10-10 (NPK) fertilizer at the rate of 2.0 to 4.0 pounds per inch of tree diameter at waist height (DBH) can be applied in holes evenly distributed in the ground beneath the tree. Alternatively, one can apply about 1.0 to 2.0 pounds actual nitrogen per 1000 square feet by surface-broadcasting during the dormant season; ammonium nitrate or nitrate of soda are acceptable compounds. Consult your local Extension agent for specific recommendations.
2. Lack of water is one of the most widespread and destructive abiotic stress of the landscape tree; when possible, this stress should always be prevented or alleviated. Research at Virginia Tech has shown that when dry conditions prevail, irrigating deeply twice a week for the first year after transplanting helps prevent stress to the tree. It should be remembered that moisture stress can also occur in winter. Watering trees in the fall before the ground freezes can help to prevent winter desiccation.
3. For the exclusion of certain pathogenic fungi, any of the following compounds may be applied thinly and evenly over freshly-cut surfaces and wounds: 1.0% thiram, 3.3% to 10.0% copper naphthenate, or 2.0% sodium-o-phenylphenate in an asphalt or other non-fortified tree wound preparation.
4. Tree or shrub species that appear to be immune or resistant to Verticillium wilt include:

<i>Abies spp.</i> (fir)	<i>Liquidambar styraciflua</i> (sweet gum)
<i>Amelanchier spp.</i> (serviceberry)	<i>Malus spp.</i> (apple, crabapple)
<i>Betula spp.</i> (birch)	<i>Morus spp.</i> (mulberry)
<i>Buxus spp.</i> (boxwood)	<i>Nerium oleander</i> (oleander)
<i>Carpinus spp.</i> (ironwood)	<i>Picea spp.</i> (spruce)
<i>Castanea mollissima</i> (Chinese chestnut)	<i>Pinus spp.</i> (pine)
<i>Ceanothus spp.</i> (red-root)	<i>Platanus spp.</i> (sycamore)
<i>Celtis spp.</i> (hackberry)	<i>Pyracantha spp.</i> (fire-thorn)
<i>Cercidiphyllum japonicum</i> (katsura-tree)	<i>Pyrus spp.</i> (pear)
<i>Cornus spp.</i> (dogwood)	<i>Quercus alba</i> (white oak)
<i>Crataegus spp.</i> (hawthorn)	<i>Q. falcata</i> (southern red oak)
<i>Fagus spp.</i> (Beech)	<i>Q. phellos</i> (willow oak)
<i>Ficus carica</i> (fig)	<i>Q. virginiana</i> (live oak)
<i>Ginkgo biloba</i> (maidenhair tree)	<i>Salix spp.</i> (willow)
<i>Gleditsia spp.</i> (honey locust)	<i>Sorbus aucuparia</i> (European mountain-ash)
<i>Ilex spp.</i> (holly)	<i>Taxus spp.</i> (yew)
<i>Juglans spp.</i> (walnut)	<i>Zelkova serrata</i> (zelkova)
<i>Juniperus spp.</i> (juniper)	
<i>Larix spp.</i> (larch)	



## Insects of Trees, Shrubs, Annuals, and Perennials

Eric R. Day, Extension Entomologist, Virginia Tech

Peter B. Schultz, Extension Entomologist, Hampton Roads AREC

These recommendations are intended for the non-professional gardener. The more common pest species can be controlled safely and simply with a minimum number of pesticides. For complex or persistent problems and for large shade trees or expansive areas, it is wise and economical to engage the services of an experienced commercial arborist or custom spray applicator.

### Identification and Significance of Pest Problems

Two frustrating problems with ornamentals are: 1) Knowing if, what, and when pesticides should be used on more than 100 different plant genera, and 2) determining the identity and importance of any given pest found feeding on valuable and long-established trees and shrubs. More than 2,000 species of insects and mites may be encountered on woody plants. A great majority of these are uncommon, occasional, and pose little threat of serious damage to the plants, while about 15 percent are common, injurious, and potentially destructive. One of the best reference books on the subject is *The Gardener's Bug Book* by Cynthia Westcott, which is unfortunately out of print. *Insects that Feed on Trees and Shrubs* 2nd Ed Revised is an excellent resource and is currently available.

The aesthetic nature of prized ornamentals creates high values for individual plants. Therefore, even a minor or uncommon pest can be an important and costly problem for the owner if it is severe on only one or a few plants. The average home gardener is familiar with very few of even the more important pests, thus each unfamiliar insect found feeding on valuable ornamentals creates uncertainty as to possible damage or loss of plants.

To help identify pest problems, an index is provided listing the insects and mites reported from more than 125 different kinds of ornamental plants. It is not feasible to list all of the specific pests. For example, 20-30 species of scale are known from camellia, 18-20 species from elm, and 20-24 species from oak. There are 22-25 species of borers known to attack oak, and 8-10 species of mites known to attack elm. In the index the pests are listed by type as groups or individuals. **Those of major importance which are common, injurious, and usually require control treatments are underscored.** Those which are occasional, minor, have no known control, or for which control is unnecessary in usual situations are not underscored. For each important pest or pest group, control recommendations are suggested in Table I following the index. Table II provides directions for usage.

Most pests can be identified tentatively with a minimum knowledge of entomology. To use these recommendations for a given problem, look in the index under the host plant involved. By scanning the list, the appropriate group or pest usually can be found by knowing the difference between aphids, borers, leafhoppers, scale insects, lacebugs, leafminers, defoliators, etc. To further identify pests and obtain details on life histories, habits, and precise timing for control measures, consult reference books and Virginia Cooperative Extension (VCE) publications. The most complex groups are scale insects and borers. There is great variation in seasonal development patterns, and hence in timing the application of control measures. Extension agents and specialists at Virginia Tech can provide additional assistance on pest problems.

### Determining the Need for Control Measures

Applying insecticides at the wrong time of year or when unnecessary **may constitute a misuse of pesticides.** In cases of serious common pests, it is important to apply control measures before populations become large. Often, an insect infestation is found after it becomes intense and conspicuous. Then, in most cases, it is NOT the best time to apply control measures. Yet many people feel the urgency of taking remedial action immediately. Pesticides must be applied at the proper time to be effective. Frequently, it is unnecessary to apply sprays at all if the pest is minor and only present in small numbers. For numerous pests, especially gall insects, there is no known control; spraying is not feasible. Finally, it is usually unnecessary to use insecticides after an infestation has peaked and begun to subside. Parasites and predators are often present and help reduce the remaining number of pests. They can be favored by avoiding the use of pesticides. For common serious pests, application of chemicals early when populations are first getting established is most effective. Natural enemies are not adversely affected when the pest is controlled before the beneficial insects appear. Remember that unnecessary or untimely applications may be considered as a serious **MISUSE** of pesticides. It is **not** a good policy to spray all plants simply because it seems like a good idea, nor to use more insecticide than specified on the label. Pesticides are essential to the preservation of plant materials which enhance man's environment where he lives and works. Used as recommended they do much more to improve than upset it. Relatively few serious insect and mite pests of woody ornamental plants can be controlled by other than chemical means. More and more, public demands and governmental regulations require minimizing the use of pesticides. Therefore, this guide recommends relatively few materials for use around the home. These are the least toxic in nature, exhibit the least potential threat to the environment, and are essential for effective results. However, certain pests may be more difficult to control, require more costly chemicals, and require more frequent use of other pesticides. Certified Applicators' services should be utilized when necessary.

## Pesticide Names

There are four ways to identify pesticide products: the **chemical** name; the **accepted common** name; the **trade** name; and the **brand** name. Brand names (such as Bug-B-Gon) are capitalized and denote the manufacturer or distributor but do not indicate the chemical ingredients. Trade names (such as Sevin, Orthene, etc.) are capitalized and are trademark names for specific insecticides. Common names (such as carbaryl, dicofol, malathion, etc.) are coined names not capitalized, accepted by industry, scientists, and governmental agencies for specific insecticides. Chemical names for complex organic chemicals may be found on labels but are meaningless to the average user. It is essential to know which insecticides or miticides and what concentrations are in each pesticide formulation that is to be used for the desired purpose.

## Insecticides and Miticides

It is essential to use some residual insecticides to protect trees, shrubs, and turf. Many destructive insects emerge over an extended period of time or are highly mobile. Non-residual chemicals kill only those insects contacted at the time of application. It is not feasible to spray diverse ornamentals frequently enough to protect them from many types of pests. Residual insecticides are highly effective for those species and are essential until suitable alternatives can be developed. Systemic insecticide-miticide materials are not recommended for the home gardener, except imidacloprid.

Pesticides vary greatly in their properties. Malathion and diazinon on foliage remain toxic to insects for a very short period, normally not exceeding one or two days. Carbaryl may last 7–10 days on foliage or much longer on bark. Insecticides and miticides have varying residual properties depending on how they are used. Most miticides have considerable residual effectiveness for several days or more.

Resmethrin residues may persist for as much as a week or two. Pesticides also vary in their effects on pests. Carbaryl kills insects but not mites. The use of carbaryl actually encourages larger mite populations than if it is not used at all. Other insecticides have some effect in depressing mite populations but are not adequate for thorough control of mite infestations. They are also much more effective against certain pests than others. Systemic insecticides can kill both insects and mites, but usually does not work on mites and some armored scales.

When using pesticides, it is essential to treat only when necessary with accurate amounts of the recommended chemical. Over spraying is uneconomical, potentially hazardous, not more effective, and may cause plant injury or result in environmental imbalances favoring certain pests. Obtaining the correct dilution of spray with small garden equipment requires the measurement of very small quantities of chemical, such as by teaspoon or tablespoon. The percentage of error from inaccuracy can be high. Be sure to measure slightly rounded but not heaping spoonfuls of dry formulation. Although rates of application are given in these recommendations, mixing directions are provided on the label of each pesticide. Be sure to read the amounts carefully when preparing insecticidal sprays each time that sprays are applied. Keep pesticides in their original containers and the label in readable condition.

## Formulations

Most pesticides are not soluble in water and cannot be applied effectively without dilution. They must be diluted greatly in order to apply very small amounts effectively without plant injury. Therefore, insecticides are first dissolved in organic solvents to make a liquid or mixed with inert dry diluents to make a “powder.” By the addition of an emulsifier or wetting agent, either an emulsifiable concentrate (EC) or wettable powder (WP) formulation is produced to be mixed in water for applying extremely dilute, small quantities of toxicant evenly over the very large surface area to be protected. In addition to emulsifiable concentrates and wettable or sprayable powders, insecticides may be formulated and used without further dilution as dusts (D) for direct dry applications to plants, or granules (G) for direct soil or ground surface treatments. Dusts or granules should **never** be mixed with water for making applications.

Still another common formulation in the small-package or home-garden market is the pressurized can or aerosol. A true aerosol utilizes a propellant chemical which dispenses very fine droplets that float in the air. Such a space spray is for flying insects and will not provide a surface deposit to kill crawling insects. Residual spray applicators are available, either pressurized or containing a propellant, which are suitable for spraying plants. These produce coarse droplets which wet the insects and the plants. Be especially careful not to hold the applicator too close to the target; propellants can cause plant injury. It is most important to be sure the product is intended for use on ornamentals. Pressurized sprays for household pests may contain solvents which cause severe injury to plants and are intended for use only on wood or other manufactured materials.

## Combination Sprays

While these recommendations suggest the use of specific insecticides or miticides for each individual pest problem, many formulations of pesticides provide spray concentrate (liquid or wettable powders) with two or more pesticides combined. Hence, the landscape gardener can purchase one product to control several pests. In some cases, a fungicide is combined with one or more insecticides plus a miticide. An advantage of combination sprays is that less total solvent and emulsifier or wetting agent are used compared to home mixes of the same ingredients. Two disadvantages are a “trade-off” for the convenience and multiple pest coverage: 1) combination concentrates are usually more costly and 2) several pesticides are applied unnecessarily if only one pest is present. For best results in pest control, judicious use should be made of both approaches: use a “rifle shot” where it alone is effective, and the “shot-gun” where it is appropriate. Most combination spray concentrates contain less of each toxicant than if purchased separately. For example, a rose and floral spray powder might contain 12.5 percent Sevin plus other active ingredients, whereas a Sevin wettable powder usually contains 50 percent active ingredient. The rate of application for the rose and floral spray may be 8 tablespoons per gallon of water versus 2 tablespoons for the 50 percent wettable powder to achieve the same dilution rate of Sevin in the spray tank.

There are many brands of spray combination concentrates available in the marketplace.

## Sprayers and Spraying

The most important consideration is to fit the spray equipment to the job to be done. Sprayers vary from finger-depresser pumps in small bottles to large high-powered machinery. The most effective and convenient is the compressed air or knapsack sprayer.

Hose-on sprayers are the most desirable if more than a small area is to be treated regularly. Portable mist blowers are effective for plants up to 20-30 feet high, but can give erratic results and plant injury if not used properly. For large areas and tall shade trees, the services of qualified arborists or custom applicators with heavy-duty spray equipment should be engaged.

To be effective, sprays must thoroughly wet the surfaces to be treated or come into contact with the insects. Plants with highly waxy foliage often retain little spray material. Insects such as mealybugs and scale insects are protected under dense waxy secretions. It is frequently advisable to put additional spreader-sticker or more wetting agent in the spray. However, if an additive is used at all times, increased run-off and less deposit of spray material may result on non-waxy surfaces. If a wetting agent is needed but not convenient to obtain in stores, a non-sudsing detergent can be used at the rate of 1 teaspoon in 3 gallons of spray mixture.

Emulsifiable concentrates are most resistant to washing off by rain. Wettable powder sprays are not as persistent, while dusts are readily washed off by rain or irrigation. Any type of spray will be washed off if rain occurs before the sprays have dried. If sprays dry thoroughly, rain does not remove appreciable amounts of residue; the process is gradual over a period of time, depending on the amount of precipitation and the residual toxicity, chemically, of the pesticide used. If water supplies are highly alkaline (pH = 8 or higher), many insecticides will break down immediately and be ineffective.

## Spray Injury

It is very important to read all the directions and precautions on the label. Some plants are sensitive to certain insecticides. Carbaryl may cause injury to tender foliage if plants are wet when treated or in the presence of high humidity. Carbaryl will cause severe foliage injury and leaf drop on Boston ivy and Virginia creeper. Malathion is injurious to several ferns and eleagnus. Methoxychlor in liquid formulations should not be used on Chinese elm, Japanese maple, red maple, or redbud. Dimethoate is highly variable in phytotoxicity to plants; some varieties of azalea are completely defoliated while others show minor leaf burn or no effects. Dimethoate may defoliate Burford and Chinese holly; andromeda and elm foliage may be injured. Dormant oils may injure sugar and Japanese maples and numerous thin-barked trees. It should not be used on hickory, beech, birch, douglas fir, and juniper and will remove the bluish bloom from spruces. The label on the insecticide container specifies plants susceptible to injury. **Be sure to read ALL of the directions and use insecticides only for those pests specified on the label.** Potential injury to plants by insecticides is included under phytotoxicity in Table II.

## Index to Insects and Mites by Host

Pests are listed by type as groups or individuals. Those of major importance which are common, injurious, and usually require control treatments are in bold.

**ABELIA** scale insects

**AGERATUM** aphids, cyclamen mite, spider mite, whiteflies

**ALDER** aphid (woolly), borers, defoliators, lacebug, scale insects, spider mites

**ALTHEA** (Hibiscus) aphids, defoliators, scale insects, weevils

**ANDROMEDA** lacebugs, scale insects, spider mites, whiteflies

**ARAUCARIA** mealybugs, scale insects

**ARBORVITAE** bagworm, leafminer, scale insects, spider mites, weevils

**ASH** aphid, flower gall mites, borers, defoliators, lacebug, leafminer, leaf roller, rhinoceros beetle, sawfly, scale insects, spider mites

**ASTER** aphids

**AUCUBA** scale insects, spider mites

**AZALEA** aphid, lacebug, defoliators, leafminer, leaf tier, scale insects, spider mites, borers, weevils, thrips, whiteflies

**BALSAM FIR** aphids

**BARBERRY** aphid, scale insects, webworm

**BAYBERRY** defoliators, mealybugs, scale insects

**BEECH** aphid (woolly), borers, erineum mite, defoliators, Japanese beetle, leafhopper, scale insects, spider mites

**BEGONIA** aphids, mealybugs, broad mite, cyclamen mite, spider mite, thrips, black vine weevil, whiteflies

**BIRCH** aphids, borers, Japanese beetle, lacebug, leafminer, leaf skeletonizer, leaf tier, scale insects

**BITTERSWEET** aphids, scale insects

**BOX ELDER** aphids, borers, boxelder bug, defoliators, scale insects, spider mites, webworm

**BOXWOOD** giant hornet, leafminer, psyllid, scale insects, spider mites, webworm

**BUCKEYE** defoliators, mealybugs, scale insects, spider mites

**BUTTERNUT** aphids, borers, defoliators, gall insects, gall mites, lacebug, scale insects

**BUTTONBUSH** aphids, scale insects

**CACTUS** mealybugs, scale insects

**CAMELLIA** aphids, defoliators, leafroller, mites, scale insects, weevils

**CATALPA** aphids, defoliators, scale insects

**CEDAR** (Cedrus) aphid, bagworm, bark beetle, borers sawfly, scale insects, weevils

**CHAMAECYPARIS** aphid, scale insects, spider mites, weevils

**CHERRY-LAUREL** aphid, scale insects, weevils, whitefly

**CHESTNUT** aphid, borers, defoliators, scale insects, webworm, weevils

**CHINA ASTER** aphids, broad mite, thrips, whiteflies

**CHOCKECHERRY** borers, defoliators, scale insects, tent caterpillar

**CITRUS** aphid, bagworm, borers, defoliators, leafroller,

**COTONEASTER** lacebugs, defoliators

**CRAPE MYRTLE** aphid, scale insects, weevil

**CYPRESS** aphid, bark beetle, borer, defoliators, scale insects, spider mites

**DAHLIA** aphids, beetles, borers, plant bugs, caterpillar leafhoppers, giant hornets (tear bark)

**DAY LILY** aphids, scale insects, thrips

**DELPHINIUM** cyclamen mites, aphids, leafminers

**DEUTZIA** aphids, leafminer, scale insects, weevil

**DOGWOOD** aphids, borers, cicada, gall midge, defoliators, leafhopper, leafminer, leafroller, sawflies, scale insects, whitefly

**DOUGLAS FIR** aphids, bark beetles, borers, budworm, defoliators, scale insects, weevils

**ELEAGNUS** aphids, scale insects

**ELM** aphids, bagworm, bark beetles, borers, case bearers, defoliators, gall insects, gall mites, Japanese beetle, lacebugs, leafhoppers, leafminer, rust mites, spider mites, scale insects, weevils

**EUONYMUS** aphids, scale insects, weevils

**FERNS** scale, thrips, mealybugs

**FIR** aphids, bagworm, bark beetles, borers, budworm defoliators, needleminer, sawflies, spider mites

**FLOWERING FRUITS** aphids, aphids (woolly), bark beetles, borers, bud moth, casebearers, defoliators, fruit moths, Japanese beetle, lacebugs, leafhopper, leafroller, skeletonizer, leaf tier, mealybugs, mites, plant bugs, sawflies, scale insects, tent caterpillar, thrips, webworm, weevils

**FORSYTHIA** plant bugs, scale insects, weevils, gall insects, mites

**GARDENIA** aphid, mealybugs, scale insects, spider mites, thrips, weevils, whitefly

**GERANIUM** aphids, mites, scale, Fuller rose beetles

**GINGKO** defoliator, scale insects

**GLADIOLUS** thrips, mealybugs, caterpillars, aphids, borers, bulb mites, corn earworms

**HACKBERRY** bark beetles, borers, lacebug, defoliators, gall mites, psyllids

**HAWTHORN** aphids (woolly), bark beetle, borers, bud moth, casebearer, defoliators, Japanese beetle, leafminer, leaf roller, leaf skeletonizer, sawfly, scale insects, spider mites, weevil

**HEMLOCK** aphids, bark beetle, borers, defoliators, needleminer, rust mites, sawfly, scale insects

**HIBISCUS** Japanese beetles, whitefly, aphids, sawflies

**HICKORY** aphid (woolly), bark beetle, borers, casebearer, cicada, defoliators, gall aphids, gall mites, lacebugs, leaf roller, sawflies, scale insects, spider mites, webworm, weevils mites, scale insects, thrips, weevils

**HOLLY** aphid, bud moth, berry midge, defoliators, leafminers, leaf tier, mealybugs, rust mite, scale insects, spider mites, weevils

**HONEY LOCUST** bagworm, borers, mimosa webworm, plant bug, pod gall, midge, rust mite, spider mites

**HONEYSUCKLE** aphids, defoliators, leaf roller, plant bugs, sawfly, spider mites, webworm

**HORSE CHESTNUT** bagworm, borer, Japanese beetle, leaf roller, scale insects, spider mites

**HYDRANGEA** leaf tiers, lygus bugs, spider mites

**IRIS** borer, thrips, weevil, aphids, bulb mites, slugs

**IVY** (Boston) defoliators, Japanese beetle, leafhopper, scale insects, weevil

**IVY** (English) defoliators, Japanese beetles, leafhopper, scale insects, weevil

**JUNIPER** aphid, bagworm, bark beetle, midge, scale insects, spider mites, twig girdler, webworm, weevils

**LANTANA** aphids, cyclamen mites, fleahoppers, leaf tiers, whitefly, mealybugs

**LARCH** aphid (woolly), bagworm, bark beetle, borer, bud moth, casebearer, defoliators, sawfly, weevil

**LAUREL** bud moth, psyllid, scale insects, weevils

**LIGUSTRUM** scale insects

**LILAC** aphid, borers, European hornet, rhinoceros beetle, rust mite, scale insects, thrips, weevils, whitefly

**LILY** aphids, bulb mites, symphytan

**LINDEN** aphids, bagworm, borers, defoliators, lacebugs, leafrollers, sawflies, scale insects, rust mite, spider mites, whitefly

**LOCUST** (Robinia) aphid, bagworm, borers, defoliators, leafminers, leaf roller, treehoppers, scale insects, spider mites

**LONDON PLANETREE** borers, scale insects

**MAGNOLIA** borers, scale insects, weevil, whitefly

**MAPLE** aphids, aphid (woolly), bagworm, borers, boxelder bug, defoliators, gall midges, gall mites, Japanese beetle, leafhoppers, leaf roller, leaf skeletonizer, scale insects, spider mites

**MARIGOLD** fleahoppers, lygus bugs, leafhoppers, slugs, spider mites, stalk borers

**MIMOSA** bagworms, scale insects, webworm

**MOUNTAIN ASH** aphid, bark beetle, borers, lacebug, sawfly, scale insects, spider mites

**MOUNTAIN LAUREL** borers, lacebug, scale insects, spider mite, weevils, whitefly

**MULBERRY** lacebug, scale insects, whitefly

**MYRTLE** aphids, mealybugs, scale insects

**NANDINA** scale insects

**NARCISSUS** (Daffodil) bulb mites, bulb flies, mealybugs

**OAK** aphids, borers, cicada, defoliators, gall insects, gypsy moth, Japanese beetle, lacebugs, leafminers, leafrollers, leaf skeletonizers, leaf tier, oakworm, rust mites, sawflies, scale insects, spider mites, tent caterpillars, treehoppers, webworm, weevils

**OSMANTHUS** scale insects, webworm

**PACHYSANDRA** scale insects, spider mites

**PALM** mealybugs, scale insects, spider mites, thrips

**PEONY** ants, aphids, rose chafers, 4-lined plant bug, thrips

**PERIWINKLE** (Vinca) aphids

## 4-28 Home Ornamentals: *Insects of Trees and Shrubs*

**PERSIMMON** borers, defoliators, mealybugs, psyllid, **scale insects**, thrips, whitefly  
**PETUNIA** aphids, climbing cutworms, fleabeetles, flea hoppers, mealybugs, mites  
**PHLOX** phlox bug, Asiatic garden beetle, 4-lined plant bug, **spider mites**, stalk borers  
**PHOTINIA** scale insects, aphids  
**PINE** aphids, bagworm, **bark beetle**, borers, budworm, **defoliators**, rust mites, **sawflies**, **scale insects**, spider mites, spittlebug, **tip moth**, webworm, **weevils**  
**POPLAR** aphids, **borers**, **defoliators**, **gall insects**, giant hornet, lacebug, leafminers, leafroller, **sawflies**, **scale insects**, spider mites, treehoppers, webworm, weevil  
**PRIVET** aphid, borer, leafhopper, **leafminer**, rust mite, **scale insects**, spider mites, thrips, weevils  
**PYRACANTHA** aphids, **lacebugs**, **scale insects**, **spider mites**, **webworm**, **leaf crumpler**, **weevils**  
**REDBUD** leaf roller, **scale insects**, treehopper  
**RHODODENDRON** aphids, **borers**, budworm, giant hornet, Japanese beetle, **lacebugs**, **scale insects**, **spider mites**, thrips, **weevils**, **whitefly**  
**ROSE** aphids, **borers**, budworm, **defoliators**, **Japanese beetle**, **leafhopper**, leafroller, leaf tier, midge, **sawflies**, **scale insects**, **spider mites**, **thrips**, treehopper, webworm, weevils, whitefly  
**SASSAFRAS** defoliators, **Japanese beetles**, leafroller, scale insects, **weevil**  
**SERVICEBERRY** borers, leafminer, sawfly, **scale insects**, **spider mites**  
**SNAPDRAGON** corn earworms, cyclamen mites, plant bugs, slugs, spider mites  
**SOURGUM** borer, leafminer, **scale insects**  
**SPIREA** aphids, defoliators, leafhopper, leafroller, scale insects, **spider mites**  
**SPRUCE** aphids, bark beetles **borers**, bud moth, budworm, defoliators, **gall aphids**, needleminer, scale insects, **spider mites**, **weevils**  
**STEPHANOTIS** scale insects  
**SWEETGUM** bagworm, borers, defoliators, leaf tier, **scale insects**, webworm  
**SWEETPEA** aphids, cutworms, symphytan, lygus bugs, spider mites  
**SYCAMORE** aphids, bagworm, borers, **defoliators**, Japanese beetles, **lacebugs**, scale insects, treehopper, webworm, weevils  
**TAXUS** (Yew) **gall mite**, **scale insects**, **weevils**  
**TULIP TREE** aphids, borers, **scale insects**, **weevils**  
**TUPELO** aphids, leaf miner  
**VIRGINIA CREEPER** aphids, **defoliators**, **Japanese beetle**, leafhoppers, scale insects, weevils  
**WALNUT** aphids, borers, casebearer, **defoliators**, **lacebugs**, rust and gall mites, sawfly, **scale insects**, spider mites, webworm  
**WEIGELIA** plant bug, scale insects, weevil  
**WILLOW** aphids, **borers**, **defoliators**, **gall insects**, giant hornet, **Japanese beetle**, **lacebugs**, leafhoppers, **sawflies**, **scale insects**, **spider mites**, spittlebug, thrips, treehopper, webworm, weevils  
**WISTERIA** aphids, defoliators, leaf roller, **scale insects**, spider mites, webworm, weevil  
**WITCH-HAZEL** defoliators, gall insects  
**YUCCA** plant bug, **mealybugs**, **scale insects**  
**ZINNIA** aphids, Asiatic garden beetles, flea hopper, Japanese beetle, lygus bugs, spider mites, whitefly

**Table 4.3 - Timing for Borer Treatment**

<b>Pest</b>	<b>Time of Treatment</b>
ash borer, banded	Late July and early September
azalea stem borer	Mid-May and mid-June
bronze birch borer	Mid-May and early, mid- and late June
dogwood borer	Mid-May and repeat 2 to 3 times at 6-week intervals
dogwood twig borer	Early to mid-May
emerald ash borer	April or May with systemic insecticide
iris borer	When leaves are 5-6" tall
lilac borer	Early May and repeat 6 weeks later
locust borer	Late August to mid-September (when goldenrod is in bloom)
mottled willow borer (poplar and willow borer)	Mid- to late June and late August to early September
peach tree borer	July and repeat at 6-week intervals
rhododendron borer	Late June
round-headed and flat-headed tree borers	Early May, early June, and early July
two-lined chestnut borer	Mid- to late May and mid- to late June
Zimmerman pine moth	Mid-April and late fall

**Table 4.4 - Timing for Scale Insect Treatment**

<b>Pest</b>	<b>Crawler Dates</b>	<b>Treatment Dates</b>
azalea bark scale	June 5 to 30	June 10 and 20
brown soft scale	—	Treat when scale insects appear, then 2-3 times at 10 day intervals
calico scale	Same as lecanium scale	
camellia scale	May 1 to June 5 and September 15 to 30.	May 10 and 20 and/or September 10 and 20
cottony maple scale	June 5 to 25	June 10 and 20
cottony maple leaf scale	June 1 to 10	June 15 to 30
cottony camellia scale	June 1 to 10	June 10 to 20
euonymus scale	May 5 to June 10, 1st generation; July 1 to 25, 2 <sup>nd</sup> generation	May 10 and 20, and July 5 and 15
European elm scale	June 5 to 25	June 10 to 15
European fruit lecanium scale	June 1 to 20	June 10 to 15
fletcher scale	June 5 to 25	June 10 to 15
florida red scale	May 5 to 15	May 15 to 30
florinia hemlock scale (elongate hemlock scale)	Peak May 15 to June 20	May 20 to 25 and June 5 to 10
forbes scale	June 1 to 15	June 5 to 10
golden oak scale	June 1 to 30	June 10 and June 20
gloomy scale	June 10 to 20	June 20 to 30
Japanese scale	—	Treat at 2-week intervals, June 1 to September 1
juniper scale	April 5 to 20 and June 5 to 20	April 10 to 15 and/or June 10 to 15
latania scale	—	June 25, July 10, and September 20
lecanium scale	May 25 to June 25	June 15 to 20

**Table 4.4 - Timing for Scale Insect Treatment (cont.)**

<b>Pest</b>	<b>Crawler Dates</b>	<b>Treatment Dates</b>
magnolia scale	—	September 1 to 20
obscure scale	—	red oaks in mid-July; white oaks in mid-August
oak kermes	June 1 to 20	June 10 to 15
oystershell scale	May 1 to 20 and July 15 to 25	May 5 to 20 and/or July 20 to 25
pine needle scale	April 20 to May 30 and July 10 to 20	May 5 to 20 and/or July 10 to 20
pine tortoise scale	June 10 to July 5	June 20 to 25
rose scale	Late May to June 30	June 5 to 10; June 20 to 25; and in mid-August
San Jose scale	—	June 10 to 15; July 10 to 15; and September 10 to 15
tea scale	—	2 to 3 times at 10 day intervals when infested
tuliptree scale	—	September 1 to 20
wax scale	June 1 to 25	June 10 to 30
white peach scale	April 25 to May 15; July 1 to 15; and August 20 to September 15	May 1 and 10; July 5 and 15; and September 1 and 10
woolly pine scale	Mid-June	June 15 to 20

## Plant Injury

Insecticides vary greatly in their phytotoxicity. Be sure to avoid treating sensitive plants. Cautions on the label usually indicate plants which should not be sprayed. **Read the entire label carefully.** **Carbaryl** may injure tender foliage if plants are wet when treated or in the presence of high humidity; it should not be used at any time on Boston ivy or Virginia creeper. **Endosulfan** may injure white birch, redbud, and Anderson yew. **Malathion** may cause injury to certain junipers, eleagnus, hibiscus, some rose varieties, and certain ferns. Petroleum oils for dormant or summer spraying are much safer, but should not be used on birch, beech, sugar and Japanese maple, hickory, walnut, butternut, douglas fir, spruces, or juniper.

It is important not to mix pesticides which are not compatible with each other, and avoid formulations not intended for use on plants. Formulations used for structural pest control should not be applied to plants.

**Table 4.5 - Control Measures for Major Pests and Pest Groups**

Pest	Control	Timing of Treatment	Remarks
<b>Adelgids</b> spruce gall adelgid	Dormant oil Malathion Imidacloprid	Treat just before buds break in the spring, and/or in September and early October after galls have opened. Use Dormant oil in late March.	Spring treatments should be applied before cottony egg masses are evident on buds. Cooley spruce gall adelgid on Douglas fir does not produce galls; it feeds openly on the needles. Sprays can be applied in September and October.
pine bark adelgid	Insecticidal soap Malathion Imidacloprid	Treat in late April or early May and repeat 2-3 weeks later.	Use a forceful spray to penetrate cottony secretions and wash aphids from twigs and bark. Use less-toxic materials in public areas and around homes.
hemlock woolly adelgid	Dormant oil (Horticultural oil) Insecticidal soap Imidacloprid	Treat anytime with Dormant oil although early November is best. Treat with Imidacloprid in April or May as a soil drench.	The best compounds are horticultural oils which smother the insects. A 1% solution is recommended from May through September, and a 2% solution from October to April. Thoroughly wet entire plant including the bark of branches and the trunk. Use a forceful spray; be sure the new growth is thoroughly wet. Dormant oil is also called horticultural oil.
hickory leafstem gall aphid	Malathion Insecticidal soap	Treat just as new buds are beginning to open. Timing is critical.	Because aphids begin feeding immediately as leaf buds begin to open, control is very difficult and often ineffective. A minor pest of older well established trees.
<b>Aphids</b> (general)	Acephate (Orthene) Bifenthrin (Talstar) BotaniGard Cyfluthrin Esfenvalerate Horticultural oil Imidacloprid Insecticidal soap Malathion Neem oil Permethrin Pyrethrins + PBO Resmethrin Rotenone Tetramethrin	When first seen. Some (spirea, willow twig, white pine ) occur in the spring. Others (crape myrtle, giant bark, willow leaf, linden, maple, and oak) build up in mid-summer. Many (white pine aphid) may be present, migrating to hosts throughout the season and in the fall.	Apply control measures before populations become large. Aphids may infest buds, leaves, stems, branches, or trunks of the host plants. Be sure to follow all label directions and precautions. Use less toxic and less hazardous materials in public areas, around homes, and where plants are to be moved or transplanted. Be aware of lady beetles, aphid lions, syrphid larvae, and other predators that may reduce populations. Do not spray when plants are flowering and honey bees are active.
<b>Bagworm</b> Acephate (Orthene)	Carbaryl (Sevin) Permethrin Malathion	Apply treatments when bags are less than 1/2 inch. Late May in coastal Virginia, early to mid-June elsewhere. Controls less effective in mid- to late summer.	Lightly misting the foliage is sufficient. Mist blower treatments are effective. Do not use the more toxic or hazardous materials in public areas or around homes. Sevin may lead to mite increases.
	<i>Bacillus thuringiensis</i> ( <i>B.t.</i> )	Treat when larvae are young in mid- to late June.	Lightly misting the foliage is sufficient. Mist blower treatments are effective.
	Remove and burn bags	August to May for light infestation of a few infested trees.	Overwintering eggs remain inside the bags until hatching in late May. Destroy the bags; eggs will hatch from bags thrown on the ground.

**Table 4.5 - Control Measures for Major Pests and Pest Groups (cont.)**

<b>Pest</b>	<b>Control</b>	<b>Timing of Treatment</b>	<b>Remarks</b>
<b>Bark Beetles</b> (Deciduous trees)	Endosulfan (Thiodan) Permethrin	Treatments should be applied to prevent infestation of and breeding in the bark. Treat trees and wood with bark attached as soon as they are cut. Treat weakened or injured trees in late April and repeat 2 or 3 times at monthly intervals.	Thoroughly soak the bark of the trunk and branches. Sprays are more concentrated than usual foliar treatments; avoid excessive drip and wear protective clothing and equipment.
elm bark beetle	Sanitation	Immediately destroy all branches larger than 1-1/2" in diameter as soon as they begin to die or are cut to prevent infestation and breeding by beetles.	Wood should NEVER be piled or stored unless all of the bark is removed. Where possible, susceptible wood should be burned or buried with at least 18-inch fill.
	Permethrin	As late in the spring as possible before LEAF BUDS open, usually early April or late March, depending on plant zone. This treatment can be supplemented with a second spray in early June.	Complete coverage of all bark is absolutely essential, especially the one-year-old twigs in the tops and outer reaches of the trees. The trunk and larger branches should be soaked thoroughly. Spraying is supplementary to sanitation.
shot-hole borer, fruit tree bark beetles, ash bark beetle ( <i>Scolytus</i> )	Endosulfan (Thiodan) Permethrin	Drench the bark of healthy trees in late April and early June.	Normally, these pests are infrequent so it is not necessary to spray all healthy trees annually. If any beetles or signs of their presence are found, treat all healthy trees in the vicinity.
(Conifers)	Endosulfan (Thiodan) Permethrin	Treat unhealthy, weakened, or damaged trees in early April, early June, and August if near infested trees. Also effective in preventing spread if sprayed on infested trees or wood before beetles emerge, or in preventing infestations in uninfested wood that is cut but cannot be disposed of immediately.	Thoroughly wet all of the bark. Healthy vigorous trees are not likely to be attacked and do not require spraying. Beetles will not reinfest or attack wood or trees dead more than one year.
	Sanitation	Throughout the year, particularly during the growing season, when trees begin dying or wood is cut. Prune out large, dying, or recently dead branches.	Dispose of susceptible wood, slash, and bark from stumps by utilization burning, burying where feasible. Beetles will not reinfest or attack wood or trees dead longer than one year.
Asian ambrosia beetle	Permethrin	Treat trunk and larger branches in early April when the daytime temperature exceeds 70°F. for the first time.	Sawdust projecting from the trunk like a toothpick is diagnostic for this insect. Treat the bark but leave infested trees in place as trap trees for 1 month before removing and destroying. Trees can often survive small infestation of just 1 or 2 beetles so not all infested trees will need to be removed.
<b>Borers</b> azalea stem borer, dogwood twig borer	Endosulfan (Thiodan) Imidacloprid Permethrin	Treat one-year-old stems throughout the tree in mid-May and in mid-June.	Cut out and destroy infested wilting stems. Imidacloprid as a soil drench prior to infestation.
banded ash borer	Endosulfan (Thiodan) Permethrin	Treat trunk and main stems in late July and again in early September.	Control measures are preventive treatments aimed at egg-laying adults and/or newly hatched larvae prior to tunneling into the tree.

**Table 4.5 - Control Measures for Major Pests and Pest Groups (cont.)**

Pest	Control	Timing of Treatment	Remarks
<b>Borers (cont.)</b> bronze birch borer	Endosulfan (Thiodan) Imidacloprid Permethrin	Treat all bark surfaces, especially in the uppermost part of the tree in mid- May, and early, mid-, and late June.	Often infests older trees that are in decline. Imidacloprid as a soil drench prior to infestation.
dogwood borer	Endosulfan (Thiodan) Permethrin	Treat trunk and larger branches in mid-May and repeat after 6 weeks.	
emerald ash borer	<i>Systemic Insecticides</i> Imidacloprid Acephate Bidrin emamectin benzoate <i>Contact insecticides</i> Permethrin Bifenthrin Carbaryl Cyfluthrin	Systemics (Imidacloprid, Acephate, Bidrin, or emamectin benzoate) need to be applied in April or May when active uptake from the roots is occurring. Contact insecticides used for branch and trunk sprays need to be applied in early May and early June.	Systemics must be applied <b>before</b> the trees show signs of infestation. Imidacloprid should be applied as a soil drench and emamectin benzoate must be applied by direct tree injection by an arborist.
lilac borer ash borer	Endosulfan (Thiodan) Permethrin	Treat trunk and branches in early May and again 6 weeks later.	Treatments also kill emerging as well as entering borers. Thorough wetting and soaking of the bark is necessary. Foliage need not be treated.
locust borer	Endosulfan (Thiodan) Imidacloprid Permethrin	Treat the trunk and larger branches in late August to mid-September (before goldenrod is in bloom).	Sprays applied in early spring provide adequate control if fall treatments were not made. Imidacloprid as a soil drench prior to infestation.
mottled willow borer (poplar and willow borer)	Endosulfan (Thiodan) Imidacloprid Permethrin	Treat all bark surfaces in mid- to late June and in late August-early September.	Imidacloprid as a soil drench prior to infestation.
oak borer	Endosulfan (Thiodan) Permethrin	Treat trunk to ground level in early June.	Large populations are likely in even-numbered years.
peach tree borer	Endosulfan (Thiodan) Permethrin	Treat trunks and soil around the base in July and repeat in 6 weeks.	
pine sawyer	Permethrin	Treat in May.	Treat trunks of remaining trees after infested trees are removed. These insects are usually secondary.
rhododendron borer	Endosulfan (Thiodan) Permethrin	Treat the trunks and larger branches in late June.	
round-headed and flat-headed tree borer	Endosulfan (Thiodan) Imidacloprid Permethrin	Treat bark of trunk and branches in early May, early June, and early July.	Imidacloprid as a soil drench prior to infestation.
round-headed and flat-headed borers, bark beetles, and bark weevils in felled logs or trees only	Endosulfan (Thiodan) Permethrin	Thoroughly wet the bark surface immediately after trees or logs are cut.	Remove bark to eliminate breeding sites.
two-lined chestnut borer	Endosulfan (Thiodan) Imidacloprid Permethrin	Treat trunk and branches during mid- to late May and mid- to late June.	Imidacloprid as a soil drench prior to infestation.

<b>Table 4.5 - Control Measures for Major Pests and Pest Groups (cont.)</b>			
<b>Pest</b>	<b>Control</b>	<b>Timing of Treatment</b>	<b>Remarks</b>
<b>Boxelder Bug</b>	Carbaryl (Sevin) Cyfluthrin Malathion	Treat seed bearing female trees and flower beds where seeds fall and collect.	Boxelder bugs are rarely pests on their host trees but become nuisances when they collect on the outside of buildings and enter buildings in search of overwintering sites.
<b>Cicada</b> (periodical cicada)	Carbaryl (Sevin) Permethrin	Treat bark of twigs on susceptible hosts soon after adult male singing becomes evident, usually around early May.	Netting around small trees may keep most cicada off the trees. Use netting with a 1/4" holes. Cicada damage is caused by adult females inserting eggs in deep slits in twigs. Control is necessary only for young trees in the year of the 13-year and 17-year brood emergence in various locations. Annual cicadas in late summer are not pests. See <a href="http://www.ext.vt.edu/pubs/entomology/444-276/444-276.html">http://www.ext.vt.edu/pubs/entomology/444-276/444-276.html</a> for emergence dates of the 17-year cicada in your county.
<b>Cutworms, Climbing Cutworms</b>	Permethrin Pyrethrins + PBO <i>Bacillus thuringiensis</i> (B.t.)	Treat when cutworms are found.	Feeding occurs at night. Thoroughly wet the soil with spray. Apply in the evening. Physical barriers may work as well.
<b>Defoliators</b> all other defoliators (caterpillars, sawflies, leaf beetles, etc.)	Acephate (Orthene) <i>Bacillus thuringiensis</i> (B.t.) Bifenthrin (Talstar) Cyfluthrin Carbaryl (Sevin) Conserve SC Malathion Permethrin	When insects are first observed feeding. Timing varies with the species. It is critical to observe plants regularly to detect feeding as soon as it begins. Once caterpillars are larger than 1.5 inch long, it is usually too late for control that season.	Insecticide combinations marketed by formulators and distributors are available. Consult the labels for specific uses and precautions. Mist blowers are effective. (Use <i>Bt</i> only for caterpillars)
buck moth caterpillar	Acephate Carbaryl (Sevin) Permethrin	Treat in mid- to late May or June when eggs have hatched but larvae are small.	Sevin may injure tender foliage if plants are wet when treated or humidity is high.
cankerworms	Acephate (Orthene) <i>Bacillus thuringiensis</i> (B.t.) Carbaryl (Sevin) Permethrin	In May when the leaves are half to two-thirds full size, treatments must be applied when loopers are small.	
eastern tent caterpillar	Acephate Carbaryl (Sevin) Cyfluthrin Esfenvalerate Imidacloprid Malathion Pyrethrins + PBO Tetramethrin	Treat in April after leaves open.	A sporadic pest, not a pest every year.

**Table 4.5 - Control Measures for Major Pests and Pest Groups (cont.)**

Pest	Control	Timing of Treatment	Remarks
<b>Defoliators (cont.)</b> euonymus leaf notcher	Carbaryl (Sevin) Acephate Conserv	In late March or early April when insects are seen.	Sprays are usually ineffective if applied when caterpillars are less than 0.5 inch long.
fall webworm	Acephate (Orthene) Bifenthrin (Talstar) <i>Bacillus thuringiensis</i> (B.t.) Carbaryl (Sevin) Dycarb Esfenvalerate Permethrin	When larvae first begin to feed in late June. Repeat in late July.	
flea beetles	Carbaryl (Sevin) Cyfluthrin Esfenvalerate Fluvalinate (Mavrik) Permethrin	When insects are found feeding on host plants as adults or as larvae.	Sevin may injure tender foliage if plants are wet when treated or humidity is high.
grasshoppers	Carbaryl (Sevin) Cyfluthrin Esfenvalerate Pyrethrins + PBO	When grasshoppers are found feeding.	Grasshoppers are infrequent pests but can be destructive when abundant.
gypsy moth	Acephate (Orthene) <i>Bacillus thuringiensis</i> (B.t.) Carbaryl (Sevin) Cyfluthrin Diflubenzuron (Dimilin) Esfenvalerate Permethrin	When leaves have expanded but caterpillars are small, usually in mid-May.	Mist blowers and aerial applications are effective. Large trees may require power equipment.
Japanese beetle	Acephate Carbaryl (Sevin) Cyfluthrin Esfenvalerate Imidacloprid Malathion Pyrethrins + PBO Tetramethrin	In late June or early July after adults have begun to congregate on selected hosts. Repeat as necessary into August.	Since adults actively fly and move continuously, they seem to be present constantly even where treatments have been applied. Treat with Imidacloprid in spring when new growth starts.
rose chafer	Malathion	During June and mid-summer when insects are found.	Adults are active flyers and move continually onto susceptible hosts.
roseslugs	Acephate Carbaryl (Sevin) Imidacloprid Malathion	Throughout the growing season when young larvae are seen on plants, especially in May, June.	Close inspection of plants is necessary to time treatments when larvae are young and damage is not yet severe.
sawflies	Acephate Carbaryl (Sevin) Esfenvalerate (Pine sawflies) Imidacloprid Malathion	Timing varies in the season depending on the host plant and the sawfly species.	Label uses are limited to pines, larch, ash, and spruce.
tussock moth	Permethrin	In mid-May or late August.	Treat when larvae are small.
willow leaf beetle	Carbaryl (Sevin) Imidacloprid Pyrethrins + PBO	In May, June, and later if infestations persist. There may be several generations in a season.	Be sure to treat the undersides of the leaves.

<b>Table 4.5 - Control Measures for Major Pests and Pest Groups (cont.)</b>			
<b>Pest</b>	<b>Control</b>	<b>Timing of Treatment</b>	<b>Remarks</b>
<b>European Hornet</b>	No direct control with insecticides	By observing the direction and flight path of hornets from the point of damage, the nesting site can be found. Destroy the nest. Hornets collect the bark for use in building their nest.	Lilac, boxwood, and certain other trees and shrubs. Rarely sting. Usually nest in hollow trees.
<b>Gall Insects</b>	Carbaryl (Sevin)	Treatments are effective when insects are active, before galls appear in spring.	Most gall insects sting or feed on the host to incite the galls. Most gall insects leave the galls when mature. Disposing of galls is not effective in reducing the pest unless they can be cut out while they are actively growing, such as horned oak gall and gouty oak gall.
<b>Iris Borer</b>	Carbaryl (Sevin) Permethrin Imidacloprid	Treat when leaves are 5 to 6 inches tall.	Dispose of dry leaves and debris in the fall.
<b>Lacebugs</b>	Acephate (Orthene) Carbaryl (Sevin) Cyfluthrin Imidacloprid Malathion Methoxychlor Pyrethrins + PBO Tetramethrin	On evergreens, overwintering eggs hatch in mid- to late May. Treat in late May or early June and repeat at 3-week intervals. On deciduous hosts, adults emerge in May. Treat in late May and repeat at 3-week intervals.	Consult the label for host plants and specific pests listed under directions for use. Treatments must cover the undersides of the leaves thoroughly. Control of the first generations is most important to slow population buildup. Examine foliage for lacebugs into fall.
<b>Leafhoppers</b>	Acephate Carbaryl (Sevin) Cyfluthrin Esfenvalerate Imidacloprid Malathion Permethrin Pyrethrins + PBO Resmethrin	When leafhoppers are first seen and before stippling on undersides of leaves becomes extensive.	Thorough coverage is essential on the undersides of the leaves. Check plants as soon as leaf buds open in spring; continue checking into early summer.
<b>Leafminers</b> azalea leafminer	Acephate (Orthene) Imidacloprid Pyrethrins + PBO Permethrin Tetramethrin	Treat in mid-late May or when mines are first seen on the plants.	Be cautious with dimethoate on azaleas, some varieties may be susceptible to plant injury.
boxwood leaf miner	Malathion Permethrin Pyrethrins + PBO Tetramethrin	Treat in April or early May when adults are active.	Numerous adults can be eliminated before eggs are laid.
	Imidacloprid	Treat in April as a soil drench.	This systemic treatment is most effective in eliminating miners. It is also effective later in the season, but needs to be applied before miner activity.

**Table 4.5 - Control Measures for Major Pests and Pest Groups (cont.)**

Pest	Control	Timing of Treatment	Remarks
<b>Leafminers (cont.)</b> holly leafminers	Acephate Carbaryl (Sevin) Imidacloprid Permethrin Pyrethrins + PBO Tetramethrin Imidacloprid	Treat in mid-May when adults are active on the foliage.	Helps reduce feeding punctures on undersides of leaves but may not prevent all mines in the foliage.
oak leafminer	Acephate (Orthene) Imidacloprid Permethrin Pyrethrins + PBO Tetramethrin	Treat when mines are first seen - less than 1/4 inch. Several generations occur each session.	Rake and destroy leaves in fall.
All other leafminers	Acephate (Orthene) Imidacloprid	Treat in mid- to late June after eggs have hatched.	These systemics are effective in eliminating miners, they are also effective later in the season, but mines will be present on the foliage.
<b>Leafrollers, Leaf Tiers</b>	Acephate <i>Bacillus thuringiensis (Bt)</i> Carbaryl (Sevin) Cyfluthrin Permethrin Pyrethrins + PBO	Treat when insects are first seen. On some hosts, injury occurs in early spring when new buds are opening.	Consult the label for specific host plants listed.
<b>Mealybugs</b>	Horticultural oil	Treat in late spring, before new growth begins.	Forceful spray streams help penetrate cracks and crevices in the bark and waxy secretions that protect the mealybugs. Spray on warm days when the temperature remains above 40° F (5°C) for 12- 24 hours. Do not spray sensitive plants listed on the label.
	Acephate (Orthene) Carbaryl (Sevin) Cyfluthrin Imidacloprid Malathion Permethrin	Treat whenever mealybugs are first noticed. Repeat 2-3 applications if necessary until infestation is eliminated.	Forceful spray streams help penetrate cracks and crevices in the bark and waxy secretions that protect the mealybugs.
<b>Mites</b> hemlock rust mite eriophyid mites	Horticultural oil	Treat in early spring before new growth develops.	Do not use on sensitive plants indicated on the label.
	Carbaryl (Sevin)	Treat when mites are found in	Thoroughly wet the undersides of very early spring, in late fall, or leaves with a full coverage spray. during the growing season.
spruce mite, southern red mite, boxwood mite	Acephate Bayer 3-in-1 Dienchlor (Pentac) Isotox Malathion Permethrin Horticultural oil	Treat in late April or early May and/or in September and October, except for horticultural oil, which should be used in early spring, just before new growth starts.	Thoroughly wet all of the foliage and stems with a full coverage spray. Use Isotox only if it contains a miticide.
honeylocust mite	Bayer 3-in-1 Insecticidal soap Permethrin	One application in late June or early July will prevent damage. Treat when mites occur to control established infestations.	Thoroughly wet the undersides of leaves with a full coverage spray.

**Table 4.5 - Control Measures for Major Pests and Pest Groups (cont.)**

<b>Pest</b>	<b>Control</b>	<b>Timing of Treatment</b>	<b>Remarks</b>
<b>Mites</b> (cont.) two-spotted spider mite	Acephate Bayer 3-in-1 Dicofol (Kelthane) Insecticidal soap	Treat whenever mites first appear. Infestations may occur from spring to fall. Mite infestations are directly proportionate to increasingly warmer temperatures.	Thoroughly wet the foliage and stems with a full coverage spray.
<b>Plant Bugs, Planthoppers</b>	Carbaryl (Sevin) Malathion Resmethrin	Treat when insects or signs of damage first appear. Treat honeylocust as soon as new growth begins.	Control is difficult because plant bugs are active flyers and move around continuously.
<b>Psyllids</b> (Boxwood psyllid, hackberry psyllid)	Acephate Carbaryl (Sevin)	Treat in late April or early May as new growth begins to develop.	
<b>Rose Slugs</b>	Acephate Carbaryl (Sevin) Imidacloprid Malathion Rotenone	Spray when small larvae are first seen. Timing depends on the species and the host. Rose slugs, like most sawflies, are gregarious, working in groups, localized on certain branches of the host.	Roses are susceptible.
<b>Sawflies</b>	Acephate Carbaryl (Sevin) Imidacloprid Malathion	Treat when insects are first seen. Various species can occur throughout the growing season. Treat in April for Virginia pine sawfly. Larvae are gregarious, thus broods are clustered on one branch or localized on scattered trees.	A number of damaging species are not listed on labels. Ash, larch, pines, and spruces are listed.
<b>Scale Insects</b> (General all scales)	Acephate (crawlers) Cyfluthrin (crawlers) Horticultural oil Imidacloprid (soft scale) Imidacloprid (armored scale suppression only) Permethrin	For horticultural oil, treat in late March or early April before new growth develops, and when temperatures are not likely to go below 40°F (5°C) for 12-24 hours. For other insecticides on list treat at crawler date.	Do not spray oil-sensitive plants listed under precautions on the label. Be sure to follow the dosage rates given on the label for the various scale species. Oils can also be used as summer sprays when indicated on the label. Imidacloprid may not control all types of scales.
Azalea bark scale	Horticultural oil Imidacloprid Insecticidal soap Malathion Permethrin	Crawlers: June 5-30 Treat June 10-20.	
brown soft scale	Carbaryl (Sevin) Horticultural oil Imidacloprid Insecticidal soap Permethrin	Treat when scale insects appear. Treat 2-3 times at 10-day intervals.	This scale insect does not winter out-of-doors in colder plant zones of Virginia.
calico scale	Carbaryl (Sevin) Horticultural oil Insecticidal soap Imidacloprid Permethrin	Crawlers: June 1-20. Treat June 10-15.	
camellia scale	Horticultural oil Imidacloprid Insecticidal soap Permethrin	Crawlers: May 1-June 5 and September 15-30. Treat May 10-20 and/or September 10-20.	

**Table 4.5 - Control Measures for Major Pests and Pest Groups (cont.)**

Pest	Control	Timing of Treatment	Remarks
Scale Insects (cont.) cottony camellia scale	Carbaryl (Sevin) Horticultural oil Imidacloprid Insecticidal soap Malathion Permethrin	Crawlers: June 1-10. Treat June 10-20.	
cottony maple leaf scale	Acephate (Orthene) Carbaryl (Sevin) Horticultural oil Insecticidal soap Imidacloprid	Crawlers: June 1-10. Treat June 15-30.	
cottony maple scale	Carbaryl (Sevin) Horticultural oil Insecticidal soap Imidacloprid Permethrin	Crawlers: June 5-25. Treat June 10-20.	Be sure to thoroughly cover stems and branches near the ground.
euonymus scale	Carbaryl (Sevin) Horticultural oil Insecticidal soap Malathion Permethrin	Crawlers: first generation May 5-June 10; second July 1-25. Treat May 10-20 and July 5-15.	
European elm scale	Carbaryl (Sevin) Horticultural oil Imidacloprid Insecticidal soap Permethrin	Crawlers: June 5-25. Treat June 10-15.	
fern scale	Carbaryl (Sevin) Horticultural oil Insecticidal soap Permethrin	Crawlers: first appear in mid-May. Treat at 2-week intervals as needed.	
florinia hemlock scale	Horticultural oil Insecticidal soap Permethrin	Crawlers: peak May 15-June 20, some produced throughout the season. Treat May 20-25 and June 5-10.	
letcher scale	Carbaryl (Sevin) Horticultural oil Insecticidal soap Imidacloprid Permethrin	Crawlers: in early to mid-June. Treat June 15-20.	On Taxus and Arborvitae.
Florida red scale	Acephate (Orthene) Carbaryl (Sevin) Horticultural oil Insecticidal soap Permethrin	Crawlers: May 5-15. Treat May 15-30.	
forbes scale	Carbaryl (Sevin) Horticultural oil Insecticidal soap Malathion Permethrin	Crawlers: June 1-15. Treat June 5-10.	Label uses restricted to flowering fruits.
gloomy scale	Carbaryl (Sevin) Horticultural oil Insecticidal soap Permethrin	Crawlers: peak June 10-20. Treat June 20-30.	Serious pest that is difficult to control.

#### 4-40 Home Ornamentals: *Insects of Trees and Shrubs*

<b>Table 4.5 - Control Measures for Major Pests and Pest Groups (cont.)</b>			
<b>Pest</b>	<b>Control</b>	<b>Timing of Treatment</b>	<b>Remarks</b>
Scale Insects (cont.) golden oak scale	Horticultural oil Insecticidal soap Permethrin	Crawlers: June 1-30. Treat June 10 and June 20.	
Japanese scale	Carbaryl (Sevin) Horticultural oil Malathion Permethrin	Crawlers: June 1-September 1. Treat at 2-week intervals June- September.	
juniper scale	Carbaryl (Sevin) Horticultural oil Insecticidal soap Malathion Permethrin	Crawlers: April 5-20 and June 5-20. Treat April 10-15 and/or June 10-15.	Crawler dates vary based on temperature.
latania scale	Horticultural oil Insecticidal soap Permethrin	Crawlers: continuous from June through season. Treat 2-3 times at 10 day intervals.	
lecanium scale	Horticultural oil Imidacloprid Permethrin	Crawlers: May 25-June 25. Treat June 15-20.	Treat for oak lecanium June 1-10 in coastal areas. lecanium, crawlers from June 1-20. Treat June 10-15.
magnolia scale	Acephate Cyfluthrin Horticultural oil Insecticidal soap Imidacloprid Permethrin	Treat September 1-20.	
oak kermes	Horticultural oil Permethrin	Crawlers: June 1-20. Treat June 10-15.	
obscure scale	Carbaryl (Sevin) Horticultural oil Malathion Permethrin	Crawlers: on red oak during July. Treat white oaks in mid-August.	Also treat with oil as a dormant spray.
oystershell scale	Carbaryl (Sevin) Horticultural oil Insecticidal soap Permethrin	Crawlers: May 1-20 and July 15-25. Treat May 5-10 and/or July 20-25.	
peony scale	Carbaryl (Sevin) Horticultural oil Insecticidal soap Malathion Permethrin	Crawlers: mid-May. Treat in late May.	
pine needle scale	Carbaryl (Sevin) Horticultural oil Insecticidal soap Malathion Permethrin	Crawlers: April 20-May 30 and July 10-20. Treat May 5-20 and/or July 15-20.	
pine tortoise scale	Carbaryl (Sevin) Horticultural oil Imidacloprid Insecticidal soap Permethrin	Crawlers: June 10-July 5. Treat June 20-25.	

**Table 4.5 - Control Measures for Major Pests and Pest Groups (cont.)**

Pest	Control	Timing of Treatment	Remarks
<b>Scale Insects</b> (cont.) rose scale	Carbaryl (Sevin) Horticultural oil Insecticidal soap Permethrin	Crawlers: late May-June 30, possible second generation in August. Treat June 5-10 and 20-25 and in mid-August.	
San Jose scale	Carbaryl (Sevin) Horticultural oil Insecticidal soap Lime Sulfur spray	Crawlers: at least 3 generations June, July, and September. Treat June 10-15, July 10-15, September 10-15.	Lime sulfur as dormant spray only.
tea scale	Horticultural oil Insecticidal soap Permethrin	Crawlers: throughout season in overlapping generations. Treat 2-3 times at 10-day intervals when infested.	
Tuliptree scale	Acephate (crawlers) Cyfluthrin (crawlers) Horticultural oil (winter best) Permethrin	Treat September 1-20.	
wax scale	Carbaryl (Sevin) Horticultural oil Permethrin	Crawlers: June 1-25. Treat June 10-30.	Thoroughly wet foliage and bark with a full-coverage spray.
white peach scale	Horticultural oil Insecticidal soap Malathion Permethrin	Crawlers: April 25-May 15, July 1-15, August 20- September 15. Treat May 1-10, July 5-15, September 1-10.	
<b>Spittlebugs</b>	Carbaryl (Sevin) Cyfluthrin Permethrin	Treat in early June if yellowing or damage occurs.	Rarely of economic importance.
<b>Slugs and Snails</b>	MesuroI Metaldehyde	Apply when pests are observed.	
<b>Tent Caterpillars</b>	Acephate <i>Bacillus thuringiensis</i> (B.t.) Carbaryl (Sevin) Esfenvalerate Malathion Permethrin	Treat in early spring as new growth is developing and when caterpillars are small.	Caterpillars leave the nests to feed on the foliage during the day. Apply full coverage spray to the entire tree. Forest tent caterpillar does not make a tent.
<b>Thrips</b>	Acephate (Orthene) Cyfluthrin Imidacloprid	Treat in June when thrips are active on new foliage.	
<b>Tip Moths</b>	Acephate (Orthene) Imidacloprid Permethrin	Treat with liquid formulation in mid-March, April, June, and July when moths are flying.	Spray entire tree to runoff. Two- and three-needle pines are susceptible to tip moth. Imidacloprid can be used as a soil drench.
<b>Treehoppers</b> (Thornbugs)	Carbaryl (Sevin)	Treat when nymphs are seen on twigs (usually in clusters) before adults are present to begin egg-laying, usually in late summer and fall.	Apply sprays to cover the small twigs thoroughly. Usually a minor pest.
<b>Twig Girdlers,</b> <b>Twig Pruners</b>	Carbaryl (Sevin)	Gather and burn fallen branches and twigs in late fall.	Oak, hickory, and many trees and shrubs are susceptible.

4-42 Home Ornamentals: *Insects of Trees and Shrubs*

<b>Table 4.5 - Control Measures for Major Pests and Pest Groups (cont.)</b>			
<b>Pest</b>	<b>Control</b>	<b>Timing of Treatment</b>	<b>Remarks</b>
<b>Webworms</b> cotoneaster webworm	Permethrin Pyrethrins + PBO	Treat when larvae are first found. Timing not well established.	Apply a full-coverage spray, wetting foliage to the point of runoff.
fall webworm	<i>Bacillus thuringiensis</i> (B.t.) Permethrin Pyrethrins + PBO	Treat in late June or early July when larvae are small and webs just starting to form. Treat for second generation in August or early September.	Caterpillars are gregarious and infest individual branches. Apply full-coverage foliar spray to infested area, or entire tree in years of high populations.
juniper webworm	Permethrin Pyrethrins + PBO	Treat in late July or in August when larvae are small. Spring treatments may be applied when plants are found to be infested.	Apply a forceful spray to penetrate severely webbed foliage. Thoroughly wet the foliage to runoff.
mimosa webworm	Acephate Permethrin Pyrethrins + PBO	Apply foliage sprays at 4- to 5-day intervals until the infestation is controlled.	
pine webworm	Permethrin Pyrethrins + PBO	Treat in early June.	
<b>Weevils</b> Two-banded Japanese weevil, black vine weevil	Acephate (Orthene) Imidacloprid	Apply in July as a full-coverage spray when foliar feeding is first observed.	Orthene is for black vine weevil adults.
pales weevil	Permethrin	April	Treat stumps of trees cut less than 12 months ago and new seedlings.
white pine weevil	Endosulfan (Thiodan) Malathion Pyrethrins + PBO	Apply sprays in the spring before adults lay eggs, normally prior to April 1-10.	Treat only the main terminal leaders of the tree down to the first whorl of branches. Thoroughly wet the bark.
	Cut out and burn infested leaders.	Prune out infested leaders during June.	Adults begin emerging from infested leaders in July.
<b>Whiteflies</b>	Acephate Cyfluthrin Esfenvalerate Imidacloprid Permethrin Resmethrin Tetramethrin	When whiteflies are found. Treat every 3 weeks until infestation is controlled.	See label.
	Endosulfan (Thiodan)	When whiteflies are found.	Do not apply to chrysanthemum varieties noted on label. Do not spray on birch.
<b>Zimmerman Pine Moth</b>	Permethrin	Treat in early to mid-April and in early September.	Apply as full coverage spray to the point of runoff.

**Table 4.6 - Directions for Pesticide Usage**

There are many formulations and distributors of various brands of chemicals, hence, there is considerable variation in the names and concentrations of formulations available. The following table is a guide to the more common formulations and amounts to use.

**The product label is the final authority on uses and amounts to mix for treating plants.**

**Abbreviations:**

G-granules, granular; W, WP-wettable, wettable powder; E, EC-emulsifiable concentrate;

S, SP-sprayable, sprayable powder; F-flowable, A-aerosol, D-dust, tbsp-tablespoon; tsp-teaspoon

**Equivalents:**

1 pound dry formulation per 100 gallons = 1 tablespoon per gallon

1 pint liquid formulation per 100 gallons = 1 teaspoon per gallon

3 teaspoons = 1 tablespoon = 1/2 fluid ounce = 14.8 cc

4 tablespoons = 1/4 cup = 2 fluid ounces = 59.2 cc

16 tablespoons = 1 cup = 8 fluid ounces = 1/2 pint = 236.6 cc

2 pints = 1 quart = 946.2 cc or 0.946 liter

8 pints = 4 quarts = 1 gallon = 3785 cc

1 liter = approx. 33 fluid ounces or 1 quart 1 fluid ounce

Chemical	Formulation	Pests Controlled	Amount to Use in		Potential Plant Injury
			1 gal	3 gal	
acephate (Orthene)	9.4% EC	aphids	2 tbsp	6 tbsp	elm, crabapple, maple, poplar, redbud, weigella, hibiscus, gloxina, salvia, philodendron
		other labeled uses	3 tbsp	9 tbsp	
<i>Bacillus thuringiensis</i> (Dipel, B.t., Thuricide or Bactospeneine, etc.)	various	defoliating caterpillars	Amounts depend on product and formulation. See label for exact amounts for specific pests.		—
carbaryl (Sevin)	21.5% Liq.	all labeled uses	1 1/4 tbsp	4 tbsp	Plants in bloom, Boston ivy, English ivy, schefflera, Boston fern, <i>peperomia</i> sp., aluminum plant, syngonium, (When adding a miticide on plants susceptible to mites, check phytotoxicity for dicofol.) May burn tender foliage when wet if humidity is high.
	50W	all labeled uses	2 tbsp	6 tbsp	
	5D	all labeled uses	Ready-to-Use		
diazinon	25% EC	all labeled uses	2 tsp	2 tbsp	African violet, ferns, gardenia, hibiscus
Knox Out	1A	all labeled uses	—	—	poinsettia, stephanotis, pilea, jade, adiantum, anthurium, asparagus ferns, begonia, cissus, <i>Hoya</i> sp., <i>Peperomia</i> sp., <i>Scindapsus</i> sp.
dimethoate (Cygon)		For outdoor use only, use only for hosts and pests listed on the label.	see label	see label	Burford and other Chinese holly, begonia, ferns, crape myrtle, hibiscus, mums, dahlias, Easter lilies, hydrangea, honey locust, dogwood, elm, maple, andromeda, viburnum, flowering almond, flowering cherry, geranium, potted plants, certain azalea varieties, new growth on andromeda (Pieris)

#### 4-44 Home Ornamentals: *Insects of Trees and Shrubs*

**Table 4.6 - Directions for Pesticide Usage (cont.)**

Chemical	Formulation	Pests Controlled	Amount to Use in		Potential Plant Injury
			1 gal	3 gal	
horticultural oil	98%	For dormant use on specified plant and pests	5.1/3 tbsp	1 pint Japanese maple,	sugar and beech, birch, walnut, butternut, hickory, redbud, juniper, douglas fir, blue spruce
		For growing season use on specified plants and pests	2 2/3 tbsp	1 cup	
endosulfan (Thiodan, Thiogard)	9.7% EC	All labeled uses	2 tbsp	6 tbsp	See label
	3% D		Ready-to-Use		
imidacloprid	various	See label	See label		See label
insecticidal soap	various	aphids, mealybugs, lacebug, psyllids, scales, thrips, whiteflies	Varies with Formulation		See label
lime sulfur	26% EC	All labeled uses	2 tsp	2 tbsp	See label for use as dormant spray.
malathion	various	aphids, mealybugs, 4- lined plant bugs, Japanese beetles, leafhoppers, tarnished plant bugs, thrips, scale insects, millipedes, springtails.	Varies with formulation		ferns, crassula, gloxinia, petunia, Canaert, red cedar, red carnations, roses, Saint paulia, viola, blossoms on poinsettia, orchids, sweet peas, begonias, kalanchoe, cyclamens, anthuriums, aralia cissus, <i>Ficus</i> sp., <i>peperomia</i> sp., hibiscus, pilea, schefflera, scindapsus, syngonium.
metaldehyde (bait)	3.25% Pellets	snails, slugs	Use 1 lb/1000 sq ft (100'x10'). Irrigate prior to application. Scatter on or beneath benches, around border, edges, etc. May be placed in pots if plants are well established. Apply to soil around plants, not to foliage.		—
methoxychlor (Marlate)	50WP	Japanese beetles, leafhoppers, lace bugs, blister beetles, cucumber beetles, flea beetles, rose chafers, rose slugs, sawflies	2 tbsp	6 tbsp	Mums. Do not spray when temperature is above 85° F.
permethrin	various	See label	See label	See label	See label
phosmet (Imidan)	12.5WP	elm spanworms, cankerworms, gypsy moths	3 tbsp	9 tbsp	See label
pyrethrins	various	See label	See label	See label	See label
resmethrin	23.4EC	aphids whiteflies	1 tsp	1 tbsp	See label
rotenone	various	See label	See label	See label	See label
spinosad	various	See label	See label	See label	See label

## Organic Controls for Insects of Home Ornamentals

Eric R. Day, Extension Entomologist, Virginia Tech

Peter B. Schultz, Extension Entomologist, Hampton Roads AREC

**Table 4.7 - Organic Control Use**

Product <sup>1</sup>	Insects Controlled	Remarks
<i>Bacillus thuringiensis</i>	Most caterpillars, loopers, hornworms and bagworms	This product, also known as Bt, is sold under many trade names
M-One (Bt/Sandiego)	Elm leaf beetle, willow leafbeetle	This is a new strain of <i>Bacillus thuringiensis</i> , variety: <i>san diego</i> , which is particularly effective against selected beetle larvae.
Insecticidal soap	Works well on soft bodied insects in particular aphids, mites, lacebugs and mealybugs	
Rotenone	Many garden insect pests including Japanese beetles, flea beetles, aphids, weevils, leafhopper.	Usually sold as a dust, but some formulations can be mixed in water.
Pyrethrin	Broad spectrum, works on a wide variety of insects	Usually sold mixed with other botanical insecticides such as rotenone.
Pyrethrin/ Diatomaceous Earth	Whiteflies, fireants	Follow all label precautions.
Neem	Broad sprctrum	See label for precautions
Hot Pepper Wax	Aphid 1, Mite1, Thrips	See label for precautions
Spinosan	Caterpillar 1, Beetle 1	See label for precautions
Gnatrol (Bt/H-14)	Fungus gnats	Used as a soil drench
Predators <sup>1</sup>	Insects Controlled	Remarks
Lady beetles	Feed on aphids and other soft bodied insects	<i>Hippodamia</i> and other lady beetles are sold for controlling aphids on outdoor plantings, but they may leave to find other prey. <i>Cryptolremus</i> for mealybug, <i>Delphastus</i> for whitefly.
Lacewings	Aphids, scales, mealy bugs and other soft bodied insects	Immature lacewings are called aphidlions. Most are <i>Chrysoperla</i> .
Predatory mites	Mostly for control of spider mites.	Release approximately 2/square foot. <i>Phytoseiulus persimilus</i> will work in most situations, <i>Mesoseiulus</i> and <i>Amblyseius</i> work for greenhouse and interior scape.
Predatory nematodes	Many ground dwelling and boring insect pests	These nematodes will actively seek host prey and do not harm plants or humans. Exhibit for fungus gnats, grubs and weevils.
Parasitic wasps	Many insect pests on the foliage including caterpillars and whiteflies	<i>Trichogramma</i> wasps work well on many caterpillars. <i>Encarsia formosa</i> for greenhouse whitefly. <i>Diglyphus</i> for leafminer, <i>Aphytis</i> for armored scale.

<sup>1</sup>Botanical insecticides are derived from various plant parts and are commonly used in organic control situations. It is important to read the label and follow all precautions regarding protective clothing, mixing and labeled plants. Just because it is derived from plants doesn't mean that safety can be disregarded. Biological control is in two major forms. Microbial, which is a formulation containing a microorganism such as *Bacillus thuringiensis*, or the other form, which involves the release of predatory insects or mites, such as lady beetles. Use caution with insecticides when a release of predators is planned. Also see the Organic and Biological Control section of the Insect Identification Laboratory homepage on the World Wide Web: <http://www.ento.vt.edu/Facilities/OnCampus/IDInfo.html>



## **Insects of Foliage and Houseplants**

*Eric R. Day, Extension Entomologist, Virginia Tech*

Relatively few kinds of insects, mites, and related pests occur on foliage and houseplants. However, those few have an extensive host range and can be highly destructive to the wide variety of valuable plants grown in the home.

Cultural and mechanical control measures are very important. They are often more practical than insecticides. Relatively few individual plants are grown in the home, but may represent a variety of kinds that seldom are all infested with pests at any one time. The use of pesticides in the home is generally undesirable and messy. Also, the preparation of small quantities is employed. Chemical injury to plants (phytotoxicity) may be a potential problem since foliage plants and other houseplants vary widely in their susceptibility to sprays and pesticides.

Insecticides should be used primarily as corrective control treatments when pests are known to have become established, not as a regular preventive measure. However, treatments should be applied before infestations become severe. Before applying any pesticide, **be sure** to read **all** of the directions on the label as well as directions and precautions for each pest and plant in the control recommendations.

The major pests include: aphids, whiteflies, mealybugs, scale insects, and mites (spider mites, cyclamen mite, bulb mite). Less common are thrips, cutworms and other caterpillars, millipedes, and sowbugs. Fungus gnats and springtails are primarily nuisance pests, seldom causing serious damage.

### **Cultural Control**

Prevention is the best way to protect house plants from insects. Once established, the more common pests are most difficult to eliminate, even with pesticides, and easily spread to nearby healthy plants. Cultural control includes the following important aspects of proper plant care.

#### **A. Exclusion**

Carefully inspect any plant to be purchased or propagated for evidence of pests.

Buy or propagate **only** pest-free plants.

Isolate new plants from the vicinity of existing plants for at least a month and look for evidence of pests before placing them among clean, healthy plants.

Remove and isolate any existing plant at the first suspicion of pest infestation.

Avoid placing plants close together to discourage pests from crawling from plant to plant.

Never permit compassion for a sick plant to justify bringing home diseased, pest-ridden plants to recover and hopefully become beautiful again. Discard infested, damaged plants.

#### **B. Sanitation**

Use clean pots, potting materials, soil mix components.

Use only sterilized soil or soil mixes.

Do not contaminate potting soil or pots with garden soil, compost, old soil from used pots, or cuttings from infested plants.

Eliminate weeds; they support pest populations.

#### **C. Resistance (Plants not attacked by or that are less susceptible to pests)**

Select plant types and varieties known to be relatively free from attack by insect and mite pests.

Avoid growing cultivars that are more prone to attack by pests.

### **Mechanical Control**

When relatively few plants are lightly infested with insects or mites, several mechanical control methods may be used effectively. Usually a continued effort is necessary over a period of time and the job itself is time consuming. First isolate the plant from the non-infested area. (If plants are severely infested, see item 4).

## 4-48 Home Ornamentals: *Insects of Foliage and Houseplants*

1. **Washing** the plant with warm or tepid water, or water with a small amount of insecticidal soap, is effective in removing aphids, mealybugs, mites, thrips, and to some extent scale insects and whiteflies. Lightly spray the leaves and stems, particularly where leaves and branches join the stems, with a gentle spray from a faucet or sink hose. The bases of the stems and the crowns of plants are difficult to wash, but often harbor the pests. Washing with a light spray of water alone is not as effective as a soap mixture, especially for mites, scale insects, and whiteflies.
2. **Wiping** or cleaning foliage and stems (both upper and lower leaf surfaces) with a very soft brush or cloth **dampened** with detergent washing solution or rubbing alcohol will remove most of the pests. This method is better for scale insects and mites. Those individuals along leaf veins are especially difficult to wipe away. Excessive alcohol may be injurious to the plant.
3. **Hand-removal** with a cotton swab or a cotton-tipped toothpick dipped in rubbing alcohol, or fine tweezers is a convenient way to remove mealybugs, some scale insects, and aphids when only a few individuals are present. Be sure to check cracks and crevices where petioles and branches join the stems. Slugs and caterpillars can be picked off individually or brushed into a container of alcohol for disposal. Slugs and cutworms feed at night and are most easily found after the plant has been in the dark for an extended period of time.
4. **Plant trimming.** If plants become severely infested and have extensive damage, wash the plants to dislodge excess insects or mites, then prune away the most severely injured foliage and stems to permit regrowth and recovery. Repeat the washing process. This is a good time to repot the plant and renew the soil medium. Follow up with regular washing or insecticidal treatments. If entire plants are damaged, it is best to destroy them without contaminating other plants or planting areas. Remember that handling and moving severely infested plants often results in dislodging some of the pests or permitting them to drop, be brushed, or blown off the plants.

## Chemical Control

Plants can be treated with insecticides or miticides by any method that conveniently but thoroughly covers **ALL** of the plant surfaces. Generally, the use of a pesticide is quicker and more convenient than mechanical control measures. However, dense plants with multiple stems and bushy foliage to the soil level almost defy good coverage. Applying materials can be messy and involves

considerable handling. Certain plants are more difficult to wet with sprays than others. House plants may be variously susceptible to injury by pesticides. In treating relatively few plants, only small amounts of pesticides are needed, making measuring and mixing difficult. Despite these problems, plants must be treated with insecticides when it is necessary. It is best to apply treatments out-of-doors away from other plants when feasible or in a well-ventilated garage or basement.

## Spraying

Spraying is usually the most effective and most convenient way to apply insecticides and miticides to plants, soil, pots, saucers, etc. Plants should be sprayed until thoroughly wet, but without excessive drip. Spray deposit decreases with runoff. Sprayers must be cleaned thoroughly and allowed to dry after each use. Most pesticide sprays are highly corrosive to metal. Some liquid formulations will dissolve certain types of plastic. Sprays may be applied in several ways:

## Aerosols

Aerosols are available in small pressurized cans ready-to-use and pump spray bottles. These are most convenient, but more expensive than mixing dilute sprays from concentrates. Never hold the container close to the plants treated. Injury is likely to result from the propellant, solvent, or excess spray deposit nearest the can. Plants should **NOT** be thoroughly wetted with aerosols, unless so directed on the label.

## Hand Atomizers

Hand atomizers are hand-pumped sprayers that have a 0.5 pint to 1.0 quart metal “tank” or are fitted to accommodate a standard screw-top jar. The most effective is a sprayer that delivers a continuous spray and that has an adjustable nozzle governing the direction of the spray upward or downward.

## Hand Misters

Hand misters are available for “watering” plants by misting, or used containers from window or household cleaning products may be used as inexpensive, replaceable sprayers. A thumb-depressor pump atomizes the spray adequately enough for treating small numbers of plants.

## Compressed Air Sprayers

Compressed air sprayers are the most effective, serviceable, and versatile. However, they are more expensive and generally larger than is necessary for a few small houseplants. If a compressed air sprayer is available, it still may be the most convenient way to treat even small numbers of plants if they are moved outside or to a garage or basement.

## Tips and Precautions for Spraying

1. For hard to wet foliage, add a spreader-sticker to the spray according to the label directions; or, add 0.25 to 0.33 teaspoon of low-sudsing detergent (NOT SOAP) to a gallon of spray mix, or its equivalent in lesser quantities.
2. Do **not** dispose of excess spray material in household drains, outdoor catchbasins, near any water supplies or let runoff into streams. Spread or spray it out as much as possible away from gardens, children, and pet areas where it will not pose a hazard.
3. **Never** put or store insecticides in other than their original container, and **never** leave containers with or without contents outside of proper storage areas. Keep pesticide supplies in a separate storage area that is locked and labeled "Pesticides." Carefully dispose of empty containers in normal trash disposal.
4. Thoroughly wash yourself after spraying, and clean all equipment and sprayed areas.

## Dipping

Dipping plants into a large container of an insecticide-water mixture is effective and avoids any atomized spray in the air. However, this technique requires a larger amount of pesticide mix and creates the problem of disposing of the excess. The mixture must be ample in a large enough container to accommodate the top of the largest plant to be inverted and dipped. Do **not** dispose of excess mixture into the sink or other drains that empty into sewage systems. Dispose of excess on or in the ground where runoff or other contamination is not likely. Do **not** use any container that is involved with food or personal use.

## Dusting

Dusts are not as commonly available for use on house plants, but are effective. They tend to leave excessively evident residues, to be messy if used indoors, and to be easily washed off if plants are misted or watered from above. Dusts are available in small "squeeze" bottles or plastic containers, or can be put into used plastic bottles that have removable caps with small dispenser openings such as those holding lotions or shampoo. The most efficient is a commercial hand duster. Only a barely visible coating of dust is necessary to be effective. Do not coat the foliage.

## General Information

### *Insecticides and Miticides*

The basic insecticides and miticides used are available under a great many brand or trade names. Even with considerable knowledge about pesticides, the many product names, formulations, and ingredient statements are formidable and confusing. Individual

pesticides are identified by their common names (such as malathion, diazinon, or resmethrin, for example) or trade name (such as Orthene, or Sevin, for example). Brand names (such as Isotox or Blue Dragon, for example) do not identify the pesticide in the container; the ingredient statement on the label should be consulted to determine the contents. In some cases, the contents are specified, unfortunately, only with the long chemical name.

### *Formulations*

Pesticides are available in ready-to-use mixtures (push-button aerosols, pre-diluted sprays, and dusts) and as spray concentrates to be mixed with water. The latter include emulsifiable or sprayable concentrates, sometimes indicated as EC-emulsifiable concentrate, EL-emulsifiable liquid, E-emulsifiable, S-sprayable, F-flowable, and WP or W-wettable powder. The number preceding the letter indicates the percentage concentrate (2E, 4EC, etc.). In general, emulsion type sprays provide the most resistance to washing off, but the greatest hazard of plant injury. Wettable powders or flowable formulations are somewhat more readily washed off but are safer to apply on plants. They form suspensions in the spray "tank," however, and must be continually agitated to achieve uniform deposit of spray material. Dusts are readily washed off plants.

It is extremely important to follow label directions for mixing for each formulation used. **Use only the recommended amount.** Increasing the amount of concentrate in the spray mix will **not** make the spray more effective. It will increase the hazard to the person spraying and the likelihood of plant injury.

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### Active Ingredients

It is most economical and logical to apply only the insecticide and/or miticide that is needed and effective. The best indication of which material is effective against which pests is given in these recommendations and on the labels of the products. Certain insecticides work more effectively against some insects than others. Using the wrong chemical is ineffective and a waste of time and money. Always follow all of the directions on the label. Apply treatments only for the pests and plants listed on the label.

Although there are many different products in many combinations, and frustratingly few with houseplants specified by the name on the label, the insecticides and miticides listed in this publication are effective for the pests indicated. Be sure to note the potential plant injury reference. If pests infest plants that are not listed on the label, spray the recommended insecticide on a few leaves and observe if any injury results after a 3- or 4-day period.

**Table 4.8 - Chemical Names and Potential Plant Injury**

Familiar, Common, and Chemical Names	Formulation	Amount Per Gallon	Potential Plant Injury
<b>insecticidal soap</b>	Various	See label	See label
<b>malathion</b> (Cynthion) O,O-Dimethyl S-(1,2-diarbethoxyethyl) phosphorodithioate OR O, O-dimethyl phosphorodithioate of diethylmercaptosuccinate ferns	50% EC	1.5 tsp	anthurium, aralia, <i>Asparagus plumosa spengeri</i> , begonia, <i>Cissus antarctica</i> , crassuala, dieffenbachia (dumb cane), <i>Fiscus</i> sp., <i>Peperomia</i> sp., <i>Pilea</i> sp., schefflera, syndapsis (pathos) syngonium.
<b>Mesuroil</b> (methiocard) (Slug-Geta) 3,5-Dimethyl-4 (methylthio) phenol methylcarbamate	2% Bait	—	None listed.
<b>metalddehyde</b> (Bug-Geta) polymer of acetaldehyde OR metacetaldehyde	3.25% Bait	—	None listed.
<b>Orthene</b> (acephate) O, S-Dimethyl acetylphosphoramidothioate	9.4% EC	3.0 tbsp	gloxinia, philodendron, sabria (repeat application), aphelandra, schefflera, Neanthe belle palm, Nephrolepis fern.
<b>pyrethrins</b>	0.3 A	—	See Label
<b>resmethrin</b> (SBP 1382) 5-Benzyl-3-furyl methyl-2, 2-dimethyl-3-(2-methylpropenyl) cyclopropanecarboxylate (70% trans and CIS ISOMERS) (often with tetramethrin)	24.3% EC	1.0 tsp	General injury may occur if plants are confined in small closed space at high temperature and humidity for longer than prescribed exposure periods.
<b>Sevin</b> (carbaryl) 1-Naphthyl N-methylcarbamate	50% WP	2.0 tbsp	Boston ivy, English ivy, Boston fern, schefflera, <i>Peperomia</i> sp., <i>Pilea cadierri</i> (aluminum plant), syngonium.

**Table 4.9 - Recommended Use**

<b>Pest</b>	<b>Pesticide</b>	<b>Remarks</b>
Aphids	resmethrin, Orthene, malathion, insecticidal soap, imidacloprid	Spray when aphids are first seen. Repeat when necessary.
Armyworms	malathion, Orthene	Hand-picking may be adequate for just a few caterpillars. Wet the soil well while treating the foliage.
Cutworms	malathion, Sevin	Hand-picking may be adequate for just a few caterpillars. Look for them after rooms have been darkened for a few hours; they feed at night. Wet the soil well while treating the plants.
Cyclamen mite	insecticidal soap	Make 2-3 applications at 10-day intervals. For non-chemical control, plants may be immersed with their pots in water carefully maintained at 115° for 15 minutes.
Fungus gnats	Gnatrol	Treat the soil with a light watering.
Mealybugs	pyrethrins, Orthene, malathion, insecticidal soap	Treat 2-4 times at 7- to 10-day intervals.
Millipedes	malathion	Wet the soil and treat the bottom of pots. Millipedes stay in soil.
Scale insects	Orthene, malathion, pyrethrins, insecticidal soap	Treat 2-4 times at 7- to 10-day intervals. Severely infested plants are best discarded.
Slugs, snails	Mesurol, metaldehyde	Do not use mesurol around food plants. Evenly, but lightly, scatter bait on the soil surface; do not put the bait on the foliage. Apply only to established plants. Do not water for 24-48 hours.
Spider mites	insecticidal soap	Treat 2-3 times at 10-day intervals. Insecticidal soap and spider mite aerosols or atomizers are effective if Kelthane is not available.
Springtails	malathion	Treat the soil with a light watering.
Whiteflies	Orthene, resmethrin, tetramethrin, imidacloprid	Treat 2-3 times at 7- to 10-day intervals.



## **Weeds of Ornamentals**

*Jeffrey F. Derr, Extension Weed Scientist, Hampton Roads AREC*

### **Nonchemical Weed Control**

Use a 2- to 4-inch deep mulch. Avoid overmulching. Suitable mulch materials include pine bark, hardwood bark, pine straw, leaves, or similar organic materials. Rock mulches can also be used in certain landscape situations for weed management and tend to provide greater weed control than an organic mulch. Consider placing a landscape fabric under a rock mulch to act as a soil separator. Do not spread mulch that has an off-odor (rotten egg/sulfur smell or an ammonia odor) or plant injury can occur. Mulches will suppress annual weeds but generally will not control perennial weeds.

Landscape fabrics overcome the porosity problem inherent to solid black plastic. Use a shallow mulch layer (1 inch) above the fabric. A rock mulch/fabric combination would be expected to provide greater weed control than an organic mulch fabric combination. Fabric mulch combinations improve weed control over mulch alone. Use a landscape fabric with limited open space. Use landscape fabrics only in woody landscape beds. Fabrics will inhibit emergence of herbaceous perennials and will inhibit rooting in of groundcovers. Certain weeds, such as yellow nutsedge, can penetrate through landscape fabrics.

### **Chemical Control**

There is now a selection of herbicides for use in nursery stock. Selection of a given herbicide must be based on the particular weed and crop situation. Most of the herbicides listed in this section are available primarily to lawn service and landscape maintenance firms. Commercial recommendations are listed in Pest Management Guide 456-017 for horticultural crops. Many of the herbicides listed are not packaged in quantities suitable for the homeowner. The herbicide with the greatest utility to the homeowner is trifluralin (Treflan, Preen Garden Weed Preventer) since it is safe on a wide range of ornamentals and is packaged in small quantities.

Tables 1, 2, and 3 list which herbicides are registered for use on individual nursery species. Check herbicide labels to determine specific cultivars that can be treated. These registrations are only for liners or rooted cuttings planted into the field. Consult herbicide labels to determine which compounds can be used in propagation, be it seedbed or vegetative propagation. See VCE Publication 456-017 for a discussion of weed control in greenhouses.

None of the preemergent herbicides are effective against all weed species. Tank-mixing of herbicides often broadens the spectrum of weed control. If a chemical application kills all but one species, that species will multiply. This results in a shift in weed population and eventually weed control with that product becomes ineffective. Chemical rotation can reduce the buildup of a tolerant species. Use of directed sprays of a nonselective herbicide (glyphosate) or cultivation is usually necessary to give control of all species.

Applications should be made to limited areas until experience is gained with a given herbicide. Any application of a new herbicide should include an untreated area to allow observation of weed control and possible injury. Small and shallow-rooted plants are more easily injured than large established plants. Sandy soil and excessive watering also increase chances of injury. Irrigate after a granular herbicide application to wash the granules off the leaf surfaces. Certain granular herbicides will cause spotting of foliage.

It is wise to keep a separate sprayer for herbicides because certain ones are difficult to clean from the spray tank.

The selection of herbicides that can be used safely under landscape trees will be based on several considerations. Some residual herbicides cannot be applied under trees that have been recently transplanted. In many situations, desirable shrubs or turf beneath shade trees preclude the use of any residual-type herbicide in the immediate area. Residual herbicides should not be used where trees are planted in or are growing in a depressed area that prevents water from draining away from the tree. Likewise, herbicides should not be applied over exposed roots or be allowed to contact injured root or stem tissue. Mulching normally reduces weed control requirements while creating a better environment for rapid growth of newly planted trees. Since most herbicides used for preemergence weed control will not have activity on perennial weeds or vines, to control these pests a postemergence herbicide must be used that can be selectively applied to the low-growing weeds.

Never apply herbicides in a circle around the tree. This results in a higher rate of application near the trunk of the tree which may cause injury. Uniform distribution is critical for effective weed control. Since many of the herbicides used for preemergence weed control require rainfall or irrigation for activation, they should be applied in early spring when rainfall is likely or be near a source of water for irrigation. Do not apply residual herbicides where rainfall run-off will drain directly across desirable turf. A postemergence herbicide can often be tank-mixed with a residual herbicide to control existing weeds.

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Herbicides should be applied using a low pressure (25-40 psi) sprayer and nozzle tips that do not produce a fine mist that may cause drift problems. **Prior** to herbicide application, the product label should be read and particular attention should be given to the **precaution** section on each label.

**Table 4.10 - Recommended Use**

Application <sup>1</sup>	Weed Problem	Chemical Rate/1000 sq ft	Remarks
Postplant, but preemergence to weeds	Annual grasses and certain broadleaf weeds	oryzalin 0.8-1.4 oz (Surflan 4AS 1.5-2.9 fl oz)	Can be applied overtop or as a directed spray on field and container-grown ornamentals. Will not control established weeds. Irrigation will improve weed control.
		pendimethalin 2.0-4.0 (Corral 2.7 G 1.7-2.6 lb or Pendulum 2G 2.3-4.6 lb or Pendulum WDG 1.2-2.4 oz)	Apply prior to weed germination. Do not apply to moist foliage. Irrigate after application.
		prodiamine 0.26-0.5 oz (Barricade 65 WG 0.4-0.8 oz, Barricade 4 FL 0.5-1.1 fl oz)	Apply prior to weed germination in landscape ornamentals. Do not apply more than 0.8 oz Barricade 65 WG or 1.1 fl oz Barricade 4 FL/1000 sq ft/year.
		trifluralin 1.4 oz (Treflan 5G 1.8 lb or Preen Garden Weed Preventer 1.47 G 6.2 lb)	Will not control established weeds. Use lower rate if incorporated or higher rate and irrigate after application. Apply as a directed spray. Consult label for use on specific soil types.
		isoxaben 0.18-0.36 oz (Gallery 0.25-0.5 oz)	Do not apply to new plantings until soil has settled and no cracks are present. Apply prior to weed germination. Combine with oryzalin for improved control of annual grasses.
		isoxaben + trifluralin (Snapshot 2.5 TG 2.3-4.6 lb)	A prepackaged mixture of the active ingredients in Gallery and Treflan. Apply prior to weed germination.
	Annual grasses and certain annual and perennial broadleaf weeds like dogfennel, lambsquarters, ragweed, smartweed, wild chrysanthemum (artemisia), dock, asters, wild carrot	dichlobenil 1.5-2.2 oz (Casoron, Barrier 4G 2.3-3.4 lb)	Apply in the late fall, winter, or early spring before seeds of annual weeds germinate, or after cultivation has removed all growing weeds. If dichlobenil remains on the soil surface during warm weather, activity will be lost. Do not apply until 4 weeks after transplanting. <b>Note:</b> Use higher rate for control of certain perennials in ornamentals established at least one year. Do not remove old weed growth before making a surface application in the fall for control of perennial weeds.
	Primarily annual grasses and yellow nutsedge	metolachlor 0.5-0.8 oz (Pennant Magnum 0.5-0.9 fl oz)	Apply to weed-free soil. Direct toward base of ornamentals established for at least 2 weeks.
Postemergence to weeds	All weeds controlled	glyphosate (Roundup and other trade names, see label for rates)	Apply as a directed spray in established plantings. Also cleared for site preparation prior to planting nursery stock. Adjust rate of application to weed species according to label instructions. Do not contact bark or foliage of desired plants or severe systemic injury may occur.

<sup>1</sup>Apply only to species listed on the container label.

**Table 4.10 - Recommended Use (cont.)**

Application <sup>1</sup>	Weed Problem	Chemical Rate/1000 sq ft	Remarks
	Annual and perennial grasses including bermudagrass, quackgrass, and johnsongrass	fluazifop-P-butyl 0.19 oz (Ornamec 2.5 fl oz plus 0.5 fl oz nonionic surfactant/gal)	Spot treatment for emerged grasses. May be applied ovetop of selected ornamentals but should be applied as a directed spray after budbreak through hardening of new growth. Treat annual grasses prior to tillering. Treat perennial grasses at the following stages of growth: bermudagrass, 4-8 inch runners: johnsongrass, 12-18 inches tall; quackgrass, 3- 5 leaves, but not more than 10 inches tall. Apply only to actively growing grasses not under moisture stress. Repeat applications may be necessary on some perennial grasses.
	Annual weeds and certain perennial weeds	glufosinate (Finale-various formulations, see label for rates)	Apply as a directed spray in established plantings. Do not contact bark or foliage of desired plants.
	Annual and perennial grasses	sethoxydim 0.21 oz (Segment 2.0-3.0 fl oz/ 1.0 gal water)	Spot treatment for emerged grasses. May be applied ovetop of ornamentals to actively growing grasses. Treat annual grasses prior to tillering. Treat perennial grasses as follows: bermudagrass, 6 inch runners; johnsongrass, 12-20 inches tall; quackgrass, 6 inches tall; wirestem muhly, 6 inches tall. Repeat applications may be necessary on perennial grasses. Less than optimum results are likely if treatments are applied during moisture stress.
	Yellow nutsedge and certain broad-leaf weeds	bentazon (Basagran T/O 3/4 to 1 1/2 fl oz in 1.0 to 2.0 gal)	A second application 10-14 days later will generally be needed for acceptable yellow nutsedge control. Apply as a directed spray to small, actively growing young weeds. Minimize contact with foliage of desired trees and shrubs.
	Poison ivy	glyphosate (Roundup and other trade names, see label for rates)	Apply as a foliar spray when poison ivy is actively growing. Use shielded spray to prevent contact of leaves or green bark of desired plants.
	Yellow and purple nutsedge	halosulfuron 0.7 g (SedgeHammer 0.9 g)	Mix 0.9 g SedgeHammer plus 2 tsp nonionic surfactant in 1 to 2 gal of water for spot treatment. Lightly wet nutsedge foliage. Directed spray in established woody ornamentals only. Do not apply to herbaceous ornamentals.

<sup>1</sup>Apply only to species listed on the container label.

**Table 4.11 - Guide for Herbicide Selection Annual and Perennial Flowers, Vines, and Groundcovers<sup>1</sup>**

	Acclaim	Barricade	Ornamec	Gallery	Pendulum	Pennant	Segment	Surflan	Treflan
<b>Annual and Perennial Flowers</b>									
Alyssum	-	-	-	-	F	F	F	-	F
Aster	-	F	-	-	F	F	-	-	F
Begonia	F	-	-	-	F	-	F	-	-
Chrysanthemum	F	-	-	-	F	F	F	F	F
Coleus	F	-	-	-	-	-	F	-	-
Daffodil	-	F	-	-	F	F	-	F	F
Dahlia	-	-	-	-	F	-	-	-	F
Daylily	F	F	F	-	F	F	F	-	-
Delphinium	-	-	-	-	-	F	-	-	-
Ferns	-	-	-	-	F	-	-	-	-
Forget-me-not	F	-	-	-	-	-	-	-	F
Four-o'clock	-	-	-	-	-	-	-	-	F
Geranium	F	-	-	-	-	F	F	F	-
Gladiolus	F	F	-	-	F	F	F	F	F
Hosta	F	F	F	F	F	F	F	-	-
Impatiens	-	-	-	-	-	-	F	F	F
Iris	F	F	-	-	F	F	F	F	F
Lily	-	F	-	-	F	F	-	-	-
Marigold	-	-	F	-	F	F	F	F	F
Nasturtium	-	-	-	-	-	-	-	-	F
Pansy	-	-	-	-	F	-	F	F	-
Peony	F	-	-	-	-	-	-	-	-
Periwinkle	F	-	-	-	F	-	F	-	-
Petunia	F	-	-	-	F	F	F	-	F
Phlox	F	-	-	-	-	F	-	-	F
Salvia	-	-	-	-	F	-	F	-	F
Shasta daisy	F	-	F	-	F	-	F	-	F
Snapdragon	F	-	-	-	F	F	F	-	F
Sunflower	-	-	-	-	-	-	-	-	F
Sweetpea	-	-	-	-	-	-	-	-	F
Sweet William	F	-	F	-	F	F	F	-	F
Tulip	-	F	-	-	F	F	-	F	F
Zinnia	F	-	F	-	-	F	F	F	F
<b>Vines and Groundcovers</b>									
Ajuga	F	-	-	-	F	F	-	-	-
Bamboo	-	-	-	-	-	-	-	-	-
Clematis	-	-	-	-	-	-	-	-	-
English ivy	F	F	F	F	F	F	F	F	F

<sup>1</sup>This table should be used only as a guide. An 'F' indicates the herbicide is registered for use on that species when field-grown or planted in landscapes. Check the herbicide label for special considerations such as variety, plant growth stage, rate adjustment, or application precautions prior to application.

**Table 4.11 - Guide for Herbicide Selection Annual and Perennial Flowers, Vines, and Groundcovers<sup>1</sup>(cont.)**

	Acclaim	Barricade	Ornamec	Gallery	Pendulum	Pennant	Segment	Surflan	Treflan
Euonymus	-	F	F	-	F	F	-	F	-
Honeysuckle	-	F	-	-	-	F	-	-	-
Jasmine	-	-	-	-	F	-	-	-	-
Liriope	F	F	F	F	F	F	F	F	F
Pachysandra	-	-	F	F	F	F	F	-	F
Pampasgrass	-	F	-	F	F	F	-	-	-
Santolina	-	F	-	-	-	-	-	-	-
Sedum	-	F	-	-	F	F	-	-	F
Vinca (Periwinkle)	F	F	F	-	F	F	F	F	F
Yucca	-	F	F	-	F	F	-	F	-

<sup>1</sup>This table should be used only as a guide. An 'F' indicates the herbicide is registered for use on that species when field-grown or planted in landscapes. Check the herbicide label for special considerations such as variety, plant growth stage, rate adjustment, or application precautions prior to application.

**Table 4.12 - Guide for Herbicide Selection - Narrowleaf and Broadleaf Evergreens<sup>1</sup>**

Tolerant Species	Acclaim	Barricade	Casoron	Pennant	Ornamec
<b>Narrowleaf Evergreens</b>					
Arborvitae	-	F	F	F	F
Cedar ( <i>Cedrus</i> )	-	-	-	-	-
Chamaecyparis	-	F	-	-	-
Cryptomerica	-	-	-	-	-
Fir	-	F	-	F	F
Hemlock	-	F	-	F	F
Juniper	F	F	F	F	F
Leyland cypress	-	-	-	-	F
Pine	F	F	F	F	F
Spruce	-	F	-	F	F
Yew	F	F	F	F	F
<b>Broadleaf Evergreens</b>					
Aucuba	-	F	-	F	F
Azalea	F	F	F	F	F
Barberry	F	F	F	F	F
Bayberry	-	-	-	F	-
Boxwood	F	F	F	F	F
Camellia	-	-	F	F	F
Euonymus	F	F	F	F	F

<sup>1</sup>This table should be used only as a guide. An 'F' indicates the herbicide is registered for use on that species when field-grown or planted in landscapes. Check the herbicide label for special considerations such as variety, plant growth stage, rate adjustment, or application precautions prior to application.

**Table 4.12 - Guide for Herbicide Selection - Narrowleaf and Broadleaf Evergreens<sup>1</sup>(cont.)**

<b>Tolerant Species</b>	<b>Acclaim</b>	<b>Barricade</b>	<b>Casoron</b>	<b>Pennant</b>	<b>Ornamec</b>		
Holly	F	F	-	F	F		
Leucothoe	-	-	F	F	-		
Magnolia (Southern)	F	F	F	F	F		
Mahonia	-	-	-	-	F		
Mountain laurel	-	-	-	F	-		
Osmanthus	-	F	F	F	-		
Pittosporum	-	F	F	F	-		
Pyracantha	F	F	F	F	F		
Rhododendron	F	F	F	F	F		
<b>Tolerant Species</b>	<b>Gallery</b>	<b>Segment</b>	<b>Pendulum</b>	<b>Snapshot</b>	<b>Surflan</b>	<b>Treflan</b>	
<b>Narrowleaf Evergreens</b>							
Arborvitae	F	F	-	-	F	F	
Cedar ( <i>Cedrus</i> )	F	-	F	-	-	-	
Cryptomeria	F	-	F	-	F	-	
Chamaecyparis	F	-	F	F	-	-	
Fir	F	F	F	F	F	F	
Hemlock	-	F	F	-	-	F	
Juniper	F	F	F	F	F	F	
Leyland cypress	-	F	F	-	-	-	
Pine	F	F	F	F	F	F	
Spruce	F	F	F	F	F	F	
Yew	F	F	F	-	F	F	
<b>Broadleaf Evergreens</b>							
Aucuba	-	-	F	-	-	-	
Azalea	F	F	F	F	F	F	
Barberry	F	F	F	F	F	F	
Bayberry	-	-	-	-	-	-	
Boxwood	F	F	F	F	F	F	
Camellia	-	F	F	-	-	F	
Euonymus	-	F	F	-	F	F	
Holly	F	F	F	F	F	F	
Leucothoe	-	-	F	-	F	-	
Magnolia (Southern)	-	F	F	-	F	-	
Mahonia	-	-	-	-	F	-	
Mountain laurel	F	-	F	-	F	F	
Osmanthus	-	F	F	-	F	F	

<sup>1</sup>This table should be used only as a guide. An 'F' indicates the herbicide is registered for use on that species when field-grown or planted in landscapes. Check the herbicide label for special considerations such as variety, plant growth stage, rate adjustment, or application precautions prior to application.

**Table 4.12 - Guide for Herbicide Selection - Narrowleaf and Broadleaf Evergreens<sup>1</sup>(cont.)**

Tolerant Species	Acclaim	Barricade	Casoron	Pennant	Ornamec
Pittosporum	F	F	-	-	F
Pyracantha	F	F	F	-	F
Rhododendron	-	F	F	F	F

<sup>1</sup>This table should be used only as a guide. An 'F' indicates the herbicide is registered for use on that species when field-grown or planted in landscapes. Check the herbicide label for special considerations such as variety, plant growth stage, rate adjustment, or application precautions prior to application.

**Table 4.13 - Guide for Herbicide Selection - Deciduous Trees and Shrubs<sup>1</sup>**

Tolerant Species	Acclaim	Barricade	Casoron	Pennant	Ornamec
<b>Deciduous Trees</b>					
Amelanchier (serviceberry)	-	-	-	-	-
Ash	-	-	F	F	F
Beech	-	-	-	F	-
Birch	-	-	F	F	F
Cherry	-	-	-	F	-
Crabapple	-	F	F	F	-
Dawn redwood	-	-	-	-	-
Dogwood	-	F	F	F	F
Elm	-	-	F	-	-
Ginkgo	-	-	-	F	-
Goldenchain tree	-	-	-	-	-
Goldenrain tree	-	-	-	-	-
Hawthorn	F	F	F	-	-
Honeylocust	-	-	F	F	F
Linden	-	-	-	-	-
Magnolia	F	F	F	F	F
Maple	F	F	F	F	F
Oak	-	F	F	F	F
Pear	-	F	-	F	-
Poplar	-	-	F	F	-
Redbud	-	-	F	-	F
Russian Olive	-	-	F	F	F
Sourgum ( <i>Nyssa</i> )	-	-	-	-	-
Sourwood ( <i>Oxydendron</i> )	-	F	-	-	-
Sweetgum	-	-	-	F	F
Sycamore	-	-	F	-	-
Tulip tree	-	-	F	F	-
Walnut	F	-	F	-	-

<sup>1</sup>This table should be used only as a guide. An 'F' indicates the herbicide is registered for use on that species when field-grown or planted in landscapes. Check the herbicide label for special considerations such as variety, plant growth stage, rate adjustment, or application precautions prior to application.

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**Table 4.13 - Guide for Herbicide Selection - Deciduous Trees and Shrubs<sup>1</sup>(cont.)**

Tolerant Species	Acclaim	Barricade	Casoron	Pennant	Ornamec	
Willow	F	-	F	F	F	
Zelkova	-	-	-	-	-	
<b>Deciduous Shrubs</b>						
Abelia	-	F	-	F	-	
Cotoneaster	-	F	F	F	F	
Crape myrtle	-	F	-	F	F	
Deutzia	-	-	F	-	-	
Euonymus	-	F	F	F	-	
Flowering quince	-	-	F	-	F	
Forsythia	-	F	F	F	-	
Hibiscus	-	C	-	F	-	
Honeysuckle	-	F	F	F	-	
Hydrangea	F	F	-	F	-	
Hypericum	-	-	-	F	-	
Lilac	-	-	F	F	F	
Nandina	F	F	F	F	-	
Photinia	F	F	F	F	F	
Privet	F	F	F	F	F	
Rose	F	F	F	F	F	
Spirea	-	F	F	F	F	
Viburnum	F	F	-	F	F	
Vitex	-	-	-	-	-	
Weigela	F	F	F	F	F	
Witchhazel ( <i>Hamamelis</i> )	-	-	-	-	-	
Tolerant Species	Gallery	Segment	Pendulum	Snapshot	Surflan	Treflan
<b>Deciduous Trees</b>						
Amelanchier (serviceberry)	-	-	-	-	-	-
Ash	F	F	F	-	-	F
Beech	-	-	-	-	-	-
Birch	F	F	F	F	-	F
Cherry	F	F	F	-	F	F
Crabapple	F	F	F	-	-	F
Dawn redwood	-	-	F	-	-	-
Dogwood	-	F	F	F	-	F
Elm	F	-	F	F	-	-
Ginkgo	-	-	-	F	F	-
Goldenchain tree	-	-	-	-	-	-
Goldenrain tree	-	-	-	-	F	-
Hawthorn	-	-	F	-	-	-

<sup>1</sup>This table should be used only as a guide. An 'F' indicates the herbicide is registered for use on that species when field-grown or planted in landscapes. Check the herbicide label for special considerations such as variety, plant growth stage, rate adjustment, or application precautions prior to application.

**Table 4.13 - Guide for Herbicide Selection - Deciduous Trees and Shrubs<sup>1</sup>(cont.)**

Tolerant Species	Acclaim	Barricade	Casoron	Pennant	Ornamec	
Honeylocust	-	F	F	F	-	F
Linden	F	F	-	-	-	-
Magnolia	-	F	F	-	F	-
Maple	F	F	F	F	F	F
Oak	F	F	F	F	F	F
Pear	F	F	F	-	F	-
Poplar	-	F	F	-	-	-
Redbud	-	-	-	-	-	F
Russian olive	-	F	-	F	-	-
Sourgum ( <i>Nyssa</i> )	-	-	-	-	-	-
Sourwood ( <i>Oxydendron</i> )	-	-	F	-	-	-
Sweetgum	F	F	F	F	F	F
Sycamore	F	F	F	F	-	F
Tulip tree	-	F	F	-	-	F
Walnut	-	F	F	-	-	F
Willow	F	F	F	F	-	F
Zelkova	-	-	-	-	-	-
<b>Deciduous Shrubs</b>						
Abelia	-	F	F	-	F	-
Cotoneaster	F	F	F	F	F	F
Crape myrtle	-	F	F	F	F	-
Deutzia	-	-	F	F	-	F
Euonymus	-	F	F	F	F	F
Flowering quince	-	-	F	-	-	-
Forsythia	-	F	F	F	F	F
Hibiscus	F	F	F	-	F	-
Honeysuckle	-	F	-	-	-	F
Hydrangea	-	F	F	-	-	-
Hypericum	-	-	-	-	-	-
Lilac	F	F	F	-	F	F
Nandina	F	F	F	F	F	-
Photinia	F	F	F	F	F	-
Privet	-	F	F	F	F	F
Rose	F	-	F	F	F	F
Spirea	-	F	F	F	-	F
Viburnum	F	F	-	F	F	F
Vitex	-	-	-	-	-	-
Weigela	-	-	-	F	F	F
Witchhazel ( <i>Hamamelis</i> )	-	-	-	-	-	-

<sup>1</sup>This table should be used only as a guide. An 'F' indicates the herbicide is registered for use on that species when field-grown or planted in landscapes. Check the herbicide label for special considerations such as variety, plant growth stage, rate adjustment, or application precautions prior to application.

**Table 4.14 - Guide to Weeds that May Be Controlled by Preemergence Herbicides Approved for Use in Ornamentals**

Weed	Barricade	Casoron
<b>Grasses And Sedges</b>		
Annual bluegrass	G	G
Barnyardgrass	G	G
Bermudagrass	N	P
Cheat	-	-
Crabgrass	G	G
Fall panicum	-	G
Goosegrass	G	G
Johnsongrass (seedling)	-	G
Microstegium	G	-
Orchardgrass, fescue	N	G
Quackgrass	-	G
Small grains (volunteer)	-	-
Stinkgrass	-	-
Yellow nutsedge	N	G
<b>Broadleaf Weeds</b>		
Artemisia (wild chrysanthemum)	-	G
Bittercress	-	-
Canada thistle	-	-
Carpetweed	G	G
Chickweed	G	G
Dandelion	-	G
Dock	-	G
Dodder	-	G
Dogfennel	-	G
Eclipta	P	-
Filaree	-	-
Galinsoga (quickweed)	-	-
Groundsel, common	-	G
Henbit (deadnettle)	-	G
Horseweed (marestail)	-	G
Knotweed	-	-
Lambsquarters	-	G
Morning-glory	-	G
Mustard	-	-
Nightshade	-	-

G = good control, F = fair, P = poor, N = no control, and - = no information.

**Table 4.14 - Guide to Weeds that May Be Controlled by Preemergence Herbicides Approved for Use in Ornamentals (cont.)**

Weed	Barricade	Casoron				
Pigweed	-	G				
Poison Ivy	N	N				
Prickly lettuce	-	-				
Prickly sida	-	G				
Purslane	-	G				
Pusley, Florida	-	-				
Ragweed	P	G				
Red sorrel	-	G				
Shepherdspurse	-	-				
Smartweed	-	G				
Sowthistle	-	-				
Spurge, spotted (prostrate)	G	-				
Velvetleaf	-	-				
Veronica (speedwell)	-	-				
Wild aster	-	-				
Wild carrot	-	G				
Yellow woodsorrel ( <i>Oxalis</i> )	G	G				
Weed	Pennant	Gallery	Pendulum	Snapshot	Surflan	Treflan
<b>Grasses and Sedges</b>						
Annual bluegrass	-		G	G	G	-
Barnyardgrass	G	P	G	G	G	G
Bermudagrass	N	-	N	N	N	N
Cheat	-	N	-	-	-	-
Crabgrass	G	-	G	G	G	G
Fall panicum	G	F	G	G	G	G
Foxtails	G	-	G	G	G	G
Goosegrass	G	F	G	G	G	G
Johnsongrass (seedling)	-	-	G	G	G	G
Microstegium	-	-	G	-	G	-
Orchardgrass, fescue	N	N	N	N	N	N
Quackgrass	N	-	-	N	N	N
Small grains (volunteer)	-	-	-	-	-	-
Stinkgrass	-	-	-	-	-	-
Yellow nutsedge	G	N	N	N	N	N
<b>Broadleaf Weeds</b>						
Artemisia (wild chrysanthemum)	-	-	N	-	-	-

G = good control, F = fair, P = poor, N = no control, and - = no information.

**Table 4.14 - Guide to Weeds that May Be Controlled by Preemergence Herbicides Approved for Use in Ornamentals (cont.)**

Weed	Barricade	Casoron				
Bittercress	P	G	F	G	G	F
Canada thistle	-	-	N	-	N	N
Carpetweed	F	G	G	G	-	-
Chickweed	F	G	G	G	F	G
Dandelion	-	-	-	-	-	-
Dock	-	-	-	-	-	-
Dodder	-	-	-	-	-	-
Dogfennel	-	G	-	G	G	-
Eclipta	P	G	P	G	G	-
Filaree	-	-	-	-	-	-
Galinsoga (quickweed)	G	G	N	G	N	N
Groundsel, common	P	F	P	G	P	-
Henbit (deadnettle)	G	G	-	G	G	-
Horseweed (marestail)	-	F	-	G	-	-
Knotweed	-	-	-	-	-	-
Lambsquarters	P	G	F	G	G	F
Morningglory	N	P	P	-	N	N
Mustard	-	-	-	-	-	-
Nightshade	G	-	P	G	P	P
Pigweed	G	G	F	-	F	F
Poison Ivy	N	N	N	N	N	N
Prickly lettuce	-	-	-	-	-	-
Prickly sida	P	-	-	-	P	P
Purslane	F	G	F	G	F	F
Pusley, Florida	-	-	-	-	-	-
Ragweed	N	G	N	G	N	N
Red sorrel	-	-	-	-	-	-
Shepherdspurse	-	G	N	-	N	N
Smartweed	P	G	-	-	P	P
Sowthistle	-	-	F	-	-	-
Spurge, prostrate (spotted)	P	F	G	G	G	-
Velvetleaf	P	F	G	G	P	P
Veronica (speedwell)	-	-	-	-	-	-
Wild aster	-	-	-	-	-	-
Wild carrot	-	-	-	-	-	-
Yellow woodsorrel	P	F	G	G	F	-

G = good control, F = fair, P = poor, N = no control, and - = no information.

**Table 4.15 - Guide to Weeds that May be Controlled by Postemergence Herbicides Approved for Use in Ornamentals**

Weed	Acclaim	Basagran	Finale	Ornamec	Roundup	Segment
<b>Grasses and Sedges</b>						
Annual bluegrass	N	N	G	P	G	P
Bamboo	N	-	P	-	F	-
Barnyardgrass	-	N	G	G	G	G
Bermudagrass	F	N	F	G	G	F
Cheat	-	N	-	-	G	-
Crabgrass	G	N	G	G	G	G
Fall panicum	-	N	G	G	G	G
Foxtails	G	N	G	G	G	G
Goosegrass	G	N	G	G	G	G
Johnsongrass (seedling)	-	N	-	G	G	G
Microstegium	G	-	G	G	G	G
Orchardgrass, fescue	N	N	P	F	G	F
Quackgrass	P	N	P	G	G	G
Small grains (volunteer)	-	N	-	G	G	G
Stinkgrass	-	N	-	-	G	-
Yellow nutsedge	N	F	F	N	G	N
<b>Broadleaf Weeds</b>						
Artemisia (wild chrysanthemum)	N	-	-	N	F	N
Bittercress	N	G	-	N	G	N
Canada thistle	N	-	-	N	G	N
Carpetweed	N	-	-	N	G	N
Chickweed	N	-	G	N	G	N
Dandelion	N	-	G	N	G	N
Dock	N	-	-	N	G	N
Dodder	N	-	-	N	G	N
Dogfennel	N	-	-	N	G	N
Eclipta	N	G	G	N	G	N
Filaree	N	-	-	N	G	N
Galinsoga (quickweed)	N	-	-	N	G	N
Groundsel, common	N	F	G	N	G	N
Henbit (deadnettle)	N	-	G	N	G	N
Horseweed (marestail)	N	-	G	N	G	N
Knotweed	N	-	-	N	G	N
Lambsquarters	N	P	G	N	G	N

G=good control, F=fair, P=poor, N=no control, and -=no information

**Table 4.15 - Guide to Weeds that May be Controlled by Postemergence Herbicides Approved for Use in Ornamentals (cont.)**

Weed	Acclaim	Basagran	Finale	Ornamec	Roundup	Segment
Morning-glory	N	P	-	N	G	N
Mustard	N	-	G	N	G	N
Nightshade	N	-	-	N	G	N
Pigweed	N	P	G	N	G	N
Poison Ivy	N	N	-	N	G	N
Prickly lettuce	N	-	G	N	G	N
Prickly sida	N	G	-	N	G	N
Purslane	N	-	G	N	G	N
Pusley, Florida	N	-	-	N	G	N
Ragweed	N	G	G	N	G	N
Red sorrel	N	-	G	N	G	N
Shepherdspurse	N	-	G	N	G	N
Smartweed	N	G	G	N	G	N
Sowthistle	N	-	-	N	G	N
Spurge, prostrate (spotted)	N	N	G	N	G	N
Velvetleaf	N	G	G	N	G	N
Veronica (speedwell)	N	-	-	N	G	N
Wild aster	N	-	-	N	G	N
Wild carrot	N	-	-	N	G	N
Yellow woodsorrel ( <i>Oxalis</i> )	N	N	G	N	G	N

G=good control, F=fair, P=poor, N=no control, and -=no information