

## **Control of Ornamental Diseases**

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### **Overview**

Home gardens are unique ecosystems, unlike professional nurseries. Making a beautiful home garden does not necessarily mean spraying pesticides on a preventive schedule. It is possible to use non-chemical approaches to avoid and control disease problems in home gardens.

### **General Cultural Controls**

Many pathogens attack ornamental plants. Some, like rusts, are very aggressive but may not survive if their host plant tissues are absent. Others, like *Botrytis*, are ubiquitous and opportunistic; they attack only physiologically-weakened plants. Home gardeners can lessen the risk of disease and plant loss by reducing pathogen populations and increasing plant vigor.

- **Crop rotation:** Rotating crops is an effective way to control diseases caused by soilborne pathogens. Little is known about these pathogens, but it is a safe rule of thumb to plant different crops in a flower bed each year. Each pathogen has a host range and its population may decline if the pathogen's favorite host plants are not present. Crop rotation may not eliminate a pathogen from soil, but it slows the inoculum build-up in a flower bed.
- **Sanitation:** It is important to remove dead plants and diseased plant parts as well as to keep the tools you use clean. Removing dead plants reduces inoculum during a growing season and removing diseased plant parts avoids unintentional spreading of a pathogen from one plant to another. It is best to remove dead or severely diseased plants from a flower bed as soon as you see them; otherwise, they become sources of inoculum for disease progression. Symptomatic limbs, leaves and flowers should be pruned from plants and removed from the bed. Sterilize pruners with 70% alcohol solution regularly.
- **Fertilization and irrigation:** Fertilize and water plants only as needed. This improves plant physiology and limits the excess water pathogens need to reproduce, germinate, and attack ornamental plants.

### **General Biological Controls**

Biological control in the home garden means using resistant plant species and beneficial microbes that outcompete or are hostile to pathogens. There are many kinds of ornamental plant species and cultivars, and some are almost disease-free while others are very prone to pathogen attack. Gardening exclusively with resistant plant species and cultivars is an option for gardeners who want to avoid and manage disease problems. Choosing the right plants is usually site-specific and should be guided by personal experience and careful research. The future of plant disease management is the use of beneficial microbes. Use composted green waste or other organic matter to enhance naturally-occurring beneficial microbes already in the soil.

### **General Chemical Controls**

Chemical control should be the last resort for disease management in a home garden. Unlike cultural and biological controls, the efficacy of most chemicals is pathogen-specific. There are five major groups of pathogens: fungi, bacteria, oomycetes (*Phytophthora*, *Pythium*, downy mildew), nematodes, and viruses. Some chemicals control only diseases caused by fungi. These chemicals are called "fungicides". Similarly, the pesticides that control only bacterial, oomycete, and nematode diseases are regarded as "bactericides," "oomycetocides," and "nematicides," respectively. When chemical control is necessary, it is critical to first determine the nature of a disease, then select the right chemical. Review pesticide labels carefully and follow instructions strictly to avoid any health hazards and phytotoxicity. Using the same pesticide repeatedly may make the target pathogen resistant. It is best to alternate pesticides with different modes of action.

### **Determine the Nature of a Disease Problem by Using the Index of Ornamental Plants and Their Diseases**

The index below is divided into two groups: Herbaceous Plants and Woody Ornamental Plants and within each group it is arranged alphabetically by the common name of the host plant with its scientific name in parentheses. Common diseases that usually require chemical treatments are in *italics*.

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

### Herbaceous Plants

**African daisy (*Gerbera*)** – Pythium root rot

**Ageratum (*Floss flower*)** – Southern blight

**Anemone** – foliar nematode, *Phytophthora* 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

**Baby's breath (*Gypsophila*)** – bacterial soft rot

**Balloon flower (*Platycodon*)** – Rhizoctonia crown rot

**Basil (*Ocimum basilicum*)** – *Alternaria* leaf spot, *Fusarium* root rot

**Bedding plants** – damping-off

**Begonia** – anthracnose, *Botrytis* blight, *Fusarium* stem rot, powdery mildew, *Rhizoctonia* root/stem rot, root knot nematode

**Bergenia** – Pythium root rot

**Black-eyed Susan (*Rudbeckia*)** – Pythium root rot, *Rhizoctonia* stem rot, *Septoria* leaf spot, downy mildew

**Blanket flower (*Gaillardia*)** – Pythium root rot, white smut

**Bugleweed (*Ajuga*)** – *Phomopsis* dieback, *Phytophthora* root rot, *Pythium* root rot, *Rhizoctonia* root/crown rot, root knot nematode, *Southern blight*, viral disease, web blight

**Buttercup (*Ranunculus*)** – bacterial blight, web blight

**Cactus** – Pythium root rot

**Caladium** – Pythium root rot

**Canarygrass (*Phalaris*)** – web blight

**Calibrachoa (*Million bells*)** – *Phytophthora* crown rot, black root rot, *Rhizoctonia* root rot, Southern blight

**Campanula (*Bellflower*)** – *Fusarium* crown rot

**Candytuft (*Iberis*)** – anthracnose, Pythium root rot

**Canna lily (*Canna*)** – lesion nematodes, Pythium root rot

**Carnation (*Dianthus*)** – *Alternaria* leaf spot, bacterial spot, *Botrytis* blight, *Fusarium* stem rot, powdery mildew, *Rhizoctonia* stem rot, rust

**Century plant (*Agave*)** – crown rot

**Cereus (*Epiphyllum*)** – oedema

**Chrysanthemum (*Dendranthema*)** – 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

**Cockcomb (*Celosia*)** – Pythium root rot, *Rhizoctonia* root rot

**Coleus** – Bacterial spot, *botrytis* blight, downy mildew

**Columbine (*Aquilegia*)** – Pythium root rot

**Coral bells (*Heuchera*)** – Pythium root rot

**Cyclamen** – *Fusarium* wilt

**Dahlia** – crown gall, powdery mildew

**Daisy (*Chrysanthemum*)** – *Pythium* root rot, bacterial blight, web blight

**Daylily (*Heemerocallis*)** – anthracnose, rust, leaf streak, Southern blight

**Forget-me-not (*Myosotis*)** – web blight

**Foxglove (*Digitalis*)** – black root rot, *Fusarium* root rot, *Pythium* root rot

**Gayfeather (*Liatris*)** – *Sclerotinia* stem rot

**Geranium (*Pelargonium*)** – bacterial blight, bacterial leaf spot, bacterial wilt, *Botrytis* blight, oedema, *Pythium* root rot/blackleg, *Rhizoctonia* root rot, rust, viral disease

**Gladiolus** – *Botrytis* leaf blight, *Curvularia* leaf blight, *Fusarium* yellows, *Penicillium* corm rot, *Rhizoctonia* corm rot

**Globe amaranth (*Gomphrena*)** – leaf spot

**Goldenrod (*Solidago*)** – rust

**Goldenstar (*Chrysogonum*)** – Southern blight

**Goutweed (*Aegopodium*)** – leaf spot

**Hellebore (*Helleborus*)** – black leaf spot, *Botrytis* blight, *Pythium* root rot, *Rhizoctonia* root rot, Southern blight

**Hollyhock (*Alcea*)** – root knot nematode, rust

**Hosta** – anthracnose, *Botrytis* blight, leaf spot, root rot, soft rot, Southern blight, virus X

**Ice plant (*Delosperma*)** – Pythium root rot

**Impatiens** – *Alternaria* leaf spot, bacterial fasciation, *Botrytis* blight, downy mildew, *Fusarium* crown rot, powdery mildew, *Pythium* root/stem rot, *Rhizoctonia* root/stem rot, root knot nematodes, *Verticillium* wilt, viral diseases

**Iris** – *Botrytis* blight, *Heterosporium* leaf spot, soft rot

**Jack-in-the-pulpit a (*Arisaem*)** – rust

**Jade plant (*Crassula*)** – oedema, Pythium root rot

**Kaffir lily (*Clivia*)** – leaf spot, Southern blight

**Larkspur (*Consolida*)** – Pythium root rot, *Rhizoctonia* crown/root rot

- Leucanthemum** – Phytophthora root rot, Rhizoctonia root rot
- Lewisia** – soft rot
- Lily (*Lilium*)** – anthracnose, Botrytis blight, Pythium root rot
- Lilyturf (*Liriope*)** – anthracnose, foliar nematodes, Fusarium wilt, Mycosphaerella leaf spot, Phytophthora root rot, viral disease
- Lisianthus (*Eustoma*)** – Botrytis blight, Fusarium root/stem rot
- Lobelia** – Pythium root rot, viral disease
- Loosestrife (*Lysimachia*)** – Rhizoctonia root/stem rot, Southern blight
- Lupine (*Lupinus*)** – anthracnose, brown spot, Pythium root rot
- Madagascar periwinkle (*Catharanthus*)** – black root rot, Botrytis blight, *Phytophthora blight*, Pythium root rot, Rhizoctonia stem/root rot
- Mallow (*Malva*)** – rust
- Marigold (*Tagetes*)** – Alternaria blight, Botrytis blight, crown gall, Fusarium stem/root rot, Pythium root rot, Rhizoctonia stem rot
- Mexican aster (*Cosmos*)** – Botrytis blight, Phomopsis stem canker, powdery mildew, white smut
- Mondo grass (*Ophiopogon*)** – anthracnose
- Monkshood (*Aconitum*)** – Southern blight
- Morning glory (*Ipomoea*)** – rust, white rust
- Nephtytis (*Syngonium*)** – bacterial leaf spot
- Orchid (*Cattleya*)** – bacterial brown spot
- Orchid (*Cymbidium*)** – viral disease
- Ornamental grass, or Maiden grass (*Miscanthus*)** – anthracnose
- Pachysandra** – leaf spot, Pythium root rot, Southern blight, *Volutella blight*
- Pansy (*Viola*)** – anthracnose, black root rot, Botrytis blight, Cercospora leaf spot, *Phytophthora root/crown rot*, *Pythium root/crown rot*
- Persian violet (*Exacum*)** – viral disease
- Petunia** – Botrytis blight, *Fusarium root/crown rot*, *Phytophthora root/crown rot and foliage blight*, *Pythium root/crown rot*, Rhizoctonia root/stem rot, viral disease
- Phlox** – bacterial leaf spot, black root rot, Colletotrichum stem canker, *powdery mildew*, Pythium root rot, southern blight, viral disease, web blight
- Pincushion flower (*Scabiosa*)** – Botrytis blight
- Poinsettia (*Euphorbia pulcherima*)** – bacteria blight, bacterial leaf spot, Botrytis blight, *powdery mildew*, *Pythium root rot*, scab
- Pratia** – Southern blight
- Purslane (*Portulaca*)** – Rhizoctonia stem rot
- Purple heart (*Setcreasea*)** – leaf spot blight
- Peony (*Paeonia*)** – Botrytis blight, Cercospora leaf spot, Cladosporium leaf/stem blotch, Rhizoctonia root rot
- Rain lily (*Zephyranthes*)** – anthracnose
- Rock rose (*Helianthemum*)** – Botrytis blight
- Salvia** – bacterial leaf spot, downy mildew, Pythium root rot, Rhizoctonia stem rot
- Sea thrift (*Armeria*)** – web blight
- Sinningia (*Gloxinia*)** – viral disease
- Snapdragon (*Antirrhinum*)** – *Cercospora leaf spot*, downy mildew, *Phytophthora root/crown rot*, Pythium root rot, Rhizoctonia stem rot, rust, Verticillium wilt, viral diseases
- Solomon seal (*Polygonatum*)** – Penicillium rot
- Speedwell (*Veronica*)** – Phytophthora root rot
- Spiderwort (*Tradescantia virginica*)** – Southern blight
- Spurge (*Euphorbia*)** – anthracnose, Botryosphaeria dieback canker
- Statice (*Limonium*)** – Phytophthora root rot, Pythium root rot, Rhizoctonia root rot
- Stone crop (*Sedum*)** – 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
- Strawflower (*Helichrysum*)** – Fusarium stem rot
- Sunflower (*Helianthus*)** – Alternaria leaf/stem spot
- Sweet alyssum (*Lobularia*)** – Rhizoctonia stem rot
- Sweet woodruff (*Galium*)** – Rhizoctonia stem/root rot, Southern blight
- Thanksgiving cactus (*Schlumbergera*)** – oedema, Pythium root rot
- Tickseed (*Coreopsis*)** – Botrytis blight, Rhizoctonia root/stem rot, rust, viral disease
- Tulip (*Tulipa*)** – Botrytis blight, Fusarium basal rot
- Vervain (*Verbena*)** – powdery mildew, Pythium root rot
- Water celery (*Oenanthe javanica*)** – Fusarium crown rot
- Water lily (*Nelumbo*)** – Cercospora leaf spot
- Wood sorrel (*Oxalis*)** – rust

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

**Yellow archangel (*Lamiastrum*)** – Rhizoctonia root/stem rot, Southern blight

**Zinnia** – *Alternaria blight*, bacterial leaf spot, Botrytis stem canker, *powdery mildew*, Pythium root rot

### Woody Ornamental Plants

**Arborvitae (*Thuja*)** – Armillaria root/stem rot, *Cytospora canker*, Kabatina tip blight, *Phomopsis twig/needle blight*, *Phytophthora root rot*, Pythium root rot, Seiridium twig canker, web blight

**Ash (*Fraxinus*)** – anthracnose, ash yellows, Botryosphaeria canker, rust

**Aucuba** – anthracnose, Botryosphaeria dieback, leaf spot, *Phomopsis dieback*, ring nematode

**Autumn olive (*Elaeagnus*)** – *Phytophthora root rot*

**Azalea (*Rhododendron*)** – anthracnose, Armillaria root rot, *Botryosphaeria 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

**Bamboo** – Pythium root rot

**Barberry (*Berberis*)** – *Phytophthora root rot*

**Bay laurel (*Laurus nobilis*)** – *Cercospora leaf spot*

**Bayberry (*Myrica*)** – Botryosphaeria dieback, *Phytophthora root rot*

**Bearberry (*Arctostaphylos*)** – Pythium root rot, *Phytophthora root rot*

**Beech (*Fagus*)** – anthracnose, Botryosphaeria canker, Hypoxylon canker, viral disease

**Birch (*Betula*)** – anthracnose, Botryosphaeria dieback, Botrytis blight, red heart, Septoria leaf spot

**Black gum (*Nyssa sylvatica*)** – anthracnose, Botryosphaeria dieback, leaf spot

**Bluebeard (*Caryopteris*)** – *Phytophthora stem/root rot*, Pythium root rot

**Boston ivy (*Parthenocissus*)** – Phyllosticta leaf spot

**Boxwood (*Buxus*)** – Botryosphaeria dieback, *boxwood blight*, *boxwood decline*, lesion nematode, Macrophoma leaf spot, Volutella blight

**Buckeye (*Aesculus*)** – Guignardia blotch Butterfly bush (Buddleia) – *Phytophthora root rot*, Rhizoctonia root rot

**Camellia** – anthracnose, Botryosphaeria dieback, leaf/flower gall, leaf spot, oedema, petal/flower blight, *Phytophthora root rot*, Pythium root rot, viral disease

**Catalpa** – bacterial wetwood, Verticillium wilt

**Cedar (*Cedrus*)** – Armillaria root rot, *Phomopsis needle/twig blight*

**Cherry laurel (*Prunus laurocerasus*)** – anthracnose, bacterial leaf spot, bacterial shot hole, Botryosphaeria dieback, *Phomopsis dieback*, leaf spots, *Phytophthora root rot*, Pythium root rot, zonate leaf spot

**Chokeberry (*Aronia*)** – Pythium root rot

**Cinquefoil (*Potentilla*)** – foliar nematodes

**Clematis** – leaf spot, *Phytophthora root rot*

**Cleyera** – Armillaria root rot

**Coneflower (*Echinacea*)** – aster yellows, foliar nematodes, Pythium root rot, viral disease

**Cotoneaster** – leaf spot, *Phytophthora root rot*, web blight

**Crabapple (*Malus*)** – Coniothyrium leaf spot, *fire blight*, *frog-eye leaf spot*, *powdery mildew*, rust, scab

**Crape myrtle (*Lagerstroemia*)** – leaf spot, *powdery mildew*, sooty mold

**Cypress (*Cupressus*)** – Botryosphaeria dieback, Kabatina dieback, tip blights, *Phytophthora root rot*, *Seiridium canker*

**Daphne** – anthracnose, *Phytophthora root/stem rot*

**Dawn redwood (*Metasequoia*)** – *Dothiorella canker*, needle blight

**Dogwood (*Cornus*)** – anthracnose, Armillaria root rot, Botryosphaeria dieback/canker, Botrytis blight, Discula anthracnose, Fusarium canker, leaf spot, *Phomopsis dieback*, *powdery mildew*, Pythium root rot, *Septoria leaf spot*, *spot anthracnose*, viral disease

**Douglas fir (*Pseudotsuga*)** – Botryosphaeria canker, Swiss needle cast

**Dove tree (*Davidia*)** – *Phomopsis dieback*

**Dracaena** – Fusarium blight, Pythium root rot

**Drooping leucothoe (*Leucothoe*)** – Botryosphaeria dieback, *Cylindrocladium leaf spot*, Phyllosticta leaf spot, *Phytophthora root rot*

**Eastern red cedar (*Juniperus virginiana*)** – *Cercospora blight*, Kabatina tip blight, Pestalotia blight, *Phomopsis tip blight*, rust, bacterial leaf scorch, Botryosphaeria canker, *Cytospora canker*, Dutch elm disease, *Verticillium wilt*

**Elm (*Ulmus*)** – bacterial wetwood

**English ivy (*Hedera helix*)** – anthracnose, bacterial leaf spot, oedema, Phyllosticta leaf spot, *Phytophthora root rot*, Pythium root rot, Rhizoctonia root rot

**Eucalyptus** – anthracnose, Botryosphaeria dieback, crown gall, Fusarium canker, *Phomopsis dieback*, *Phytophthora*



root rot, powdery mildew, Pythium root rot

**Euonymus** – powdery mildew

**Falsecypress (*Chamaecyparis*)** – Phytophthora root rot, Seiridium canker, web blight

**Fatsia** – leaf spot

**Fig (*Ficus*)** – anthracnose, Phytophthora root rot

**Filbert (*Corylus*)** – eastern filbert blight

**Fir (*Abies*)** – Botrytis blight, Cytospora canker, oedema, *Phytophthora root/crown rot*

**Firethorn (*Pyracantha*)** – Botryosphaeria dieback, *fire blight*, Phomopsis dieback, scab

**Flowering apricot/cherry/peach/plum (*Prunus*)** – 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

**Flowering pear (*Pyrus calleryana*)** – Botryosphaeria canker, Entomosporium leaf spot, fire blight, rust

**Forsythia** – Botryosphaeria dieback, crown gall, Phomopsis gall, Phytophthora root rot, ringer nematodes, Sclerotinia twig blight, web blight

**Fringe tree (*Chionanthus*)** – leaf spot

**Gardenia** – anthracnose, Phytophthora root/crown rot

**Germander (*Teucrium*)** – Rhizoctonia root rot, Southern blight

**Hawthorn (*Crataegus*)** – Cercospora leaf spot, *Entomosporium leaf spot*, rust

**Heather (*Erica*)** – Phytophthora root rot

**Heavenly bamboo (*Nandina*)** – Cercospora leaf spot, Phytophthora root rot, Pythium root rot

**Hibiscus** – *Phytophthora root rot*, Pythium root rot, viral disease

**Hickory (*Carya*)** – downy leaf spot, Gnomonia leaf spot, Phomopsis gall, powdery mildew, zonate leaf spot

**Holly (*Ilex*)** – *anthracnose*, bacterial blight, black root rot, Botryosphaeria dieback, leaf spot, root knot nematodes, oedema, Phomopsis dieback, *Phytophthora root rot*, Pythium root rot, Rhizoctonia root rot, rust, tar spot, web blight

**Honeylocust (*Gleditsia*)** – Botryosphaeria canker, Thyronectria canker

**Hornbeam (*Carpinus*)** – Pythium root rot

**Honeysuckle (*Lonicera*)** – Botryosphaeria dieback, Botrytis blight, *Herpobaisdium leaf blight*, powdery mildew

**Hydrangea** – anthracnose, Armillaria root rot, bacte-

rial leaf spot, *Botrytis blight*, Cercospora leaf spot, *Phytophthora root rot*, Pythium root rot, powdery mildew

**Incense cedar (*Calocedrus*)** – Seiridium canker

**Indian hawthorn (*Rhaphiolepis*)** – *Entomosporium leaf spot*

**Inkberry (*Ilex glabra*)** – black root rot, Phytophthora root rot

**Japanese cedar (*Cryptomeria*)** – needle blight, *Phomopsis twig blight*, Phytophthora root rot

**Japanese pieris (*Pieris*)** – Botryosphaeria dieback, Phomopsis canker, Phytophthora root rot

**Japanese photinia red-tip (*Photinia*)** – Armillaria root rot, bacterial blight, Botryosphaeria canker, *Entomosporium leaf spot*, powdery mildew

**Juniper (*Juniperus*)** – Kabatina tip blight, Pestalotia dieback, *Phytophthora root rot*, Pythium root rot, *rust*

**Lavender (*Lavandula*)** – Phytophthora root rot, Pythium root rot

**Lavender cotton (*Santolina*)** – Rhizoctonia root rot

**Leyland Cypress (*Cupressocyparis*)** – phytophthora root rot

**Lilac (*Syringa*)** – anthracnose, *bacterial blight*, Botrytis blight, Cercospora leaf spot, *Phytophthora root rot*, powdery mildew

**Linden (*Tilia*)** – spot anthracnose, white rot

**Magnolia** – bacterial leaf spot, powdery mildew

**Maple (*Acer*)** – *Anthracnose*, bacterial scorch, bacterial wetwood, Botryosphaeria 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*

**Mimosa (*Albizia*)** – Fusarium wilt

**Mountain laurel (*Kalmia*)** – Botryosphaeria dieback, Cercospora leaf spot

**Mulberry (*Morus*)** – berry blight

**Ninebark (*Physocarpus*)** – powdery mildew, Rhizoctonia root rot

**Oak (*Quercus*)** – *anthracnose*, Armillaria root rot, bacterial scorch, *bacterial wetwood*, Botryosphaeria canker, Cyliandrocladium root rot, Discula anthracnose, Hypoxylon canker, *leaf blister*, Phomopsis dieback, powdery mildew, rust, smooth patch, spot anthracnose, *Tubakia leaf spot*

**Oleander (*Nerium oleander*)** – bacterial gall

**Paxistima** – Phytophthora root rot

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

**Periwinkle (*Vinca minor*)** – oedema, *Phoma dieback*, *Phomopsis dieback*, *Phyllosticta* stem rot/leaf spot, *Pythium* root rot, *Rhizoctonia* root/stem rot, Southern blight

**Pine (*Pinus*)** – *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, *Phaciidiopycnis* canker, *Phytophthora* root rot, *pinewood nematodes*

**Pistache (*Pistacia*)** – *Verticillium* wilt

**Poplar (*Populus*)** – *Botryosphaeria* canker, leaf spot

**Pothos (*Epipremnum*)** – *Phytophthora* stem rot

**Privet (*Ligustrum*)** – anthracnose, *Cercospora* leaf spot, *Phytophthora* root rot

**Redbud (*Cercis*)** – *Botryosphaeria* dieback, *botrytis* blight, *Fusarium* canker, leaf spot, *Verticillium* wilt

**Redwood (*Sequoia*)** – *Cercospora* needle blight, *Phomopsis* needle blight

**Rose (*Rosa*)** – anthracnose, *black spot*, *Botryosphaeria* dieback, *Botrytis* blight, *crown gall*, *downy mildew*, *Phomopsis* canker, *powdery mildew*, *Pythium* root rot, *rose rosette disease*, viral disease

**Rosemary (*Rosmarinus*)** – *Botrytis* blight, crown gall, *Phytophthora* root rot, *Pythium* root rot

**Rose-of-Sharon (*Hibiscus syriacus*)** – leaf spot

**Russian arborvitae (*Microbiota decussata*)** – *Phytophthora* root rot

**Service berry (*Amelanchier*)** – rust, *Entomosporium* leaf spot

**Silverbell (*Styrax*)** – leaf spot

**Smoke bush (*Cotinus*)** – anthracnose, *Verticillium* wilt

**Snowball bush (*Viburnum*)** – spot anthracnose, bacterial scorch, *Botryosphaeria* dieback, *Botrytis* blight, *phoma* leaf spot, *Phytophthora* root rot, *Rhizoctonia* root rot

**Sourwood (*Oxydendrum arboreum*)** – leaf spot

**Spiraea** – leaf spot

**Spruce (*Picea*)** – *Cytospora* canker, *Phytophthora* root rot, *Pythium* root rot, needle blight, tip blight

**St Johnswort (*Hypericum*)** – *Phytophthora* stem/root rot, rust, *Rhizoctonia* root rot

**Sweetgum (*Liquidambar*)** – *Cercospora* leaf spot, *Endothia* canker, *Sphaeropsis* gall

**Sycamore (*Platanus*)** – anthracnose, bacterial scorch, *Botryosphaeria* dieback, *powdery mildew*

**Thyme (*Thymus*)** – *Pythium* root rot

**Tree-of-heaven (*Ailanthus*)** – *Fusarium* stem/root rot

**Trumpet vine (*Campsis*)** – anthracnose

**Tulip tree (*Liriodendron*)** – powdery mildew

**Umbrella tree (*Schefflera*)** – oedema, *Pythium* root rot

**Wax myrtle (*Myrica cerifera*)** – anthracnose, *Botryosphaeria* dieback, *Phytophthora* root rot, *Septoria* leaf spot

**Weeping fig (*Ficus benjamina*)** – anthracnose, *Phomopsis* gall

**Weigela** – *Phytophthora* root rot, *Pythium* root rot

**Willow (*Salix*)** – *Armillaria* root rot, *Botryosphaeria dieback*, *Botrytis* blight, black canker, *Cercospora* leaf spot, crown gall, rust, scab, white rot

**Wisteria** – *Botryosphaeria* dieback

**Witchhazel (*Hamamelis*)** – *Botryosphaeria* dieback, leaf spot, powdery mildew

**Yellowhorn (*Xanthoceras sorbifolium*)** – *Botrytis* blight

**Yellow wood (*Cladastris*)** – anthracnose

**Yew (*Taxus*)** – *Botryosphaeria* dieback, *Phytophthora* root rot

**Yucca** – bacterial soft rot, *Mycosphaerella* leaf spot

## When to Call a Professional

The index of ornamental plants and their diseases is designed to help those who use this PMG to narrow down the targets quickly. It is also the starting point for further research, as gardeners can compare and determine the exact causes of disease problems. Consult a professional when a final diagnosis cannot be determined with the information available online.

## General Chemical Recommendation

<b>Table 4.1 - General Guidelines for Pesticide Selection</b>			
<b>Disease</b>	<b>Common Name</b>	<b>Trade Name</b>	<b>Manufacturer</b>
<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 3336WP	Dragon
Rhizoctonia root/stem rot	Fludioxonil	Medallion	Southern AG
Web blight	Pentachloronitrobenzene	Turf & Ornamental Fungicide	Hi-Yield
Sclerotinia root rot		Terraclor	Southern AG
Southern blight		Azalea, Camellia, Crape Myrtle Spray	Ferti-lome
Botrytis blight	Thiophanate-methyl	Halt Systemic	Ferti-lome
Diplodia tip blight		Lawn Fungus Control	Scotts
Kabatina dieback		Systemic Fungicide	Green Light
Phomopsis dieback		Systemic Fungicide 3336WP	Dragon
Phomopsis needle blight	Mancozeb	Mancozeb flowable with Zinc	Bonide
Sclerotinia stem rot	Propiconazole	Infuse Systemic	Bonide
Tip blight			

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

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

Disease	Common Name	Trade Name	Manufacturer
<b>Fungal (cont.)</b>			
Powdery mildew	Potassium bicarbonate	Remedy	Bonide
	Sulfur	3-in-1 Rose & Flower Care	Ortho
		Garden Fungicide	Safer
		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
		Triple Action Ready-To-Use	Ferti-lome
		Triple Action Neem Oil	Southern AG
		Fungicide 3	Garden State
	Jobba oil	E-Rase RTU	Monterey
	Sesame oil	Organocide	Organic Lab
	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	Rose Pride 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	Fung-Away Fungicide	Green Light
		Fung-Away Systemic Lawn Spray	
		Fung-Away Systemic Lawn Spray	
		Hose-End Concentrate	
		Lawn Fungicide Granules	Hi-Yield



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

Disease	Common Name	Trade Name	Manufacturer	
Fungal (cont.)				
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	Lawn & Garden Disease Control	Bonide	
Anthrachnose		Lawn Disease Control	Ortho	
Black spot (rose)		Liquid Systemic Fungicide II	Ferti-lome	
Boxwood blight	Chlorothalonil	Landscape & Garden Fungicide	Ferti-lome	
Cercospora leaf spot		Daconil	Hi-Yield	
Curvularia leaf blight		Daconil 2787	Dragon	
Cylindrocladium leaf spot		Daconil Fungicide Ready-to-Use	Garden Tech	
Entomosporium leaf spot		Fung-Onil Multi-Purpose Fungicide	Bonide	
(Eastern) filbert blight		Garden Disease Control	Ortho	
Gnomonia leaf spot		Multipurpose Fungicide	Tiger Brand	
Heterosporium		Mancozeb	Mancozeb Disease Control	Dragon
Leaf streak (daylily)			Mancozeb Flowable	Bonide
Macrophoma leaf spot		Maneb	Maneb Garden Fungicide	Hi-Yield
Mycosphaerella leaf spot	Captan	Captan	Bonide	
Phyllosticta leaf spot		Captan Wettable Powder	Dragon	
Purple-eye leaf spot	Copper hydroxide	Copper Fungicide	Hi-Yield	
Scab	Copper salts	LIQUI-COP	Monterey	
Septoria leaf spot		Liquid Copper Fungicide	Bonide	
Spot anthracnose		Copper Fungicide	Dragon	
Volutella blight	Thiophanate-methyl	Halt Systemic	Ferti-lome	
Web blight		Lawn Fungus Control	Scotts	
Zonate leaf spot		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		
	Leaf/flower gall	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	
Multipurpose Fungicide			Tiger Brand	
Tebuconazole		Advanced Garden Disease Control	Bayer	

## 4-10 Home Ornamentals: *Control of Ornamental Diseases*

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

Disease	Common Name	Trade Name	Manufacturer
Fungal (cont.)			
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	Landscape & Garden Fungicide
	Daconil		Hi-Yield
	Daconil		Garden Tech
	Daconil 2787		Dragon
	Daconil Fungicide Ready-to-Use		Garden Tech
	Fung-Onil Multi-Purpose Fungicide		Bonide
	Garden Disease Control		Ortho
Bacterial			
Fire blight	Copper	Liquid Copper Fungicide	Bonide
Soft rot	Copper hydroxide	Copper Fungicide	Hi-Yield
	Copper salts	LIQUI-COP	Monterey
	Copper diammonia diacetate	Liquid Copper Fungicide	Southern AG
	Copper oxinate	Copper Soap	Concern
	Copper octanoate	Garden Disease Control	Ortho
	Fosetyl-Al	Monterey Aliette	Monterey
	Streptomycin sulfate	Fire Blight Spray	Bonide, Ferti-lome
Crown gall	Purchase healthy plants		
Nematode - No nematicide available for homeowner use.			
Viral - No chemicals for control of viral diseases.			

## **Diseases of Landscape Trees**

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### **Overview**

Many diseases of landscape trees can be effectively managed or prevented by cultural control methods. Choosing the right plant for the right place, purchasing healthy disease-resistant plant material, using proper planting techniques, and providing proper nutrition and adequate water will help trees to maintain their best defense against pathogens and keep trees strong and healthy.

### **General Cultural Controls**

- It is advisable to purchase healthy plants from a reputable nursery. Do not purchase pot bound container plants or plants that are off-color, wilting, and/or have signs or symptoms of pests or diseases.
- Avoid common landscape tree diseases by careful selection of tree species or cultivars. Cultivars with resistance to the most common diseases are available for many tree species. Nursery personnel or your local Extension agent can help identify the best resistant cultivars for the tree species you wish to purchase. Refer to electronic fact sheets on problem-free trees and problem-free shrubs for Virginia at the following urls:
- <http://pubs.ext.vt.edu/450/450-237/450-237.html>
- <http://pubs.ext.vt.edu/450/450-236/450-236.html>
- Optimal soil pH is critical for optimal nutrient uptake by plants. If a soil pH problem is suspected, soil pH should be determined by a soil test. Fertilizer applications should be based on soil test results to avoid unnecessary fertilizer application, over-application of fertilizer and fertilizer runoff. The Virginia Tech Soil Testing Laboratory provides soil pH and nutrient analysis for a fee. Fertilizer recommendations and recommendations for modifying the soil pH, if necessary, are included in the soil test report.
- Many problems with landscape trees are caused by poor site choice or poor cultural practices. It is especially important to choose a site with the proper soil and drainage for a particular tree species. Poor drainage is a common cause of decline in tree species not adapted to wet sites.
- Drought stress makes many woody plants susceptible to disease and is a common cause of establishment failure in new tree plantings. Research at Virginia Tech shows that in dry conditions (rainfall less than 1" per week), irrigating deeply twice a week for the first year after transplanting helps prevent stress to the tree. Note that irrigation must be applied directly to the rootball of plants transplanted from a container. Also, the rootball of a container plant will dry before surrounding soil, so irrigation may have to be applied more frequently for container transplants. Root balls of pot-bound plants tend to shed water, rather than absorbing water, so avoid purchasing pot bound plants. Moisture stress can also occur over the winter when the ground is frozen. Watering trees in the fall before the ground freezes helps prevent winter desiccation. This is especially important for broad-leaved evergreen plants.
- Improper planting is a common and serious problem associated with unhealthy or declining landscape trees. One of the most common planting problems is planting trees too deeply. Many trees cannot tolerate being planted too deeply and will gradually decline. The structural root nearest the soil line should be placed no deeper than 1 to 3 inches below the soil surface, measured 4 inches out from the trunk. (Structural roots are the large, woody roots that support the tree/shrub.) Note that structural roots are sometimes placed too deeply when potted or planted at the nursery. If this is the case, remove excess soil or potting medium so that plants can be set to the correct depth in the landscape. Also avoid wounding trees when planting, since this can allow colonization by secondary decay fungi and subsequent wood decay.
- Stem-girdling roots are another serious problem that is associated with improper planting and/or planting root bound container trees. Stem-girdling roots cause tree decline, which typically leads to death, and symptoms often only become obvious when trees are mature. To avoid stem-girdling roots, carefully examine roots of container plants before purchasing. Signs of girdling roots include a circular pattern of the fibrous roots on the outer surface of the root ball or main lateral roots that grow straight downward or in a circular pattern instead of extending laterally from the trunk. Do not purchase trees with obvious problems in the main structural roots or container trees that are severely pot-bound. Loosen or sever encircling fibrous roots to prevent continued circular growth after transplanting.

For more information on proper tree planting practices refer to "Tree and Shrub Planting Guidelines" (<http://pubs.ext.vt.edu/430/430-295/430-295.pdf>) .

### General Biological Controls

Although fewer biological control products are available for control of plant diseases than insects, some biological control products have come on the market in recent years. Biological control products consist of a microbe (usually either a fungus or a bacterium) that outcompetes or is antagonistic to growth of a certain pathogen. Pay careful attention to the shelf life of biological control products. They are composed of live organisms and have a shorter shelf life than chemical pesticides.

### General Mechanical Controls

- Prune trees to maintain shape and remove dead or diseased plant tissues. Canker-causing pathogens may produce fruiting structures or remain dormant on dead or dying branches. Pruning helps to remove pathogen inoculum and prevent future infections. Prune branches well below any evident discolored or dead wood. Remove branches from the site, bury them in soil, or burn them according to local ordinances.
- Dip pruning tools between cuts in rubbing alcohol or in a household bleach solution consisting of 1 part bleach + 9 parts water. The solution is more effective if a little soap is added as a wetting agent.
- Place a thin layer of mulch (no more than two inches deep) in a donut-shaped ring around trees to help prevent lawnmower or weed-eater injury to tree trunks. Mechanical injury to trees can invite secondary decay organisms.
- Apply mulch to trees properly. When mulch is piled against the base of a tree trunk, the bark remains moist and becomes susceptible to invasion by decay organisms or insects and to feeding damage by voles (rodents that feed below the mulch surface). This may girdle and kill the tree. Apply mulch in a donut-shaped ring around the trunk with little or no mulch actually touching the tree trunk.

### General Chemical Controls

- Use fungicides to control landscape tree diseases only when a destructive disease is a known threat. Few tree diseases require regular spray schedules on a yearly basis. For example, spraying to control anthracnose diseases is useful during prolonged damp weather in late winter and early spring.
- Most fungicides for home landscape use are designed to be protective. To be effective, they must be applied BEFORE the fungus is deposited on the plant surface.
- Reapply fungicides if they are washed off by rain. Adding a spreader-sticker to the fungicide suspension can enhance disease control.
- Organic control products vary in their application intervals, and many organic products have a shorter application interval than chemical pesticides. Pay careful attention to label instructions.

### Precautions

- Some chemical fungicides are toxic to fish. It is important to follow recommended procedures for disposing of any excess fungicide. Do not pour excess fungicides into drainage outlets that lead to bodies of water. Prepare only the amount of fungicide needed for a given application so that all of the fungicide can be sprayed and none or little is left over.
- Repeated use of certain fungicides, such as single-site toxicants, can make pathogens resistant to fungicides. If the label lists precautions about the maximum number of sprays allowed in one season or suggests rotation with fungicides of a different chemical class (FRAC code), pay special attention to this information.

### When to Call a Professional

- Trees with significant dieback or wood decay may pose a risk to surrounding building structures or to people. Have dead branches pruned promptly to avoid damage to people or property.
- A tree with internal decay in its trunk may be compromised structurally and could be susceptible to wind or storm damage. A licensed arborist can test trees by boring a series of small holes into the trunk to determine the extent of the decay. This test is worthwhile if the tree poses a risk to people or nearby buildings.

### Links to Useful Sources of Information

- <https://pubs.ext.vt.edu/category/plant-diseases.html> (VT plant disease fact sheets)
- <http://www.ipmimages.org/> (Bugwood Network's plant disease and insect image archive)

Table 4.2 - Fungicide Use

Plant and Disease	Labeled Pesticides—by common chemical name	Recommendation
<b>Ash (<i>Fraxinus</i>)</b> Anthracnose (Various fungi)	Calcium hydroxide + copper sulfate (Bordeaux mixture) Chlorothalonil Chlorothalonil + thiophanate methyl Mancozeb Metconazole Propiconazole Tebuconazole Thiophanate methyl Thiophanate methyl + mancozeb	<b>Chemical Control:</b> Apply fungicides at label rates and intervals, beginning at bud break or first sign of disease. <b>Cultural Control:</b> Collect and either burn or bury fallen leaves to reduce overwintering of fungal inoculum. <b>Precautions/Remarks:</b> Note that some fungicides should be rotated with other products to prevent the development of fungicide resistance in the pathogen population. Pay special attention to label instructions regarding the maximum number of times a product should be applied sequentially or the total quantity of product that may be applied per season.
Rust ( <i>Puccinia</i> )	Mancozeb Metconazole Myclobutanil Tebuconazole Thiophanate methyl	<b>Chemical Control:</b> Apply fungicides in early spring. Later applications are not effective. Follow label rates and intervals. <b>Precautions/Remarks:</b> By the time symptoms of this disease are noted, control will not be effective.
<b>Beech (<i>Fagus</i>)</b> Anthracnose (Various fungi)	See fungicide list for ash anthracnose.	<b>Precautions/Remarks:</b> Follow recommendations for control of ash anthracnose.
Canker (various fungi)	No chemical controls	<b>Cultural Control:</b> Prune affected branches below the canker and remove pruned branches from the landscape.
<b>Birch (<i>Betula</i>)</b> Anthracnose (Various fungi)	See fungicide list for ash anthracnose.	<b>Precautions/Remarks:</b> Follow recommendations for control of ash anthracnose.
<b>Black Gum (<i>Nyssa sylvatica</i>)</b> Felt Fungus ( <i>Septobasidium fumigatum</i> )		<b>Chemical Control:</b> There are no controls for this fungus and this fungus does not infect or parasitize the tree. If the tree looks healthy during the growing season, it may not be necessary to control the insect (refer to Insects of Trees section, "Scale insects, General"). <b>Precautions/Remarks:</b> Fungi in this genus form parasitic/mutualistic relationships with scale insects. They do not parasitize the plant, but they parasitize the scale insect and they obtain nutrients from the insects after the insects feed on the plant. At the same time, the fungus provides a protective habitat for the scale insect.
Canker (various fungi)	No chemical controls	<b>Cultural Control:</b> Prune affected branches below the canker and remove pruned branches from the landscape.
Cryptocline Leaf Spot (Cryptocline betularum)	See fungicide list for ash anthracnose.	<b>Chemical Control:</b> Begin fungicide applications when leaf spots first appear and repeat according to label directions. <b>Cultural Control:</b> Remove fallen leaves to reduce inoculum available for future infections. <b>Precautions/Remarks:</b> This disease is also known as birch anthracnose and occurs on <i>Betula nigra</i> and <i>Betula lenta</i> . It can cause significant defoliation.
<b>Buckeye (<i>Aesculus</i>)</b> Leaf Spot and Blotch ( <i>Guignardia</i> )	See fungicide list for ash anthracnose.	<b>Precautions/Remarks:</b> Follow recommendations for control of ash anthracnose.



Table 4.2 - Fungicide Use (cont.)

Plant and Disease	Labeled Pesticides—by common chemical name	Recommendation
<b>Catalpa (<i>Catalpa</i>)</b> Verticillium Wilt ( <i>Verticillium</i> )	No chemical controls	<b>Precautions/Remarks:</b> Verticillium wilt cannot be controlled with fungicides. Replace trees that have died from this disease with immune species (see list). <b>Trees or Shrubs Not Reported to be Affected by Verticillium Wilt:</b> <div><div><i>Abies</i> spp. (fir) <i>Amelanchier</i> spp. (serviceberry) <i>Betula</i> spp. (birch) <i>Buxus</i> spp. (boxwood) <i>Carpinus</i> spp. (ironwood) <i>Castanea mollissima</i> (Chinese chestnut) <i>Ceanothus</i> spp. (red-root) <i>Celtis</i> spp. (hackberry) <i>Cercidiphyllum japonicum</i> (katsura tree) <i>Cornus</i> spp. (dogwood) <i>Crataegus</i> spp. (hawthorn) <i>Fagus</i> spp. (beech) <i>Ficus carica</i> (fig) <i>Ginkgo biloba</i> (ginkgo) <i>Gleditsia triacanthos</i> (honey locust) <i>Ilex</i> spp. (holly) <i>Juglans</i> spp. (walnut) <i>Juniperus</i> spp. (juniper)</div><div><i>Larix</i> spp. (larch) <i>Liquidambar styraciflua</i> (sweetgum) <i>Malus</i> spp. (apple, crabapple) <i>Morus</i> spp. (mulberry) <i>Nerium oleander</i> (oleander) <i>Picea</i> spp. (spruce) <i>Pinus</i> spp. (pine) <i>Platanus</i> spp. (sycamore) <i>Pyracantha</i> spp. (firethorn) <i>Pyrus</i> spp. (pear) <i>Quercus alba</i> (white oak) <i>Quercus falcata</i> (southern red oak) <i>Quercus phellos</i> (willow oak) <i>Quercus virginiana</i> (live oak) <i>Salix</i> spp. (willow) <i>Sorbus aucuparia</i> (European mountain ash) <i>Taxus</i> spp. (yew) <i>Zelkova serrata</i> (zelkova)</div></div> <b>Related Fact Sheets:</b> <a href="https://vtechworks.lib.vt.edu/handle/10919/48804?show=full">https://vtechworks.lib.vt.edu/handle/10919/48804?show=full</a>
<b>Chestnut (<i>Castanea</i>)</b> Canker/Chestnut Blight ( <i>Cryphonectria</i> )	No chemical controls	<b>Cultural Control:</b> Excise cankers at least one inch beyond visibly stained bark tissues and remove pruned branches from the landscape. Fungicides are not effective for control.
<b>Cherry, Ornamental (<i>Prunus</i>)</b> Brown rot ( <i>Monilinia</i> )	Chlorothalonil Propiconazole Potassium bicarbonate	<b>Chemical Control:</b> Applying a registered fungicide, beginning when blossoms open, may help protect trees from the blossom blight phase of the disease. <b>Cultural Control:</b> Control may be difficult if disease is severe.
Cankers (various fungi)		<b>Cultural Control:</b> Prune out affected branches below cankers back to healthy wood. <b>Precautions/Remarks:</b> Ornamental cherries are susceptible to a variety of fungal canker diseases and therefore may not be the best choice for landscape plantings. Symptoms include swollen, sunken, or cracked areas and oozing gum on the bark. Dieback occurs above the canker. Fungicides are not effective for control. If cankers occur on the trunk, trees cannot be saved.
Cherry leaf spot ( <i>Blumeriella</i> )	Chlorothalonil Propiconazole Myclobutanil Neem oil Potassium bicarbonate	<b>Chemical Control:</b> To prevent the disease on ornamental cherries, fungicide applications are recommended at regular intervals, starting when leaves first become fully mature and continuing until late summer. <b>Cultural Control:</b> Rake and remove fallen leaves to prevent overwintering of fungal inoculum. <b>Precautions/Remarks:</b> Severe defoliation reduces winter hardiness. Prolonging leaf retention by controlling the disease will improve winter hardiness of the tree.
Cercospora leaf spot ( <i>Pseudocercospora</i> )	Chlorothalonil Myclobutanil Neem oil Potassium bicarbonate Propiconazole	<b>Chemical Control:</b> Three to four applications of a preventative fungicide should begin at leaf emergence. Repeat applications according to product label directions. Fungicide applications initiated when symptoms are apparent will not be effective. <b>Cultural Control:</b> Remove fallen leaves to reduce inoculum available for future infections. <b>Precautions/Remarks:</b> This disease can cause early defoliation, which will weaken the tree and make the tree more susceptible to winter injury.

Table 4.2 - Fungicide Use (cont.)

Plant and Disease	Labeled Pesticides—by common chemical name	Recommendation
<b>Conifers</b> Needle Cast Diseases (various fungi)	Calcium hydroxide + copper sulfate (Bordeaux mixture) Chlorothalonil Mancozeb Mancozeb + copper hydroxide	<p><b>Chemical Control:</b> Needle casts are caused by a variety of 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 most needle cast fungi. Fungicide treatment for several years in a row may be necessary so that new growth will hide branches with missing needles in the interior canopy.</p> <p>Apply Bordeaux mixture when new growth emerges, as needles emerge from the sheath, and when needles are 2/3 mature length.</p> <p>Apply chlorothalonil at bud break, followed by applications at 3- to 4-week intervals until needles are fully elongated.</p> <p>Apply copper products at first sign of disease and repeat at 7- to 14-day intervals.</p> <p>Begin mancozeb sprays in spring or early summer and repeat after heavy rains and at 2-week intervals.</p> <p><b>Cultural Control:</b> Collect and remove fallen twigs and needles from the landscape in autumn.</p> <p><b>Precautions/Remarks:</b> Copper hydroxide should NOT be tank-mixed with Aliette or phytotoxicity may occur. The spray solution should also have a pH &gt;6.5 to avoid phytotoxicity.</p>
<b>Crabapple (<i>Malus</i>)</b> Cedar-Apple Rust ( <i>Gymnosporangium juniperi-virginianae</i> )	Mancozeb Metconazole Myclobutanil Propiconazole Tebuconazole Thiophanate methyl Thiophanate methyl + mancozeb	<p><b>Chemical Control:</b> Apply fungicides at label rates beginning at bud break or first sign of disease.</p> <p><b>Biological Control:</b> <i>Bacillus subtilis</i> is a bacterium that prevents or reduces infection by the cedar-apple rust fungus. Applications should be repeated at 3- to 7-day intervals.</p> <p><b>Cultural Control:</b> Many cultivars of crabapple have resistance to this and other crabapple diseases. Choose cultivars with resistance to as many of these diseases as possible for new plantings.</p> <p><b>Precautions/Remarks:</b> Removal of red cedars, the alternate host for the fungus, can help to reduce the amount of fungal inoculum available for infecting apples and crabapples; however, this control method is usually not practical as spores can spread from other red cedars in the surrounding area. Note label instructions regarding rotation of certain fungicides with other products to prevent the development of fungicide resistance.</p>
Japanese Apple Rust ( <i>Gymnosporangium yamadae</i> )	Mancozeb Metconazole Myclobutanil Propiconazole Tebuconazole Thiophanate methyl Thiophanate methyl + mancozeb	<p><b>Chemical Control:</b> Fungicides recommended for control of cedar-apple rust should also control this rust disease.</p> <p><b>Cultural Control:</b> Japanese apple rust is a disease that was recently introduced to the United States. It is not yet known how cultivars of crabapple that have been bred for resistance to cedar-apple rust will respond to this new rust species. The alternate hosts of Japanese apple rust are Chinese juniper (<i>Juniperus chinensis</i>) and Himalayan juniper (<i>Juniperus squamata</i>). Removal of these species in the vicinity of susceptible crabapples may reduce disease occurrence on the crabapple.</p> <p><b>Precautions/Remarks:</b> Symptoms of Japanese apple rust on the juniper host are less conspicuous than the galls caused by cedar-apple rust. Japanese apple rust causes fusiform swellings on juniper stems.</p>

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

Plant and Disease	Labeled Pesticides—by common chemical name	Recommendation
<b>Crabapple (<i>Malus</i>)</b> (cont.) Fire blight ( <i>Erwinia amylovora</i> )	Streptomycin sulfate	<p><b>Chemical Control:</b> Streptomycin sprays should be applied at label rates during bloom, starting at 20-30% bloom, using no more than 5 applications at 10-14 day intervals. Use of streptomycin after bloom is not effective.</p> <p><b>Biological Control:</b> <i>Bacillus subtilis</i> is a bacterium that can be applied as a preventative control at 3- to 7-day intervals.</p> <p><b>Cultural Control:</b> Prune out affected branches at least 6 inches below discolored wood and remove pruned branches from the landscape. It is best to prune in late summer when fire blight bacteria are no longer active to avoid spreading bacteria during the pruning operation. Disinfect pruning tools with rubbing alcohol or a solution of 1 part bleach to 9 parts water between cuts. See comments regarding resistant cultivars in Cedar-Apple Rust section.</p> <p><b>Precautions/Remarks:</b> Streptomycin sulfate is an antibiotic and should not be sprayed unnecessarily. Follow label rates carefully and do not spray outside the bloom period.</p>
Powdery Mildew ( <i>Podosphaera</i> )	Chlorothalonil Metconazole Myclobutanil Neem oil Potassium bicarbonate Propiconazole Sulfur Tebuconazole Thiophanate methyl Thiophanate methyl + mancozeb	<p><b>Chemical Control:</b> Commercial products containing several of these fungicides are OMRI-approved, e.g. neem oil, potassium bicarbonate, and sulfur.</p> <p><b>Biological Control:</b> <i>Bacillus subtilis</i> is a bacterium that can be applied as a preventative control at 3- to 7-day intervals.</p> <p><b>Cultural Control:</b> See comments regarding resistant cultivars in Cedar-Apple Rust section.</p> <p><b>Precautions/Remarks:</b> Note label instructions regarding rotation of certain fungicides with other products to prevent development of resistance in the pathogen population.</p> <p><b>Related Fact Sheets:</b>  <a href="http://pubs.ext.vt.edu/450/450-603/450-603.html">http://pubs.ext.vt.edu/450/450-603/450-603.html</a></p>
Scab ( <i>Venturia</i> )	Mancozeb Metconazole Myclobutanil Propiconazole Tebuconazole Thiophanate methyl Thiophanate methyl + mancozeb	<p><b>Chemical Control:</b> Apply fungicides at label rates beginning at bud break or first sign of disease.</p> <p><b>Biological Control:</b> <i>Bacillus subtilis</i> is a bacterium that can be applied as a preventative control at 3- to 7-day intervals.</p> <p><b>Cultural Control:</b> The scab fungus overwinters on fallen leaves. Remove fallen leaves in autumn if practical. See comments regarding resistant cultivars in Cedar-Apple Rust section.</p> <p><b>Precautions/Remarks:</b> Note label instructions regarding rotation of certain fungicides with other products to prevent development of resistance in the pathogen population.</p>
Needle Cast Diseases (various fungi)	Calcium hydroxide + copper sulfate (Bordeaux mixture) Chlorothalonil Mancozeb Mancozeb + copper hydroxide	<p><b>Chemical Control:</b> Needle casts are caused by a variety of 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 most needle cast fungi. Fungicide treatment for several years in a row may be necessary so that new growth will hide branches with missing needles in the interior canopy.</p> <p>Apply Bordeaux mixture when new growth emerges, as needles emerge from the sheath, and when needles are 2/3 mature length.</p> <p>Apply chlorothalonil at bud break, followed by applications at 3- to 4-week intervals until needles are fully elongated.</p> <p>Apply copper products at first sign of disease and repeat at 7- to 14-day intervals.</p> <p>Begin mancozeb sprays in spring or early summer and repeat after heavy rains and at 2-week intervals.</p> <p><b>Cultural Control:</b> Collect and remove fallen twigs and needles from the landscape in autumn.</p> <p><b>Precautions/Remarks:</b> Copper hydroxide should NOT be tank-mixed with Alette or phytotoxicity may occur. The spray solution should also have a pH &gt;6.5 to avoid phytotoxicity.</p>

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

Plant and Disease	Labeled Pesticides—by common chemical name	Recommendation
<b>CYPRESS FAMILY</b>		
<b>Dawn Redwood</b> ( <i>Metasequoia</i> ) Dothiorella Canker ( <i>Dothiorella</i> )	No chemical controls	<b>Cultural Control:</b> Prune affected branches below the canker and remove pruned branches from the landscape.
<b>Giant Sequoia</b> ( <i>Sequoiadendron giganteum</i> ) <b>Italian cypress</b> ( <i>Cupressus sempervirens</i> ) Cercospora Blight ( <i>Pseudocercospora juniper</i> and <i>Passalora sequoiae</i> )	Azoxystrobin Chlorothalonil Copper hydroxide Mancozeb Myclobutanil Thiophanate methyl Thiophanate methyl + mancozeb	<b>Chemical Control:</b> Apply fungicides at bud break and repeat during the growing season according to product label directions. Fungicides are not practical for large trees. Severely diseased trees should be removed.  <b>Cultural Control:</b> Allow generous spacing between trees to promote foliar drying. Avoid planting susceptible trees in low lying areas where conditions will be moist and favor disease development.  <b>Precautions/Remarks:</b> This disease is reported to occur on other members of the Cypress family ( <i>Cupressaceae</i> ), but susceptibility varies among cypress species. In Virginia we have observed Cercospora Blight on Giant sequoia and Italian cypress. This disease causes needle loss that progresses from the bottom of the tree upward and can be quite severe in Virginia's moist climate. Severe defoliation can lead to death, so avoidance of Italian cypress and Giant Sequoia in Virginia may be warranted.
<b>Leyland Cypress</b> ( <i>x Cupressocyparis leylandii</i> ) Cankers ( <i>Seiridium</i> , <i>Botryosphaeria</i> )	No chemical controls	<b>Cultural Control:</b> Trees are predisposed to these canker diseases by drought stress. In some cases, decline can be reversed in the early stages of disease with adequate irrigation. Prune out affected branches below cankers (look for cracked, swollen or sunken bark with resin droplets) and remove pruned branches from the landscape. Dip pruning tools in rubbing alcohol or a solution of 1 part bleach to 9 parts water between cuts to avoid spreading the pathogen.  <b>Precautions/Remarks:</b> Seiridium canker is a common disease on Leyland cypress. Be sure to water trees regularly and deeply as needed after transplanting to prevent these diseases.
<b>Dogwood (Cornus)</b> Bacterial Wetwood/Slime Flux (various bacteria)	No chemical controls	<b>Precautions/Remarks:</b> 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 less commonly affected. Often a rancid or stinky odor emanates from affected tissue due to fatty acids produced by a complex of microorganisms. External signs on bark include vertical light or dark streaks with seeping liquids, wet or dry when observed. The word "wetwood" derives from the wet appearance of cross-sections of the wood. This disease has no real practical management. Fluxing in oak trees may become more severe in trees that have undergone high environmental stress situations and may disappear when stressors are gone. Stinging insects or other pests may be attracted to fluxing sites.  Note: In oaks bacterial wetwood is sometimes confused with Ramorum Blight (= Sudden Oak Death), which is not currently known to occur in Virginia.

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

Plant and Disease	Labeled Pesticides—by common chemical name	Recommendation
<b>Dogwood (<i>Cornus</i>)</b> (cont.) Discula Anthracnose ( <i>Discula destructiva</i> )	Azoxystrobin Chlorothalonil Mancozeb Metconazole Myclobutanil Neem oil Propiconazole Tebuconazole Thiophanate methyl	<p><b>Chemical Control:</b> Apply azoxystrobin at 7 to 28-day intervals; chlorothalonil and mancozeb at 7 to 10-day intervals; metconazole at 14 to 28-day intervals; myclobutanil at 10 to 14-day intervals; tebuconazole at 14 to 21-day intervals; and thiophanate methyl at 7 to 14-day intervals. Note fungicide rotation recommendations on each fungicide label.</p> <p><b>Cultural Control:</b> Understory trees are more prone to infection. Plant trees in full sun and water, mulch, and fertilize as necessary to maintain good growth. One cultivar of <i>Cornus florida</i> with resistance to Discula anthracnose has been developed ('Appalachian Spring'); however, this cultivar does not have resistance to powdery mildew, another important disease of dogwood. Kousa dogwood (<i>Cornus kousa</i>) has resistance but is not immune to the disease; leaf and flower spots will occur on kousa dogwood, but trees are not killed by the fungus. Several hybrids of kousa and flowering dogwood (e.g. 'Stellar' series) with resistance to both Discula anthracnose and powdery mildew are available.</p> <p><b>Precautions/Remarks:</b> This disease develops rapidly and may kill the tree. It is especially serious at cool temperatures, high moisture, higher elevations, and near water sources. Note label instructions regarding rotation of certain fungicides with other products to prevent the development of fungicide resistance.</p>
Powdery Mildew ( <i>Oidium</i> )	Azoxystrobin Chlorothalonil Metconazole Myclobutanil Neem oil Potassium bicarbonate Propiconazole Sulfur Tebuconazole Thiophanate methyl Thiophanate methyl + mancozeb	<p><b>Chemical Control:</b> Apply fungicides at label rates beginning at bud break or first sign of disease.</p> <p><b>Biological Control:</b> <i>Bacillus subtilis</i> is a bacterium that can be applied as a preventative control at 3- to 7-day intervals.</p> <p><b>Cultural Control:</b> Cultivars of flowering dogwood, kousa dogwood, and hybrid (flowering x kousa) dogwoods with resistance to powdery mildew are available for new plantings.</p> <p><b>Precautions/Remarks:</b> Although powdery mildew diseases of some plant species are primarily a cosmetic problem, powdery mildew of dogwood can severely stunt the tree. Note label instructions regarding rotation of certain fungicides with other products to prevent the development of fungicide resistance.</p> <p><b>Related Fact Sheets:</b>  <a href="http://pubs.ext.vt.edu/450/450-603/450-603.html">http://pubs.ext.vt.edu/450/450-603/450-603.html</a></p>
Septoria Leaf Spot ( <i>Septoria</i> )	Azoxystrobin Calcium hydroxide + copper sulfate (Bordeaux mixture) Chlorothalonil Copper ammonium complex Mancozeb Metconazole Myclobutanil Tebuconazole Thiophanate methyl Thiophanate methyl + mancozeb	<p><b>Chemical Control:</b> Although fungicides are registered for control of Septoria leaf spot, the disease often occurs toward the end of the growing season and fungicide control may not be warranted. If the disease occurs earlier in the season, azoxystrobin can be applied at 7- to 28-day intervals, Bordeaux mixture or myclobutanil at 10 to 14-day intervals; copper ammonium complex or thiophanate methyl at 7 to 14-day intervals; chlorothalonil or mancozeb at 7 to 10-day intervals; metconazole at 14 to 28-day intervals; tebuconazole at 14 to 21-day intervals; and thiophanate methyl + mancozeb at 7-day intervals at label rates.</p> <p><b>Precautions/Remarks:</b> Leaf spots caused by Septoria may resemble Discula anthracnose leaf spots; however, Septoria leaf spots are more angular and more consistent in size, whereas Discular leaf spots vary widely in size and are not angular. Dieback is not associated with Septoria leaf spot. Note label instructions regarding rotation of certain fungicides with other products to prevent the development of fungicide resistance.</p>



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

Plant and Disease	Labeled Pesticides—by common chemical name	Recommendation
<b>Dogwood (<i>Cornus</i>)</b> (cont.) Spot Anthracnose ( <i>Elsinoe</i> )	Azoxystrobin Chlorothalonil Copper ammonium complex Mancozeb Tebuconazole Thiophanate methyl + mancozeb	<p><b>Chemical Control:</b> Fungicides should be applied at label rates beginning when buds begin to open and then repeated three times: when bracts have fallen, four weeks after bract fall, and in late summer after flower buds form.</p> <p><b>Cultural Control:</b> Removal of fallen leaves may help prevent new infections if the tree is isolated.</p> <p><b>Precautions/Remarks:</b> Although the names of the diseases are similar, spot anthracnose is a distinct disease from Discula anthracnose. Spot anthracnose is not fatal to the tree. It is present to some degree every year, but is more severe in wet springs. Leaf and bract spots are tiny and do not enlarge. The fungus attacks the leaves and flowers but not the branches. Note label instructions regarding rotation of certain fungicides with other products to prevent the development of fungicide resistance.</p>
<b>Douglas-fir (<i>Pseudotsuga</i>)</b> Swiss Needle Cast ( <i>Phaeocryptopus</i> )	Calcium hydroxide + copper sulfate (Bordeaux mixture) Chlorothalonil Mancozeb	<p><b>Chemical Control:</b> See comments on control of needle cast diseases in Conifers section.</p>
<b>Elm (<i>Ulmus</i>)</b> Bacterial Scorch ( <i>Xylella</i> )	Oxytetracycline (OTC)	<p><b>Chemical Control:</b> Injections of OTC are helpful in symptom remission; however, this antibiotic does not eliminate the bacteria from the tree and treatment is generally not practical or economical for homeowners, except for highly valuable trees. Application requires specialized equipment available through use of a professional arborist. Note that treatment suppresses symptoms only during the year of treatment; thus, repeat treatments would be necessary for continued symptom suppression.</p> <p><b>Cultural Control:</b> Pruning out affected branches that are not yet severely affected may slow symptom progression. Branches should be pruned back as far as possible. Tree genera most commonly diagnosed with bacterial leaf scorch in Virginia include oak, sycamore and elm, but many other genera are also susceptible to the disease. New hosts of bacterial leaf scorch continue to be identified. Some tree species currently not reported to be hosts to the bacterial scorch pathogen include European black alder (<i>Alnus glutinosa</i>), European beech (<i>Fagus sylvatica</i>), black gum (<i>Nyssa sylvatica</i>), yellow buckeye (<i>Aesculus flava</i>), northern catalpa (<i>Catalpa speciosa</i>), katsura-tree (<i>Cercidophyllum japonicum</i>), Kentucky coffeetree (<i>Gymnocladus dioica</i>), American linden (<i>Tilia americana</i>), littleleaf linden (<i>T. cordata</i>), silver linden (<i>T. tomentosa</i>), cucumbertree (<i>Magnolia acuminata</i>), Osage orange (<i>Maclura pomifera</i>), tulip poplar (<i>Liriodendron tulipifera</i>), and Japanese zelkova (<i>Zelkova serrata</i>). These species can be considered as replacement trees.</p> <p><b>Precautions/Remarks:</b> The bacterium causes leaf scorch, a slow decline, and, ultimately, tree death. Leafhoppers and treehoppers are known vectors of the disease, but insect control has not proven effective in controlling the disease.</p> <p><b>Related Fact Sheets:</b> <a href="http://pubs.ext.vt.edu/3001/3001-1433/3001-1433.html">http://pubs.ext.vt.edu/3001/3001-1433/3001-1433.html</a></p>
Bacterial Wetwood/Slime Flux (various bacteria)	No chemical controls	<p><b>Precautions/Remarks:</b> See comments for bacterial wetwood on dogwood.</p>
Black Leaf Spot ( <i>Gnomonia</i> )	Mancozeb	<p><b>Chemical Control:</b> Apply mancozeb at label rates at budbreak and 1 to 2 times thereafter at 10- to 14-day intervals.</p> <p><b>Cultural Control:</b> Collect and either burn or bury fallen leaves to prevent overwintering of the fungus.</p>

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

Plant and Disease	Labeled Pesticides—by common chemical name	Recommendation
<b>Elm (<i>Ulmus</i>) (cont.)</b> Dutch Elm Disease (DED) ( <i>Ophiostoma novo-ulmi</i> )	Thiabendazole Propiconazole	<p><b>Chemical Control:</b> Although promising results have been reported for both preventative (before symptom development) and curative (after symptom development) control of this disease, research has not adequately documented the: (1) degree and completeness of disease control, (2) extent of translocation of the fungicide within the sapwood and therefore the degree of protection, (3) residual life of the fungicide, and (4) optimum dosage for individual trees of varying sizes and configurations. Therefore, results of fungicide injection may be inconsistent; however, injection has been successful in many cases and should be considered for high value or high hazard trees.</p> <p>Injections are made in flare roots. Systemic fungicides should be injected <b>before</b> removal of diseased branches. Treatment administered after crown involvement exceeds 5% may not be effective. Injections should be made by trained arborists.</p> <p><b>3-year treatment for preventative and curative management of DED:</b> Inject 12.0 fl oz thiabendazole (Arbotect 20-S) in 6 gal 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 ¼ inch. 1 ½ - 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 insect control and a sanitation program (pruning of diseased limbs) to obtain best results. Be sure to flush injection holes with several liters of water following fungicide injection as this promotes faster wound closure.</p> <p>Propiconazole (Alamo) is also registered for both preventative and curative control of DED by macroinjection, microinjection, or infusion. Follow label rates, taking note that recommended rates for curative control are higher than for preventative control. Dilutions for injection can vary but total delivery rates per DBH inch should be followed. The frequency of propiconazole treatment required is not clearly known, but research indicates that a 6 ml rate should protect trees for 24 months, whereas a 10 ml rate should protect for 36 months. Curative treatments should be repeated every 12-36 months. Preventative treatment is preferable to curative treatment when possible; severely affected trees may not respond to treatment.</p> <p><b>Cultural Control:</b> An integrated program is strongly recommended to protect susceptible elms from DED. Prompt removal and destruction of affected branches or dead trees is necessary to prevent spread of the fungal pathogen by beetle vectors. Affected branches should be pruned at the trunk using recommended pruning procedures.</p> <p>Root grafts between affected and nearby healthy trees should be severed to prevent transmission of the fungus through graft unions.</p> <p>There are many DED-resistant cultivars available, so use a resistant cultivar for any new planting.</p>
<b>Filbert/European hazelnut (<i>Corylus avellana</i>)</b> Eastern Filbert Blight ( <i>Anisogramma anomala</i> )	Copper	<p><b>Chemical Control:</b> Preventative fungicides can be used to manage this disease on ornamental filbert trees that are not already severely affected. Beginning at budswell, apply three to four applications of a copper fungicide at product label intervals. Follow label precautions and directions.</p> <p><b>Cultural Control:</b> Infected branches should be pruned out well below visible cankers. Do not leave infested debris in the landscape.</p> <p><b>Precautions/Remarks:</b> Precautions/Remarks: Carefully follow copper fungicide label precautions relating to phytotoxicity.</p> <p><b>Related Fact Sheet:</b> <a href="http://wiki.bugwood.org/Anisogramma_anomala_(eastern_filbert_blight)">http://wiki.bugwood.org/Anisogramma_anomala_(eastern_filbert_blight)</a></p>

Table 4.2 - Fungicide Use (cont.)

Plant and Disease	Labeled Pesticides—by common chemical name	Recommendation
<b>Hawthorn (<i>Crataegus</i>)</b> Cedar-Quince Rust ( <i>Gymnosporangium clavipes</i> )	Chlorothalonil Azoxystrobin Chlorothalonil + thiophanate methyl Metconazole Myclobutanil Tebuconazole Thiophanate methyl	<b>Chemical Control:</b> Spray fungicides at label rates at pre-bloom stage. Generally three sprays, beginning at bud break, are effective in preventing the disease. Fungicides applied after bloom are not effective for control. <b>Precautions/Remarks:</b> Note label instructions regarding rotation of certain fungicides with other products to prevent the development of fungicide resistance.
<b>Hickory (<i>Carya</i>)</b> Leaf Spot ( <i>Microstoma</i> )	No chemical controls	<b>Chemical Control:</b> This disease is not serious enough to warrant chemical control. <b>Cultural Control:</b> Collect and either burn or bury diseased leaves to prevent overwintering of the fungus.
<b>Honeylocust (<i>Gleditsia</i>)</b> Cercospora Leaf Spot ( <i>Cercospora</i> )	Azoxystrobin Chlorothalonil Copper hydroxide Mancozeb Myclobutanil Thiophanate methyl Thiophanate methyl + mancozeb	<b>Chemical Control:</b> Apply fungicides at label rates beginning at bud break or first sign of disease.
<b>Larch (<i>Larix</i> sp.)</b> Mycosphaerella Needle Cast ( <i>Mycosphaerella</i> )	Copper Mancozeb	<b>Chemical Control:</b> Preventative fungicides can be used to manage this disease. Three to six applications of preventative fungicides, repeated at product label intervals, beginning in early June are recommended. <b>Cultural Control:</b> Remove fallen needles to reduce fungal inoculum for future infections. <b>Precautions/Remarks:</b> Repeated needle loss from this disease can lead to branch dieback and/or stunting. Carefully follow copper fungicide label precautions relating to phytotoxicity.
<b>Magnolia (<i>Magnolia</i>)</b> Leaf Scorch/Winter Injury	Foliar anti-transpirant	<b>Chemical Control:</b> Magnolia leaves are especially prone to winter desiccation. A foliar anti-transpirant, such as Moisturin or Wilt-Pruf, can be applied according to manufacturer's directions. <b>Cultural Control:</b> If conditions are dry in the fall, water the tree deeply before the ground freezes.
<b>Magnolia (<i>Magnolia</i>)</b> Sooty Mold (various fungi)	No chemical controls for the fungus	<b>Chemical Control:</b> In some cases an appropriate insecticide may be recommended. Identify and control insects that secrete the honeydew on which the sooty mold grows. For magnolia, refer to the section on control of magnolia scale in the "Insects of Trees and Shrubs" section. <b>Precautions/Remarks:</b> Sooty mold fungi appear as a black coating on the leaf surface of several different tree and shrub species. They do not parasitize the plant; they simply grow on the honeydew substance secreted by certain insects, such as aphids and scales.
<b>Maple (<i>Acer</i>)</b> Anthracnose ( <i>Kabatella</i> , others)	See fungicide list for ash anthracnose.	<b>Chemical Control:</b> 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 ash anthracnose can be used for control. <b>Cultural Control:</b> Collect and either burn or bury fallen leaves to reduce overwintering of fungal inoculum.
Purple-eye Leaf Spot ( <i>Phyllosticta minima</i> )		<b>Chemical Control:</b> This is not a serious threat to the overall health of the tree and does not usually warrant fungicide control. <b>Cultural Control:</b> Raking and removing fallen leaves in fall will reduce the amount of overwintering inoculum that would be available to infect the trees next year.

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

Plant and Disease	Labeled Pesticides—by common chemical name	Recommendation
Scorch	No chemical controls	<p><b>Precautions/Remarks:</b> Scorch, the burning of leaf margins, may occur in spring or summer due to moisture stress. Supplemental watering and mulching often alleviate or prevent the problem. Anti-transpirants may be helpful.</p> <p>Note that bacterial scorch has also been found to cause scorch in red maple (<i>Acer rubrum</i>), boxelder (<i>Acer negundo</i>), and sugar maple (<i>Acer saccharum</i>). Refer to the Bacterial Scorch section under Elm for details.</p>
<b>Maple (<i>Acer</i>) (cont.)</b> Verticillium Wilt ( <i>Verticillium</i> )	No chemical controls	<p><b>Cultural Control:</b> Some research indicates that vigorous nitrogen fertilization with ammonium sulfate, above the rate a tree might receive on a standard maintenance program, may enhance recovery in infected trees.</p> <p>Avoid planting susceptible species in soil where trees have been diagnosed with Verticillium wilt. Refer to the list under the Catalpa section.</p>
Zonate Leaf Spot ( <i>Cristulariella</i> )	Mancozeb	<p><b>Chemical Control:</b> This disease often appears late in the season when fungicide treatment is no longer warranted. If the disease appears early in the season, which is sometimes seen in Norway and red maple, mancozeb fungicide can be used at label rates.</p> <p><b>Cultural Control:</b> Collect and either burn or bury diseased leaves to prevent overwintering of the fungus.</p>
<b>Mimosa (<i>Albizia</i>)</b> Mimosa Wilt ( <i>Fusarium</i> )	No chemical controls	<p><b>Cultural Control:</b> The mimosa wilt pathogen is soil-borne but has a very narrow host range. Replace trees that have died from this disease with species other than mimosa.</p> <p><b>Related Fact Sheets:</b>  <a href="http://pubs.ext.vt.edu/2811/2811-1020/2811-1020.html">http://pubs.ext.vt.edu/2811/2811-1020/2811-1020.html</a></p>
<b>Mountain Ash (<i>Sorbus</i>)</b> Cytospora Canker ( <i>Cytospora</i> )	No chemical controls	<p><b>Cultural Control:</b> Prune affected branches back to healthy wood and remove pruned branches from the landscape.</p>
<b>Oak (<i>Quercus</i>)</b> Anthracnose ( <i>Various fungi</i> )	See fungicide list for ash anthracnose.	<p><b>Chemical Control:</b> Normally this disease is not serious enough to warrant chemical control; however, fungicides recommended for control of ash anthracnose can be used if fungicide control is desired. Adequate coverage may be difficult for large trees.</p>
Bacterial Scorch ( <i>Xylella</i> )	See control information for bacterial scorch on elm.	<p><b>Related Fact Sheets:</b>  <a href="http://pubs.ext.vt.edu/3001/3001-1433/3001-1433.html">http://pubs.ext.vt.edu/3001/3001-1433/3001-1433.html</a></p>
Bacterial Wetwood (various bacteria)	No chemical controls	<p><b>Precautions/Remarks:</b> See remarks for bacterial wetwood on dogwood.</p>
Chlorosis (abiotic)	Soil pH can be changed chemically to alleviate symptoms.	<p><b>Cultural Control:</b> The most common cause of chlorosis in oaks is high soil pH (<math>\geq 7.0</math>). Lowering soil pH makes nutrients that aid in chlorophyll synthesis more available to the plant. Soil pH can be lowered by applying an acid-producing fertilizer, sulfur, aluminum sulfate, or other acidic compound to the soil. For an exact rate, submit soil samples to the VT Soil Testing Lab for analysis and recommendations. On sites where soil is difficult to amend, foliar applications of iron chelate can be used. Trunk implantation devices, such as capsules or "Medicaps," are also available.</p> <p><b>Precautions/Remarks:</b> 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. Although the most common cause of chlorosis on oaks in Virginia is high soil pH, chlorosis can also be caused by structural abnormalities in roots, e.g. girdling roots, or by poor drainage, a condition that is common in parking lot islands.</p>
Endothia Canker ( <i>Endothia</i> )	No chemical controls	<p><b>Cultural Control:</b> Remove cankered branches at the trunk or at the major adjoining branch and remove pruned branches from the landscape. Avoid wounding of any kind, especially lawnmower injuries and pruning wounds (especially in pin oak). Keep pin oaks well watered and apply fertilizer as needed.</p> <p><b>Precautions/Remarks:</b> Endothia canker is most commonly seen on pin oak, but may also occur on other species of oak, including live oak.</p>

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

Plant and Disease	Labeled Pesticides—by common chemical name	Recommendation
<b>Oak (<i>Quercus</i>)</b> (cont.) Leaf blister ( <i>Taphrina</i> )	Mancozeb	<b>Precautions/Remarks:</b> This disease rarely causes significant stress to oak trees in Virginia. The pathogen infects leaves early in the spring and repeat infections do not occur. By the time symptoms are noticed, chemical control is not effective. If fungicides are used, they must be applied in early spring prior to disease development. Follow label rates and precautions.
Powdery Mildew ( <i>Sphaerotheca</i> )	No chemical control needed	<b>Precautions/Remarks:</b> This disease is usually a late season disease on oaks and control is not warranted.
Ramorum Blight (Sudden Oak Death) ( <i>Phytophthora ramorum</i> )	Not known to occur in Virginia at this time	<b>Chemical Control:</b> The disease is not known to occur in Virginia at this time and treatment is not recommended in areas where infected plants are not already present. <b>Precautions/Remarks:</b> Purchase plants only from reputable growers. This disease is present on the west coast of the United States and affects many woody shrub species, causing symptoms that can be easily overlooked. Quarantines have been invoked on infested counties in the West and all plants shipped from nurseries in infested counties are inspected and approved prior to shipment; however, there is little to no oversight of individuals who may sell plants via the internet. The disease can spread from woody shrub species to oak trees. Virginia nurseries are actively inspected for presence of this disease, so it is best to purchase plants from a reputable local nursery.
Tubakia Leaf Spot ( <i>Tubakia</i> )	No chemical control needed	<b>Chemical Control:</b> This disease is usually a late season disease and chemical control is typically not warranted. However, chlorothalonil and propiconazole are registered for control. <b>Cultural Control:</b> Rake and remove fallen leaves to prevent overwintering of the fungus.
<b>Ornamental Pear (<i>Pyrus</i>)</b> Fire Blight ( <i>Erwinia amylovora</i> )	No chemical control needed for ornamental pear	<b>Cultural Control:</b> Bradford pear ( <i>Pyrus calleryana</i> ) has resistance to fire blight, but cultivars vary in their level of resistance. In years when weather is conducive to fire blight, some dieback may occur in Bradford pear. In general, the level of damage does not warrant chemical control. Prune out affected branches well below any signs of bark discoloration. Disinfect pruning tools between cuts by dipping in rubbing alcohol or a solution of 1 part bleach to 9 parts water. Remove pruned branches from the landscape. <b>Precautions/Remarks:</b> Bradford pear is more prone to mechanical and cultural problems than it is to disease. Branches break easily in wind or ice storms. The species is also very sensitive to deep planting and poor drainage and responds to these conditions by turning black (both 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.



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

Plant and Disease	Labeled Pesticides—by common chemical name	Recommendation
<b>Pine (<i>Pinus</i>)</b> Diplodia Tip Blight ( <i>Diplodia</i> )	Calcium hydroxide + copper sulfate (Bordeaux mixture) Chlorothalonil Propiconazole Thiophanate methyl	<p><b>Chemical Control:</b> Apply Bordeaux mixture when new growth starts, as needles emerge from the sheath, and when needles are 2/3 mature length. Freshly prepared Bordeaux mixture is more effective than commercial Bordeaux mixture.</p> <p>Apply chlorothalonil at bud swell and repeat at 10- to 14-day intervals.</p> <p>Apply thiophanate methyl in spring when new growth emerges. Make a second application just before needles emerge from the sheath and a third application 7 days later.</p> <p>Thorough coverage with fungicides is necessary for optimal disease control.</p> <p><b>Cultural Control:</b> 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 and white resin accumulates on bark. Such branches should be pruned back to healthy wood. Take care to disinfect pruning tools frequently in rubbing alcohol or a solution of 1 part bleach to 9 parts water.</p> <p><b>Precautions/Remarks:</b> On highly susceptible species, such as Austrian pine, the disease may kill the tree in the absence of early intervention. Note label instructions regarding rotation of certain fungicides with other products to prevent the development of fungicide resistance.</p>
Dothistroma Needle Blight ( <i>Dothistroma</i> )	Fixed copper Bordeaux mixture	<p><b>Chemical Control:</b> Begin protectant fungicide applications when new needles first emerge in spring and repeat 3 to 4 weeks later. Fungicide applications when needles drop later in the spring and summer will not be effective.</p> <p><b>Cultural Control:</b> Remove fallen twigs and needles to reduce fungal inoculum for future infections.</p> <p><b>Precautions/Remarks:</b> Refer to information on Bordeaux mixture above (under Pine, Diplodia Tip Blight). Follow copper product label precautions regarding copper phytotoxicity.</p>
Disorders of Eastern White Pine ( <i>Pinus strobus</i> )	No chemical controls	<p><b>Precautions/Remarks:</b> Eastern white pine is a species that is particularly sensitive to a wide array of stresses. It is easily injured by insufficient or excess soil moisture and does not do well where soil profiles have been disturbed or where soil is compacted, e.g. around new building construction. White pine is also susceptible to certain herbicides, deicing salt and air pollutants. Most of these stresses result in overall yellowing, browning and/or stunting of the needles. Individual cases must be examined to be diagnosed.</p>
Needle Cast Diseases (various fungi)	See Conifers section	<p><b>Chemical Control:</b> Refer to information on control of needle cast diseases in the Conifers section.</p>
Needle Rust ( <i>Coleosporium</i> )	No chemical control needed	<p><b>Precautions/Remarks:</b> Although this disease may be unsightly on the needles, it rarely causes significant stress to trees and fungicide control is not warranted.</p>
Pine Wilt (esp. in Japanese Black Pine) ( <i>Bursaphelenchus</i> )	No chemical controls	<p><b>Cultural Control:</b> Remove affected trees, including stumps, to prevent egg-laying by the beetles that vector the nematode pathogen.</p> <p><b>Precautions/Remarks:</b> As the beetles mature in the stump or dying tree, they acquire the pine wilt nematode. When adults emerge and fly to healthy trees, they transmit the disease.</p>
Seasonal Needle Drop (abiotic)	No chemical controls	<p><b>Precautions/Remarks:</b> 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 these inner needles gradually and the discoloration and needle loss 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 remain on the tree for some time before they drop, resulting in a striking inner yellowing of the tree. These symptoms often lead homeowners to believe the trees are dying. Seasonal needle drop is a natural occurrence in pines and other conifers. It may be more noticeable in some years than others, but it is no cause for concern.</p>

Table 4.2 - Fungicide Use (cont.)

Plant and Disease	Labeled Pesticides—by common chemical name	Recommendation
<b>Pine (<i>Pinus</i>)</b> (cont.) Procerum Root Disease (White Pine Root Decline) ( <i>Leptographium</i> )	Insecticides may be needed if stumps are not removed.	<b>Chemical Control:</b> If stumps are not removed, insecticide treatment of stumps is recommended to prevent further spread of the disease by the pales weevil. Refer to the weevils section in (pales weevil) Table 4.5 in the "Insects of Trees, Shrubs, Annuals, and Perennials" for a recommendation for stump treatment for pales weevil. <b>Cultural Control:</b> Complete removal and/or destruction of dying trees, including stumps, is recommended. White pine should NOT be used as a replacement tree. <b>Precautions/Remarks:</b> The fungus <i>Leptographium</i> (= <i>Verticicladiella</i> ) <i>procerum</i> is the suspected causal agent, but may not be the sole contributing 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 stumps of trees that have been cut down.
<b>Planetree (See Sycamore)</b>		
<b>Ornamental Plum (<i>Prunus</i>)</b> Black Knot ( <i>Dibotryon</i> )	Chlorothalonil Mancozeb + copper hydroxide	<b>Chemical Control:</b> Fungicide sprays are not effective if sanitation is not practiced. See cultural control information below. Fungicide sprays can be applied from bud break until early summer during wet seasons, which are conducive to disease. Follow label rates and timing of application. <b>Cultural Control:</b> Prune out galled branches at least 2 inches below the gall as soon as galls are noticed. The fungus produces its black fruiting bodies on the surface of the gall. To prevent new infections, if possible, prune out affected branches before the galls turn black. Remove pruned branches from the landscape. Avoid planting ornamental plums near stands of wild cherry trees, which often serve as a source of fungal inoculum.
<b>Poplar (<i>Populus</i>)</b> Canker (various fungi)	No chemical controls	<b>Cultural Control:</b> Prune out cankered branches back to healthy wood and remove prunings from the landscape. <b>Precautions/Remarks:</b> Avoid planting Lombardy poplar, which is highly susceptible to canker diseases.
<b>Red Cedar (<i>Juniperus virginiana</i>)</b> Cercospora Blight ( <i>Cercospora</i> )	Calcium hydroxide + copper sulfate (Bordeaux mixture) Liquid copper fungicide	<b>Chemical Control:</b> Make first fungicide application in early June; second application in late July. Additional applications may be needed during periods of heavy rain. Follow label rates and precautions. <b>Precautions/Remarks:</b> This disease is distinguished from Phomopsis tip blight by the appearance of symptoms from the inside of the tree out and from the bottom of the tree to the top. Phomopsis blight attacks from the shoot tips back.
<b>Redbud (<i>Cercis</i>)</b> Botryosphaeria die-back ( <i>Botryosphaeria</i> )	No chemical controls	<b>Cultural Control:</b> 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. Infection often follows drought stress. Water trees deeply during drought to prevent disease. <b>Related Fact Sheets:</b> <a href="http://pubs.ext.vt.edu/450/450-726/450-726.html">http://pubs.ext.vt.edu/450/450-726/450-726.html</a>
<b>Spruce (<i>Picea</i>)</b> Cytospora canker ( <i>Cytospora</i> )	No chemical controls	<b>Cultural Control:</b> Prune out cankered branches back to healthy wood and remove prunings from the landscape. Infection often follows drought or other stresses. Water trees deeply during drought to prevent disease.
Rhizosphaera needle cast ( <i>Rhizosphaera</i> )	Calcium hydroxide + copper sulfate (Bordeaux mixture) Chlorothalonil Mancozeb + copper hydroxide	<b>Chemical Control:</b> Begin fungicide application when new needles are ½ to 1 inch long. Repeat application of Bordeaux mixture when needles are full length. Repeat chlorothalonil or mancozeb + copper according to product label directions. <b>Precautions/Remarks:</b> The disease kills the interior needles and fungicide treatment may be needed for several consecutive years before trees appear to have full foliage again.
Stigmata needle cast ( <i>Stigmata</i> )	No research-based results available on chemical control	<b>Chemical Control:</b> The symptoms of this disease are very similar to those of Rhizosphaera needle cast. Little to no research has been done comparing effectiveness of fungicide treatments for this disease. Until such results become available, we suggest trying the fungicide treatment recommended for Rhizosphaera needle cast.

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

Plant and Disease	Labeled Pesticides—by common chemical name	Recommendation
<b>Sweetgum (Liquidambar)</b> Bleeding canker ( <i>Botryosphaeria</i> )	No chemical controls	<b>Cultural Control:</b> Stress, particularly drought stress, predisposes trees to disease. Watering trees deeply during drought can prevent disease and can sometimes help the tree to wall off early infections. <b>Related Fact Sheets:</b> <a href="http://pubs.ext.vt.edu/450/450-726/450-726.html">http://pubs.ext.vt.edu/450/450-726/450-726.html</a>
<b>Sycamore (Platanus)</b> Anthracnose (Various fungi)	For list of foliar-applied fungicides, see fungicide list for ash anthracnose. Propiconazole (injectable) Thiabendazole hypophosphite (injectable)	<b>Chemical Control:</b> The fungicides listed for ash anthracnose can be used for control of sycamore anthracnose as well; however, if spray application is undesirable because of the tree's location or size, injections of thiabendazole hypophosphite can be made in late summer. Inject the 3X rate used in elm for management of Dutch elm disease, or follow label rates. Propiconazole can also be applied by injection. Follow label rates. <b>Cultural Control:</b> London planetree, which is a hybrid of sycamore and oriental planetree, has resistance to anthracnose and is preferable to sycamore for new plantings. <b>Precautions/Remarks:</b> Anthracnose can be severely disfiguring to sycamore during repeated long, moist cool springs. Trees may appear to be almost completely defoliated early in the growing season; however, as weather warms up, the fungus becomes less active and trees usually put out a flush of new growth in midsummer. Anthracnose should not be confused with bacterial scorch (see below). Anthracnose lesions tend to follow the leaf veins, whereas symptoms of bacterial scorch appear along leaf margins.
Bacterial Scorch ( <i>Xylella</i> )	See controls for bacterial scorch of elm.	<b>Chemical Control:</b> See comments for bacterial scorch of elm.
<b>Black walnut (Juglans nigra)</b> Anthracnose (Various fungi)	See fungicide list for anthracnose of ash.	<b>Chemical Control:</b> Follow directions for control of ash anthracnose.
Thousand cankers disease ( <i>Geosmithia morbida</i> ) (vectored by the walnut twig beetle – <i>Pityophthorus juglandis</i> )	At this time there are no chemical controls for the fungus that causes Thousand Cankers Disease.	<b>Cultural Control:</b> Avoid introduction of the disease to new locations. Do not transport walnut plants or products from one location to another. Buy walnut logs, lumber or firewood only from a reputable source. If you suspect walnut thousand cankers disease, place samples of affected, but not dead, branches 1-4" in diameter in a sealable plastic bag, then place into a second sealable bag and seal. Bring samples to your local county VCE office for mailing to the Plant Disease Clinic for diagnosis. If you remove a walnut tree growing within the quarantine area, be aware that under quarantine regulations, you may not dispose or distribute the wood outside the quarantine area. <b>Precautions/Remarks:</b> To see a Virginia map and list of Thousand Cankers Disease quarantined counties visit this url ( <a href="http://www.vdacs.virginia.gov/images/tcdmap.jpg">http://www.vdacs.virginia.gov/images/tcdmap.jpg</a> ) at the Virginia Department of Agriculture and Consumer Services. Under the quarantine, all walnut plants and plant parts of walnut, including lumber, logs, stumps, firewood, roots, branches, mulch and chips, are prohibited from being moved out of the quarantine area.
<b>Willow (Salix)</b> Black canker and scab ( <i>Physalospora</i> / <i>Glomerella</i> and <i>Venturia</i> )	Mancozeb	<b>Chemical Control:</b> Apply fungicide beginning at bud break at label rates and intervals. <b>Precautions/Remarks:</b> These two diseases often occur together, causing damage to new shoots and twigs. Disease is more severe in wet springs. Cultivars of willow vary in susceptibility to this disease.
Galls (various causes)	No chemical controls	<b>Cultural Control:</b> If desired for cosmetic purposes, galls on larger trees may be removed surgically. Disinfest tools between cuts with rubbing alcohol or a solution of 1 part bleach to 9 parts water. Galls should be removed during late fall or midsummer when sap flow is minimal.
<b>Willow (Salix) (cont.)</b> Fungal cankers (various cankers)	No chemical controls	<b>Cultural Control:</b> Prune out cankered branches back to healthy wood and remove prunings from the landscape. <b>Precautions/Remarks:</b> Willows are susceptible to a variety of fungal canker diseases. Symptoms appear as discolored or cracked bark with dieback above the canker.

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

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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. For color photographs and biology of tree and shrub pests, see *Garden Insects of North America* by Whitney Cranshaw and David Shetlar. *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 in italics.** Those which are occasional, minor, have no known control, or for which control is unnecessary in usual situations are not in italics. For each important pest or pest group, control recommendations are suggested in Table 4-5 following the index. Table 4-6 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 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, permethrin, 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 are 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- to 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 do 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 not economical, 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-depressor 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 *Elaeagnus*. 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.**

## 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 *italics*.

**Abelia** – scale insects

**Agertum** – *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*, Emerald ash borer, *leafminer*, scale insects, *spider mites*, weevils

**Ash** – aphid, flower gall mites, *borers*, defoliators, Emerald Ash borer, 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

**Camelia** – *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*

**Chokecherry** – 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

**Elaeagnus** – *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

**Ginkgo** – 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, mites, sawflies, *scale insects*, *spider mites*, thrips, webworm, 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, symphylan

**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 Plantree** – 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

**Muleberry** – *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

## 4-32 Home Ornamentals: *Insects of Trees, Shrubs, Annuals, and Perennials*

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

**Periwinkle** – (Vinca) aphids

**Persimon** – borers, *defoliators*, mealybugs, psyllid, *scale insects*, thrips, whitefly

**Petunia** – aphids, climbing cutworms, flea beetles, 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

**Rebud** – 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

**Tree-of-heaven** – spotted lanternfly

**Tupelo** – aphids, leafminer

**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

**Weigela** – 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 - Proposed 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 - Proposed 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, 1 <sup>st</sup> 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. **Malathion** may cause injury to certain junipers, *Elaeagnus*, 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**

<b>Pest</b>	<b>Pesticides Approved</b>	<b>Recommendations</b>
<b>Adelgids</b> Spruce gall adelgid	Carbaryl Bifenthrin <i>Paraffin oil</i> <i>Dormant oil</i>	<p><b>Timing of pesticide treatment:</b> 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.</p> <p><b>Remarks:</b> 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.</p> <p><b>Biological controls:</b> Brown lacewings</p> <p><b>Cultural control:</b> Remove and destroy galls when green, moist and growing. Avoid growing Douglas firs and spruce together. Plant resistant or tolerant varieties of Douglas firs. Green needled plants are generally more resistant than blue.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/ENTO/ENTO-146/ENTO-146.html">https://pubs.ext.vt.edu/ENTO/ENTO-146/ENTO-146.html</a></p>
Pine bark adelgid	<i>Paraffin oil</i> <i>Dormant oil</i>	<p><b>Timing of pesticide treatment:</b> Treat in late April or early May and repeat 2-3 weeks later.</p> <p><b>Remarks:</b> 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.</p> <p><b>Biological controls:</b> Larvae of lady beetles, lacewings, and hoverflies</p> <p><b>Cultural control:</b> General overall health. Avoid fertilizing plants too much. Extra nutrients encourage bug growth.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2907/2907-1402/2907-1402.html">https://pubs.ext.vt.edu/2907/2907-1402/2907-1402.html</a></p>
Hemlock woolly adelgid	Imidacloprid Dinotefuran <i>Dormant oil</i> <i>Potassium laurate</i> Thiamethoxam see table 4.6	<p><b>Timing of pesticide treatment:</b> Treat anytime with Dormant oil although early November is best. Treat with Imidacloprid in April or May as a soil drench. For imidacloprid, see "Bee Advisory Box"</p> <p><b>Remarks:</b> 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.</p> <p><b>Biological controls:</b> Black lady beetle, Chinese lady beetles, Tooth-necked fungus beetle</p> <p><b>Cultural control:</b> Discourage animal visits; monitor plant material movement from around it; clean vehicles, clothes, etc; selectively remove heavily infested trees. Don't stress the plant. Prune dead limbs; don't fertilize infested trees; use a stream of water to dislodge eggs and crawlers between April and June. Plant resistant species.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/3006/3006-1451/3006-1451.html">https://pubs.ext.vt.edu/3006/3006-1451/3006-1451.html</a></p>
Hickory leaf-stem gall aphid	Carbaryl	<p><b>Timing of pesticide treatment:</b> Treat just as new buds are beginning to open. Timing is critical.</p> <p><b>Biological controls:</b> 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.</p> <p><b>Cultural control:</b> Encourage natural predators by not removing all of the galls. Prune out galls while still green. Rake up and destroy fallen infested leaves.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/ENTO/ENTO-146/ENTO-146.html">https://pubs.ext.vt.edu/ENTO/ENTO-146/ENTO-146.html</a></p>

*Italicized pesticides are organic control options.*

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

<b>Pest</b>	<b>Pesticides Approved</b>	<b>Recommendations</b>
<b>Aphids</b> (general)	Bifenthrin	<b>Timing of pesticide treatment:</b> 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. For imidacloprid, see "Bee Advisory Box"
	Imidacloprid	
	Permethrin	
	Malathion	<b>Biological controls:</b> 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. Green lacewings, lady beetles, and aphid parasites ( <i>Aphidius colemani</i> , <i>Aphidius ervi</i> and <i>Aphidius abdominalis</i> ).
	Carbaryl	
	Esfenvalerate	
	<i>Neem Oil</i>	
	Insecticidal Soap	
	<i>Spinosin</i>	<b>Cultural control:</b> Keep the plant in overall good health. Do not overuse nitrogen when fertilizing.
	<i>Pyrethrins</i>	
	Soybean Oil	<b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/444/444-220/444-220.html">https://pubs.ext.vt.edu/444/444-220/444-220.html</a>
	Zeta-Cypermethrin	
<b>Bagworms</b> General	Bifenthrin	<b>Timing of pesticide treatment:</b> 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.
	Imidacloprid	
	Permethrin	<b>Remarks:</b> 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. Carbaryl may lead to mite increases.
	Malathion	
	Carbaryl	<b>Biological controls:</b> Parasitic wasps.
	Esfenvalerate	
	<i>Neem Oil</i>	<b>Cultural controls:</b> Pick off the bags in light infestations and destroy them, remove silk to not girdle the limb.
	<i>Bacillus thuringensis (Bt)</i>	
	<i>Spinosin</i>	<b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1008/2808-1008.html">https://pubs.ext.vt.edu/2808/2808-1008/2808-1008.html</a>
	<i>Pyrethrins</i>	
	Soybean Oil	
	Zeta-Cypermethrin	
<b>Bark beetles</b> General	<i>Azadirachtin</i>	<b>Timing of pesticide treatment:</b> 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. For imidacloprid, see "Bee Advisory Box"
	Bifenthrin	
	Cypermethrin	
	Disodium octaborate tetrahydrate	<b>Remarks:</b> 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.
	Imidacloprid	
	Permethrin	<b>Biological controls:</b> Encourage natural predators: woodpeckers, blackbellied clerid, trogossitid, snakeflies, and parasitic wasps. Release has not helped heavily infested trees.
	Zeta-Cypermethrin	
	see table 4.6	<b>Cultural controls:</b> Reduce tree stress. Be sure the tree is suited to the area. Avoid injuries, damage and soil compaction. Properly prune infested limbs, remove and dispose of so that the beetles do not emerge and infest nearby plants. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/444/444-216/444-216.html">https://pubs.ext.vt.edu/444/444-216/444-216.html</a>

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

<b>Pest</b>	<b>Pesticides Approved</b>	<b>Recommendations</b>
<b>Bark beetles</b> (cont.) Elm bark beetle	<i>Azadirachtin</i> <i>Beauveria bassiana</i> Bifenthrin Carbaryl Imidacloprid Permethrin see table 4.6	<b>Timing of pesticide treatment:</b> 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. For imidacloprid, see "Bee Advisory Box"  <b>Remarks:</b> 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.  <b>Biological controls:</b> Encourage natural predators: parasitic wasps, clerid beetles.  <b>Cultural controls:</b> Maintain a healthy, stress-free condition for the plant. Prune infested branches out of the tree during the dormant season. Remove, burn or bury the pruned branches. Plant tolerant or resistant elms to Dutch elm disease.  <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/444/444-216/444-216.html">https://pubs.ext.vt.edu/444/444-216/444-216.html</a>
Shot-hole borer, fruit tree bark beetles, ash bark beetle	See General Bark beetles	<b>Timing of pesticide application:</b> Drench the bark of healthy trees in late April and early June.  <b>Remarks:</b> 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.  <b>Biological controls:</b> See General Bark beetles  <b>Cultural controls:</b> See General Bark beetles  <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/444/444-216/444-216.html">https://pubs.ext.vt.edu/444/444-216/444-216.html</a>
Conifers, pine bark beetle	Beta-cyfluthrin Imidacloprid Permethrin <i>Pyrethrins</i>	<b>Timing of pesticide treatment:</b> 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. For imidacloprid, see "Bee Advisory Box"  <b>Remarks:</b> 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.  <b>Biological controls:</b> Natural predators – woodpeckers, blackbellied clerid, trogossitid, snakeflies and parasitic wasps  <b>Cultural controls:</b> Reduce tree stress. Be sure the tree is suited to the area. Avoid injuries, damage, and soil compaction. Properly prune infested limbs, remove and dispose of so that the beetles do not emerge and infest nearby plants.  Sanitation should be done 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.  <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/444/444-216/444-216.html">https://pubs.ext.vt.edu/444/444-216/444-216.html</a>

*Italicized pesticides are organic control options.*

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

<b>Pest</b>	<b>Pesticides Approved</b>	<b>Recommendations</b>
Granulate ambrosia beetle	Beta-cyfluthrin Bifenthrin Cryolite Cyfluthrin Cypermethrin Disodium octabrate tetrahydrate Esfenvalerate Imidacloprid Lambda-Cyhalothrin Permethrin see table 4.6	<p><b>Timing of pesticide application:</b> Treat trunk and larger branches in early April when the daytime temperature exceeds 70°F for the first time. For imidacloprid, see “Bee Advisory Box”</p> <p><b>Remarks:</b> 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.</p> <p><b>Biological controls:</b> None known at this time.</p> <p><b>Cultural controls:</b> Remove and burn infected trees.</p>
<b>Borers</b> Azalea stem borer, dogwood twig borer	Bifenthrin Imidacloprid	<p><b>Timing of pesticide treatment:</b> Treat one-year-old stems throughout the tree in mid-May and in mid-June. For imidacloprid, see “Bee Advisory Box”</p> <p><b>Remarks:</b> Cut out and destroy infested wilting stems. Imidacloprid as a soil drench prior to infestation.</p> <p><b>Biological controls:</b> Tachinid fly and Braconid wasp. Encourage native predators such as woodpeckers.</p> <p><b>Cultural controls:</b> Remove infested branches below hollow section to prevent larvae spread. Remove dead branches. Increase overall plant health.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/444/444-625/444-625.html">https://pubs.ext.vt.edu/444/444-625/444-625.html</a></p>
Banded ash borer	<i>Azadirachtin</i> Beta-cyfluthrin Bifenthrin Carbaryl Cyfluthrin Imidacloprid Permethrin <i>Spinosyn</i>	<p><b>Timing of pesticide treatment:</b> Treat trunk and main stems in late July and again in early September. For imidacloprid, see “Bee Advisory Box”</p> <p><b>Remarks:</b> Control measures are preventive treatments aimed at egg-laying adults and/or newly hatched larvae prior to tunneling into the tree.</p> <p><b>Biological controls:</b> Several parasitic wasps (braconid wasp &amp; Chaclid wasp).</p> <p><b>Cultural controls:</b> Improve general overall health. Reduce tree stress. Be sure the tree is suited to the area. Avoid planting in full sun. Avoid injuries, damage, and soil compaction. It has been suggested that wrapping young plants from soil to first large limb prevents sunburn and infestation but some studies have shown that wrapping during planting increases the possibility of borer damage. Properly prune infested limbs, remove and dispose of so that the beetles do not emerge and infest nearby plants.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/ENTO/ENTO-133/ENTO-133.html">https://pubs.ext.vt.edu/ENTO/ENTO-133/ENTO-133.html</a></p>
Bronze birch borer	Bifenthrin Imidacloprid Permethrin see table 4.6	<p><b>Timing of pesticide treatment:</b> Treat all bark surfaces, especially in the uppermost part of the tree in mid-May, and early, mid-, and late-June. For imidacloprid, see “Bee Advisory Box”</p> <p><b>Remarks:</b> Often infests older trees that are in decline. Imidacloprid as a soil drench prior to infestation.</p> <p><b>Biological controls:</b> Several parasitic wasps (Braconid, Ichneumon &amp; Chaclid wasp).</p> <p><b>Cultural controls:</b> Plant varieties that are more resistant to infestation. River birch (<i>Betula nigra</i>) and its cultivar Heritage birch are the most resistant while European white birch (<i>Betula pendula</i>) is the most susceptible. Grow herbaceous plants over shallow root systems to reduce heat stress. Improve general overall health. Reduce tree stress. Be sure the tree is suited to the area. Avoid planting in full sun. Avoid injuries, damage, and soil compaction. Properly prune infested limbs, remove and dispose of so that beetles do not emerge and infest nearby plants.</p>

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

Pest	Pesticides Approved	Recommendations
<b>Borers (cont.)</b>	Acetamiprid	<b>Timing of pesticide treatment:</b> Treat trunk and larger branches in mid-May and repeat after 6 weeks.
Dogwood borer	Bifenthrin	<b>Biological controls:</b> Entomophagous nematode, <i>Steinernema carpocapsae</i>
	Permethrin	<b>Cultural controls:</b> Improve general overall health. Reduce tree stress. Be sure the tree is suited to the area. Avoid planting in full sun and grafted species to reduce possibilities of burr knots. Avoid injuries, damage, and soil compaction. Properly prune infested limbs, remove and dispose of so that the beetles do not emerge and infest nearby plants.
	<i>Azadirachtin</i>	<b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1010/2808-1010.html">https://pubs.ext.vt.edu/2808/2808-1010/2808-1010.html</a>
Emerald ash borer	Systemic Insecticides: Imidacloprid <i>Azadirachtin</i> Dinotefuran emamectin benzoate	<b>Timing of pesticide treatment:</b> Systemics (Imidacloprid, Azadirachtin, 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. For imidacloprid, see “Bee Advisory Box”  <b>Remarks:</b> 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.
	Contact Insecticides: Permethrin Bifenthrin Carbaryl Cyfluthrin	<b>Biological controls:</b> None commercially available at this time. <b>Cultural controls:</b> Remove infested trees as soon as possible. Consider planting resistant Asian species of ash. <b>Related fact sheet:</b> <a href="http://pubs.ext.vt.edu/ENTO/ENTO-76/ENTO-76.html">http://pubs.ext.vt.edu/ENTO/ENTO-76/ENTO-76.html</a> and <a href="https://pubs.ext.vt.edu/2904/2904-1290/2904-1290.html">https://pubs.ext.vt.edu/2904/2904-1290/2904-1290.html</a>
Lilac borer, ash borer	Bifenthrin Imidacloprid Permethrin see table 4.6	<b>Timing of pesticide treatment:</b> Treat trunk and branches in early May and again 6 weeks later. For imidacloprid, see “Bee Advisory Box”  <b>Remarks:</b> Treatments also kill emerging as well as entering borers. Thorough wetting and soaking of the bark is necessary. Foliage need not be treated. <b>Biological controls:</b> None known at this time. <b>Cultural controls:</b> Improve general overall health. Reduce tree stress. Be sure the tree is suited to the area. Avoid planting in full sun. Avoid injuries, damage, and soil compaction. Properly prune infested limbs in fall and winter, remove and dispose of so that beetles do not emerge and infest nearby plants. <b>Related fact sheets:</b> <a href="https://pubs.ext.vt.edu/444/444-278/444-278.html">https://pubs.ext.vt.edu/444/444-278/444-278.html</a> <a href="https://pubs.ext.vt.edu/ENTO/ENTO-142/ENTO-142.html">https://pubs.ext.vt.edu/ENTO/ENTO-142/ENTO-142.html</a>
Locust borer	Bifenthrin Imidacloprid Permethrin see table 4.	<b>Timing of pesticide treatment:</b> Treat the trunk and larger branches in late August to mid-September (before goldenrod is in bloom). For imidacloprid, see “Bee Advisory Box”  <b>Remarks:</b> Sprays applied in early spring provide adequate control if fall treatments were not made. Imidacloprid as a soil drench prior to infestation. <b>Biological controls:</b> Encourage natural predators: woodpeckers & wheel bugs. <b>Cultural controls:</b> Improve general overall health. Reduce tree stress. Be sure the tree is suited to the area. Avoid planting in full sun. Avoid injuries, damage, and soil compaction. Properly prune infested limbs, remove and dispose of so that beetles do not emerge and infest nearby plants. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/ENTO/ENTO-141/ENTO-141.html">https://pubs.ext.vt.edu/ENTO/ENTO-141/ENTO-141.html</a>

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

<b>Pest</b>	<b>Pesticides Approved</b>	<b>Recommendations</b>
<b>Borers (cont.)</b>	Bifenthrin	<b>Timing of pesticide treatment:</b> Treat all bark surfaces in mid- to late June and in late August to early September. For imidacloprid, see "Bee Advisory Box"
Mottled willow borer (poplar and willow borer)	Imidacloprid Permethrin see table 4.6	<b>Remarks:</b> Imidacloprid as a soil drench prior to infestation.
oak borer	Bifenthrin Imidacloprid Permethrin see table 4.6	<p><b>Timing of pesticide treatment:</b> Treat trunk to ground level in early June. For imidacloprid, see "Bee Advisory Box"</p> <p><b>Remarks:</b> Large populations are likely in even-numbered years.</p> <p><b>Biological controls:</b> Possible benefit from <i>B. bassiana</i></p> <p><b>Cultural controls:</b> Improve general overall health. Reduce tree stress. Be sure the tree is suited to the area. Avoid injuries, damage, and soil compaction. Properly prune infested limbs, remove and dispose so that beetles do not emerge and infest nearby plants.</p> <p><b>Related fact sheet:</b> <a href="http://pubs.ext.vt.edu/444/444-215/444-215.html">http://pubs.ext.vt.edu/444/444-215/444-215.html</a></p>
Peach tree borer	<i>Azadirachtin</i> Bifenthrin Chlorantraniliprole Esfenvalerate Gamma-cyhalothrin Lambda-Cyhalothrin Permethrin Zeta-Cypermethrin see table 4.6	<p><b>Timing of pesticide treatment:</b> Treat trunks and soil around the base in July and repeat in 6 weeks.</p> <p><b>Biological controls:</b> Parasitic wasps &amp; nematodes: Braconid &amp; Ichneumon wasps and <i>Steinernema carpocapsae</i> nematode. Pheromone traps.</p> <p><b>Cultural controls:</b> Improve general overall health. Reduce tree stress. Be sure the tree is suited to the area. Avoid injuries, damage, and soil compaction. Properly prune infested limbs, remove and dispose of so that beetles do not emerge and infest nearby plants.</p>
Pine sawyer	Permethrin	<p><b>Timing of pesticide treatment:</b> Treat in May.</p> <p><b>Remarks:</b> Treat trunks of remaining trees after infested trees are removed. These insects are usually secondary.</p> <p><b>Biological controls:</b> None known at this time.</p> <p><b>Cultural controls:</b> Improve general overall health. Reduce tree stress. Be sure the tree is suited to the area. Avoid injuries, damage, and soil compaction. Properly prune infested limbs, remove and dispose of so that beetles do not emerge and infest nearby plants.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2907/2907-1399/2907-1399.html">https://pubs.ext.vt.edu/2907/2907-1399/2907-1399.html</a></p>
Rhododendron borer	Bifenthrin Permethrin	<p><b>Timing of pesticide treatment:</b> Treat the trunks and larger branches in late June.</p> <p><b>Biological controls:</b> Encourage natural predators: woodpeckers &amp; hymenopterous parasitoids. Pheromone traps.</p> <p><b>Cultural controls:</b> Improve general overall health. Reduce tree stress. Be sure the tree is suited to the area. Avoid injuries, damage, and soil compaction. Properly prune infested limbs, remove and dispose of so that beetles do not emerge and infest nearby plants.</p> <p><b>Related fact sheet:</b> <a href="http://pubs.ext.vt.edu/444/444-215/444-215.html">http://pubs.ext.vt.edu/444/444-215/444-215.html</a></p>
Round-headed and flat-headed tree borer	Acetamiprid Avermectin B1 Clothianidin Esfenvalerate Imidacloprid Permethrin see table 4.6	<p><b>Timing of pesticide treatment:</b> Treat bark of trunk and branches in early May, early June, and early July. For imidacloprid, see "Bee Advisory Box"</p> <p><b>Remarks:</b> Imidacloprid as a soil drench prior to infestation.</p> <p><b>Biological controls:</b> None known at this time.</p> <p><b>Cultural controls:</b> Improve general overall health. Reduce tree stress. Be sure the tree is suited to the area. Avoid injuries, damage, and soil compaction. Properly prune infested limbs when borers are not active, remove and dispose of so that beetles do not emerge and infest nearby plants.</p> <p><b>Related fact sheet:</b> <a href="http://pubs.ext.vt.edu/444/444-215/444-215.html">http://pubs.ext.vt.edu/444/444-215/444-215.html</a></p>

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

Pest	Pesticides Approved	Recommendations
<b>Borers</b> (cont.)	Bifenthrin	<b>Timing of pesticide treatment:</b> Treat trunk and branches during mid- to late May and mid- to late June. For imidacloprid, see “Bee Advisory Box”
Two-lined chestnut borer	Permethrin Imidacloprid	<b>Remarks:</b> Imidacloprid as a soil drench prior to infestation. <b>Biological controls:</b> Encourage natural predators: woodpeckers, Chalcid wasps. <b>Cultural controls:</b> Improve general overall health. Reduce tree stress. Be sure the tree is suited to the area. Avoid injuries, damage, and soil compaction. Soil aeration is helpful. Properly prune infested limbs when borers are not active, remove and dispose of so that beetles do not emerge and infest nearby plants.
<b>Boxelder bug</b>	Bifenthrin Imidacloprid Permethrin Malathion Carbaryl Esfenvalerate <i>Neem Oil</i> <i>Bacillus thuringensis</i> (Bt) <i>Spinosin</i> <i>Pyrethrins</i> Soybean Oil	<b>Timing of pesticide treatment:</b> Treat seed bearing female trees and flower beds where seeds fall and collect. <b>Remarks:</b> 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>Biological controls:</b> None known at this time. <b>Cultural controls:</b> Replace female boxelder trees in landscape.
<b>Cicada</b> (periodical cicada) General	Beta-cyfluthrin Bifenthrin Carbaryl Cyfluthrin Deltamethrin Esfenvalerate Gamma-cyhalothrin Lambda-Cyhalothrin see table 4.6	<b>Timing of pesticide treatment:</b> Treat bark of twigs on susceptible hosts soon after adult male singing becomes evident, usually around early May. <b>Remarks:</b> 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://pubs.ext.vt.edu/444-276/444-276.html">http://pubs.ext.vt.edu/444-276/444-276.html</a> for emergence dates of the 17-year cicada in your county. <b>Biological controls:</b> None known at this time. <b>Cultural controls:</b> Use netting to cover newly planted trees. Remove flagging damage. Improve general overall health. Reduce tree stress. Be sure the tree is suited to the area. Avoid injuries, damage and soil compaction. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/444/444-276/444-276.html">https://pubs.ext.vt.edu/444/444-276/444-276.html</a>
<b>Cutworms, climbing cutworms</b>	Bifenthrin Imidacloprid Permethrin Malathion Carbaryl Esfenvalerate <i>Neem Oil</i> <i>Bacillus thuringensis</i> (Bt) <i>Spinosin</i> <i>Pyrethrins</i> Soybean Oil	<b>Timing of pesticide treatment:</b> Treat when cutworms are found. For imidacloprid, see “Bee Advisory Box” <b>Remarks:</b> Feeding occurs at night. Thoroughly wet the soil with spray. Apply in the evening. Physical barriers may work as well. <b>Biological controls:</b> Encourage natural predators: birds, Ichneumonid, Chalcid, and Braconid wasps, and <i>Steinernema carpocapsae</i> nematodes. <b>Cultural controls:</b> Consider using endophytic grasses for renovations. Remove broad-leaf weeds in spring after the first leaves have expanded. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/3104/3104-1547/3104-1547.html">https://pubs.ext.vt.edu/3104/3104-1547/3104-1547.html</a>

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

Pest	Pesticides Approved	Recommendations
Defoliators (caterpillars, sawflies, leaf beetles)	Bifenthrin	<b>Timing of pesticide treatment:</b> 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. For imidacloprid, see "Bee Advisory Box"
	Imidacloprid	
	Permethrin	<b>Remarks:</b> 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.) Imidacloprid is an option for leaf feeding beetles.
	Malathion	
	Carbaryl	<b>Biological controls:</b> The <i>Coleomegilla maculata</i> , <i>Hippodamia convergens</i> , <i>Harmonia axyridis</i> lady beetles.
	Esfenvalerate	
	Neem Oil	<b>Cultural controls:</b> For a small number, handpick the individuals off of plants. Improve general overall health. Reduce tree stress. Be sure the tree is suited to the area. Avoid injuries, damage and soil compaction. Properly prune infested limbs if numbers are too large.
	<i>Bacillus thuringiensis</i> (Bt)	
	<i>Spinosin</i>	<b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/ENTO/ENTO-75/ENTO-75.html">https://pubs.ext.vt.edu/ENTO/ENTO-75/ENTO-75.html</a>
	<i>Pyrethrins</i>	
	Soybean Oil	
Buck moth caterpillar	Gamma-cyhalothrin	<b>Timing of pesticide treatment:</b> Treat in mid- to late May or June when eggs have hatched but larvae are small.
	<i>Bacillus thuringiensis</i> (Bt)	
		<b>Biological controls:</b> None known at this time.
		<b>Cultural controls:</b> Remove individually from plants if there are low numbers. Be careful to not touch with bare hands and hollow hairs will break off in gloves.
		<b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/ENTO/ENTO-18/ENTO-18NP.html">https://pubs.ext.vt.edu/ENTO/ENTO-18/ENTO-18NP.html</a>
Cankerworms	<i>Azadirachtin</i>	<b>Timing of pesticide treatment:</b> In May when the leaves are half to two-thirds full size, treatments must be applied when loopers are small.
	<i>Bacillus thuringiensis</i> (Bt)	
	<i>Canola oil</i>	<b>Biological controls:</b> Parasitizers (wasps: <i>Telenomus alsophilae</i> , <i>Euplectrus mellipes</i> , <i>Trichogramma minutum</i> ), birds, and ground beetles ( <i>Calosoma frigidum</i> )
	Carbaryl	
	Cyfluthrin	<b>Cultural controls:</b> Band tree trunks with sticky traps to prevent the females from laying eggs. Improve general overall health. Reduce tree stress. Be sure the tree is suited to the area. Avoid injuries, damage, and soil compaction.
	Deltamethrin	
	<i>Insecticidal soap</i>	
	Lambda-Cyhalothrin	
	<i>Spinosin</i>	
	see table 4.6	
Eastern tent caterpillar	Bifenthrin	<b>Timing of pesticide treatment:</b> Treat in April after leaves open.
	Permethrin	
	Malathion	<b>Remarks:</b> A sporadic pest, not a pest every year.
	Carbaryl	
	Esfenvalerate	<b>Biological controls:</b> Encourage natural predators: birds, some beneficial wasps or tachinid flies.
	Neem Oil	
	<i>Bacillus thuringiensis</i> (Bt)	<b>Cultural controls:</b> Find and remove eggmasses in the fall after leaves have fallen. In the spring, scrape tent off the tree in the early morning or late afternoon so caterpillars are in the tent and either crush or drop into soapy water to destroy caterpillars. Prune lightly; too much does more damage than needed.
	<i>Spinosin</i>	
	<i>Pyrethrins</i>	
	Soybean Oil	
		<b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/444/444-274/444-274.html">https://pubs.ext.vt.edu/444/444-274/444-274.html</a>

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

<b>Pest</b>	<b>Pesticides Approved</b>	<b>Recommendations</b>
<b>Defoliators</b> (cont.) Euonymus leaf notcher	Bifenthrin Carbaryl Dimilin Zeta-Cypermethrin	<b>Timing of pesticide treatment:</b> In late March or early April when insects are seen. <b>Remarks:</b> Sprays are usually ineffective if applied when caterpillars are less than 0.5 inch long. <b>Biological controls:</b> None known at this time. <b>Cultural controls:</b> Prune out egg masses. Avoid planting euonymus in affected areas.
Fall webworm	Bifenthrin Permethrin Malathion Carbaryl Esfenvalerate <i>Neem Oil</i> <i>Bacillus thuringensis</i> (Bt) <i>Spinosin</i> <i>Pyrethrins</i> Soybean Oil	<b>Timing of pesticide treatment:</b> When larvae first begin to feed in late June. Repeat in late July. <b>Biological controls:</b> Encourage natural predators: birds, predatory stink bugs, predatory wasps and flies. <b>Cultural controls:</b> Pull down webs in larger trees and destroy the caterpillars. Pruning out webs in small trees is also effective. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1013/2808-1013.html">https://pubs.ext.vt.edu/2808/2808-1013/2808-1013.html</a>
Flea beetles	Bifenthrin Imidacloprid Permethrin Malathion Carbaryl Esfenvalerate <i>Neem Oil</i> <i>Bacillus thuringensis</i> (Bt) <i>Spinosin</i> <i>Pyrethrins</i> Soybean Oil	<b>Timing of pesticide treatment:</b> When insects are found feeding on host plants as adults or as larvae. For imidacloprid, see "Bee Advisory Box" <b>Remarks:</b> Carbaryl may injure tender foliage if plants are wet when treated or humidity is high. <b>Biological controls:</b> None known at this time. <b>Cultural controls:</b> Plant seedlings and transplants in well-prepared beds to hasten growth and vigor. Control weeds, and remove trash-plant particles to maintain good sanitation. Gauze can be used as a mesh for seedlings in heavy infestations or use floating row covers. Mulching helps in isolated plantings. Vacuuming foliage is effective but needs to be repeated often. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/3104/3104-1549/3104-1549.html">https://pubs.ext.vt.edu/3104/3104-1549/3104-1549.html</a>
Grasshoppers	<i>Azadirachtin</i> Bifenthrin Carbaryl Cyfluthrin Deltamethrin Esfenvalerate Imidacloprid <i>Insecticidal soap</i> Malathion Permethrin see table 4.6	<b>Timing of pesticide treatment:</b> When grasshoppers are found feeding. For imidacloprid, see "Bee Advisory Box" <b>Remarks:</b> Grasshoppers are infrequent pests but can be destructive when abundant. <b>Biological controls:</b> Encourage natural predators: birds and parasites (robber flies). Poultry have been known to heavily eat grasshoppers. Use the protozoan, <i>Nosema locustae</i> , in baits to attract and infect the insects with the pathogenic spores. <b>Cultural controls:</b> Water breeding areas to grow more vegetation and keep grasshoppers off ornamental plants. Avoid mowing these areas. Floating row covers are also effective for young plants. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/3104/3104-1550/3104-1550.html">https://pubs.ext.vt.edu/3104/3104-1550/3104-1550.html</a>

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

<b>Pest</b>	<b>Pesticides Approved</b>	<b>Recommendations</b>
<b>Defoliators (cont.)</b>	See Gypsy Moth separately.	<b>Timing of pesticide treatment:</b> When leaves have expanded but caterpillars are small, usually in mid-May.
Gypsy moth		<b>Remarks:</b> Mist blowers and aerial applications are effective. Large trees may require power equipment.
Japanese beetle	Acetamiprid Bifenthrin Malathion Esfenvalerate Imidacloprid Permethrin Clothianidin Deltamethrin Lambda-Cyhalothrin Gamma-cyhalothrin Thiamethoxam Zeta-Cypermethrin see table 4.6	<p><b>Timing of pesticide treatment:</b> In late June or early July after adults have begun to congregate on selected hosts. Repeat as necessary into August. For imidacloprid, see “Bee Advisory Box”</p> <p><b>Remarks:</b> 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.</p> <p><b>Biological controls:</b> Nematodes (<i>Steinernema</i>), Milky spore (<i>Bacillus popilliae</i>) can be used for turf application to suppress grubs, but are slow acting. Traps with floral lures and sex attractants can be placed in landscape but it is possible to attract more beetles than were originally in the area if there is not a larger effort to reduce amounts.</p> <p><b>Cultural controls:</b> Plant resistant plant species. Remove diseased fruit from trees and ground and maintain good sanitation. In early stages, picking off bugs by hand helps, or shake branches early in the morning when insects are sluggish. Drop insects into soapy water to kill.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2902/2902-1101/2902-1101.html">https://pubs.ext.vt.edu/2902/2902-1101/2902-1101.html</a></p>
Rose chafer	Acetamiprid <i>Azadirachtin</i> Carbaryl Imidacloprid Lambda-Cyhalothrin Malathion Permethrin <i>Pyrethrins</i> see table 4.6	<p><b>Timing of pesticide treatment:</b> During June and mid-summer when insects are found. For imidacloprid, see “Bee Advisory Box”</p> <p><b>Remarks:</b> Adults are active flyers and move continually onto susceptible hosts.</p> <p><b>Biological controls:</b> Use pheromone traps around affected area to trap beetles.</p> <p><b>Cultural controls:</b> For few beetles, hand picking is effective. Cultivating in May will help destroy pupae. Increasing soil moisture (planting clover with turf) and shade will reduce the larvae that survive. Cover plants with cheese cloth, or use trap plants (spirea, deutzia, andromeda, white rose, and blackberry) to reduce damage to other plants and increase yield when handpicking.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/3104/3104-1564/3104-1564.html">https://pubs.ext.vt.edu/3104/3104-1564/3104-1564.html</a></p>
Rose slugs	Carbaryl Deltamethrin <i>Insecticidal soap</i> see table 4.6	<p><b>Timing of pesticide treatment:</b> Throughout the growing season when young larvae are seen on plants, especially in May, June.</p> <p><b>Remarks:</b> Close inspection of plants is necessary to time treatments when larvae are young and damage is not yet severe.</p> <p><b>Biological controls:</b> None known at this time.</p> <p><b>Cultural controls:</b> Handpick to remove insects carefully as this is a stinging caterpillar, or spray plants with water; once knocked off, the insects cannot climb back onto the plant.</p>
Sawflies	See sawflies separately.	<p><b>Timing of pesticide treatment:</b> Timing varies in the season depending on the host plant and the sawfly species.</p> <p><b>Remarks:</b> Label uses are limited to pines, larch, ash, and spruce.</p>
Tussock moth	<i>Azadirachtin</i> Bifenthrin Carbaryl Chlorantraniliprole Diflubenzuron Gamma-cyhalothrin Lambda-Cyhalothrin Lannate Methoxyfenozide Permethrin <i>Pyrethrins</i> Tebufenozide see table 4.6	<p><b>Timing of pesticide treatment:</b> In mid-May or late August.</p> <p><b>Remarks:</b> Treat when larvae are small.</p> <p><b>Biological controls:</b> Encourage natural predators (parasitic wasps, spiders, and birds) in the early larval stage.</p> <p><b>Cultural controls:</b> Prune out localized infestations.</p>

*Italicized pesticides are organic control options.*

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

<b>Pest</b>	<b>Pesticides Approved</b>	<b>Recommendations</b>
<b>Defoliators</b> (cont.) Willow leaf beetle	Bifenthrin Carbaryl Imidacloprid <i>Spinosyn</i> see table 4.6	<b>Timing of pesticide treatment:</b> In May, June, and later if infestations persist. There may be several generations in a season. For imidacloprid, see “Bee Advisory Box” <b>Remarks:</b> Be sure to treat the undersides of the leaves. <b>Biological controls:</b> Encourage natural predators: Assassin bugs and asian lady beetles. <b>Cultural controls:</b> Some pubescent (layer of hairs on leaf) varieties are resistant. Maintain overall health of the plant. Generally requires several years of heavy feeding to kill tree. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/ENTO/ENTO-139/ENTO-139.html">https://pubs.ext.vt.edu/ENTO/ENTO-139/ENTO-139.html</a>
<b>European hornet</b>	2-methyl-1-butanol & Acetic acid & Heptyl butyrate	<b>Timing of pesticide treatment:</b> 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. <b>Remarks:</b> Lilac, boxwood, and certain other trees and shrubs. Rarely sting. Usually nest in hollow trees. <b>Biological controls:</b> None known at this time. <b>Cultural controls:</b> Fill in holes in old trees and man-made structures to reduce places for insects to nest. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2911/2911-1422/2911-1422.html">https://pubs.ext.vt.edu/2911/2911-1422/2911-1422.html</a>
<b>Fire ant (imported)</b>	Abamectin (bait) Avermectin B1 Beta-cyfluthrin Bifenthrin Carbaryl Cyfluthrin Deltamethrin Fipronil Hydramethylnon (bait) Imidacloprid Indoxacarb (bait) Lambda-Cyhalothrin Permethrin see table 4.6	<b>Timing of pesticide treatment:</b> When ants or mounds are observed. For imidacloprid, see “Bee Advisory Box” <b>Remarks:</b> Nurseries and landscapers shipping out of the quarantine area must contact VDACS. The Two-Step method of a bait followed in several days by mound treatments to sensitive or highly trafficked areas is effective within the quarantine area. Combinations of chemicals are also available. Many products are sold under multiple trade names. <b>Biological controls:</b> Encourage native species of ants (competition). <b>Cultural controls:</b> Pour boiling water onto ant hills after cool mornings, especially after a rainfall when the highest number of ants will be in the hill at a time. Plant shade trees. Inspect new plants before buying to ensure the plants are pest free. Remove litter and organic matter from lawns to reduce feeding areas and maintain good sanitation. Mowing frequently will encourage the disturbed colonies to move to less bothered areas. Don’t transport planting items (plants themselves, mulch, soil, etc.) from infected areas.
<b>Gall insects</b>	Carbaryl	<b>Timing of pesticide treatment:</b> Treatments are effective when insects are active, before galls appear in spring. <b>Remarks:</b> 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>Biological controls:</b> None known at this time. <b>Cultural controls:</b> Maintain good overall health of the plant. Fertilize in the summer, irrigate during dry times, and prune limbs regularly. If galls numerous, some can be pruned out and destroyed. <b>Related fact sheets:</b> <a href="https://pubs.ext.vt.edu/ENTO/ENTO-147/ENTO-147.html">https://pubs.ext.vt.edu/ENTO/ENTO-147/ENTO-147.html</a> <a href="https://pubs.ext.vt.edu/ENTO/ENTO-146/ENTO-146.html">https://pubs.ext.vt.edu/ENTO/ENTO-146/ENTO-146.html</a> <a href="https://pubs.ext.vt.edu/ENTO/ENTO-145/ENTO-145.html">https://pubs.ext.vt.edu/ENTO/ENTO-145/ENTO-145.html</a>

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

<b>Pest</b>	<b>Pesticides Approved</b>	<b>Recommendations</b>
<b>Gypsy moth</b>	Acetamiprid Bifenthrin Carbaryl Cis-7,8-Epoxy-2-methyloctadecane Cypermethrin Dimillin Gypsy moth NPV Lambda-Cyhalothrin Methoxyfenozide Permethrin <i>Spinosyn</i> Tebufenozide <i>Azadirachtin</i> <i>Bacillus thuringiensis</i> (Bt) <i>Canola oil</i> <i>Pyrethrins</i> see table 4.6	<p><b>Biological controls:</b> Encourage natural predators: mice, shrews, and ground beetles.</p> <p><b>Cultural controls:</b> Burlap skirts and barrier bands: Collect caterpillars under the burlap skirt every few days and kill by placing in a water/detergent mixture. Barrier bands are either slick or sticky and stop insect movement up to the foliage. Scraping off egg masses into soapy water is also effective in the fall or winter.</p> <p><b>Related fact sheets:</b> <a href="http://pubs.ext.vt.edu/444/444-840/444-840.html">http://pubs.ext.vt.edu/444/444-840/444-840.html</a></p>
<b>Iris borer</b>	<i>Pyrethrins</i>	<p><b>Timing of pesticide treatment:</b> Treat when leaves are 5 to 6 inches tall.</p> <p><b>Remarks:</b> Dispose of dry leaves and debris in the fall.</p> <p><b>Biological controls:</b> Beneficial nematodes (heterorhabditis and steinernema)</p> <p><b>Cultural controls:</b> Plant resistant varieties. Sanitation: remove plant debris and diseased plants.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/ENTO/ENTO-140/ENTO-140.html">https://pubs.ext.vt.edu/ENTO/ENTO-140/ENTO-140.html</a></p>
<b>Lacebugs</b>	Bifenthrin Imidacloprid Permethrin Malathion Carbaryl Esfenvalerate <i>Neem Oil</i> <i>Insecticidal Soap</i> <i>Spinosin</i> <i>Pyrethrins</i> Soybean Oil	<p><b>Timing of pesticide treatment:</b> 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. For imidacloprid, see "Bee Advisory Box"</p> <p><b>Remarks:</b> 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.</p> <p><b>Biological controls:</b> Encourage natural predators: assassin bugs, lacewing larvae, lady beetles, spiders, pirate bugs, &amp; predatory mites.</p> <p><b>Cultural controls:</b> Maintain overall health of the plant. Mulch. Prune out damage. Plant resistant varieties or plant susceptible ones in partially shaded areas. Can spray infected plants with a high-pressure stream of water to knock insects off.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/3104/3104-1581/3104-1581.html">https://pubs.ext.vt.edu/3104/3104-1581/3104-1581.html</a></p>

*Italicized pesticides are organic control options.*

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

Pest	Pesticides Approved	Recommendations
<b>Leafhoppers</b>	Bifenthrin Imidacloprid Permethrin Malathion Carbaryl Esfenvalerate <i>Neem Oil</i> <i>Insecticidal Soap</i> <i>Spinosin</i> <i>Pyrethrins</i> Soybean Oil	<b>Timing of pesticide treatment:</b> When leafhoppers are first seen and before stippling on undersides of leaves becomes extensive. For imidacloprid, see "Bee Advisory Box" <b>Remarks:</b> 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>Biological controls:</b> Natural predators: spiders, lacewings, pirate bugs, lady beetles, predatory mites, bigeyed bugs, damsel bugs, & assassin beetles. <b>Cultural controls:</b> Maintain overall health of the plant and removed damaged plants. Avoid overfertilization. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/3104/3104-1553/3104-1553.html">https://pubs.ext.vt.edu/3104/3104-1553/3104-1553.html</a>
<b>Leafminers</b> Azalea leafminer	<i>Azadirachtin</i> Carbaryl	<b>Timing of pesticide treatment:</b> Treat in mid- to late-May or when mines are first seen on the plants. <b>Remarks:</b> Some varieties may be susceptible to plant injury. <b>Biological controls:</b> Encourage natural predators: parasitic wasps. <b>Cultural controls:</b> Maintain overall health of the plant. A healthy plant will outgrow damage. Prune out and destroy infested branches. Handpicking for small populations is effective. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/3104/3104-1554/3104-1554.html">https://pubs.ext.vt.edu/3104/3104-1554/3104-1554.html</a>
Boxwood leafminer	Avermectin B1 Carbaryl Clothianidin Deltamethrin Imidacloprid Malathion see table 4.6	<b>Timing of pesticide treatment:</b> Treat in April or early May when adults are active. For imidacloprid, see "Bee Advisory Box" <b>Remarks:</b> Numerous adults can be eliminated before eggs are laid. <b>Biological controls:</b> Encourage natural predators. <b>Cultural controls:</b> Handpicking for smaller populations is effective. Plant resistant varieties. Prune foliage before adult emergence. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/3104/3104-1554/3104-1554.html">https://pubs.ext.vt.edu/3104/3104-1554/3104-1554.html</a>
Holly leafminers	Carbaryl Deltamethrin Acephate & see table 4.6	<b>Timing of pesticide treatment:</b> Treat in mid-May when adults are active on the foliage. <b>Remarks:</b> Helps reduce feeding punctures on undersides of leaves but may not prevent all mines in the foliage. <b>Biological controls:</b> Encourage natural predators: parasitic wasps. <b>Cultural controls:</b> Plant resistant hollies: 'Blue Prince' and 'Blue Princess' varieties. Collect affected fallen leaves and destroy them. Handpick infested leaves off the plant for light infestations. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/3104/3104-1554/3104-1554.html">https://pubs.ext.vt.edu/3104/3104-1554/3104-1554.html</a>
Oak leafminer	Carbaryl Deltamethrin see table 4.6	<b>Timing of pesticide treatment:</b> Treat when mines are first seen - less than 1/4 inch. Several generations occur each session. <b>Remarks:</b> Rake and destroy leaves in fall. <b>Biological controls:</b> None known at this time. <b>Cultural controls:</b> Remove leaves that are affected. Burn infested leaves in the fall. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/3104/3104-1554/3104-1554.html">https://pubs.ext.vt.edu/3104/3104-1554/3104-1554.html</a>
All other leafminers	Imidacloprid	<b>Timing of pesticide treatment:</b> Treat in mid- to late June after eggs have hatched. For imidacloprid, see "Bee Advisory Box" <b>Remarks:</b> These systemics are effective in eliminating miners; they are also effective later in the season, but mines will be present on the foliage. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/3104/3104-1554/3104-1554.html">https://pubs.ext.vt.edu/3104/3104-1554/3104-1554.html</a>

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

<b>Pest</b>	<b>Pesticides Approved</b>	<b>Recommendations</b>
<b>Leafrollers, leaf tiers</b>	<i>Azadirachtin</i>	<b>Timing of pesticide treatment:</b> Treat when insects are first seen. On some hosts, injury occurs in early spring when new buds are opening.
	<i>Bacillus thuringiensis</i> (Bt)	
	<i>Canola oil</i>	<b>Remarks:</b> Consult the label for specific host plants listed.
	Bifenthrin	
	Carbaryl	<b>Biological controls:</b> Encourage natural predators: lacewing, assassin bug, & parasitic wasps
	Clothianidin	
	Deltamethrin	<b>Cultural controls:</b> Minimize plant stress by watering, fertilizing, etc.
	Esfenvalerate	
	Fenpropanate	
	Lambda-Cyhalothrin	
	<i>Mineral oil</i>	
	<i>Neem oil</i>	
	Nylar	
	Permethrin	
	<i>Pyrethrins</i>	
	Spinetoram	
	<i>Spinosyn</i>	
	see table 4.6	
<b>Mealybugs</b>	Bifenthrin	<b>Timing of pesticide treatment:</b> Treat in late spring, before new growth begins. For imidacloprid, see "Bee Advisory Box"
	Imidacloprid	
	Permethrin	<b>Remarks:</b> 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 to 24 hours. Do not spray sensitive plants listed on the label.
	Malathion	
	Carbaryl	<b>Biological controls:</b> Encourage natural predators: ladybeetles, ladybird beetles, lacewing, parasitoids, parasitic wasps, & spiders.
	Esfenvalerate	
	<i>Neem Oil</i>	<b>Cultural controls:</b> Inspect all new plants to ensure they are pest free. Control weeds, remove mummified fruits, and maintain general sanitation. Prune carefully. Keep good air flow, avoid overfertilization.
	Insecticidal Soap	
	<i>Spinosin</i>	
	<i>Pyrethrins</i>	
<b>Mites</b> Hemlock rust mite, eriophyid mites	Soybean Oil	
	Avermectin B1	<b>Timing of pesticide treatment:</b> Treat in early spring before new growth develops.
	Carbaryl	
	Fenprothion	<b>Remarks:</b> Do not use on sensitive plants indicated on the label.
	<i>Lime Sulfur</i>	
	<i>Mineral oil</i>	<b>Biological controls:</b> Encourage natural predators: Phytoseiid mites, lacewings, lady beetles, & predatory mites.
	Petroleum hydrocarbons	
	<i>Pyrethrins</i>	<b>Cultural controls:</b> Maintain overall plant health. Don't overfertilize.
	Spirodiclofen	
	Spiromesifen	
	<i>Sulfur</i>	
	see table 4.6	

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

Pest	Pesticides Approved	Recommendations
<b>Mites (cont.)</b> Spider mites, including: spruce mite, southern red mite, box-wood mite	<i>Neem Oil</i> <i>Insecticidal Soap</i> <i>Dormant Oil</i> <i>Soybean Oil</i> <i>Sulfur</i>	<p><b>Timing of pesticide treatment:</b> 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.</p> <p><b>Remarks:</b> Thoroughly wet all of the foliage and stems with a full coverage spray. Use Isotox only if it contains a miticide.</p> <p><b>Biological controls:</b> Encourage natural predators: lady beetles, minute pirate bugs, predatory thrips, and phytoseiid mites.</p> <p><b>Cultural controls:</b> Maintain overall health of the plant. Irrigate in dry weather and avoid overfertilization. Inspect new plants for signs of mites. Knock off mites with a forceful jet of water. Can wipe leaves off by hand, clean up infested areas with soap and water.</p> <p><b>Related fact sheets:</b> <a href="https://pubs.ext.vt.edu/444/444-221/444-221.html">https://pubs.ext.vt.edu/444/444-221/444-221.html</a>  <a href="https://pubs.ext.vt.edu/444/444-235/444-235.html">https://pubs.ext.vt.edu/444/444-235/444-235.html</a>  <a href="https://pubs.ext.vt.edu/ENTO/ENTO-42/ENTO-42.html">https://pubs.ext.vt.edu/ENTO/ENTO-42/ENTO-42.html</a></p>
Honey locust mite	Avermectin B1 Nissorun Spiromesifen <i>Insecticidal soap</i>	<p><b>Timing of pesticide treatment:</b> One application in late June or early July will prevent damage. Treat when mites occur to control established infestations.</p> <p><b>Remarks:</b> Thoroughly wet the undersides of leaves with a full coverage spray.</p> <p><b>Biological controls:</b> Encourage natural predators: ladybird beetle, minute pirate bugs, predatory thrips, &amp; phytoseiid mites.</p> <p><b>Cultural controls:</b> Maintain overall health of the plant. Irrigate in dry weather and avoid overfertilization. Inspect new plants for signs of mites. Knock off mites with a forceful jet of water. Can wipe leaves off by hand, clean up infested areas with soap and water</p>
two-spotted spider mite	<i>Neem Oil</i> <i>Insecticidal Soap</i> <i>Dormant Oil</i> <i>Soybean Oil</i> <i>Sulfur</i>	<p><b>Timing of pesticide treatment:</b> Treat whenever mites first appear. Infestations may occur from spring to fall. Mite infestations are directly proportionate to increasingly warmer temperatures.</p> <p><b>Remarks:</b> Thoroughly wet the foliage and stems with a full coverage spray.</p> <p><b>Biological controls:</b> Encourage natural predators: predatory mites.</p> <p><b>Cultural controls:</b> Maintain overall health of the plant. Irrigate in dry weather and avoid overfertilization. Inspect new plants for signs of mites. Knock off mites with a forceful jet of water. Can wipe leaves off by hand, clean up infested areas with soap and water. Reduce dust.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/444/444-221/444-221.html">https://pubs.ext.vt.edu/444/444-221/444-221.html</a></p>
<b>Plant bugs, plant hoppers</b>	Bifenthrin Imidacloprid Permethrin Malathion Carbaryl Esfenvalerate <i>Neem Oil</i> <i>Insecticidal Soap</i> <i>Spinosin</i> <i>Pyrethrins</i> <i>Soybean Oil</i>	<p><b>Timing of pesticide treatment:</b> Treat when insects or signs of damage first appear. Treat honeylocust as soon as new growth begins. For imidacloprid, see “Bee Advisory Box”</p> <p><b>Remarks:</b> Control is difficult because plant bugs are active flyers and move around continuously.</p> <p><b>Biological controls:</b> None known at this time.</p> <p><b>Cultural controls:</b> Maintain overall health of the plant. Irrigate in dry weather and avoid overfertilization. Remove leaf litter. Reduce mulch thickness. Inspect new plants for signs of mites. Knock off mites with a forceful jet of water. Can wipe leaves off by hand, clean up infested areas with soap and water. Hand pick the nymphs off the plant for small infestations.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/3104/3104-1568/3104-1568.html">https://pubs.ext.vt.edu/3104/3104-1568/3104-1568.html</a></p>

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

<b>Pest</b>	<b>Pesticides Approved</b>	<b>Recommendations</b>
<b>Psyllids</b> Boxwood psyllid, hackberry psyllid	Carbaryl see table 4.6	<b>Timing of pesticide treatment:</b> Treat in late April or early May as new growth begins to develop. <b>Biological controls:</b> None known at this time. <b>Cultural controls:</b> Prune out infested tips and destroy before nymphs hatch in mid-May.
<b>Rose Slugs</b>	Beta-Cyfluthrin Carbaryl Deltamethrin <i>Insecticidal soap</i> Permethrin <i>Tall oil soaps</i> see table 4.6	<b>Timing of pesticide treatment:</b> 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 braches of the host. <b>Remarks:</b> Roses are susceptible. <b>Biological controls:</b> None known at this time. <b>Cultural controls:</b> Handpick insects or use a strong jet of water to remove insects.
<b>Sawflies</b>	<i>Azadirachtin</i> Clothianidin Dimethoate Imidacloprid <i>Insecticidal soap</i> Lambda-Cyhalothrin Permethrin Thiamethoxam see table 4.6	<b>Timing of pesticide treatment:</b> 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. For imidacloprid, see "Bee Advisory Box" <b>Remarks:</b> A number of damaging species are not listed on labels. Ash, larch, pines, and spruces are listed. <b>Biological controls:</b> Encourage native predators: parasites, rodents and birds. <b>Cultural controls:</b> Maintain overall plant health and reduce tree stress. For small numbers, handpick insects off of plants. Use a strong water jet to knock insects off the plant. For small, accessible populations, shake them off or prune off damaged areas lightly. Remove competing vegetation. Remove egg clusters in late winter and destroy, or knock off clusters on limbs into soapy water. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2911/2911-1424/2911-1424.html">https://pubs.ext.vt.edu/2911/2911-1424/2911-1424.html</a>
<b>Scale insects</b> General	Bifenthrin Imidacloprid Permethrin Malathion Carbaryl Esfenvalerate <i>Neem Oil</i> <i>Insecticidal Soap</i> <i>Spinosin</i> <i>Pyrethrins</i> Soybean Oil	<b>Timing of pesticide treatment:</b> 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. For imidacloprid, see "Bee Advisory Box" <b>Remarks:</b> 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. <b>Biological controls:</b> None known at this time. <b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a>
Azalea bark scale	Acetamiprid Imidacloprid Malathion <i>Paraffin oil</i>	<b>Timing of pesticide treatment:</b> Crawlers: June 5-30 Treat June 10-20. For imidacloprid, see "Bee Advisory Box" <b>Biological controls:</b> Encourage natural predators: Parasitic lady beetles and wasps. <b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Remove heavily infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants. Light infestations can be scraped or wiped off branches. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a>

*Italicized pesticides are organic control options.*

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

Pest	Pesticides Approved	Recommendations
<b>Scale insects</b> (cont.)  Brown soft scale	Same as general	<p><b>Timing of pesticide treatment:</b> Treat when scale insects appear. Treat 2-3 times at 10-day intervals.</p> <p><b>Remarks:</b> This scale insect does not winter out-of-doors in colder plant zones of Virginia.</p> <p><b>Biological controls:</b> Encourage natural predators: lady beetles. Control ants that could be protecting the insects from other natural enemies.</p> <p><b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Remove heavily infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants. Small populations can be removed by handpicking individuals, or by scrubbing limbs with mesh sponge to remove adults. A high pressure water jet can also be used to knock insects off the plant.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a></p>
Calico scale	Acetamiprid <i>Azadirachtin</i> Carbaryl Imidacloprid <i>Mineral oil</i> <i>Neem oil</i>	<p><b>Timing of pesticide treatment:</b> Crawlers: June 1-20. Treat June 10-15. For imidacloprid, see "Bee Advisory Box"</p> <p><b>Biological controls:</b> Encourage natural predators: parasitic wasps, minute pirate bugs, lacewings, lady beetles, predaceous midges, &amp; birds.</p> <p><b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a></p>
Camellia scale	Imidacloprid	<p><b>Timing of pesticide treatment:</b> Crawlers: May 1-June 5 and September 15-30. Treat May 10-20 and/or September 10-20. For imidacloprid, see "Bee Advisory Box"</p> <p><b>Biological controls:</b> Encourage natural predators: Ladybird beetles, parasitic wasps.</p> <p><b>Cultural controls:</b> Ants visitations mean the infestation is not being controlled. If few insects, scrape off and dispose of. Handpick or pick off infested leaves if limited in number.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a></p>
Cottony camellia scale	See General Scale insecticide list	<p><b>Timing of pesticide treatment:</b> Crawlers: June 1-10. Treat June 10-20.</p> <p><b>Biological controls:</b> Encourage natural predators: parasitic wasps, lady beetles. Control honeydew ants that might protect the insects from natural predators.</p> <p><b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a></p>
Cottony maple leaf scale	See General Scale insecticide list	<p><b>Timing of pesticide treatment:</b> Crawlers: June 1-10. Treat June 15-30.</p> <p><b>Biological controls:</b> Encourage natural predators: ladybeetles.</p> <p><b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants. Hand remove females if it is a small number and within reach.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a></p>
Crape myrtle bark scale	Imidacloprid	<p><b>Timing of Pesticide Treatment:</b> Soil drench in spring as growth starts.</p> <p><b>Biological Controls:</b> Lady beetles will feed on this scale</p> <p><b>Cultural Control:</b> Maintain healthy plants, do not apply too much nitrogen fertilizer.</p>
<i>Italicized pesticides are organic control options.</i>		

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

<b>Pest</b>	<b>Pesticides Approved</b>	<b>Recommendations</b>
Scale insects (cont.) Cottony maple scale	Acetamiprid Imidacloprid <i>Mineral oil</i> <i>Paraffin oil</i>	<b>Timing of pesticide treatment:</b> Crawlers: June 5-25. Treat June 10-20. For imidacloprid, see "Bee Advisory Box" <b>Remarks:</b> Be sure to thoroughly cover stems and branches near the ground. <b>Biological controls:</b> Encourage natural predators: ladybeetles. <b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Institute a watering schedule. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants. Hand remove females if it is a small number and within reach. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1011/2808-1011.html">https://pubs.ext.vt.edu/2808/2808-1011/2808-1011.html</a>
Euonymus scale	Acetamiprid <i>Lime Sulfur</i> Malathion Nylar <i>Paraffin oil</i>	<b>Timing of pesticide treatment:</b> Crawlers: first generation May 5-June 10; second July 1-25. Treat May 10-20 and July 5-15. <b>Biological controls:</b> Encourage natural predators: ladybird beetle. <b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants. Plant resistant species: ( <i>E. alatus</i> , <i>E. kiautschovicus</i> ) Variegated varieties are more susceptible to infestations. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/444/444-277/444-277.html">https://pubs.ext.vt.edu/444/444-277/444-277.html</a>
European elm scale	Acetamiprid <i>Mineral oil</i> <i>Paraffin oil</i>	<b>Timing of pesticide treatment:</b> Crawlers: June 5-25. Treat June 10-15. <b>Biological controls:</b> Encourage natural predators: ladybird beetles, parasitic wasps. Control ants that might protect the insects from these natural predators. <b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants. Asiatic elms (Siberian elm, Chinese elm) are resistant. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a>
Fern scale	Buprofezin	<b>Timing of pesticide treatment:</b> Crawlers: first appear in mid-May. Treat at 2-week intervals as needed. <b>Biological controls:</b> Encourage natural predators: ladybird beetles, parasitic wasps, & lacewings. Control ants that might protect the insects from these natural predators. <b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a>
Fletcher scale	Acetamiprid Dimethoate Malathion <i>Paraffin oil</i> Thiamethoxam see table 4.6	<b>Timing of pesticide treatment:</b> Crawlers: in early to mid-June. Treat June 15-20. <b>Remarks:</b> On Taxus and Arborvitae. <b>Biological controls:</b> Encourage natural predators: minute pirate bugs, lacewings, lady beetles, & predaceous midges. <b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a>
Florida red scale	Acetamiprid Buprofezin Imidacloprid Malathion <i>Mineral oil</i> Nylar Spirotetramat	<b>Timing of pesticide treatment:</b> Crawlers: May 5-15. Treat May 15-30. For imidacloprid, see "Bee Advisory Box" <b>Biological controls:</b> None known at this time. <b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants. Maintain overall health and pruning. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a>

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

<b>Pest</b>	<b>Pesticides Approved</b>	<b>Recommendations</b>
<b>Scale insects</b> (cont.) Florinia hemlock scale	See General Scale insecticide list	<p><b>Timing of pesticide treatment:</b> Crawlers: peak May 15-June 20, some produced throughout the season. Treat May 20-25 and June 5-10.</p> <p><b>Biological controls:</b> None known at this time.</p> <p><b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a></p>
Forbes scale	Carbaryl Malathion <i>Mineral oil</i>	<p><b>Timing of pesticide treatment:</b> Crawlers: June 1-15. Treat June 5-10.</p> <p><b>Remarks:</b> Label uses restricted to flowering fruits.</p> <p><b>Biological controls:</b> None known at this time.</p> <p><b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a></p>
Gloomy scale	See General Scale insecticide list	<p><b>Timing of pesticide treatment:</b> Crawlers: peak June 10-20. Treat June 20-30.</p> <p><b>Remarks:</b> Serious pest that is difficult to control.</p> <p><b>Biological controls:</b> Encourage natural predators: lacewing, lady beetles, &amp; predaceous midges.</p> <p><b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/ENTO/ENTO-44/ENTO-44.html">https://pubs.ext.vt.edu/ENTO/ENTO-44/ENTO-44.html</a></p>
Japanese scale	see table 4.6	<p><b>Timing of pesticide treatment:</b> Crawlers: May 15 - June 10, August 5 - 10. Treat at 2-week intervals June-September.</p> <p><b>Biological controls:</b> None known at this time.</p> <p><b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a></p>
Juniper scale	Malathion <i>Lime Sulfur</i> <i>Mineral oil</i> <i>Paraffin oil</i>	<p><b>Timing of pesticide treatment:</b> Crawlers: April 5-20 and June 5-20. Treat April 10-15 and/or June 10-15.</p> <p><b>Remarks:</b> Crawler dates vary based on temperature.</p> <p><b>Biological controls:</b> Encourage natural predators: lady beetles, predatory mites, &amp; parasitic wasps.</p> <p><b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a></p>
Latania scale	Malathion <i>Mineral oil</i>	<p><b>Timing of pesticide treatment:</b> Crawlers: continuous from June through season. Treat 2-3 times at 10-day intervals.</p> <p><b>Biological controls:</b> Encourage natural predators: ladybeetles, &amp; parasitic wasps. Control ants that might protect the insects from these natural predators.</p> <p><b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a></p>

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## 4-54 Home Ornamentals: *Insects of Trees, Shrubs, Annuals, and Perennials*

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

Pest	Pesticides Approved	Recommendations
Scale insects (cont.)	Carbaryl	<b>Timing of pesticide treatment:</b> Crawlers: May 25-June 25. Treat June 15-20. For imidacloprid, see "Bee Advisory Box"
Lecanium scale	Imidacloprid	<b>Remarks:</b> Treat for oak lecanium June 1-10 in coastal areas. Lecanium crawlers from June 1-20. Treat June 10-15.
	<i>Neem oil</i>	<b>Biological controls:</b> Encourage natural predators: ladybird beetles and lacewings.
	Nylar	<b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants.
	<i>Soybean oil</i>	<b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a>
	see table 4.6	
Magnolia scale	Malathion	<b>Timing of pesticide treatment:</b> Treat September 1-20.
	<i>Paraffin oil</i>	<b>Biological controls:</b> Encourage natural predators: lady beetles.
		<b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants.
		<b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/444/444-623/444-623.html">https://pubs.ext.vt.edu/444/444-623/444-623.html</a>
Oak kermes	Malathion	<b>Timing of pesticide treatment:</b> Crawlers: June 1-20. Treat June 10-15.
	<i>Paraffin oil</i>	<b>Biological controls:</b> Encourage natural predators: parasitic wasps, lady beetles.
		<b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants. Remove scales by hand (scrape off).
Obscure scale	<i>Mineral oil</i>	<b>Timing of pesticide treatment:</b> Crawlers: on red oak during July. Treat white oaks in mid-August.
	<i>Paraffin oil</i>	<b>Remarks:</b> Also treat with oil as a dormant spray.
	<i>Soybean oil</i>	<b>Biological controls:</b> Encourage natural predators: lady beetles & parasitic wasps.
		<b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants.
		<b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/3104/3104-1583/3104-1583.html">https://pubs.ext.vt.edu/3104/3104-1583/3104-1583.html</a>
Oystershell scale	Acetamiprid	<b>Timing of pesticide treatment:</b> Crawlers: May 1-20 and July 15-25. Treat May 5-10 and/or July 20-25. For imidacloprid, see "Bee Advisory Box"
	Buprofezin	<b>Biological controls:</b> Encourage natural predators: twice stabbed ladybeetle, & predatory mites.
	Carbaryl	<b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants. Scrub scales off branches but do not injure bark.
	Imidacloprid	<b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a>
	<i>Lime Sulfur</i>	
	Malathion	
	<i>Mineral oil</i>	
	<i>Paraffin oil</i>	
Peony scale	See General Scale insecticide list	<b>Timing of pesticide treatment:</b> Crawlers: mid-May. Treat in late May.
		<b>Biological controls:</b> Encourage natural predators: lacewings, parasitic wasps, and lady beetles (twice-stabbed, multicolored asian).
		<b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants.
		<b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a>

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

<b>Pest</b>	<b>Pesticides Approved</b>	<b>Recommendations</b>
<b>Scale insects</b> (cont.)	Acetamiprid	<b>Timing of pesticide treatment:</b> Crawlers: April 20-May 30 and July 10-20. Treat May 5-20 and/or July 15-20.
Pine needle scale	<i>Azadirachtin</i>	<b>Biological controls:</b> Encourage natural predators: twice-stabbed lady beetle & parasitic wasps.
	Bifenthrin	<b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants.
	Gamma-Cyhalothrin	<b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2907/2907-1400/2907-1400.html">https://pubs.ext.vt.edu/2907/2907-1400/2907-1400.html</a>
	Lambda-Cyhalothrin	
	<i>Lime Sulfur</i>	
	Malathion	
	<i>Mineral oil</i>	
	Oxydemeton-methyl	
	<i>Paraffin oil</i>	
	Permethrin	
	see table 4.6	
Pine tortoise scale	Gamma-Cyhalothrin	<b>Timing of pesticide treatment:</b> Crawlers: June 10-July 5. Treat June 20-25.
	Lambda-Cyhalothrin	<b>Biological controls:</b> Natural predators: parasitic wasps, lady beetle, pirate bugs, and lacewings
		<b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants. Increase distance between plants.
		<b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/3101/3101-1529/3101-1529.html">https://pubs.ext.vt.edu/3101/3101-1529/3101-1529.html</a>
Rose scale	Malathion	<b>Timing of pesticide treatment:</b> Crawlers: late May-June 30, possible second generation in August. Treat June 5-10 and 20-25 and in mid-August.
	<i>Lime Sulfur</i>	<b>Biological controls:</b> Encourage natural predators: lady beetles and parasitic wasps.
	<i>Mineral oil</i>	<b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants. Light infestations can be scraped off by hand. Remove weeds.
	<i>Paraffin oil</i>	<b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/3104/3104-1565/3104-1565.html">https://pubs.ext.vt.edu/3104/3104-1565/3104-1565.html</a>
	see table 4.6	
San Jose scale	Same as general	<b>Timing of pesticide treatment:</b> Crawlers: at least 3 generations June, July, and September. Treat June 10-15, July 10-15, September 10-15.
		<b>Remarks:</b> <i>Lime Sulfur</i> as dormant spray only.
		<b>Biological controls:</b> Encourage natural predators: lady beetle and parasitic wasps
		<b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants.
		<b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a>
<b>Scale insects</b>	Acetamiprid	<b>Timing of pesticide treatment:</b> Crawlers: throughout season in overlapping generations. Treat 2-3 times at 10-day intervals when infested. For imidacloprid, see "Bee Advisory Box"
Tea scale	Dimethoate	<b>Biological controls:</b> Encourage natural predators: parasitic wasps.
	Imidacloprid	<b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants.
	Malathion	<b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a>
	<i>Paraffin oil</i>	

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

<b>Pest</b>	<b>Pesticides Approved</b>	<b>Recommendations</b>
<b>Scale insects</b> (cont.) Tuliptree scale	<i>Paraffin oil</i>	<p><b>Timing of the pesticide treatment:</b> Treat September 1-20.</p> <p><b>Biological controls:</b> Encourage natural predators: lady beetles, predatory mites, and parasitic wasps. Control ants that might protect the insects from these natural predators.</p> <p><b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid over-fertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a></p>
Wax scale	Acetamiprid Buprofezin Malathion	<p><b>Timing of pesticide treatment:</b> Crawlers: June 1-25. Treat June 10-30.</p> <p><b>Remarks:</b> Thoroughly wet foliage and bark with a full-coverage spray.</p> <p><b>Biological controls:</b> None known at this time.</p> <p><b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid overfertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants. Handpick off scales for small populations.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/444/444-622/444-622.html">https://pubs.ext.vt.edu/444/444-622/444-622.html</a> And <a href="http://pubs.ext.vt.edu/444/444-622/444-622.html">http://pubs.ext.vt.edu/444/444-622/444-622.html</a></p>
White Prunicola Scale/White Peach Scale	Buprofezin Imidacloprid <i>Mineral oil</i> <i>Paraffin oil</i> <i>bifenthrin</i> Spirotetramat	<p><b>Timing of pesticide treatment:</b> Treat with dormant oil in early spring before bud break.</p> <p>Treat for crawlers in mid to late June with acephate, cyfluthrin, insecticidal soap, lambda-cyhalothrin, or neem oil. For imidacloprid, see "Bee Advisory Box"</p> <p><b>Biological controls:</b> Encourage natural predators: ladybeetles and lacewings.</p> <p><b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Avoid over-fertilization. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants.</p> <p><b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html">https://pubs.ext.vt.edu/2808/2808-1012/2808-1012.html</a></p>
<b>Skeletonizers</b>	<i>Bacillus thuringiensis (Bt)</i> Carbaryl	<p><b>Timing of pesticide treatment:</b> May or when damage starts.</p> <p><b>Remarks:</b> Use <i>Bacillus thuringiensis (B.t.)</i> for Lepidoptera only. Use others for beetles and sawflies.</p> <p><b>Biological controls:</b> Encourage natural predators: parasites.</p> <p><b>Cultural controls:</b> Handpick to remove small populations.</p>
<b>Slugs and snails</b>	<i>Boric acid</i> Deltamethrin <i>Ferric phosphate</i> <i>Insecticidal soap</i> Metaldehyde Silicon dioxide see table 4.6	<p><b>Timing of pesticide treatment:</b> Apply when pests are observed.</p> <p><b>Biological controls:</b> Encourage natural predators: toads, snakes, some ground beetles, wild birds, and ducks. Toad is the most important.</p> <p><b>Cultural controls:</b> Control weeds. Use a dusty, scratchy barrier (road dust, cinders, sawdust, gravel or sand). Handpick off plants at night and place slugs in soapy water or rubbing alcohol. Trap slugs: invert a melon, grapefruit peel or flower pot, wooden boards, asphalt shingles. Check daily.</p>

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

<b>Pest</b>	<b>Pesticides Approved</b>	<b>Recommendations</b>
<b>Spittlebugs</b>	Bifenthrin Imidacloprid Permethrin Malathion Carbaryl Esfenvalerate <i>Neem Oil</i> <i>Insecticidal Soap</i> <i>Spinosin</i> <i>Pyrethrins</i> Soybean Oil	<b>Timing of pesticide treatment:</b> Treat in early June if yellowing or damage occurs. For imidacloprid, see “Bee Advisory Box” <b>Remarks:</b> Rarely of economic importance. <b>Biological controls:</b> Encourage natural predators: pipunculid fly. <b>Cultural controls:</b> Maintain overall health of the plant with regular fertilization, mowing, thatch control, and proper collection and destruction of clippings. Avoid over-irrigation. For accessible spittlebugs, hand remove and drop in alcohol or use a strong water spray.
<b>Spotted Lanternfly</b>	Dinotefuran Imidacloprid Carbaryl Bifenthrin Insecticidal soap Malathion <i>Pyrethrins</i> <i>Neem oil</i> <i>Spinosad</i> Zeta-cypermethrin	<b>Special Statement:</b> In Virginia, Spotted Lanternfly is currently found in Frederick County, the City of Winchester, and eastern Clarke County. It is also in isolated spots in Shenandoah and Warren Counties. If you are outside of those areas and think you have spotted lanternfly, submit a sample to your local Cooperative Extension Office <b>Timing of pesticide treatment:</b> Treat in late May or when they are found. For Imidacloprid or dinotefuran, see “Bee Advisory Box” For information on control of SLF in residential yards, see: <a href="https://www.pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/ENTO/ento-322/ENTO-322.pdf">https://www.pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/ENTO/ento-322/ENTO-322.pdf</a> <b>Remarks:</b> Can be found on over 70 different trees and plants, but its preferred host is tree-of-heaven, <i>Ailanthus altissima</i> <b>Biological Controls:</b> None available at this time <b>Cultural controls:</b> Remove all tree-of-heaven from property. Herbicide treatments are the only effective method since cutting this tree will cause stump and root sprouts. See Virginia Cooperative Extension, publication 420-322 for methods of eliminating tree-of-heaven from yards, <a href="https://pubs.ext.vt.edu/420/420-322/420-322.html">https://pubs.ext.vt.edu/420/420-322/420-322.html</a> . For detailed management of SLF on trees and shrubs in back yards see table 2.X <b>Related web resources:</b> <a href="https://ext.vt.edu/spotted-lanternfly">https://ext.vt.edu/spotted-lanternfly</a>
<b>Tent caterpillars</b>	Bifenthrin Permethrin Malathion Carbaryl Esfenvalerate <i>Neem Oil</i> <i>Bacillus thuringiensis (Bt)</i> <i>Spinosin</i> <i>Pyrethrins</i> Soybean Oil	<b>Timing of pesticide treatment:</b> Treat in early spring as new growth is developing and when caterpillars are small. <b>Remarks:</b> 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>Biological controls:</b> Tachinid fly. <b>Cultural controls:</b> Avoid planting wild cherry, flowering crabapple, cherry. Prune out egg masses and destroy. Destroy tents by hand, or high-pressure water hose. Burning causes more damage. Kill caterpillars by crushing or dropping in warm soapy water; prune out tents in early morning. Caterpillars congregate in the tent at night. Prefers chokecherry, ash, basswood, birch, cottonwood, elm, maple, and oak. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/444/444-274/444-274.html">https://pubs.ext.vt.edu/444/444-274/444-274.html</a>
<b>Thrips</b>	Bifenthrin Imidacloprid Permethrin Malathion Carbaryl Esfenvalerate <i>Neem Oil</i> <i>Insecticidal Soap</i> <i>Spinosin</i> <i>Pyrethrins</i> Soybean Oil	<b>Timing of pesticide treatment:</b> Treat in June when thrips are active on new foliage. For imidacloprid, see “Bee Advisory Box” <b>Biological controls:</b> Encourage natural predators: minute pirate bugs, predaceous mites ( <i>Iphiseius degenerans</i> , Hypoaspis mites). <b>Cultural controls:</b> Maintain overall plant health, and sanitation, and avoid excessive fertilizing. Reduce excess soil. Control weeds (alternative hosts). Prune and destroy injured and infested branches. Use a strong spray of water to knock them off plants. Use row covers, and reflective mulch. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/444/444-281/444-281.html">https://pubs.ext.vt.edu/444/444-281/444-281.html</a>

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

<b>Pest</b>	<b>Pesticides Approved</b>	<b>Recommendations</b>
<b>Tip moths</b>	Bifenthrin Carbaryl Dimethoate Esfenvalerate Fipronil Permethrin <i>Pyrethrins</i> <i>Spinosyn</i> see table 4.6	<b>Timing of pesticide treatment:</b> Treat with liquid formulation in mid-March, April, June, and July when moths are flying. For imidacloprid, see “Bee Advisory Box” <b>Remarks:</b> Spray entire tree to runoff. Two- and three-needle pines are susceptible to tip moth. Imidacloprid can be used as a soil drench. <b>Biological controls:</b> Encourage natural predators: predatory insects & birds. <b>Cultural controls:</b> Shear off damaged tips of light infestations below the dead section. Scavengers will eat them once on the ground. Inspect new seedlings for injured buds and twigs. American arborvitae is very susceptible, while western red cedar is rather resistant.
<b>Treehoppers (Thornbugs)</b>	Bifenthrin Carbaryl Deltamethrin Imidacloprid see table 4.6	<b>Timing of pesticide treatment:</b> Treat when nymphs are seen on twigs (usually in clusters) before adults are present to begin egg-laying, usually in late summer and fall. For imidacloprid, see “Bee Advisory Box” <b>Remarks:</b> Apply sprays to cover the small twigs thoroughly. Usually a minor pest. <b>Biological controls:</b> Few natural enemies. <b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants.
<b>Twig girdlers, twig Pruners</b>	<i>Azadirachtin</i> Carbaryl	<b>Timing of pesticide treatment:</b> Gather and burn fallen branches and twigs in late fall. <b>Remarks:</b> Oak, hickory, and many trees and shrubs are susceptible. <b>Biological controls:</b> Two wasp parasitoids. Downy woodpecker, blue jay, and black-capped chickadee. Parasites: <i>Eurytoma magdalis</i> , <i>Iphiaulax agrili</i> , and <i>Horismenus</i> sp., and a checkered flower beetle <b>Cultural controls:</b> Maintain overall plant health and reduce plant stress. Remove infested plant debris. Prune heavily infested limbs. Inspect new plants and buy only pest-free plants. Pick up loose twigs on the ground and destroy. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2911/2911-1423/2911-1423.html">https://pubs.ext.vt.edu/2911/2911-1423/2911-1423.html</a>
<b>Webworms</b> Barberry Webworm	Bifenthrin Permethrin Malathion Carbaryl Esfenvalerate <i>Neem Oil</i> <i>Bacillus thuringiensis</i> (Bt) <i>Spinosin</i> <i>Pyrethrins</i> Soybean Oil	<b>Timing of pesticide treatment:</b> Treat in mid to late July when larvae are small and webs just starting to form. For imidacloprid, see “Bee Advisory Box” <b>Remarks:</b> Caterpillars are gregarious and infest areas within a plant. Apply full-coverage foliar spray to infested area, or entire shrub in years of high populations. <b>Biological controls:</b> Encourage natural predators: parasitic wasps, flies, & birds. <b>Cultural controls:</b> Prune out small infestations. Do not remove defoliated barberry shrubs, they will recover if healthy.
Cotoneaster webworm	<i>Bacillus thuringiensis</i> (Bt) Permethrin <i>Spinosyn</i>	<b>Timing of pesticide treatment:</b> Treat when larvae are first found. Timing not well established. <b>Remarks:</b> Apply a full-coverage spray, wetting foliage to the point of runoff. <b>Biological controls:</b> None known at this time. <b>Cultural controls:</b> Handpick or prune out and destroy pests. Remove overwintering eggs.

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

<b>Pest</b>	<b>Pesticides Approved</b>	<b>Recommendations</b>
<b>Webworms</b> Fall webworm	Bifenthrin Permethrin Malathion Carbaryl Esfenvalerate <i>Neem Oil</i> <i>Bacillus thuringiensis</i> (Bt) <i>Spinosin</i> <i>Pyrethrins</i> Soybean Oil	<b>Timing of pesticide treatment:</b> 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. For imidacloprid, see "Bee Advisory Box"  <b>Remarks:</b> Caterpillars are gregarious and infest individual branches. Apply full-coverage foliar spray to infested area, or entire tree in years of high populations.  <b>Biological controls:</b> Encourage natural predators: parasitic wasps, flies, & birds.  <b>Cultural controls:</b> If in reach, cut the webs out of the tree, remove and destroy. Strong water spray can dislodge tents.  <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2808/2808-1013/2808-1013.html">https://pubs.ext.vt.edu/2808/2808-1013/2808-1013.html</a>
Juniper webworm	<i>Bacillus thuringiensis</i> (Bt) Permethrin <i>Spinosyn</i>	<b>Timing of pesticide treatment:</b> Treat in late July or in August when larvae are small. Spring treatments may be applied when plants are found to be infested.  <b>Remarks:</b> Apply a forceful spray to penetrate severely webbed foliage. Thoroughly wet the foliage to runoff.  <b>Biological controls:</b> Natural parasites: predaceous ground beetles, rove beetle, parasitic tachinid fly, parasitic braconid wasps, earwig, rove beetle, robber fly, & paper wasp.  <b>Cultural controls:</b> Irrigate to help the plant grow out of damage. For turf, thatch removal. For small populations, handpick caterpillars, prune and destroy webs.
Mimosa webworm	Avermectin B1 <i>Bacillus thuringiensis</i> (Bt) Bifenthrin Carbaryl Deltamethrin <i>Pyrethrins</i> see table 4.6	<b>Timing of pesticide treatment:</b> Apply foliage sprays at 4- to 5-day intervals until the infestation is controlled.  <b>Biological controls:</b> Encourage natural predators: insects and birds that feed on larvae.  <b>Cultural controls:</b> Clear away leaf debris, pull down the webs, and drop caterpillars in soapy water. Use less susceptible honeylocust varieties ( <i>Gleditsia tricanthos</i> ): "Moraine", "Shademaster" and "Imperial". Sunburst is very susceptible. Thornless varieties of honeylocust suffer the most.
Pine webworm	<i>Azadirachtin</i> <i>Bacillus thuringiensis</i> (Bt) Permethrin	<b>Timing of pesticide treatment:</b> Treat in early June.  <b>Biological controls:</b> Encourage natural predators: parasitic wasps ( <i>Eulophidae</i> , <i>Braconidae</i> , <i>Chalcididae</i> , <i>Ichneumonidae</i> ), parasitic flies, assassin bugs, & birds  <b>Cultural controls:</b> Maintain overall plant health. For a few scattered nests prune out of trees before larvae pupate, or handpick and remove larvae.
<b>Weevils</b> Two-banded Japanese weevil, black vine weevil	<i>Azadirachtin</i> <i>Beauveria bassiana</i> Bifenthrin Clothianidin Cryolite Fluvalinate Imidacloprid <i>Metarhizium anisopliae</i> <i>Pyrethrins</i> see table 4.6	<b>Timing of pesticide treatment:</b> Apply in July as a full-coverage spray when foliar feeding is first observed. For imidacloprid, see "Bee Advisory Box"  <b>Remarks:</b> Acephate is for black vine weevil adults.  <b>Biological controls:</b> Entomopathogenic nematodes.  <b>Cultural controls:</b> Shake or tap plant to dislodge beetles. Catch beetles in a sheet or paper underneath the plant. Don't jar the plant too badly. Destroy weevils by dropping them in a can of water with some soap or freeze them. Remove excessive mulch.  <b>Related fact sheets:</b> <a href="https://pubs.ext.vt.edu/444/444-624/444-624.html">https://pubs.ext.vt.edu/444/444-624/444-624.html</a> <a href="https://pubs.ext.vt.edu/444/444-210/444-210.html">https://pubs.ext.vt.edu/444/444-210/444-210.html</a>

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

<b>Pest</b>	<b>Pesticides Approved</b>	<b>Recommendations</b>
<b>Weevils</b> (cont.)	Efenvalerate (Asana)	<b>Timing of pesticide treatment:</b> April
Pales weevil	Permethrin	<b>Remarks:</b> Treat stumps of trees cut less than 12 months ago and new seedlings. <b>Biological controls:</b> None known at this time. <b>Cultural controls:</b> Apply as a full coverage spray to seedlings immediately after planting. Dilute Asana in water. Thoroughly soak stumps and ground surface 1-2 feet around stumps or slash prior to mid- March. Only stumps or wood cut since previous summer needs treatment, First year stumps only. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/2902/2902-1102/2902-1102.html">https://pubs.ext.vt.edu/2902/2902-1102/2902-1102.html</a>
White pine weevil	Asana Avermectin B1 Bifenthrin Diflubenzuron dinotefuran Emamectin benzoate Imidacloprid	<b>Timing of pesticide treatment:</b> Apply sprays in the spring before adults lay eggs, normally prior to April 1-10. For imidacloprid, see "Bee Advisory Box" <b>Remarks:</b> Treat only the main terminal leaders of the tree down to the first whorl of branches. Thoroughly wet the bark. <b>Biological controls:</b> None known at this time. <b>Cultural controls:</b> Prune out infested branches below bark discoloration before adults emerge, and burn branches. Maintain good sanitation. Heavily clay soils and sodded fields have high weevil hazards. Remove older eastern white pine reservoirs in nearby forest stands. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/444/444-270/444-270.html">https://pubs.ext.vt.edu/444/444-270/444-270.html</a>
<b>Whiteflies</b>	Bifenthrin Imidacloprid Permethrin Malathion Carbaryl Esfenvalerate <i>Neem Oil</i> <i>Insecticidal Soap</i> <i>Spinosin</i> <i>Pyrethrins</i> Soybean Oil	<b>Timing of pesticide treatment:</b> When whiteflies are found. Treat every 3 weeks until infestation is controlled. For imidacloprid, see "Bee Advisory Box" <b>Remarks:</b> See label. <b>Biological controls:</b> Encourage natural predators: spiders, wasps ( <i>Encarsia</i> , <i>Eretmocerus</i> ), bigeyed bugs, lacewing larvae, lady beetle larvae. <b>Cultural controls:</b> Check new plants for insects. Remove older leaves by hand on heavily infested plants when they are in nymphal and pupal stages. Vacuum up adults in the morning and place bag with insects inside another bag in the freezer for 24 hours. (best at the beginning of an infestation). Maintain good sanitation. Control weeds. Take care when the numbers are small. Do not ignore them. Yellow cards with tanglefoot or tack trap on surface will help control numbers. <b>Related fact sheet:</b> <a href="https://pubs.ext.vt.edu/444/444-280/444-280.html">https://pubs.ext.vt.edu/444/444-280/444-280.html</a>
<b>Zimmerman pine moth</b>	Bifenthrin Methoxyfenozide Permethrin Tebufenozide	<b>Timing of pesticide treatment:</b> Treat in early to mid-April and in early September. <b>Remarks:</b> Apply as full-coverage spray to the point of runoff. <b>Biological controls:</b> Parasitoid wasps. <b>Cultural controls:</b> Cut out pitch masses, destroy heavily infested trees and chip or burn parts in early August before adults emerge. Maintain sanitation.

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**Table 4.6 - List of Common Insecticide Mixtures**

Companies have been known to manufacture and market mixtures of chemicals as a single product. The following is a general list of common mixtures found and approved for sale in the state of Virginia. The amount of mixtures available is not limited to the list below. Be sure to read the pesticide label before application, especially if it contains a mixture of chemicals not listed below.

Acephate & Fenbutatin-oxide	Acephate & Synthrin	Acephate & Fenpropanate or Fenbutatin-oxide		
Basic copper sulfate & Cube resins with Rotenone	Basic copper & sulfate Carbaryl	Basic copper sulfate & Carbaryl (sevin)		
Beta-cyfluthrin & Sodium o-phenylphenate	Beta-cyfluthrin & Imidacloprid			
Bifenthrin & Imidacloprid or Zeta-Cypermethrin	Bifenthrin & Imidacloprid, Zeta-Cypermethrin & Clothianidin	Bifenthrin & Imidacloprid or Clothianidin	Bifenthrin & Clothianidin or Zeta-Cypermethrin	Bifenthrin & Imidacloprid, Clothianidin, Cyfluthrin & Zeta-Cypermethrin
Bifenthrin & Zeta-Cypermethrin	Bifenthrin & Clothianidin, Imidacloprid & Zeta-Cypermethrin	Bifenthrin & Clothianidin or Imidacloprid	Bifenthrin & Clothianidin	Bifenthrin & Imidacloprid, Clothianidin or Imidacloprid
Bifenthrin & Zeta-Cypermethrin, Clothianidin & Imidacloprid	Bifenthrin & Imidacloprid	Bifenthrin & Zeta-Cypermethrin		
Bioallethrin & Bifenthrin or Permethrin	Bioallethrin & Deltamethrin or Pyrethrins	Bioallethrin & Deltamethrin or Resmethrin		
Carbaryl & Cube resins with Rotenone	Carbaryl & Metaldehyde	Carbaryl & Cube resins, Rotenone & Malathion	Carbaryl & Malathion	Carbaryl & Malathion, Cube resins & Rotenone
Carbaryl & Copper sulfate	Carbaryl & Malathion, Cube resins, Rotenone, Sulfur, & Pyrethrins			
Clothianidin & Zeta-Cypermethrin	Clothianidin & <i>Bacillus firmus</i>	Clothianidin & Bifenthrin		
Cube resins & Rotenone	Cube resins & Pyrethrins, Carbaryl & Rotenone	Cube resins, Rotenone & Carbaryl	Cube resins, Rotenone, Pyrethrins, & Sulfur	
Deltamethrin & Geraniol & Oil of Thyme	Deltamethrin & Bioallethrin			
<i>Ferric phosphate</i> & Spinosyn A				
Gamma-Cyhalothrin & Spinosyn A				
Imidacloprid & Fluvalinate	Imidacloprid & Clothianidin	Imidacloprid & Cyfluthrin	Imidacloprid & Bifenthrin	Imidacloprid & Bifenthrin, Fluvalinate & Cyfluthrin
Imidacloprid & Bifenthrin or Cyfluthrin	Imidacloprid & Fluvalinate or Cyfluthrin	Imidacloprid & Bifenthrin, Zeta-Cypermethrin & Bioallethrin	Imidacloprid & Bifenthrin or Fluvalinate	Imidacloprid & Bifenthrin or Cyfluthrin
Imidacloprid & Bifenthrin or Beta-cyfluthrin	Imidacloprid & Metalaxyl, Bifenthrin & Carboxin	Imidacloprid & Fluvalinate	Imidacloprid & Cyfluthrin or Beta-cyfluthrin	Imidacloprid & Fluvalinate, Cyfluthrin & Beta-cyfluthrin
Imidacloprid & Dicarbaryl, Fluvalinate, Beta-cyfluthrin, Cyfluthrin, Metalaxyl & Delsene				
Insecticidal soap & Sulfur	Insecticidal soap & Sulfur or Pyrethrins	Insecticidal soap & Neem oil & Pyrethrins	Insecticidal soap & Sulfur, Pyrethrins & Neem oil	Insecticidal soap & Pyrethrins or Neem oil
Insecticidal soap & Pyrethrins with Neem oil				

**Table 4.6 - List of Common Insecticide Mixtures (cont.)**

Lambda-Cyhalothrin & Thiamethoxam	Lambda-Cyhalothrin & Chlorantraniliprole			
Paraffin oil & Lime Sulfur				
Permethrin & Pyrethrin	Permethrin & Neem oil	Permethrin & Tetramethrin	Permethrin & Pyrethrins, Synergist 264, Nylar, Piperonyl butoxide, Tetramethrin & D-Allethrin	Permethrin & Mycobutanil, Pyrethrin, Piperonyl butoxide, & Tetramethrin
Piperonyl butoxide & Pyrethrins & Permethrin	Piperonyl butoxide & Zeta-Cypermethrin, Pyrethrins & Neem oil	Piperonyl butoxide & Zeta-Cypermethrin	Piperonyl butoxide & Pyrethrins or Synergist 264	Piperonyl butoxide & Pyrethrins
Piperonyl butoxide & Zeta-Cypermethrin, Synerist 264 & Pyrethrins	Piperonyl butoxide & Pyrethrins &/or Synergist 264	Piperonyl butoxide & Pyrethrins, Permethrin & Neem oil	Piperonyl butoxide & Pyrethrins, Zeta-Cypermethrin & Neem oil	Piperonyl butoxide & Prallethrin, Synergist 264, Pyrethrins & Zeta-cypermethrin
Piperonyl butoxide & Pyrethrins, Tetramethrin, Permethrin & Neem oil	Piperonyl butoxide, 2-Phenylethyl propionate, Oil of Thyme, Neem oil, Sulfur & Canola oil	Piperonyl butoxide & Pyrethrins, Nylar, Permethrin, Synergist 264, Prallethrin, Tetramethrin, Zeta-Cypermethrin, Silicon dioxide & Neem oil	Piperonyl butoxide & Permethrin, Tetramethrin, Pyrethrins, Neem oil, Zeta-Cypermethrin & Synergist 264	Piperonyl butoxide & Pyrethrins or Neem oil
Potassium laurate & Sulfur				
Pyrethrins & Piperonyl butoxide or Permethrin	Pyrethrins & Potassium laurate	Pyrethrins, Phenylethyl propionate, & Oil of Thyme	Pyrethrins & Neem oil	Pyrethrins & Insecticidal soap
Pyrethrins & Piperonyl butoxide, Canola oil, Sulfur & Basic copper sulfate	Pyrethrins & Piperonyl butoxide	Pyrethrins & Sulfur, Permethrin, Piperonyl butoxide & Neem oil	Pyrethrins & Insecticidal soap, Canola oil, Piperonyl butoxide & Neem oil	Pyrethrins & Piperonyl butoxide or Canola oil
Pyrethrins & Piperonyl butoxide, Sulfur, Tetramethrin, Permethrin, Canola oil & Neem oil	Pyrethrins & Cube resins, Rotenone & Piperonyl butoxide	Pyrethrins & Canola oil, Piperonyl butoxide, Sulfur & Insecticidal soap	Pyrethrins & Sulfur, Insecticidal soap, Canola oil, Oil of Thyme, Neem oil & Piperonyl butoxide	Pyrethrins & Sulfur, Insecticidal soap, Piperonyl butoxide & Canola oil
Pyrethrins & Sulfur, Piperonyl butoxide, Insecticidal soap, 2-Phenylethyl propionate, Oil of Thyme, & Neem oil	Pyrethrins & Sulfur, Canola oil, Neem oil & Insecticidal soap	Pyrethrins & Sulfur, Permethrin, Piperonyl butoxide, Oil of Thyme, Rotenone, Cube resins & Canola oil	Pyrethrins & Piperonyl butoxide, Synergist 264, Permethrin, Nylar, Insecticidal soap, Silicon dioxide, Oil of Thyme, Neem oil, Cube resins, Rotenone & Deltamethrin	Pyrethrin & Piperonyl butoxide, Neem oil & Insecticidal soap Mixtures of Bifenthrin & Imidacloprid or Clothianidin
Pyrethrins & Sulfur, Piperonyl butoxide, Canola oil, Phenylethyl propionate, Oil of Thyme, & Insecticidal soap				
S-Methoprene & Hydramethylnon				
Synthrin & Bioallethrin	Synthrin & Acephate	Synthrin & Paraffin oil		
Systhane & Permethrin				
Tetramethrin & Phenothrin	Tetramethrin & Permethrin	Tetramethrin & Piperonyl butoxide, Permethrin & Phenothrin		
Thiamethoxam & Avermectin B1	Thiamethoxam & Avermectin B1 or Lambda-Cyhalothrin	Thiamethoxam & Chlorantraniliprole	Thiamethoxam & Mefenoxam, Fludioxonil, Chlorantraniliprole & Lambda-Cyhalothrin	

**Table 4.7 - 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, <i>B.t.</i> , Thuricide or Bactospeneine, etc.)	various	defoliating caterpillars	Amounts depend on product and formula- tion. 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 dico- fol.) 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		
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	
<i>Knox Out</i>	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.
imidacloprid	various	See label	See label		See label
insecticidal soap	various	aphids, mealybugs, lacebug, psyllids, scales, thrips, whiteflies	Varies with Formulation		See label



**Table 4.7 - Directions for Pesticide Usage (cont.)**

Chemical	Formulation	Pests Controlled	Amount to Use in		Potential Plant Injury
			1 gal	3 gal	
<i>Lime Sulfur</i>	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
<i>pyrethrins</i>	various	See label	See label	See label	See label
resmethrin	23.4EC	aphids whiteflies	1 tsp	1 tbsp	See label
<i>spinosad</i>	various	See label	See label	See label	See label

## Organic Controls for Insects of Home Ornamentals

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**Table 4.8 - Organic Control Use**

Product <sup>1</sup>	Insects Controlled	Remarks
<i>Azadirachtin</i>	Beetles, Aphids, Caterpillars, Others	Various trade names
<i>Bacillus thuringiensis</i>	Most caterpillars, loopers, hornworms and bagworms	This product, also known as <i>Bt</i> , is sold under many trade names
<i>Beauveria bassiana</i>	Beetles, Aphids, Others	Various trade names
Gnatrol (Bt/H-14)	Fungus gnats	Used as a soil drench
Hot Pepper Wax	Aphid, Mite, Thrips	See label for precautions
Insecticidal soap	Works well on soft bodied insects in particular aphids, mites, lacebugs and mealybugs	
Kaolin clay	Beetles, Aphids, Caterpillars, Others	Various trade names
M-One (Bt/Sandiego)	Elm leaf beetle, willow leafbeetle	Two strains of <i>Bt</i> will control potato beetles: <i>Bacillus thuringiensis</i> ssp. <i>san diego</i> is genetically engineered and therefore is not allowed in certified organic production. On the other hand, <i>B. thuringiensis</i> ssp. <i>tenebrionis</i> , a form of <i>Bt</i> that is not genetically engineered, can be used by organic producers.
Neem	Broad spectrum	See label for precautions
Mineral Oil	Caterpillar eggs and soft bodied insects such as aphids and thrips.	Only use products labeled for use on vegetable plants for pest control.
Pyrethrin	Broad spectrum, works on a wide variety of insects	Usually sold mixed with other botanical insecticides such as rotenone.
Pyrethrin/ Diatomaceous Earth	Whiteflies, fire ants	Follow all label precautions.
Spinosan	Caterpillar, Beetle	See label for precautions
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 aphid lions. Most are <i>Chrysoperla</i> .
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.
Predatory mites	Mostly for control of spider mites.	Release approximately 2/square foot. <i>Phytoseiulus persimilis</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.

<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.



## **Insects of Foliage and Houseplants**

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

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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).

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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 ready-to-use cans 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. Ready-to-use sprayers are also effective and useful for small numbers.

## 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 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.

## 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 4.9 - 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>	50% EC	1.5 tsp	anthurium, aralia, <i>Asparagus plumosa spengeri</i> , begonia, <i>Cissus antarctica</i> , crassula, dieffenbachia (dumb cane), <i>Ficus</i> sp., <i>Peperomia</i> sp., <i>Pilea</i> sp., schefflera, syndapsis (pathos) syngonium.
<b>Mesurool</b>	2% Bait	—	None listed.
<b>metaldehyde</b>	3.25% Bait	—	None listed.
<b>pyrethrins</b>	0.3 A	—	See Label
<b>resmethrin</b>	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 or zeta-cypermethrin)	50% WP	2.0 tbsp	Boston ivy, English ivy, Boston fern, schefflera, <i>Peperomia</i> sp., <i>Pilea cadi-erri</i> (aluminum plant), syngonium.

**Table 4.10 - Recommended Use**

Pest	Pesticide	Remarks
Aphids	Permethrin, <i>Pyrethrin</i> , <i>Neem</i> , Malathion, <i>Insecticidal soap</i> , Imidacloprid, Acephate	Spray when aphids are first seen. Repeat when necessary. Imidacloprid effective in granular formulation.
Armyworms	Permethrin, <i>Pyrethrin</i> , <i>Neem</i> , Malathion	Hand picking may be adequate for just a few caterpillars. Wet the soil well while treating the foliage.
Broad mite	<i>Insecticidal soap</i> , Permethrin, <i>Pyrethrin</i> , <i>Neem</i>	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.
Cutworms	Permethrin, <i>Pyrethrin</i> , <i>Neem</i> , 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.
Fungus gnats	Gnatrol, Permethrin, <i>Pyrethrin</i> , <i>Neem</i>	Treat the soil with a light watering.
Mealybugs	<i>Pyrethrin</i> , Malathion, <i>Insecticidal soap</i> , Permethrin, <i>Pyrethrin</i> , <i>Neem</i> , Acephate	Treat 2-4 times at 7- to 10-day intervals.
Millipedes	Malathion, Permethrin, <i>Pyrethrin</i> , <i>Neem</i>	Wet the soil and treat the bottom of pots. Millipedes stay in soil.
Scale insects	Acephate, Malathion, <i>Insecticidal soap</i> , Permethrin, <i>Pyrethrin</i> , <i>Neem</i> , Sevin	Treat 2-4 times at 7- to 10-day intervals. Severely infested plants are best discarded.
Slugs, snails	Mesurool, metaldehyde, Permethrin, <i>Pyrethrin</i> , <i>Neem</i>	Do not use mesurool 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	<i>Insecticidal soap</i> , Permethrin, <i>Pyrethrin</i> , <i>Neem</i>	Treat 2-3 times at 10-day intervals. <i>Insecticidal soap</i> and spider mite aerosols or atomizers are effective.
Springtails	Malathion, Permethrin, <i>Pyrethrin</i> , <i>Neem</i>	Treat the soil with a light watering.
Whiteflies	Imidacloprid, Permethrin, <i>Pyrethrin</i> , <i>Neem</i> , Acephate	Treat 2-3 times at 7- to 10-day intervals. Imidacloprid used as a soil drench.



## Weed Management in Home Ornamental Beds

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### Overview

Weed management is necessary in flower beds and for shrub and tree plantings. Weeds reduce the aesthetic value of landscapes, and compete with desired plants for water, nutrients, and light. Weeds can also harbor insect and disease pests. Develop a year-round control program to manage both summer and winter weeds. Control weeds in lawns and other adjacent areas to limit the movement of weed seed or weed propagules into the beds. Prevent weeds from flowering, as this helps reduce the amount of weed seed in the soil over time. Remove any weeds from ornamental plants that will be planted into the landscape. Avoid planting invasive species, like bamboo, or make plans to contain the root system before planting. Control perennial weeds, especially perennial broadleaf weeds, before establishing a new flower bed, as selective control is not available in most cases after planting. For large landscape areas of one acre or more, consult the ornamentals section of the Horticultural and Forest Crops Pest Management Guide (Virginia Cooperative Extension Publication 456-017), a manual for commercial landscape firms and nursery producers.

### When to Call a Professional

Hire a landscape maintenance or other appropriate firm to help get things under control if the property

- is infested with difficult-to-control weeds, like bamboo, beach vitex, English ivy, or phragmites;
- is adjacent to wetlands or other aquatic areas; or
- has large areas that cannot be easily maintained.

### General Cultural Controls

**Cultivation/Hoeing/Hand weeding:** Control annual and perennial weeds by tilling before planting a new flower bed. Troublesome perennial weeds like bermudagrass, quackgrass, yellow nutsedge, and other creeping perennials need repeated tilling. Cut annual weeds at or slightly below the soil surface when hoeing to minimize soil disturbance. Deeper hoeing brings weed seed from greater depths in the soil to the surface where they can germinate. Controlling weeds before flowering reduces weed populations in future years by depleting the weed seed reservoir in the soil. Hoeing or hand pulling weeds controls annual weeds, but will not control creeping perennials, like yellow nutsedge, which spread by underground structures such as rhizomes and tubers.

**Organic mulches:** Pine bark, hardwood bark, pine straw and wood chips are all good for mulching. Watch soil fertility as nitrogen tie-up can occur for mulches that are not fully composted. Organic mulches are a good choice because they conserve soil moisture and cool the soil. Spread mulch two to four inches deep and avoid over mulching. Place newspaper on the soil surface before applying mulch to help suppress weeds. Organic mulches suppress or control annual weeds but not perennial ones. Shredded mulches encourage weed growth more than larger particle mulches. Use mulches that are free of weed seed and that do not have a rotten egg or ammonia odor. Improperly composted mulch can have a low pH and contain chemicals that injure crop plants.

**Rock mulches:** Lava rock, white marble, and other rock mulches can be used as an alternative to an organic mulch. Place a landscape fabric (described below) under the rock mulch to act as a soil separator. This reduces the amount of soil and weed seed that can move into the rock layer. Rock mulches provide better annual weed control than organic mulches. As organic mulches break down, they become a suitable growing medium for weeds. Rock mulches do not control perennial weeds.

**Synthetic mulches:** Use of solid black plastic or a landscape fabric improves weed control compared to an organic mulch alone. Solid black plastic is more effective for weed control than the available landscape fabrics, but water cannot pass through it. Solid black plastic could be used for annual flower beds, but landscape fabrics are more appropriate for tree and shrub beds, as these materials are porous. Place drip irrigation under solid black plastic to allow water to reach plant roots. Landscape fabrics allow for air and water movement but weed roots and shoots can penetrate through the openings in the material. Roots of ornamental plants may grow into the fabric, making it more difficult to remove the fabric later. Place the plastic or fabric on the soil surface, then cut an X or a hole into the material to plant the ornamentals. Place an organic or rock mulch above these materials. If organic mulch is placed over the landscape fabric, weeds may germinate in the mulch layer and then send roots through the fabric to the soil below. Hand weed the mulch layer when weeds are small. Black plastic and landscape fabrics control annual weeds and suppress perennial weeds, like yellow nutsedge. Control perennial weeds before spreading synthetic mulch. Do not use landscape fabrics when planting groundcovers or bulbs, since they inhibit spread of groundcovers and stop the upward movement of shoots from bulbs. Use landscape fabrics only in woody landscape beds.



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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. Certain weeds, such as yellow nutsedge, can penetrate through landscape fabrics.

### General Biological Controls

There currently are no biological control options for weed control in ornamental beds.

### General Chemical Controls

#### **Organic**

**Preemergence:** none recommended at this time

**Postemergence:** Acetic acid (Weed Pharm 20% acetic acid or other labeled formulation). Contact nonselective herbicide. Do not use unlabeled forms of acetic acid. Wear eye protection, a long-sleeved shirt, long pants, shoes, socks, and waterproof gloves since this product is corrosive. Cover the weed foliage thoroughly. Treat weeds when small, as large annual weeds may require retreatment. Perennial weeds need retreatment, as this is a contact herbicide and does not affect underground plant parts such as roots, bulbs, and rhizomes. Keep the spray off the foliage and stems of desired plants.

**Organic postemergence:** Weed Slayer (eugenol) + Agro Gold. Nonselective postemergence herbicide. Need to mix both components. Apply at a 1-3% solution. Ensure thorough coverage of weed foliage.

#### **Conventional**

##### **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 (Preen Garden Weed Preventer, others) since it is safe on a wide range of ornamentals and is packaged in small quantities.

Tables in this section 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. In most situations, apply a preemergence herbicide prior to mulching.

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 the site can be irrigated, ideally immediately after a preemergence herbicide application. 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.

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 4.11 - 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 2.68G 1.7-2.6 lb or Pendulum 2G 2.3-4.6 lb or Pendulum AquaCap 1.6-3.2 fl oz)	Apply prior to weed germination. Do not apply to moist foliage. Irrigate after application.
		prodiamine 0.26-0.5 oz (Barricade 65WG 0.4-0.8 oz, Barricade 4FL 0.5-1.1 fl oz)	Apply prior to weed germination in landscape ornamentals. Do not apply more than 0.8 oz Barricade 65WG or 1.1 fl oz Barricade 4FL/1000 sq ft/year.
		trifluralin 1.4 oz (Treflan 5G 1.8 lb or Preen Garden Weed Preventer 1.47G 6.2 lb or other labeled formulation)	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 75DF 0.25-0.5 oz, Gallery SC 0.3-0.7 fl 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 2.5TG 2.3-4.6 lb)	A prepackaged mixture of the active ingredients in Gallery and Treflan. Apply prior to weed germination.
		isoxaben + trifluralin (Preen Mulch with Extended Control Weed Preventer)	A herbicide-treated mulch for landscape ornamentals. A 2-cubic foot bag covers 12 square feet.
Primarily annual grasses and yellow nutsedge	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.
		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.
		pendimethalin + dimethenamid 0.6-1.2 oz (Freehand 1.75G 2.3-4.6 lb)	Apply prior to weed germination. Do not apply more than 9.2 lb Freehand per 1000 sq ft per year.

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

**Table 4.11 - Recommended Use (cont.)**

Application <sup>1</sup>	Weed Problem	Chemical Rate/1000 sq ft	Remarks
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.
	Annual weeds and certain perennial weeds	glufosinate (Finale 2-4 fl oz per gallon for spot treatment)	Apply as a directed spray in established plantings. Do not contact bark or foliage of desired plants.
	Annual and perennial grasses including bermudagrass, Japanese stiltgrass, 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 overtop of selected conifer, broadleaf, and non-grass 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 and perennial grasses including Japanese stiltgrass (Microstegium)	sethoxydim 0.24 oz (Segment II 1.3 fl oz + 0.6 fl oz crop oil concentrate or 0.5 fl oz methylated seed oil per gal)	Spot treatment for emerged grasses. May be applied overtop of many conifer, broadleaf, and non-grass 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.
	Crabgrass, goosegrass, foxtails, Japanese stiltgrass (Microstegium)	fenoxaprop (Acclaim Extra, Bioadvanced Bermudagrass Control for Lawns, Bioadvanced Extreme Crabgrass Killer)	Apply to the foliage of young actively growing annual grassy weeds. Can be applied to a range of conifer, broadleaf, and non-grass ornamental species.
	Bamboo	imazapyr (Arsenal)	Leaf and root absorbed. Apply to the foliage of actively growing bamboo. Do not apply near desired trees and shrubs. Do not plant treated areas until the herbicide has dissipated. Best applied by a licensed pesticide applicator due to the potential for nontarget plant injury. Research has shown that glyphosate also controls bamboo. It can be added to imazapyr for broader-spectrum weed control.
	Kudzu	glyphosate (Roundup and other trade names; see label for rates)	Apply to the foliage of actively-growing kudzu. Keep off the foliage and bark of desired plants. Spray foliage when actively growing. Do not allow spray to contact desired plants.
		triclopyr (Bioadvanced Brush Killer Plus, Ortho Max Poison Ivy & Tough Brush Killer, or other labeled formulation)	Spray foliage when actively growing. Do not allow spray to contact desired plants. Triclopyr is also effective on other legume weeds, such as lespe-deza and white clover.

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

**Table 4.11 - Recommended Use (cont.)**

Application <sup>1</sup>	Weed Problem	Chemical Rate/1000 sq ft	Remarks
Postemergence to weeds (cont.)	Yellow nutsedge and certain broad-leaf weeds	bentazon (Basagran T/O 0.75 to 1.5 fl oz in 1.0-2.0 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. Addition of an oil concentrate can improve control.
	Yellow and purple nutsedge	halosulfuron 0.7 g (SedgeHammer 0.9 g) (SedgeHammer+ 0.5 oz)	Mix 0.9 g SedgeHammer plus 2.0 tsp nonionic surfactant in 1.0-2.0 gal of water for spot treatment. No surfactant needed for SedgeHammer+. Lightly wet nutsedge foliage. Directed spray in established woody ornamentals only. Do not apply to herbaceous ornamentals.
	Poison ivy	triclopyr (Bioadvanced Brush Killer Plus, Ortho Max Poison Ivy Tough Brush Killer) or glyphosate (see above listing)	Apply to foliage of actively growing poison ivy or other undesired vines or brush. Do not allow spray to contact foliage or stems of desired broadleaf plants.
	Phragmites (common reed)	glyphosate (AquaMaster, GlyphoMate 41 or other labeled formulations) imazapyr (Arsenal) - see listing above	Use a formulation registered for aquatic use. Apply to foliage during active growth. Multiple applications will be required. Do not contact foliage of desired plants. A surfactant needs to be added if the glyphosate formulation lacks one. Check to see if a permit and an aquatic pesticide license is required before treating in or around a body of water.

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

**Table 4.12 - Guide for Herbicide Selection - Annual and Perennial Flowers, Vines, and Groundcovers<sup>1</sup>**

	Acclaim	Barricade	Freehand	Ornamec	Gallery	Pendulum 2G	Pennant	Segment	Surflan	trifluralin
<b>Annual and Perennial Flowers</b>										
Alyssum	-	-	F	-	-	F	F	F	-	F
Aster	-	F	-	-	-	F	F	-	-	F
Begonia	F	-	-	-	-	F	-	F	-	-
Chrysanthemum	F	-	-	-	-	F	F	F	F	F
Coleus	F	-	F	-	-	-	-	F	-	-
Daffodil	-	F	F	-	-	F	F	-	F	F
Dahlia	-	-	F	-	-	F	-	-	-	F
Daylily	F	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	F
Hosta	F	F	F	F	F	F	F	F	-	-
Impatiens	-	-	-	-	-	F	-	F	F	F
Iris	F	F	F	-	-	F	F	F	F	F
Lily	-	F	-	-	-	F	F	-	-	-
Marigold	-	-	F	F	-	F	F	F	F	F
Nasturtium	-	-	-	-	-	-	-	-	-	F
Pansy	-	-	-	-	-	F	-	F	F	-
Peony	F	-	-	-	-	F	-	-	-	-
Periwinkle	F	-	F	-	-	F	-	F	-	-
Petunia	F	-	F	-	-	F	F	F	-	F
Phlox	F	-	F	-	-	F	F	-	-	F
Salvia	-	-	F	-	-	F	-	F	-	F
Shasta daisy	F	-	F	F	-	F	-	F	-	F
Snapdragon	F	-	-	-	-	F	F	F	-	F
Sunflower	-	-	F	-	-	F	-	-	-	F
Sweetpea	-	-	-	-	-	-	-	-	-	F
Sweet William	F	-	F	F	-	F	F	F	-	F
Tulip	-	F	-	-	-	F	F	-	F	F
Zinnia	F	-	F	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 4.12 - Guide for Herbicide Selection - Annual and Perennial Flowers, Vines, and Groundcovers<sup>1</sup> (cont.)**

	Acclaim	Barricade	Freehand	Ornamec	Gallery	Pendulum 2G	Pennant	Segment	Surflan	trifluralin
<b>Vines and Groundcovers (cont.)</b>										
Euonymus	-	F	-	F	-	F	F	-	F	-
Honeysuckle	-	F	-	-	-	-	F	-	-	-
Jasmine	-	-	-	-	-	F	-	-	-	-
Liriope	F	F	F	F	F	F	F	F	F	F
Pachysandra	-	-	F	F	F	F	F	F	-	F
Pampasgrass	-	F	-	-	F	F	F	-	-	-
Santolina	-	F	-	-	-	-	-	-	-	-
Sedum	-	F	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 4.13 - Guide for Herbicide Selection - Narrowleaf and Broadleaf Evergreens<sup>1</sup>**

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

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**Table 4.13 - Guide for Herbicide Selection - Narrowleaf and Broadleaf Evergreens<sup>1</sup>(cont.)**

Tolerant Species	Acclaim	Barricade	Casoron	Freehand	Pennant	Ornamec
<b>Broadleaf Evergreens (cont.)</b>						
Holly	F	F	-	F	F	F
Leucothoe	-	-	F	-	F	-
Magnolia (Southern)	F	F	F	-	F	F
Mahonia	-	-	-	F	F	F
Mountain laurel	-	-	-	-	F	-
Osmanthus	-	F	F	-	F	-
Pittosporum	-	F	F	-	F	-
Pyracantha	F	F	F	-	F	F
Rhododendron	F	F	F	-	F	F
Tolerant Species	Gallery	Segment	Pendulum	Snapshot	Surflan	trifluralin
<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 4.13 - Guide for Herbicide Selection - Narrowleaf and Broadleaf Evergreens<sup>1</sup>(cont.)**

Tolerant Species	Gallery	Segment	Pendulum	Snapshot	Surflan	trifluralin
<b>Broadleaf Evergreens (cont.)</b>						
Pittosporum	F	F	-	-	-	F
Pyracantha	F	F	F	-	F	F
Rhododendron	-	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 4.14 - Guide for Herbicide Selection - Deciduous Trees and Shrubs<sup>1</sup>**

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

**Table 4.14 - Guide for Herbicide Selection - Deciduous Trees and Shrubs<sup>1</sup> (cont.)**

Tolerant Species	Acclaim	Barricade	Casoron	Freehand	Pennant	Ornamec
<b>Deciduous Trees (cont.)</b>						
Willow	F	-	F	-	F	F
Zelkova	-	-	-	-	-	-
<b>Deciduous Shrubs</b>						
Abelia	-	F	-	F	F	-
Cotoneaster	-	F	F	-	F	F
Crape myrtle	-	F	-	F	F	F
Deutzia	-	-	F	-	-	-
Euonymus	-	F	F	F	F	-
Flowering quince	-	-	F	F	-	F
Forsythia	-	F	F	F	F	-
Hibiscus	-	C	-	-	F	-
Honeysuckle	-	F	F	-	F	-
Hydrangea	F	F	-	F	F	-
Hypericum	-	-	-	-	F	-
Lilac	-	-	F	F	F	F
Nandina	F	F	F	F	F	-
Photinia	F	F	F	F	F	F
Privet	F	F	F	F	F	F
Rose	F	F	F	F	F	F
Spirea	-	F	F	F	F	F
Viburnum	F	F	-	F	F	F
Vitex	-	-	-	-	-	-
Weigela	F	F	F	F	F	F
Witchhazel ( <i>Hamamelis</i> )	-	-	-	-	-	-
Tolerant Species	Gallery	Segment	Pendulum	Snapshot	Surflan	trifluralin
<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 4.14 - Guide for Herbicide Selection - Deciduous Trees and Shrubs<sup>1</sup> (cont.)**

Tolerant Species	Gallery	Segment	Pendulum	Snapshot	Surflan	trifluralin
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 4.15 - Guide to Weeds that May Be Controlled by Preemergence Herbicides Approved for Use in Ornamentals**

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

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

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

Weed	Barricade	Casoron	Freehand			
Broadleaf Weeds (cont.)						
Pigweed	-	G	G			
Poison Ivy	N	N	N			
Prickly lettuce	-	-	-			
Prickly sida	-	G	-			
Purslane	-	G	-			
Pusley, Florida	-	-	-			
Ragweed	P	G	-			
Red sorrel	-	G	-			
Shepherd's purse	-	-	-			
Smartweed	-	G	-			
Sowthistle	-	-	F			
Spurge, spotted (prostrate)	G	-	G			
Velvetleaf	-	-	-			
Veronica (speedwell)	-	-	-			
Wild aster	-	-	-			
Wild carrot	-	G	-			
Yellow wood sorrel ( <i>Oxalis</i> ) (from seed)	G	G	G			
Weed	Pennant	Gallery	Pendulum	Snapshot	Surflan	trifluralin
Grasses and Sedges						
Annual bluegrass	-	P	G	G	G	-
Barnyardgrass	G	-	G	G	G	G
Bermudagrass	N	N	N	N	N	N
Cheat	-	-	-	-	-	-
Crabgrass	G	P	G	G	G	G
Fall panicum	G	-	G	G	G	G
Foxtails	G	-	G	G	G	G
Goosegrass	G	-	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
G = good control, F = fair, P = poor, N = no control, and - = no information.						

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

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

Weed	Pennant	Gallery	Pendulum	Snapshot	Surflan	trifluralin
<b>Broadleaf Weeds</b>						
Artemisia (wild chrysanthemum)	-	-	N	-	-	-
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 (maretail)	-	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	-	-	-	-	-	-
Shepherd's purse	-	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 wood sorrel	P	F	G	G	F	-

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

**Table 4.16 - 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 (Japanese stiltgrass)	G	-	G	G	G	G
Orchardgrass, fescue	N	N	P	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 (maretail)	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 4.16 - Guide to Weeds that May be Controlled by Postemergence Herbicides Approved for Use in Ornamentals (cont.)**

Weed	Acclaim	Basagran	Finale	Ornamec	Roundup	Segment
<b>Broadleaf Weeds (cont.)</b>						
Morningglory	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
Shepherd's purse	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 wood sorrel ( <i>Oxalis</i> )	N	N	G	N	G	N
G=good control, F=fair, P=poor, N=no control, and -=no information						



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