

Insects

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These recommendations are for use by nursery producers, commercial and municipal arborists, and other Certified Applicators, Category 3, who are responsible for the production, care, and protection of shade trees, shrubs, and other woody ornamental plants. Pest control is a highly complex and technical implementation of cultural and pest management practices.

There is no simple magic formula for pest control on trees and shrubs. More than 250 species of insects and mites are commonly found which damage or are potentially injurious to over 100 genera of woody ornamentals. Great diversity by insects in host preferences, seasonal development, periods of activity, habits, and susceptibility to insecticides requires careful planning and critical timing of control measures. It is a simple fact that insects and mites will occur, multiply, and cause serious losses if ignored or inadequately controlled. The most frequent cause of insect problems is the failure of nurserymen and arborists to carry out necessary control procedures properly at the right time due to pressures from other phases of production and maintenance. The consequence, without exception, is a much more difficult and costly situation.

The best way to control insects and mites is a preventive program. First, do not introduce pest problems. In nursery production, propagate or buy **ONLY** clean, uninfested stock plants. In municipal tree plantings or private landscaping, set out **ONLY** insect-free plant materials. The presence of a few hardly noticeable insects or mites at planting time is a sure source of extra work and costly effort later on. Second, draw up a seasonal pest monitoring schedule to prevent the establishment and buildup of insects and mites. Third, maintain regular surveillance of established plant materials and be prepared to schedule control measures for difficult or complex pest problems which arise. Take advantage of assistance from your local Extension agent and the Extension specialists at Virginia Tech.

How to Use These Recommendations

Prepare a seasonal monitoring and management schedule for your specific plant types and pest problems. Each nursery, municipality, or local area tends to have its own unique pest situation depending on routine cultural and control practices. If the pest situation is not known, conduct a thorough survey to determine which problems exist and what the control needs are. Select those treatments which most conveniently fit the work plan in your own operation. For example, the use of dormant sprays on many plants will minimize or eliminate the need for spraying operations during the busier periods of the season. Another example is controlling spruce and southern red mite in the fall rather than the spring, or controlling pine needle scale in late July rather than in May. With careful study and planning these recommendations can be adapted to an effective, seasonal, preventive control program. There are numerous built-in options and alternatives. It is essential to carry out the program precisely. Thoroughness and proper timing are critical in obtaining effective results. Degree day (DD) accumulations to the susceptible life stage are included (50° F base temperature) in the timing section. Beware that using this information without scouting can lead to unnecessary applications.

Precautions

Be absolutely sure to read and follow **ALL** of the directions and precautions on the labels and accompanying brochures of the pesticides used. Every statement included is important and can prevent serious injuries or losses. Be absolutely sure that those involved in the application of pesticides are fully informed of all precautions for use and are certified applicators. Formulations and amounts to mix in preparing sprays are given; however, consult the labels for precise directions. It is illegal to use pesticides inconsistent with uses specified on the label. Be sure the host plants and pests to be controlled are stated on the label of the product you use.

Toxicity and Hazard to Humans and Animals

As a guide to general hazards of chemicals, know the relative toxicities of common insecticides. Also study the precautionary statements on pesticide labels. Certain chemicals may be more readily absorbed through the skin than if ingested, or vice versa. Some may be relatively non-toxic to bees and birds, but highly toxic to fish. In using pesticides, avoid application where undesirable side effects may result. In spraying, it is essential to stay out of drift and direct spray. Wear protective equipment as directed by the label.

Plant Injury

Insecticides vary greatly in their phytotoxicity. Be sure to avoid treating sensitive plants. Cautions on the label usually indicate plants which should not be sprayed. **Read the entire label carefully.** **Carbaryl** may injure tender foliage if plants are wet when treated or in the presence of high humidity; it should not be used at any time on Boston ivy or Virginia creeper. **Endosulfan** may injure white birch, redbud, and Anderson yew. **Malathion** may cause injury to certain junipers, eleagnus, hibiscus, some rose varieties, certain ferns. **Methoxychlor** should not be used on Chinese elm, Japanese maple, red maple, or redbud. Petroleum oils for dormant or summer spraying are much safer, but may injure 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 never be applied to plants.

Table 4.4 - Control Measures for Major Pests and Pest Groups

Pest	Control	Timing of Treatment	Remarks
Adelgids spruce gall adelgid	bifenthrin carbaryl chlorpyrifos diazinon endosulfan imidacloprid lindane malathion	Treat just before buds break in the spring, and/or in September and early October after galls have opened.	Spring treatments should be applied before cottony egg masses are evident on buds in the spring. Cooley spruce gall adelgid on Douglas fir does not produce galls; it feeds openly on the needles. Sprays can be applied in September and October.
pine bark adelgid	bifenthrin chlorpyrifos deltamethrin diazinon endosulfan horticultural oil imidacloprid insecticidal soap lindane malathion	Treat in late April or early May and repeat 2-3 weeks later.	Use a forceful spray to penetrate cottony secretions and wash aphids from twigs and bark. Use less-toxic materials in public areas and around homes. Deltamethrin labeled for adelgids.
hemlock woolly adelgid	bifenthrin diazinon horticultural oil insecticidal soap imidacloprid thiomethoxam	Treat in late June and/or in September or October.	Thoroughly wet entire plant including the bark of branches and the trunk. Use a forceful spray; be sure the new growth is thoroughly wet.
hickory leafstem gall aphid	malathion	Treat just as new buds are beginning to open. Timing is critical.	Because aphids begin feeding immediately as leaf buds begin to open, control is very difficult and often ineffective.
Ambrosia Beetles	bifenthrin permethrin	Treat in late March or just prior to first warm period (> 70°F).	The trunk should be thoroughly treated.
Asian Ambrosia Beetles	bifenthrin permethrin	Treat trunk and larger branches in April when the daytime temperature exceeds 70°F for the first time.	Sawdust projecting from the trunk like a toothpick is diagnostic for this insect. Treat the bark but leave infested trees in place as trap trees for 1 month before removing and destroying. Trees can often survive small infestation of just 1 or 2 beetles so not all infested trees will need to be removed.

Table 4.4 - Control Measures for Major Pests and Pest Groups (cont.)

Pest	Control	Timing of Treatment	Remarks
Aphids (general)	abamectin	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. Look for honeydew or sooty mold.	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 populations. Do not spray when plants are flowering and honeybees are active.
	acephate		
	acetaprimid		
	azadirachtin		
	<i>Beauveria bassiana</i>		
	bifenthrin		
	chlorpyrifos		
	cyfluthrin		
	deltamethrin		
	diazinon		
	dimethoate		
	dinotefuran		
	disulfoton		
	endosulfan		
	fluvalinate		
	imidacloprid		
	insecticidal soap		
	lambda-cyhalothrin		
	malathion		
	methiocarb		
permethrin			
pymetrozine			
resmethrin			
rotenone			
spirotetramat			
thiomethoxam			
Bagworm	acephate	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-late summer. DD-600	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 and permethrin may lead to mite increases. Light infestations can be handpicked and destroyed. Indoxacarb is for landscape use only.
	azadirachtin		
	bifenthrin		
	carbaryl		
	chlorpyrifos		
	cyfluthrin		
	deltamethrin		
	diazinon		
	dimethoate		
	fluvalinate		
	indoxacarb		
	gamma-cyhalothrin		
	lambda-cyhalothrin		
permethrin			
spinosad			
tebufenozide			
<i>Bacillus thuringiensis (Bt)</i>	Treat when larvae are young in mid to late June.	Lightly misting the foliage is sufficient. Mist blower treatments are effective.	
remove and burn bags	August to May for light infestation of a few infested trees.	Overwintering eggs remain inside the bags until hatching in late May. Destroy the bags; eggs will hatch from bags thrown on the ground.	
Bark Beetles Deciduous trees	bifenthrin	Treatments should be applied to prevent infestation of and breeding in the bark. Treat weakened or injured trees in late April and repeat 2 or 3 times at monthly intervals.	Thoroughly soak the bark of the trunk and branches. Sprays are more concentrated than usual foliar treatments. Lindane is being phased out. Cypermethrin, landscapes only.
	chlorpyrifos		
	cypermethrin		
	lindane		
	permethrin		

Table 4.4 - Control Measures for Major Pests and Pest Groups (cont.)

Pest	Control	Timing of Treatment	Remarks
Bark Beetles (cont.) elm bark beetle	sanitation	Immediately destroy all branches larger than 1-1/2" in diameter as soon as they begin to die or are cut to prevent infestation and breeding by beetles.	Wood should NEVER be piled or stored unless all of the bark is removed. Where possible, susceptible wood should be burned or buried with at least 18 inch fill.
	bifenthrin chlorpyrifos methoxychlor permethrin	As late in the spring as possible before LEAF BUDS open. This treatment can be supplemented with a second spray in early June.	Complete coverage of all bark is absolutely essential, especially the one year-old twigs in the tops and outer reaches of the trees. The trunk and larger branches should be soaked thoroughly. Spraying is supplementary to sanitation.
Conifers	bifenthrin chlorpyrifos lindane permethrin	Treat unhealthy, weakened, or damaged trees in early April, early June, and August if near infested trees. Also effective in preventing spread if sprayed on infested trees or wood before beetles emerge, or in preventing infestations in uninfested wood that is cut but cannot be disposed of immediately.	Thoroughly wet all of the bark. Healthy vigorous trees are not likely to be attacked and do not require spraying. Beetles will not reinfest or attack wood or trees dead more than one year. Lindane is being phased out.
	sanitation	Throughout the year, particularly during the growing season, when trees begin dying or wood is cut. Prune out large, dying, or recently dead branches.	Dispose of susceptible wood, slash, and bark from stumps by burning, burying where feasible. Beetles will not reinfest or attack wood or trees dead longer than one year.
shot-hole borer, fruit tree bark beetles, ash bark beetle (<i>Scolytus</i>)	bifenthrin lindane permethrin	Drench the bark of healthy trees in late April and early June.	Lindane is being phased out.
Borers banded ash borer	bifenthrin chlorpyrifos permethrin	Treat trunk and main stems in late July and again in early September	Control measures are aimed at newly hatched larvae prior to tunneling into the tree.
lilac borer ash borer	bifenthrin chlorpyrifos endosulfan permethrin	Treat trunk and branches in early May and again 6 weeks later. DD-148	Treatments kill emerging as well as entering borers. Thorough wetting and soaking of the bark is necessary. Foliage need not be treated.
dogwood borer	bifenthrin chlorpyrifos endosulfan permethrin	Treat trunk and larger branches in mid-May and repeat after 6 weeks. DD-148	Brown frass around bark cracks and wounds indicate an infestation.
peach tree borer	bifenthrin chlorpyrifos endosulfan permethrin	Treat trunks and soil around the base in July and repeat in 6 weeks.	Cracked bark, frass, and gummosis at the root crown are signs.
rhododendron borer	bifenthrin chlorpyrifos permethrin	Treat the trunks and larger branches in late June. DD-192	Wilting foliage and dieback are symptoms.

Table 4.4 - Control Measures for Major Pests and Pest Groups (cont.)

Pest	Control	Timing of Treatment	Remarks
Borers (cont.) bronze birch borer	bifenthrin chlorpyrifos permethrin	Treat all bark surfaces, especially in the uppermost part of the tree in mid- May, early, mid-, and late June. DD-440	Bifenthrin is labeled for landscapes.
emerald ash borer	bifenthrin carbaryl cyfluthrin permethrin	Branch and trunk applications in early May and early June.	Additional insecticides are labeled as soil drenches and tree injections. See PMG 456-018 <i>Insects of trees and shrubs</i> .
two-lined chestnut borer	chlorpyrifos	Treat trunk and branches during mid- to late May and mid-late June.	
azalea stem borer, dogwood twig borer	lindane	Treat one-year old stems throughout the tree in mid-May and in mid-June.	Lindane is being phased out.
round-headed and flat-headed tree borer	bifenthrin permethrin lindane	Treat bark of trunk and branches in early May, early June, and early July.	Bifenthrin is labeled for flatheaded appletree borer in landscapes. Lindane is being phased out.
mottled willow borer (poplar and willow borer)	lindane	Treat all bark surfaces in mid-late June and in late August-early September.	Lindane is being phased out.
oak borer	bifenthrin chlorpyrifos permethrin	Treat trunk to ground level early June.	Populations are larger in even-numbered years.
locust borer	chlorpyrifos lindane	Treat the trunk and larger branches in late August to mid-September or in spring.	Sprays applied in early spring are directed at small larvae. Lindane is being phased out.
round-headed and flat-headed bor- ers, bark beetles, and bark weevils in felled logs or trees only	endosulfan lindane	Thoroughly wet the bark surface immediately after trees or logs are cut.	Lindane is being phased out.
Cicada (periodical cicada)	bifenthrin carbaryl chlorpyrifos	Treat bark of twigs on susceptible hosts soon after adult male singing becomes evident, usually around early May.	Cicada damage is caused by adult females inserting eggs in deep slits in twigs. Control is necessary only for young trees.
Defoliators general	acephate azadirachtin <i>Bacillus thuringiensis (Bt)</i> bifenthrin carbaryl chlorantraniliprole chlorpyrifos clothiandin cryolite deltamethrin diazinon malathion methoxychlor novaluron permethrin phosmet	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.	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). Novaluron is labeled for armyworms. Chlorantraniliprole for landscapes; deltamethrin for many defoliators; clothiandin for landscapes; cryolite for caterpillars.

Table 4.4 - Control Measures for Major Pests and Pest Groups (cont.)

Pest	Control	Timing of Treatment	Remarks
Defoliators (cont.) cankerworms	acephate azadirachtin <i>Bacillus thuringiensis (Bt)</i> carbaryl chlorpyrifos cyfluthrin deltamethrin diazinon fluvalinate lambda-cyhalothrin methoxychlor permethrin phosmet spinosad tebufenozide	In May when the leaves are half to two-thirds full size, treatments must be applied when loopers are small. DD-148	Do not use methoxychlor on Chinese elm, Japanese or red maple, or redbud. See Intro., Plant Injury. Mist blowers are very effective.
elm leaf beetle	bifenthrin carbaryl chlorpyrifos cyfluthrin cypermethrin deltamethrin endosulfan fluvalinate imidacloprid lambda-cyhalothrin methoxychlor spinosad	Treat in mid-to-late May, when eggs have hatched but larvae are small. Second generation may need treatment in mid-to-late July.	Do not use methoxychlor on Chinese elm. Carbaryl may injure tender foliage if plants are wet or humidity is high.
fall webworm	<i>Bacillus thuringiensis (Bt)</i> bifenthrin carbaryl chlorpyrifos cyfluthrin deltamethrin diazinon lambda-cyhalothrin methoxychlor permethrin spinosad tebufenozide	When larvae first begin to feed in late June. Repeat in late July. DD-1266	Do not use methoxychlor on Chinese elm, Japanese red maple, or redbud.
flea beetles	bifenthrin carbaryl cryolite cyfluthrin deltamethrin diazinon fluvalinate lambda-cyhalothrin spinosad	When insects are found feeding on host plants as adults or as larvae.	See precautions regarding elm leaf beetle for carbaryl.
grasshoppers	bifenthrin carbaryl chlorpyrifos deltamethrin lambda-cyhalothrin	When grasshoppers are found feeding.	Grasshoppers are infrequent pests but can be destructive when abundant.

Table 4.4 - Control Measures for Major Pests and Pest Groups (cont.)

Pest	Control	Timing of Treatment	Remarks
Defoliators (cont.) gypsy moth	acephate <i>Bacillus thuringiensis (Bt)</i> bifenthrin carbaryl chlorpyrifos cryolite cypermethrin deltamethrin diflubenzuron fluvalinate indoxacarb gamma-cyhalothrin lambda-cyhalothrin methoxychlor permethrin phosmet spinosad tebufenozide	When leaves have expanded but caterpillars are small, usually in mid-May. DD-90	See Intro., Plant Injury. Mist blowers and aerial applications are effective. Indoxacarb and cypermethrin are for landscape use only.
Japanese beetle	azadirachtin bifenthrin carbaryl clothianidin cyfluthrin deltamethrin diazinon dinotefuran gamma-cyhalothrin imidacloprid lambda-cyhalothrin malathion methoxychlor permethrin	In late June or early July after adults have begun to congregate on selected hosts. Repeat as necessary into August. DD-1029	Since adults actively fly and move continuously, they seem to be present constantly even where treatments have been applied. Clothianidin for landscapes only.
orange tortrix puss caterpillar	carbaryl chlorpyrifos	In mid-or-late summer when insects are seen.	Sprays are usually ineffective if applied when caterpillars are mature.
rose chafer	azadirachtin chlorpyrifos endosulfan malathion methoxychlor	During June and mid-summer when insects are found.	Adults are active flyers and move continually onto susceptible hosts.
rose slugs	malathion methoxychlor	Throughout the growing season when young larvae are seen on plants, especially in May, June.	Time treatments to when larvae are young and damage is not yet severe.
sawflies	azadirachtin carbaryl chlorpyrifos cyfluthrin deltamethrin gamma-cyhalothrin lambda-cyhalothrin malathion methoxychlor spinosad	Timing varies depending on the host plant and the sawfly species.	Labeled uses are limited to pines, larch, ash, and spruce.

Table 4.4 - Control Measures for Major Pests and Pest Groups (cont.)

Pest	Control	Timing of Treatment	Remarks
Defoliators (cont.) tussock moth	azadirachtin bifenthrin chlorpyrifos cyfluthrin fluvalinate gamma-cyhalothrin indoxacarb lambda-cyhalothrin methoxychlor tebufenozide spinosad	In mid-May or late August.	Treat when larvae are small. Indoxacarb is for landscape use only.
willow leaf beetle	carbaryl methoxychlor spinosad	In May, June, and later if infestations persist. There may be several generations in a season.	Be sure to treat the undersides of the leaves.
Gall Insects	carbaryl spinosad fenoxycarb thiomethoxam	Treatments are effective when insects are active, before galls appear in spring.	Spinosad is labeled for dipterous gall midges (e.g. honeylocust pod gall midge). Fenoxycarb is labeled for honeylocust pod gall midge. Thiomethoxam is labeled for honeylocust pod-gall, nipple gall, and blister gall.
Lacebugs	acephate bifenthrin carbaryl chlorantraniliprole chlorpyrifos cyfluthrin deltamethrin diazinon dimethoate disulfoton fenpropathrin imidacloprid lambda-cyhalothrin lindane malathion methoxychlor permethrin thiomethoxam	On evergreens, overwintering eggs hatch in mid-late May. Treat in late May or early June and repeat at 3-week intervals. On deciduous hosts, adults emerge in May. Treat in late May and repeat at 3-week intervals.	Consult the label for host plants and specific pests listed under directions for use. Nonsystemic treatments must cover the undersides of the leaves thoroughly. Control of the first generations is most important to slow populations buildup. Examine foliage for lacebugs. Lindane is being phased out. Chlorantraniliprole for landscapes.
Leafhoppers	acetaprimid azadirachtin bifenthrin buprofezin carbaryl chlorpyrifos clothianidin cyfluthrin deltamethrin fluvalinate gamma-cyhalothrin imidacloprid lambda-cyhalothrin permethrin resmethrin thiomethoxam	When leafhoppers are first seen and before stippling on undersides of leaves becomes extensive.	Thorough coverage of the undersides of the leaves improves control when using nonsystemics. Clothianidin for landscapes.

Table 4.4 - Control Measures for Major Pests and Pest Groups (cont.)

Pest	Control	Timing of Treatment	Remarks
Leafminers azalea leafminer	abamectin acephate azadirachtin bifenthrin clothianidin deltamethrin diazinon dimethoate fenoxycarb lambda-cyhalothrin permethrin	Treat in mid-late May or when mines are first seen on the plants.	Be cautious with dimethoate on azaleas; some varieties may be susceptible to plant injury. fenoxycarb will not control adult stages. Clothianidin for landscapes.
boxwood leafminer adults	cyromazine deltamethrin diazinon lambda-cyhalothrin malathion permethrin spinosad	Treat in late April or early May when adults are active. DD-448	Numerous adults can be eliminated before eggs are laid.
boxwood leafminer larvae	cyromazine dimethoate dinotefuran imidacloprid	Treat in May-June after eggs have hatched.	Systemic treatment is most effective in eliminating miners. It is also effective later in the season, but mines will be present in the foliage.
holly leafminer	cyromazine diazinon lambda-cyhalothrin permethrin spinosad	Treat in mid-May when new leaves are unfolding and adults are active on the foliage. (DD-192)	Helps reduce feeding punctures on undersides of leaves but may not prevent all mines in the foliage.
	acephate cyromazine dimethoate dinotefuran imidacloprid	Treat in mid-late June after eggs have hatched.	Systemics are effective in eliminating miners. Do not treat chinese or burford hollies with dimethoate.
oak leafminer	acephate permethrin lambda-cyhalothrin fenoxycarb	Treat when mines are first seen - less than 1/4 inch. Several generations occur each session.	Rake and destroy leaves in fall.
Leaf-rollers, Leaf Tiers	azadirachtin <i>Bacillus thuringiensis</i> (Bt) bifenthrin carbaryl chlorpyrifos cryolite cyfluthrin deltamethrin diazinon gamma-cyhalothrin lambda-cyhalothrin permethrin phosmet	Treat when insects are first seen. On some hosts, injury occurs in early spring when new buds are opening.	Phosmet is currently labeled for fruit trees and can be used on flowering fruits only. Consult the label for specific host plants listed.
Mealybugs	horticultural oil	Treat in late spring, before new growth begins.	Spray on warm days when the temperature remains above 40°F (5°C) for 12-24 hours. Do not spray sensitive plants listed on the label.

Table 4.4 - Control Measures for Major Pests and Pest Groups (cont.)

Pest	Control	Timing of Treatment	Remarks
Mealybugs (cont.)	acephate	Treat whenever mealybugs are first noticed. Repeat 2-3 applications if necessary until infestation is eliminated.	Forceful spray streams help penetrate cracks and crevices in the bark and waxy secretions that protect the mealybugs. Destroying infested plants is another option.
	acetaprimid		
	azadirachtin		
	<i>Beauveria bassiana</i>		
	bifenthrin		
	buprofezin		
	carbaryl		
	chlorpyrifos		
	cyfluthrin		
	deltamethrin		
	dimethoate		
	dinotefuran		
	imidacloprid		
	lambda-cyhalothrin		
	malathion		
permethrin			
pyridaben			
thiomethoxam			
Mites hemlock rust mite eriophyid mites	horticultural oil	Treat in early spring before new growth develops.	Do not use on sensitive plants indicated on the label.
	abamectin	Treat when mites are found in very early spring, in late fall, or during the growing season.	Thoroughly wet the undersides of leaves with a full coverage spray.
	carbaryl azadirachtin		
spruce mite, southern red mite, boxwood mite	abamectin acequinocyl azadirachtin bifenazate chlorpyrifos clofentazine dicofol dimethoate etoxazole fenbutatin-oxide fenpropathrin fluvalinate hexythiazox methiocarb milbectin pyridaben spinosad spiromesifen	Treat in late April or early May and/or in September and October.	Thoroughly wet all of the foliage and stems with a full coverage spray. Fenpropathrin is labeled for shade and lath house use only. Acequinocyl is labeled for spruce spider mite. See spiromesifen label for list of mite species. Etoxazole for shade and lath house use only.
honeylocust mite	dicofol	Treat when mites occur.	Thoroughly wet the undersides of leaves with a full coverage spray.
two spotted spider mite	abamectin acequinocyl bifenthrin dicofol dimethoate etoxazole fenbutatin-oxide fluvalinate hexythiazox methiocarb milbectin pyridaben spiromesifen	Treat whenever mites first appear. Infestations may occur from spring to fall. Mite infestations are directly proportionate to increasingly warmer temperatures.	Thoroughly wet the foliage and stems with a full coverage spray. Do not use acequinocyl on miniature roses. Etoxazole for shade and lath house use only. See bifenthrin label for special instructions.

Table 4.4 - Control Measures for Major Pests and Pest Groups (cont.)

Pest	Control	Timing of Treatment	Remarks
Oriental Beetle	bifenthrin chlorpyrifos imidacloprid	Treat when small larvae are present.	Most effective against early instars. Beneficial nematodes may be effective. Apply bifenthrin granules and other materials as a soil drench.
Plant Bugs, Planthoppers	bifenthrin buprofezin carbaryl chlorpyrifos cyfluthrin fluvalinate lambda-cyhalothrin malathion permethrin resmethrin thiomethoxam	Treat when insects or signs of damage first appear. Treat honeylocust as soon as new growth begins.	Control is difficult because plant bugs are active flyers and move around continuously. Fluvalinate is labeled for plant bugs. Permethrin is labeled for Lygus bugs.
Psyllids (Boxwood psyllid, hackberry psyllid)	azadirachtin <i>Beauveria bassiana</i> bifenthrin carbaryl chlorpyrifos deltamethrin lambda-cyhalothrin lindane	Treat in late April or early May as new growth begins to develop.	Addition of a wetting agent or spreader-sticker is advised. Lindane is being phased out.
Sawflies	acetaprimid azadirachtin bifenthrin carbaryl chlorpyrifos cyfluthrin deltamethrin gamma-cyhalothrin imidacloprid lambda-cyhalothrin malathion methoxychlor thiomethoxam	Treat when insects are first seen. Treat in April for Virginia pine sawfly. Larvae are gregarious and broods often cluster on one branch.	See label for which species are registered for each chemical.
Scale Insects (All scales)	deltamethrin dinotefuran horticultural oil imidacloprid lambda-cyhalothrin thiomethoxam	Treat with horticultural oil 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- to 24-hours. Oils can also be used as summer sprays when indicated on the label.	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. Thiomethoxam is labeled for softscales. Deltamethrin is labeled for scale crawlers.
Azalea bark scale	carbaryl diazinon insecticidal soap lambda-cyhalothrin malathion	Crawlers: June 5-25. Treat June 10-30.	
brown soft scale	bifenthrin buprofezin carbaryl diazinon fenoxycarb insecticidal soap lambda-cyhalothrin	Treat when scale insects appear. Treat 2-3 times at 10-day intervals.	This scale insect does not winter out-of-doors in colder plant zones of Virginia.

Table 4.4 - Control Measures for Major Pests and Pest Groups (cont.)			
Pest	Control	Timing of Treatment	Remarks
Scale Insects (cont.) calico scale	carbaryl insecticidal soap lambda-cyhalothrin	Crawlers: June 1-20. Treat June 15-30.	Often seen on Zelcova trees.
camellia scale	dimethoate insecticidal soap lambda-cyhalothrin	Crawlers first appear in May. Treat at 2-week intervals as needed.	Dimethoate is being phased out.
cottony camellia scale	carbaryl insecticidal soap lambda-cyhalothrin malathion	Crawlers: June 1-10. Treat June 15-30.	
cottony maple leaf scale	acephate carbaryl diazinon insecticidal soap lambda-cyhalothrin	Crawlers: June 1-10. Treat June 15-30.	Ovisacs are found on foliage.
cottony maple scale	carbaryl insecticidal soap lambda-cyhalothrin	Crawlers: June 5-25. Treat June 10-30.	Be sure to cover thoroughly stems and branches near the ground.
euonymus scale	carbaryl dimethoate fenoxycarb insecticidal soap malathion lambda-cyhalothrin	Crawlers: first generation May 1-10; second July 5-15. Treat May 10-20, and July 15-25.	Do not spray when beneficial lady beetles are present.
euonymus alatus scale	carbaryl diazinon dimethoate lambda-cyhalothrin	Crawlers: in June and July. Treat: June to late July.	
European elm scale	carbaryl diazinon insecticidal soap lambda-cyhalothrin	Crawlers: June 5-25. Treat June 10-30.	
fern scale	buprofezin carbaryl dimethoate insecticidal soap lambda-cyhalothrin	Crawlers: first appear in mid- May. Treat at 2-week intervals as needed.	Often on lirioppe.
fletcher scale	carbaryl dimethoate insecticidal soap lambda-cyhalothrin malathion	Crawlers: in early to mid-June. Treat June 15-20.	On Taxus and Arborvitae.
Florida red scale	acephate buprofezin carbaryl diazinon insecticidal soap lambda-cyhalothrin	Crawlers: May 5-15. Treat May 15-30.	Found on burford holly.
forbes scale	carbaryl insecticidal soap lambda-cyhalothrin malathion	Crawlers: June 1-15. Treat June 5-20.	

Table 4.4 - Control Measures for Major Pests and Pest Groups (cont.)

Pest	Control	Timing of Treatment	Remarks
Scale Insects (cont.) gloomy scale	carbaryl diazinon insecticidal soap lambda-cyhalothrin	Crawlers: peak June 10-20. Treat June 20-30.	Serious pest that is difficult to control.
golden oak scale	dimethoate insecticidal soap lambda-cyhalothrin	Crawlers: June 1-30. Treat June 10 - July 10.	
hemlock scale	dimethoate insecticidal soap lambda-cyhalothrin	Crawlers: peak May 15-June 20, some produced throughout the season. Treat May 20-25 and June 5-20.	Also called fiorinia hemlock scale.
Japanese scale	carbaryl diazinon lambda-cyhalothrin malathion	Crawlers: June 1-September 1. Treat at 2-week intervals June- September.	
juniper scale	carbaryl insecticidal soap lambda-cyhalothrin malathion	Crawlers: April 5-20 and June 5-20. Treat April 10-25 and/or June 10-25.	Crawler dates vary based on temperature.
latania scale	diazinon insecticidal soap lambda-cyhalothrin	Crawlers: continuous from June through season. Treat 2-3 times at 10 day intervals.	
lecanium scale	chlorpyrifos diazinon lambda-cyhalothrin	Crawlers: May 25-June 25. Treat June 15-30.	Treat for oak lecanium June 1-10 in coastal areas.
oak kermes	carbaryl lambda-cyhalothrin malathion	Crawlers: June 1-20. Treat June 10-30.	
obscure scale	carbaryl diazinon lambda-cyhalothrin malathion	Crawlers: on red oak during July. Treat white oaks in mid- August.	Also treat with oil as a dormant spray.
oystershell scale	buprofezin carbaryl insecticidal soap lambda-cyhalothrin	Crawlers: May 1-20 and July 15-25. Treat May 10-25 and/or July 20-30.	
peony scale	carbaryl diazinon insecticidal soap lambda-cyhalothrin malathion	Crawlers: mid-May. Treat in late May.	Often found on azaleas.
pine needle scale	bifenthrin carbaryl chlorpyrifos diazinon gamma-cyhalothrin insecticidal soap lambda-cyhalothrin malathion	Crawlers: April 20-May 30 and July 10-20. Treat May 5-30 and/or July 15-20.	
pine tortoise scale	carbaryl insecticidal soap gamma-cyhalothrin lambda-cyhalothrin	Crawlers: June 10-July 5. Treat June 20-July 15.	

Table 4.4 - Control Measures for Major Pests and Pest Groups (cont.)

Pest	Control	Timing of Treatment	Remarks
Scale Insects (cont.) rose scale	carbaryl insecticidal soap lambda-cyhalothrin	Crawlers: late May-June 30, possible second generation in August. Treat June 5-10 and 20-30 and in mid-August.	
San Jose scale	bifenthrin buprofezin carbaryl diazinon insecticidal soap lambda-cyhalothrin lime sulfur pyriproxyfen	Crawlers: at least 3 generations June, July, and September. Treat June, July, and September.	Lime sulfur as dormant spray only.
tea scale	chlorpyrifos dimethoate insecticidal soap lambda-cyhalothrin	Crawlers: throughout season in overlapping generations. Treat 2-3 times at 10-day intervals when infested.	Do not use dimethoate on Chinese or burford hollies.
wax scale	buprofezin carbaryl fenoxycarb lambda-cyhalothrin	Crawlers: June 1-25. Treat June 5-30.	Thoroughly wet foliage and bark with a full-coverage spray.
white peach scale	buprofezin chlorpyrifos diazinon fenoxycarb insecticidal soap lambda-cyhalothrin malathion	Crawlers: April 25-May 15, July 1-15, August 20-September 15. Treat May 1-15, July 5-15, September 1-15.	
Spittle Bug	bifenthrin carbaryl chlorpyrifos cyfluthrin deltamethrin gamma-cyhalothrin lambda-cyhalothrin	Treat in early June if yellowing or damage occurs.	Often noticed, but rarely of economic importance.
Slugs and Snails	metaldehyde methiocarb	Apply when pests are observed.	
Tent Caterpillars	azadirachtin <i>Bacillus thuringiensis (Bt)</i> bifenthrin carbaryl chlorpyrifos cyfluthrin deltamethrin diazinon gamma-cyhalothrin indoxacarb lambda-cyhalothrin methoxychlor permethrin spinosad tebufenozide	Treat in early spring as new growth is developing and when caterpillars are small.	Caterpillars leave the nests to feed on the foliage during the day. Apply full coverage spray to the entire tree. Forest tent caterpillar does not make a tent. Spinosad and lambda-cyhalothrin are labeled for eastern tent caterpillar only. Indoxacarb is for landscape use only.

Table 4.4 - Control Measures for Major Pests and Pest Groups (cont.)

Pest	Control	Timing of Treatment	Remarks
Thrips	abamectin acephate acetaprimid azadirachtin <i>Beauvaria bassiana</i> bifenthrin chlorpyrifos cyfluthrin dinotefuran fluvalinate imidacloprid lambda-cyhalothrin methiocarb novaluron permethrin spinosad	Treat in June when thrips are active on new foliage.	Methiocarb is labeled for western flower thrips.
Tip Moths	acephate azadirachtin bifenthrin chlorpyrifos cyfluthrin diflubenzuron dimethoate disulfoton gamma-cyhalothrin lambda-cyhalothrin permethrin tebufenozide	Treat with liquid formulation in mid March, April, June and July when moths are flying. Treat with dimethoate when larval activity begins in late April and in late May or early June. Treat with disulfoton soil application 2-3 weeks prior to adult activity in late March.	Spray entire tree to runoff. Two and three-needle pines are susceptible to tip moth. Soil systemic treatment with requires only one application annually; for nursery use and professional applicators only. Disulfoton must be incorporated and watered into the soil.
Treehoppers (Thornbugs)	bifenthrin carbaryl chlorpyrifos	Treat when nymphs are seen on twigs (usually in clusters) before adults are present to begin egg-laying, usually in late summer and fall.	Apply sprays to cover the small twigs thoroughly.
Webworms cotoneaster webworm	cyfluthrin deltamethrin diazinon gamma-cyhalothrin lambda-cyhalothrin permethrin	Treat when larvae are first found.	Apply a full-coverage spray, wetting foliage to the point of runoff.
juniper webworm	bifenthrin chlorpyrifos cyfluthrin deltamethrin diazinon gamma-cyhalothrin lambda-cyhalothrin permethrin	Treat in late July or in August when larvae are small. Spring treatments may be applied when plants are found to be infested.	Apply a forceful spray to penetrate severely webbed foliage. Thoroughly wet the foliage to runoff.

Table 4.4 - Control Measures for Major Pests and Pest Groups (cont.)

Pest	Control	Timing of Treatment	Remarks
fall webworm	<i>Bacillus thuringiensis (Bt)</i> bifenthrin chlorpyrifos cyfluthrin deltamethrin diazinon indoxacarb gamma-cyhalothrin lambda-cyhalothrin methoxychlor permethrin tebufenozide	Treat in late June or early July when larvae are small and webs just starting to form. Treat for second generation in August or early September.	Caterpillars are gregarious and infest individual branches. Apply full-coverage foliar spray to infested area, or entire tree in years of high populations. Indoxacarb is for landscape use only.
mimosa webworm	carbaryl chlorpyrifos cyfluthrin deltamethrin diazinon gamma-cyhalothrin lambda-cyhalothrin permethrin	Apply foliage sprays at 4-5 day intervals until the infestation is controlled.	
pine webworm	bifenthrin chlorpyrifos cyfluthrin deltamethrin diazinon gamma-cyhalothrin lambda-cyhalothrin permethrin	Treat in early June.	
Weevils Two banded Japanese weevil, black vine weevil	acephate <i>Beauveria bassiana</i> bifenthrin chlorpyrifos lambda-cyhalothrin	Apply in June or July as a full-coverage spray when foliar feeding is first observed.	Lambda-cyhalothrin is for black vine weevil adults.
white pine weevil	bifenthrin gamma-cyhalothrin lindane Cut out and burn infested leaders.	Apply sprays in the late spring before adults lay eggs, normally prior to April 1-10 Prune out infested leaders during June.	Treat only the main terminal leaders of the tree down to the first whorl of branches. Thoroughly wet the bark. Lindane is being phased out. Adults begin emerging from infested leaders in July.

Table 4.4 - Control Measures for Major Pests and Pest Groups (cont.)

Pest	Control	Timing of Treatment	Remarks
Whiteflies	abamectin acetaprimid azadirachtin <i>Beauvaria bassiana</i> bifenthrin chlorpyrifos clothianidin cyfluthrin dinotefuran fenoxycarb fluvalinate imidacloprid lambda-cyhalothrin novaluron permethrin pymetrozine pyridaben resmethrin spiromesifen spirotetramat thiomethoxam	When whiteflies are found. Treat every three weeks until infestation is controlled.	See labels for whitefly species. Clothianidin for landscapes.
	endosulfan	When whiteflies are found.	Do not apply endosulfan to chrysanthemum varieties noted on label. Do not spray endosulfan on birch.
Zimmerman Pine Moth	bifenthrin dimethoate endosulfan lindane	Treat in early to mid-April and in early September. (DD-121)	Apply as full coverage spray to the point of runoff. Lindane is being phased out.

Table 4.5 - Directions for Pesticide Usage

Chemical	Formulation	Pests Controlled	Amount to Use		Phototoxicity and Remarks
			per 100 gal	per 3 gal	
abamectin (Avid)	0.15EC	aphids, mites leafminers, thrips whiteflies	4.0-8.0 fl oz	0.75-1.5 tsp	See label for rate and volume directions and for resistant management. Do not use on ferns or Shasta Daisy. Generic products exist. 12-hr REI SIGNAL WORD - CAUTION
acephate (Orthene)	75 S 97	All labeled uses.	see label for rates		Rates differ as to pests. See label for phytotoxicity list. 24-hr REI SIGNAL WORD - CAUTION
acequinocyl (Shuttle)	15SC	two-spotted spider mite, spruce spider mite	6.4-12.8 fl oz	1.0-2.0 tsp	Do not use on miniature roses or impatiens. Use low rate on standard roses. See label for resistance management. 12-hr REI SIGNAL WORD - CAUTION
acetaprimid (Tristar)	70WSP 30 SG	aphids, European pine sawfly, tentiform leaf miner, mealybug, leafhopper, whiteflies, thrips	see label for rates	see label for rates	See label for resistance management, restrictions, and precautions. 70 WSP in water soluble packets. 12-hr REI SIGNAL WORD - CAUTION

Table 4.5 - Directions for Pesticide Usage (cont.)

Chemical	Formulation	Pests Controlled	Amount to Use		Phototoxicity and Remarks
			per 100 gal	per 3 gal	
Arena	50 WDG .25 G	see label	see label for rates	see label for rates	See label for proper rate for target pest and for drench applications. Aloft is registered for landscape use. 12-hr REI SIGNAL WORD - CAUTION.
azadirachtin (Azatin, Triact, Ornazin)	various	All labeled uses.	see label for rates	see label for rates	Product is sold by several companies, and in many formulations. 4-hr REI SIGNAL WORD - CAUTION
<i>Bacillus thuringiensis</i> (Bt)	various	defoliating caterpillars (see label)	see label for rates	see label for rates	Product is sold by many companies, and in many formulations. 4-hr REI SIGNAL WORD - CAUTION
<i>Beauveria bassiana</i> (BotaniGard)	22WP ES	aphids, mealybugs, thrips, whiteflies	0.5-2.0 lb 0.5-2.0 qt	1.5-6.0 tbsp 1.0-4.0 tbsp	12-hr REI SIGNAL WORD - CAUTION
bifenazate (Floramite)	50 WP	mites	2.0-4.0 oz	—	See label for species controlled. Do not use in successive applications. Sold in water-soluble bags. 12-hr REI SIGNAL WORD - CAUTION
bifenthrin (Talstar, Onyx Pro)	F		see label for rates	—	Onyx Pro is labeled for nurseries. Generic products exist. 12-hr REI SIGNAL WORD - WARNING.
	0.2G	All labeled uses.	see label for rates		SIGNAL WORD - CAUTION
buprofezin (Talus)	70 WSP	See label for pests: leafhoppers, mealy bugs, planthoppers, scales, whiteflies	6.0-14.0 oz	—	Sold in water soluble bags. Consult label for rate for pests. 12-hr REI SIGNAL WORD - CAUTION
carbaryl (Sevin)	50W SL 23.4% EC	All labeled uses.	2.0 lbs 1.0 qt 2.0 qt	6.0 tbsp 3.0 tbsp 4.0 tbsp	Do not apply to wet foliage or in high humidity, injury may result. 12-hr REI SIGNAL WORD - WARNING
chlorantraniliprole (Acelepryn)	1.67 SC	Leaf-feeding caterpillars, lacebugs, birch leaf miner	see label for rates	see label for rates	No signal word required. 4-hr REI. For landscape use.
chlorpyrifos (Dursban) (DuraGuard)	2E	See label for pests.	1.0 pt	1.0 tbsp	See label for sensitive plants. SIGNAL WORD - WARNING
	4E		8.0 oz	1.5 tsp	
	50W		0.5 lb-6.0 lb	—	
	ME		1.5-3.0 pt	1.5-3.0 tbsp	Rates vary with formulation. Read label carefully. 50W in water-soluble packets. See label for special rates for borers, bark beetles, and weevils. 12-hr REI
cinnamaldehyde (Cinnamite)	30%	aphids, mites	85 fl oz	2.5 fl oz	Can cause injury to some plant species. 4-hr REI SIGNAL WORD - CAUTION
clofentezine (Ovation)	5 SC	mites	2.0 fl oz	1.0 tbsp	Not for landscape use. 12-hr REI SIGNAL WORD - CAUTION

Table 4.5 - Directions for Pesticide Usage (cont.)

Chemical	Formulation	Pests Controlled	Amount to Use		Phototoxicity and Remarks
			per 100 gal	per 3 gal	
clothianidin (Arena)	50 WDG .25G	aphids, mealybugs, whiteflies	see label	see label	Landscape use only. 12-hr REI SIGNAL WORD - CAUTION
cryolite (Kryocide)	D	see label	see remarks	see remarks	Rate is 8.0-24.0 lbs/A. 12-hr REI SIGNAL WORD - CAUTION
cyfluthrin (Discus, Decathlon)	20WP F	See label.	1.3-1.9 oz	0.75-1.0 tsp	Discus also contains imidacloprid. 12-hr REI SIGNAL WORD - WARNING
cypermethrin	2 EC	gypsy moth, box elder bug, bark beetles, borer, elm leaf beetle	see label for rates	see label for rates	Bark spray only in landscapes.
cyromazine (Citation)	75WP	leaf miners, shoreflies, fun- gus gnats	2.66 oz	—	Sold in water-soluble pouches. Not to exceed 6 applications/ crop. Shoreflies on greenhouse crops only. 12-hr REI SIGNAL WORD - CAUTION
deltamethrin (Deltagard)	5 SC	see label	4.0-8.0 fl oz	0.75-1.5 tsp	Registered for landscape and nursery ornamentals. 12-hr REI. SIGNAL WORD - CAUTION
diazinon	AG500, 4F 50W	See label for pests.	1.0-3.0 pt 1.0-3.0 lb	1.0-3.0 tbsp 3.0-9.0 tbsp	Not all formulations have the same pests on the label. Read the label carefully. 12-hr REI SIGNAL WORD - WARNING
	Knox-out	See label.	3.0-6.0 pt	1.0-2.0 tbsp	See label. 12-hr REI SIGNAL WORD - CAUTION
dicofol (Kelthane)	50 WP	mites	0.5-1.0 lb	3.0 tbsp	See label. 48-hr REI SIGNAL WORD - DANGER
diflubenzuron (Dimilin)	25W	Pine tip moth, gypsy moth	4.0 oz	2.0 tsp	12-hr REI SIGNAL WORD - CAUTION
dimethoate (Cygon, Dimate)	4E	See label for pests con- trolled, rate, and other ornamental list.	1.0-4.0 pt	1.5-11.6 tsp or 0.5-4.0 tbsp	Do not use on Burford Holly. See label for restrictions. Rates vary with formulations. 48-hr REI SIGNAL WORD - WARNING
	2.67 E	See label Soil drench	0.75-3.1 pt	0.75-3.0 tbsp	Increase rate proportionally for larger plants. See label for specific directions.
dinotefuran (Safari)	20SG	aphids, scales, thrips, Japanese beetles, mealybugs, whiteflies, leafminers	See label for rates.		See label for proper rate for target pest. See label for scale species. Apply as foliar spray or drench. 12-hr REI SIGNAL WORD - CAUTION
disulfoton (DiSystem)	15% granular	All labeled uses.	See label for rates. Rates differ for shrubs, trees, flowers and ground covers.		DO NOT USE WITH PRE- EMERGENT HERBICIDES. 48-hr REI SIGNAL WORD - DANGER

Table 4.5 - Directions for Pesticide Usage (cont.)

Chemical	Formulation	Pests Controlled	Amount to Use		Phototoxicity and Remarks
			per 100 gal	per 3 gal	
endosulfan (Thionex)	50 WP	All labeled uses.	1.0-1.5 lb	—	Sold in water-soluble bags. Do not exceed 6 lbs/A/year. 24-hr REI SIGNAL WORD - WARNING
	3 EC	All labeled uses.	0.66-1.33 qt	1.33-2.66 tbsp	Rate varies depending on pest. See label. Do not exceed 4 qts/A/year.
etoxazole (TetraSan)	5 WDG 5 WSP	spider mites	see label for rates	see label for rates	Shade and lath house use only. 12-hr REI. SIGNAL WORD - CAUTION
fenbutatin oxide (Promite)	50WP	mites	8.0-16.0 oz	—	Sold in soluble pouches. 48-hr REI SIGNAL WORD - DANGER
fenoxycarb (Precision)	25WP	All labeled uses.	2.0-8.0 oz	—	See label for proper rate for target pest. Sold in 1-oz pouches. 12-hr REI SIGNAL WORD - CAUTION
fenpropathrin (Tame)	2.4 EC	All labeled uses.	5.33-16.0 oz	1.0-3.0 tsp	24-hr REI SIGNAL WORD - DANGER
fluvinate (Mavrik)	2 F	All labeled uses.	4.0-10.0 fl oz	0.75-2.0 tsp	See label for precautions and rates for root weevils. For outdoor plantings and containerized nursery stock. 12-hr REI SIGNAL WORD - CAUTION
gamma-cyhalothrin (Proaxis)	(0.5 F)	all labeled uses	2.56-5.12 fl oz	—	SIGNAL WORD - CAUTION
hexythiazox (Hexygon)	50 WP	mites	1.0-2.0 oz or 4.0-6.0 oz/A	0.5-1.0 tsp	Use only once/crop cycle. 12-hr REI SIGNAL WORD - CAUTION.
horticultural oils	various	All labeled uses.	See label for rates.		Numerous companies sell this product. See label for phytotoxicity. 4- to 12-hr REI SIGNAL WORD - CAUTION
imidacloprid (Marathon, Discus)	1 G 60 WP II F	aphids, mealybugs, thrips, whiteflies	See label for rates		See label for application directions. Labeled for soil and foliar application. Discus also contains cyfluthrin. Generic products exist. 12-hr REI SIGNAL WORD - CAUTION
indoxacarb (Provaunt)	30WDG	caterpillars, sawfly, leafhoppers	1.25-5.0 oz	—	Provaunt is labeled for landscape use only. SIGNAL WORD - CAUTION.
insecticidal soap	various	All labeled uses.	See label for rates.		Several companies sell this product. 12-hr REI SIGNAL WORD - WARNING
lambda-cyhalothrin (DeltaGard)	5SC	See label.	4.0-8.0 fl oz	0.75-1.5 tsp	Labeled for commercial and residential turf and landscape ornamental plants. Generic products are sold by many companies. 12-hr REI SIGNAL WORD - CAUTION
(Scimitar, Topcide, Battle)	10 WP 9.7 CS	All labeled uses.	1.2-4.8 oz 1.5-5.0 oz	— 0.33-1.0 tsp	Battle, Scimitar are labeled for commercial landscapes; Topcide is labeled for greenhouse and shadehouse use. WP is sold in soluble packs. 24-hr REI SIGNAL WORD - WARNING
lime sulfur	26-30% L	armored scales	10.0-12.0 gal	39.0-45.0 fl oz	Apply when plants are fully dormant. Will cause yellow staining of paint, masonry. SIGNAL WORD - DANGER

Table 4.5 - Directions for Pesticide Usage (cont.)

Chemical	Formulation	Pests Controlled	Amount to Use		Phototoxicity and Remarks
			per 100 gal	per 3 gal	
lindane	25%WP	All labeled uses.	1.0 lb	3.0 tbsp	Read label carefully! 12-hr REI. Product is being phased out. SIGNAL WORD - WARNING
	20% L	All labeled uses.	1.0-18.0 pt	1.0-18.0 tbsp	See label for application directions and rate for target pest. Product is being phased out.
malathion	Various	All labeled uses.	See label	—	See label for rate and directions for rates. for target pests. Product is sold by several firms. 12-hr REI SIGNAL WORD - CAUTION
metaldehyde (Deadline, Metarex)	Bait	slugs, snails	Ready-to-use.		12-hr REI SIGNAL WORD - CAUTION
methiocarb (Grandslam, Mesuro)	75 WP	aphids, mites, slugs, snails	1.0-4.0 lb	3.0-12.0 tbsp	Do not apply with foliar fertilizer. Apply up to 4 applications/season. 24-hr REI SIGNAL WORD - WARNING
methoxychlor (Marlate)	50 WP	All labeled uses.	2.0-3.0 lb	6.0 tbsp	Chinese elm, Japanese and red maple, redbud, privet and viburnum, repeated uses on evergreens. 12-hr REI SIGNAL WORD - CAUTION
milbemectin (Ultifora)	1% EC	spider mites	8.0-16.0 fl oz	1½-3 tsp	See label for application directions. 12-hr REI SIGNAL WORD - CAUTION.
naled (Dibrom)	8E	See label.	16.0 oz	3.0 tsp	48-hr REI SIGNAL WORD - DANGER
novaluron (Pedestal)	10SC	white-flies, thrips, leaf-miners, armyworms	6.0-8.0 oz	1.0-1.5 tsp	12-hr REI SIGNAL WORD - CAUTION
permethrin (Ambush)	2E	All labeled uses.	6.4-12.8 oz	1.0-2.0 tsp	Permethrin 3.2 is sold under several trade names. Do not apply to salvia or snap-dragon. 12-hr REI SIGNAL WORD - CAUTION
	3.2EC	All labeled uses.	4.0-8.0 oz	0.75-1.5 tsp	
phosmet (Imidan)	70 W	Elm span-worm, gypsy moth, birch leaf-miner, spring cankerworm,	0.75 -1.0 lb	2.25-3.0 tbsp	See label for rates and pests on evergreens. 24-hr REI SIGNAL WORD - WARNING
pymetrozine (Endeavor)	50WG	aphids, whiteflies	2.5-5.0 oz	—	Sold in WSP. 12-hr REI SIGNAL WORD - CAUTION
pyriproxyfen (Distance)	0.86 EC	scale crawlers	see label for rates	see label for rates	See label for sensitive species. 12-hr REI SIGNAL WORD - CAUTION
pyridaben (Sanmite)	75SP	All labeled uses.	2.0-6.0 oz	—	Sold in 1.0 oz soluble bags only. 12-hr REI SIGNAL WORD - CAUTION
resmethrin	26EC	All labeled uses.	1.0 pt	1.0 tbsp	See label for precautions. SIGNAL WORD - CAUTION

Table 4.5 - Directions for Pesticide Usage (cont.)

Chemical	Formulation	Pests Controlled	Amount to Use		Phototoxicity and Remarks
			per 100 gal	per 3 gal	
spinosad (Conserve)	SC	All labeled uses.	6.0-22.0 fl oz	1.0-4.0 tbsp	See label for resistance management strategies and rates for specific pests. Compatible with IPM programs. 4-hr REI SIGNAL WORD - CAUTION
spiromesifen (Forbid, Judo)	4F	mites, whiteflies	2.0-4.0 fl oz	0.38-0.75 tsp	Forbid registered for outdoor landscapes only; Judo registered for nursery and greenhouse sites. 12-hr REI SIGNAL WORD - CAUTION
spirotetramat (Kontos)	240 SC	aphids, whiteflies	1.7-3.4 fl oz	0.07-0.1 fl oz	See label for additional pests. 24-hr REI as foliar spray; no REI for drench. SIGNAL WORD - CAUTION
tebufenozide (Confirm)	2E	See label.	4.0-16.0 fl oz	0.75-3.0 tsp	See label for rates for specific pests. 4-hr REI SIGNAL WORD - CAUTION
thiomethoxam (Flagship)	25WG .22G	aphids, lace bugs, soft scales, mealybugs, blister gall, whiteflies, sawflies, leafhoppers, plantbug, nipple gall, honeylocust podgall, hemlock wooly adelgid	2.0-4.0 oz See label	— See label	See label for application direction and specific rate. Granular is labeled for aphids, mealybugs, whiteflies, and beetle larvae (grubs). 12-hr REI SIGNAL WORD - CAUTION

Abbreviations

W, WP = wettable, wettable powder; WSP = water-soluble packets; S, SP = sprayable powder; L, LS = liquid, liquid spray; E, EC = emulsifiable, emulsifiable concentrate; SC = spray concentrate.

Precautions:

Do not apply liquid concentrate when the temperature is above 85°F (29-30°C.) or any spray when the temperature is above 90°F (32°C).

Do not apply oil sprays if the temperature is below 40°F (4-5°C) or is likely to approach or go below freezing within 24 hours. Never use a sprayer or a tank that has been used previously to apply herbicides.

Use only the recommended dosage rates. The label directions are the final authority. Wettable powders and other suspensions (flowable) require continuous agitation in the tank to avoid settling. Do not allow spray suspensions to remain in the tank without agitation, or any spray mixture to remain in a non-operating sprayer for more than 1 hour.

Clean all spraying equipment thoroughly after each use.

Use spreader-stickers only for hard-to-wet foliage and special uses. Unnecessary wetting agents and spreaders cause excess run-off.

Equivalents:

1 pt liquid in 100 gal = 1 tsp in 1 gal

1 lb powder in 100 gal = 1 tbsp in 1 gal

1 gal = 4 qt = 8 pts = 128 fl oz

1 cup = 1/2 pt = 8 fl oz = 16 tbsp

1 fl oz = 1/8 cup = 2 tbsp = 29.57 milliliter

1 lb = 16 oz = 454 grams

1 tbsp = 1/2 fl oz = 3 tsp = 14.78 milliliter

1 oz = 28.3 grams