

Insects of Trees, Shrubs, Annuals, and Perennials

Eric R. Day, Extension Entomologist, Virginia Tech

Peter B. Schultz, Extension Entomologist, Hampton Roads AREC

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

Identification and Significance of Pest Problems

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

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

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

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

Determining the Need for Control Measures

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

Pesticide Names

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

Insecticides and Miticides

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

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

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

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

Formulations

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

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

Combination Sprays

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

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

Sprayers and Spraying

The most important consideration is to fit the spray equipment to the job to be done. Sprayers vary from finger-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 eleagnus. Methoxychlor in liquid formulations should not be used on Chinese elm, Japanese maple, red maple, or redbud. Dimethoate is highly variable in phytotoxicity to plants; some varieties of azalea are completely defoliated while others show minor leaf burn or no effects. Dimethoate may defoliate Burford and Chinese holly; andromeda and elm foliage may be injured. Dormant oils may injure sugar and Japanese maples and numerous thin-barked trees. It should not be used on hickory, beech, birch, douglas fir, and juniper and will remove the bluish bloom from spruces. The label on the insecticide container specifies plants susceptible to injury. **Be sure to read ALL of the directions and use insecticides only for those pests specified on the label.** Potential injury to plants by insecticides is included under phytotoxicity in Table II.

Index to Insects and Mites by Host

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

ABELIA scale insects

AGERATUM aphids, cyclamen mite, spider mite, whiteflies

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

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

ANDROMEDA lacebugs, scale insects, spider mites, whiteflies

ARAUCARIA mealybugs, scale insects

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

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

ASTER aphids

AUCUBA scale insects, spider mites

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

BALSAM FIR aphids

BARBERRY aphid, scale insects, webworm

BAYBERRY defoliators, mealybugs, scale insects

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

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

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

BITTERSWEET aphids, scale insects

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

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

BUCKEYE defoliators, mealybugs, scale insects, spider mites

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

BUTTONBUSH aphids, scale insects

CACTUS mealybugs, scale insects

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

CATALPA aphids, defoliators, scale insects

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

CHAMAECYPARIS aphid, scale insects, spider mites, weevils

CHERRY-LAUREL aphid, scale insects, weevils, whitefly

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

CHINA ASTER aphids, broad mite, thrips, whiteflies

CHOCKECHERRY borers, defoliators, scale insects, tent caterpillar

CITRUS aphid, bagworm, borers, defoliators, leafroller,

COTONEASTER lacebugs, defoliators

CRAPE MYRTLE aphid, scale insects, weevil

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

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

DAY LILY aphids, scale insects, thrips

DELPHINIUM cyclamen mites, aphids, leafminers

DEUTZIA aphids, leafminer, scale insects, weevil

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

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

ELEAGNUS aphids, scale insects

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

EUONYMUS aphids, scale insects, weevils

FERNS scale, thrips, mealybugs

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

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

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

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

GERANIUM aphids, mites, scale, Fuller rose beetles

GINGKO defoliator, scale insects

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

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

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

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

HIBISCUS Japanese beetles, whitefly, aphids, sawflies

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

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

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

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

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

HYDRANGEA leaf tiers, lygus bugs, spider mites

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

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

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

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

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

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

LAUREL bud moth, psyllid, scale insects, weevils

LIGUSTRUM scale insects

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

LILY aphids, bulb mites, symphytan

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

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

LONDON PLANETREE borers, scale insects

MAGNOLIA borers, scale insects, weevil, whitefly

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

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

MIMOSA bagworms, scale insects, webworm

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

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

MULBERRY lacebug, scale insects, whitefly

MYRTLE aphids, mealybugs, scale insects

NANDINA scale insects

NARCISSUS (Daffodil) bulb mites, bulb flies, mealybugs

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

OSMANTHUS scale insects, webworm

PACHYSANDRA scale insects, spider mites

PALM mealybugs, scale insects, spider mites, thrips

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

PERIWINKLE (Vinca) aphids

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

Table 4.3 - Timing for Borer Treatment

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

Table 4.4 - Timing for Scale Insect Treatment

Pest	Crawler Dates	Treatment Dates
azalea bark scale	June 5 to 30	June 10 and 20
brown soft scale	—	Treat when scale insects appear, then 2-3 times at 10 day intervals
calico scale	Same as lecanium scale	
camellia scale	May 1 to June 5 and September 15 to 30.	May 10 and 20 and/or September 10 and 20
cottony maple scale	June 5 to 25	June 10 and 20
cottony maple leaf scale	June 1 to 10	June 15 to 30
cottony camellia scale	June 1 to 10	June 10 to 20
euonymus scale	May 5 to June 10, 1st generation; July 1 to 25, 2 nd 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.)

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

Plant Injury

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

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

Table 4.5 - Control Measures for Major Pests and Pest Groups

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

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

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

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

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

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

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

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

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

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

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

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

Table 4.5 - Control Measures for Major Pests and Pest Groups (cont.)			
Pest	Control	Timing of Treatment	Remarks
Mites (cont.) two-spotted spider mite	Acephate Bayer 3-in-1 Dicofol (Kelthane) Insecticidal soap	Treat whenever mites first appear. Infestations may occur from spring to fall. Mite infestations are directly proportionate to increasingly warmer temperatures.	Thoroughly wet the foliage and stems with a full coverage spray.
Plant Bugs, Planthoppers	Carbaryl (Sevin) Malathion Resmethrin	Treat when insects or signs of damage first appear. Treat honeylocust as soon as new growth begins.	Control is difficult because plant bugs are active flyers and move around continuously.
Psyllids (Boxwood psyllid, hackberry psyllid)	Acephate Carbaryl (Sevin)	Treat in late April or early May as new growth begins to develop.	
Rose Slugs	Acephate Carbaryl (Sevin) Imidacloprid Malathion Rotenone	Spray when small larvae are first seen. Timing depends on the species and the host. Rose slugs, like most sawflies, are gregarious, working in groups, localized on certain braches of the host.	Roses are susceptible.
Sawflies	Acephate Carbaryl (Sevin) Imidacloprid Malathion	Treat when insects are first seen. Various species can occur throughout the growing season. Treat in April for Virginia pine sawfly. Larvae are gregarious, thus broods are clustered on one branch or localized on scattered trees.	A number of damaging species are not listed on labels. Ash, larch, pines, and spruces are listed.
Scale Insects (General all scales)	Acephate (crawlers) Cyfluthrin (crawlers) Horticultural oil Imidacloprid (soft scale) Imidacloprid (armored scale suppression only) Permethrin	For horticultural oil, treat in late March or early April before new growth develops, and when temperatures are not likely to go below 40°F (5°C) for 12-24 hours. For other insecticides on list treat at crawler date.	Do not spray oil-sensitive plants listed under precautions on the label. Be sure to follow the dosage rates given on the label for the various scale species. Oils can also be used as summer sprays when indicated on the label. Imidacloprid may not control all types of scales.
Azalea bark scale	Horticultural oil Imidacloprid Insecticidal soap Malathion Permethrin	Crawlers: June 5-30 Treat June 10-20.	
brown soft scale	Carbaryl (Sevin) Horticultural oil Imidacloprid Insecticidal soap Permethrin	Treat when scale insects appear. Treat 2-3 times at 10-day intervals.	This scale insect does not winter out-of-doors in colder plant zones of Virginia.
calico scale	Carbaryl (Sevin) Horticultural oil Insecticidal soap Imidacloprid Permethrin	Crawlers: June 1-20. Treat June 10-15.	
camellia scale	Horticultural oil Imidacloprid Insecticidal soap Permethrin	Crawlers: May 1-June 5 and September 15-30. Treat May 10-20 and/or September 10-20.	

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

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

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

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

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

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

Table 4.6 - Directions for Pesticide Usage

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

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

Abbreviations:

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

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

Equivalents:

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

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

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

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

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

2 pints = 1 quart = 946.2 cc or 0.946 liter

8 pints = 4 quarts = 1 gallon = 3785 cc

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

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

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Table 4.6 - Directions for Pesticide Usage (cont.)

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