



2018 Cornell Pest Management Guide for Commercial Production and Maintenance of Trees and Shrubs

Cornell Cooperative Extension

These guidelines are not a substitute for pesticide labeling. Always read and understand the product label before using any pesticide.

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1 Pesticide Information

1.1 Pesticide Classification and Certification

The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) created two classifications of pesticides – general-use and restricted-use. **General-use pesticides** may be purchased and used by anyone. **Restricted-use pesticides can** only be purchased by a certified applicator. Restricted-use pesticides must also be used by a certified applicator or someone under their supervision.

The same federal law that classifies pesticides divided applicators into two groups: private and commercial. **Private applicators** use or supervise the use of pesticides to produce agricultural commodities or forest crops on land owned or rented by the private applicator or their employer. A farmer must be certified as a private applicator in order to purchase and use restricted-use pesticides on agricultural commodities. (No certification is needed if a farmer does not use restricted-use pesticides.)

A **commercial applicator** uses or supervises the use of pesticides for any purpose or on any property not covered by the private applicator classification. In New York, a commercial applicator must be certified to purchase or use any pesticide whether it is general- or restricted-use.

Information about pesticide certification and classification is available from your Cornell Cooperative Extension office (cce.cornell.edu/localoffices), regional NYSDEC pesticide specialist (www.dec.ny.gov/about/558.html), the Pesticide Applicator Training Manuals (store.cornell.edu/c-876-manuals.aspx), or the Pesticide Management Education Program (PMEP) at Cornell University (psep.cce.cornell.edu).

1.2 Use Pesticides Safely

Using pesticides imparts a great responsibility on the user to protect their health and that of others and to protect the environment. Keep in mind there is more to “pesticide use” than the application. Pesticide use includes mixing, loading, transporting, storing, or handling pesticides after the manufacturer’s seal is broken; cleaning pesticide application equipment; and preparing a container for disposal. These activities require thoughtful planning and preparation. They are also regulated by state and federal laws and regulations intended to protect the user, the community, and the environment from any adverse effects pesticides may cause.

1.2.1 Plan Ahead

Many safety precautions should be taken *before* you actually begin using pesticides. Too many pesticide applicators are dangerously and needlessly exposed to pesticides while they are preparing to apply them. Most

pesticide accidents can be prevented with informed and careful practices. **Always read the label on the pesticide container before you begin to use the pesticide.** Make sure you understand and can follow all directions and precautions on the label. Be prepared to handle an emergency exposure or spill. Know the first aid procedures for the pesticides you use.

1.2.2 Move Pesticides Safely

Carelessness in transporting pesticides can result in broken containers, spills, and contamination of people and the environment. Once pesticides are in your possession, you are responsible for safely transporting them. Accidents can occur even when transporting materials a short distance. You are responsible for a pesticide accident so take every effort to transport pesticides safely. Be prepared for an emergency.

1.2.3 Personal Protective Equipment and Engineering Controls

Personal protective equipment needs depend on the pesticide being handled. **Required personal protective equipment (PPE) are listed on pesticide labels.** The required PPE are based on the pesticide’s toxicity, route(s) of exposure, and formulation. Label required PPE are the minimum that must be worn during the pesticide’s use. Pesticide users can always wear more protection than the label requires.

The type of protective equipment used depends on the type and duration of the activity, where pesticides are being used, and exposure of the handler. Mixing/loading procedures often require extra precautions. Studies show you are at a greater risk of accidental poisoning when handling pesticide concentrates. Pouring pesticide concentrates from one container to another is the most hazardous activity. More information on personal protective equipment can be found online at umes.edu/NC170/Default.aspx?id=7184.

Engineering controls are devices that help prevent accidents and reduce a pesticide user’s exposure. One example is a closed mixing/loading system that reduces the risk of exposure when dispensing concentrated pesticides. More information on engineering controls can be found online at umes.edu/NC170/Default.aspx?id=7196.

1.2.4 Avoid Drift, Runoff, and Spills

Pesticides that move out of the target area can injure people, damage crops, and harm the environment. Choose weather conditions, pesticides, application equipment, pressure, droplet size, formulations, and adjuvants that minimize drift and runoff hazards. See product labels for specific application and equipment requirements.

2 Insect and Mite Pest Management of Trees and Shrubs

2.1 Introduction

More species and cultivars of ornamental plants are grown in nurseries and in the landscape than all other kinds of cultivated crops combined. While this is a statement of pride among ornamental horticulturists, it is likewise true that an even greater number of pest species find these plants and use them as food, causing an expenditure of time and dollars in added maintenance costs.

Concise pesticide guidelines are given in this publication for managing more than 150 species of insects and mites on over 50 kinds of ornamental trees and shrubs which grow in the four plant zones of New York. Practical and effective control of insects and mites that attack ornamental trees and shrubs can be achieved by recognizing the pests, understanding their life histories, and using a skillfully planned integrated pest management (IPM) program.

IPM goes beyond the use of chemical pesticides and includes every means of pest control that may be applied under a given set of circumstances. Useful pest control techniques must be compatible, so IPM programs may vary from nursery to nursery or landscape to landscape and may require professional assistance to organize and maintain. What follows are but fragments of the IPM concept.

2.2 How to Use the Insect and Mite Chapter

This chapter is divided into the following sections:

- 2.5 Text on Biorational Pest Management Tools and Tactics
- 2.6 Text on Chemical Insecticides
 - mode of action
 - phytotoxicity
 - timing of application
 - formulation
 - systemic insecticides
 - best management practices for soil application
 - oil sprays
 - shelf life
 - pesticide adjuvants
 - mist blowers
- 2.7 Registered Insecticides and Acaricides Table – arranged by active ingredient
- 2.8 Insects and Mites Destructive to Woody Ornamentals – arranged by host plant
- 2.9 Pest Management Timing - arranged by month/season with growing degree day (GDD) and plant phenology information (PPI)
- 2.10 Insect and Mite Pest Management – arranged by pest with IPM information, management options, and application timing

2.3 About the Tables

Sections 2.6 and 2.8 contain lists and tables that permit quick access to a mass of pest management information. Be certain that you understand the footnotes and how to use these tables. To assist in diagnosis (identification) of a pest, first look at Table 2.8.1. Find the plant of concern, then note the common or "key" pests associated with the plant. Numbers following the names of pests correspond to pages with descriptions in *Insects That Feed on Trees and Shrubs*, second edition, published by Cornell University Press. Plate numbers showing illustrations are indicated in boldface type. Book is available from Cornell University Press, 800-848-6224 (U.S. & Canada) or at <http://www.cornellpress.cornell.edu/book/?GCOI=80140100626460>

Next, turn to Table 2.10.1, remembering the name of the suspect pest. Entries for each pest include signs and/or symptoms of infestation, management options, timing of treatment, and IPM considerations. If you are interested in the characteristics of a particular pesticide-what it will control, formulations available, EPA numbers, nursery versus landscape uses, restricted-entry intervals, phytotoxicity, and other precautions-see Table 2.7.1.

The proper biological timing of control measures for each pest in each locality can be achieved through experience, by using the growing degree-day system, or by phenological indicator plants (see Table 2.9.1). Keep a record of treatments and schedules used from year to year to accumulate seasonal experience for spraying. Records of normal growth phenomena such as bud development and flowering are useful in documenting the proper time for treatment in your geographical area.

2.4 Insect and Mite Control for Propagation Ranges, Greenhouses, and Perennials

Control of insect and mite problems for interior use in greenhouses, arboreta, and interiorscapes as well as herbaceous perennials are covered in the *Cornell Guide for the Integrated Management of Greenhouse Crops and Herbaceous Perennials*. This publication is available in print and online formats through the Cornell Store at Cornell University (844-688-7620 or online at: <https://store.cornell.edu/c-875-pmep-guidelines.aspx>).

2.5 Biorational Pest Management Tools and Tactics

2.5.1 "Biorational" Controls

Biorational tactics begin with cultural and mechanical practices such as diverse cropping, crop rotation, and roguing of sick plants. Traps using food baits, light, and

attractive color or some knowledge of insect behavior. Examples include Lindgren funnel traps baited with alpha-pinene and ethanol or frontalinal for bark beetles, yellow sticky panels that attract fungus gnats and whiteflies, and pitfall traps or trap boards for black vine weevils.

Insect growth regulators (IGRs) were first recognized as useful with the discovery of the juvenile hormone biochemicals in insects. Some plants even use this chemistry as a form of protection. IGRs act on the hormonal system of immature insects; they generally do not kill adult insects and have a delayed effect. Therefore, timing applications to coincide with early immature stages is important and one should not expect to see immediate control. Treated insects may stop feeding, however. At least three major groups of IGR insecticides are now in use.

Juvenile hormone mimics act like natural juvenile hormone in insects, the presence of which ensures that the next molt will be to another immature (larval) stage in treated insects. Affected insects usually do not reach adulthood or die while molting to the next larval stage. The insecticide pyriproxyfen (Distance) is a juvenile hormone mimic. *Chitin biosynthesis inhibitors* interfere with the production of chitin, an essential component of the insect shell or skin. Insects affected by these materials are not able to molt successfully. Novaluron and diflubenzuron are members of this group that primarily target butterfly and moth caterpillars, although they are also used for other kinds of insects. Diflubenzuron (Dimilin), for example, is used against early stages of gypsy moth and other caterpillars and also has some ovicidal activity. Cyromazine (Citation) is another kind of chitin biosynthesis inhibitor, disrupting molting of fly larvae such as serpentine leafminers. A third group called *ecdysone agonists* or *ecdysone antagonists* disrupt molting by interference with the normal operation of ecdysone, a hormone important in the insect molting process. Treated insects may not be able to emerge normally. Azadirachtin (Azatin O, Azatrol, etc.) and tebufenozide (*†Confirm) are in this category. Derived from neem seed oil, azadirachtin has been used for thousands of years but only recently commercialized for horticulture in this country. It has some systemic activity when applied to roots and Ornazin is also labeled for trunk injection, although azadirachtin is primarily a foliar insecticide.

Some pesticides are microbes or derived from them. *Bacillus thuringiensis kurstaki* (Btk) bacteria produce a protein crystal endotoxin that disrupts the gut of butterfly and moth caterpillars. Formulations of the endotoxin are important insecticides used on ornamentals, vegetables, and other plants. Abamectin and spinosad are derived from the soil microorganisms *Streptomyces avermitilis* and *Saccharopolyspora spinosa*, respectively. Several commercial preparations are available that consist of spores of the insect-killing fungi *Beauveria bassiana*, *Metarhizium anisopliae*, or *Isaria fumosoroseus*. Successful use of microbial pesticides requires detailed knowledge of the pest's biology and phenology and its relationship to its host plant(s). When this knowledge is used in planning,

effectiveness can approach that of synthetic organic pesticides in some cases. Some IPM specialists include **horticultural mineral oils and insecticidal soaps** as biorational pesticides. Both are environmentally friendly in spray dilutions and degrade quickly.

Remember that most ornamental plants in urban and nursery settings are growing in an artificial, contrived environment. Left on their own many of them could not compete and would not survive. Selection often results in the propagation of plants not suitable to the truly natural environment. Such plants generally require more maintenance, including pest management, and in effect are dependent on a range of horticultural inputs.

2.6 Insecticides

2.6.1 Insecticide Classes and Modes of Action

Insecticides fall into *chemical classes* or groups such as, neonicotinoids, diamides, organophosphates, carbamates, pyrethroids, etc. For pests prone to develop insecticide-resistant populations, importance was, at one time, placed on rotating among them as one tactic to manage pesticide resistance. Sometimes materials in two different classes control pests in the same way, so now emphasis is placed on rotating among insecticides with different *modes of action*. To help simplify choosing among rotational partners, the Insecticide Resistance Action Committee (IRAC) has developed a **Mode of Action classification** system, outlined on a chart at <http://www.irac-online.org/modes-of-action/>. Some labels now include IRAC numbers representing the material's mode of action group to help users in selecting among products.

2.6.2 Phytotoxicity of Insecticides

Some plants are sensitive to certain pesticides or combinations. The label will usually name plants or incompatible pesticide tank mixes where the product should not be used. Dimethoate is one of the more variable chemicals, causing foliage injury on elm, andromeda, some varieties of azaleas but not others, Burford and Chinese (but not Japanese) holly, honeylocust, dogwood, crabapple, and maple. Carbaryl may injure tender foliage if plants are wet when treated or present on foliage during several days of high humidity. Malathion may injure certain junipers, elaeagnus, hibiscus, and some rose varieties. Avid (abamectin) has injured some Shasta daisy cultivars and should not be applied to ferns. These few examples emphasize the importance of reading the label. Check Table 2.7.1 for additional information on specific products.

2.6.3 Timing Spray Applications

Pest biology and behavior affect the timing and frequency of applications. For example, birch leafminer adults emerge from the soil to lay eggs in foliage over an extended period

Table 2.7.1. Host plant guide to insect names: an aid to diagnosis and identification

Plant	Pest	Page No.	Plate No.
Andromeda	azalea bark scale	336	160
	azalea whitefly	318	151
	lace bugs	424	204
Apple (flowering crab)	aphids	296, 300, 316	150
	cankerworms	142, 44	63, 64
	leafhoppers	412–418	216-218
	leafrollers	172	100, 101
	oystershell scale	370	177
	redbanded leafroller	214	
	roundheaded appletree borer	278	131
Arborvitae	arborvitae leafminer	142	14
	arborvitae weevil	240	244
	bagworm	176	80
	black vine weevil	240	112, 113
	Fletcher scale	98	42
	gypsy moth	138, 140	61, 62
	hemlock looper	24	
	juniper scale	106	46
	spruce spider mite	118	52, 53
Ash	blackheaded ash sawfly	134	59
	lace bugs	426	
	lilac/ash borer	260	122
	oystershell scale	370	177
Azalea	azalea bark scale	336	160
	azalea leafminer	202	93
	azalea whitefly	318	151
	black vine weevil	240	112, 113
	fruittree leafroller (azalea leaftier)	172	
	lace bugs	424	204
	rhododendron borer	258,	121
	rhododendron stem borer	288	
	southern red mite	475	229
twobanded Japanese weevil	244	114	
Barberry	twobanded Japanese weevil	244	114
Beech	aphids	296, 310	140, 147
	cankerworms	142–144	63, 64
	woolly beech aphid	296	140
Birch (white, gray, yellow, and European white)	aphids	296, 310	140, 147
	birch leafminer	184	84
	birch skeletonizer	220	
	bronze birch borer	272	128
	European hornet	494	238
	potato leafhopper	414	199
Bittersweet	euonymus scale	388	186
Boxwood	boxwood leafminer	204	94
	boxwood mite	475	229
	boxwood psyllid	290	137
Butternut	butternut gall mite	488	235
	walnut caterpillar	150	67
Cedar	arborvitae weevil	240, 244	244
	bagworm	176	80
	spruce spider mite	118	52, 53

Table 2.8.1. Pest management timing by calendar, growing degree-day (GDD), and plant phenology indicator (PPI)

Host	Pest	Stage	GDD (Base 50°F)
June (mid-): Plants in bloom: mountain laurel, mock-orange, Japanese tree lilac, Washington thorn			
Arborvitae	arborvitae leafminer	adult	533–700
	bagworm	larva	600–900
	juniper scale	crawlers	707–1260
Azalea	azalea leafminer	moth/egg	450–800
	azalea whitefly	immature/adult	448–700
	lace bug	immature	448–618
	rhododendron stem borer	adult	298–802
Beech	woolly beech aphid	nymph/adult	363–707
Birch	birch leafminer	adult	530–700
	bronze birch borer	adult	440–800
Bittersweet	euonymus scale	crawler	533–600
Boxwood	boxwood leafminer	adult	350–600
	boxwood mite	adult	245–600
Butternut	walnut blister mite	adult	363–707
Deciduous plants	aphids	immature/adult	250–2800
Deciduous plants (most)	leafhoppers	immature/adult	618–802
	rust mite	immature/adult	533–802
	dogwood borer	moth	148–700
Dogwood	elm leaf beetle	egg/larva	363–912
	European red mite	immature/adult	240–810
	twospotted spider mite	immature/adult	363–618
	woolly aphid	immature	710–1500
	euonymus scale	crawler	533–600
Evergreens (broadleaf)	southern red mite	immature/adult	618–802
Flowering fruit trees	European red mite	immature/adult	240–810
	leafhoppers	immature/adult	618–802
	twospotted spider mite	immature/adult	363–618
	hawthorn leafminer	adult	Not Available
	elongate hemlock scale	crawler/immature	360–700
Hemlock	hemlock looper	larva	448–707
	southern red mite	immature/adult	618–802
Holly	arborvitae leafminer	adult	360–?
	juniper scale	crawler	707–1260
Lilac	lilac borer	moth	400 approx.
	oystershell scale	crawler	363–707
	white peach scale = prunicola scale	crawler	707–1151
Linden	twospotted spider mite	immature/adult	363–618
Magnolia	sassafras weevil	adult/egg	363–618
Maple	greenstriped mapleworm	larva	533–1645
Mountain ash	mountain ash sawfly	larva	448–707
Mountain laurel	azalea whitefly	immature/adult	448–700
	rhododendron stem borer	adult	298–802
Oak	golden oak scale	crawler	Not Available
	kermes oak scale	crawler	298–912
	leafminers	moth/egg	533–912
	oak skeletonizer	larva	448–707
Pachysandra	euonymus scale	crawler	533–820

Table 2.9.1 Insect and mite management¹

NOTE: See Table 2.10.1 for pesticide trade names containing the active ingredients noted below. Where a specific product is listed after a recommended pesticide, only that product is labeled for that use. Always confirm that the site you plan to treat and the pest you wish to control are listed on the label before using any pesticide.

Symbols Used: * = Restricted-use pesticide; *^F = indicates a federally restricted-use pesticide. † = Not for use in Nassau and Suffolk Counties.

Arborvitae leafminers (14), *Argyresthia* sp. (moth)

Plant abnormalities:	Tips of shoots and foliage turn yellow then brown.
Management options:	Many effective larval and pupal parasites. Soil application of systemic insecticides (imidacloprid), foliar sprays to control larvae (acephate ^{##}), or moths (bifenthrin, chlorpyrifos, lambda-cyhalothrin, permethrin, spinosad). Trunk injection (emamectin benzoate). ^{##} 2(ee) recommendation of *Acephate 97 UP for use on unlabeled pest. The 2(ee) recommendation must be in the applicator's possession when using *Acephate 97 UP for control of arborvitae leafminer. See 2(ee) at http://www.dec.ny.gov/nyspad/products .
When to treat:	Soil application with imidacloprid to control larvae in early spring. Acephate foliar spray for larvae: mid-May, 150-260 GDD. Again mid-August, 1800-2200 GDD. Treat moth stage: mid-June, 533-700 GDD.
IPM considerations:	Parasites usually not abundant in specimen trees. For sprays, two applications may be required for first year of treatment; one application of spinosad during early moth flight has provided good control in one trial. If infestation is light, prune out infested tips.

Azalea bark scale (160), *Eriococcus azaleae* (felt scale)

Plant abnormalities:	Honeydew and sooty mold, yellowing leaves and dieback.
Management options:	One important chalcid wasp parasite. Acephate, acetamiprid (8.5SL, trunk spray or injection), carbaryl, cyfluthrin, horticultural oil, insecticidal soap, lambda-cyhalothrin, malathion, pyriproxyfen [Distance, 2(ee) ^{##}], spirotetramat (Kontos spray, container drench). ^{##} 2(ee) recommendation for use on unlabeled pest. The 2(ee) recommendation must be in the applicator's possession when using Distance for control of azalea bark scale. See 2(ee) at http://www.dec.ny.gov/nyspad/products .
When to treat:	Delayed dormant (oil). Again late June to late July, PPI- <i>Rhododendron maximum</i> , <i>Philadelphus</i> .
IPM considerations:	Crawlers tend to settle in twig crotches, bark crevices, and axils of leaves. Hosts include azalea, rhododendron, and andromeda.

Azalea leafminer (93), *Caloptilia azaleella* (moth)

Plant abnormalities:	Brown blotch leaf mines and leaves tied together with silk.
Management options:	Pesticides used mostly to control larvae. Parasites not capable of reducing populations to an acceptable level. Abamectin, carbaryl, dimethoate, imidacloprid (soil application), permethrin.
When to treat:	June, 450-800 GDD, PPI-Kousa dogwood, beautybush. Again in late July for second generation, 1260-1500 GDD, PPI-Abelia, sourwood. Imidacloprid soil application in spring.
IPM considerations:	Do not apply sprays when in flower. Older larvae feed externally, tying leaves together with silk. Rake and destroy fallen leaves.

Azalea lace bug (204), *Stephanitis pyrioides* see Lace bugs

Azalea whitefly (151), *Pealius azaleae*

Plant abnormalities:	Honeydew and sooty mold, discolored foliage, yellowish mottle.
Management options:	Large populations require use of pesticides. Bifenthrin, chlorpyrifos, cyfluthrin, diazinon, dimethoate, flonicamid, fluvalinate, horticultural oil, imidacloprid, lambda-cyhalothrin, malathion, neem oil, spirotetramat (Kontos).
When to treat:	Sprays early June, mid-July, 448-700 GDD. Again in mid-August, 1250-1500 GDD, and again at 2032-2150 GDD. PPI-mt. laurel, mock-orange. Imidacloprid soil application in early spring.
IPM considerations:	Whitefly feeds on undersurface of leaves on azalea, rhododendron, mt. laurel, and andromeda. Most insecticides control both adults and immatures. Resistant azalea varieties are available.

Bagworm (80, 81), *Thyridopteryx ephemeraeformis* (moth)

Plant abnormalities:	Sparse foliage; spindle-shaped bags attached to twigs/foliage.
Management options:	Several parasitic insects present in most bagworm populations, but rarely an acceptable means of control. Acephate, <i>Bacillus thuringiensis</i> subsp. <i>kurstaki</i> , bifenthrin, carbaryl, chlorantraniliprole (1.67SC spray), chlorpyrifos, cyfluthrin, diazinon, diflubenzuron, dimethoate (juniper, arborvitae),

Table 2.10.1. Insecticides and acaricides registered for ornamental trees and shrubs

Symbols Used: * = Restricted-use pesticide; *^F = indicates a federally restricted-use pesticide. † = Not for use in Nassau and Suffolk Counties.

Active Ingredient (<i>Mode of Action Group</i>) ^A Trade Name(s), Formulation, and Company	EPA Reg. No.	Organic Listed ^B	Use [‡]	REI§ (hrs.)	PPE	
					Applicator	Early Entry
Acephate (1B)						
Acecap Systemic Tree Implants (98.9%, Creative Sales) ¹	37979-1	–	N, L	NA	acf	
*Dendrex (97% Florida Silvics) ¹	64014-1	–	L	NA	acf	
*Ace-Jet (97.4%, Arborjet) ²	74578-2	–	N, L	NA	acfh	
*Acephate 97 UP (UPI)	70506-8	–	N, L	24	abcj	bejk
*Lepitect Infusible (97.4%, Rainbow Treecare) ³	74779-5	–	N, L	NA	acfh	
*Lepitect (97.4%, Rainbow Treecare) ⁴	74779-6	–	N, L	24	acfl	bck
*Orthene Turf, Tree & Ornamental 97 Spray (97S, Amvac)	5481-8978	–	N, L	24	acfl	cfk
*Orthene Turf, Tree & Ornamental WSP (75%, Amvac)	5481-8971	–	N, L	24	acfl	cfk
*Acephate 97 WDG (Makhteshim)	66222-266	–	N, L	24	acfl	cfk
*Acephate 90 Prill (90S, Makhteshim)	66222-123	–	N	24	acfm	cfk
*Acephate 90 WDG (Loveland) ⁵	34704-1051	–	N	24	acfl	cfk
*Tide Acephate 90WDG (Tide)	84229-7	–	N, L	24	acfl	cfk
*Acephate 90% Prills (90S, Control Solutions)	53883-253	–	N, L	24	acfl	cfk
*Livid 90 Prill (90S, Innvictis) ⁶	89167-27-89391	–	N, L ⁶	24	acfl	cfk

Systemic activity in foliage. Do not apply to huckleberry, cottonwood, Lombardy poplar, Balm of Gilead, sugar maple, *Viburnum suspensum*, or American elm. Phytotoxicity has occurred on certain crabapple varieties (see label). Do not spray when temperature is above 90°F. Highly toxic to honey bees, toxic to birds. For ground applications note application restrictions on the product label.

¹Implanted into base of tree trunk. ²Trunk injection; for trees and shrubs including landscape ornamentals, conifers, Christmas trees, deciduous tree farms, seed orchards, plantations and forest trees. ³Includes forest uses. ⁴Labeled for use as both a soil injection and foliar spray. ⁵Label includes uses for Douglas fir needle midge on Christmas trees. ⁶Not for outdoor residential uses.

Acephate (1B) + imidacloprid (4A)

*Avatar PLX (0.5+0.05DF, UPI)	70506-313	–	N, L	24	acfl	acf
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Labeled as a drench for black vine weevil and strawberry root weevil in certain container-grown nursery stock, for foliar application to ornamental trees and shrubs, and for bark application to crepe myrtle. Airblast (air-assist), aerial, and ULV application prohibited. Do not apply with low pressure handwand equipment except for non-agricultural or non-commercial uses. Note buffer zone requirements around aquatic areas and other application restrictions. Highly toxic to aquatic invertebrates and to honey bees exposed to direct treatment or residues. Label includes specific pollinator protection restrictions. Toxic to birds and wildlife. Do not apply to Balm of Gilead, cottonwood, Lombardy poplar or *Viburnum suspensum*. Injury has been seen on crabapples *Malus tschonoskii*, *M. floribunda*, ‘Hopa,’ ‘Pink Perfection,’ ‘Red Wine,’ and ‘Snowcloud.’ There is a 14-day spray interval except for flowering crabapples and Douglas fir.

Flowering crabapples cannot be treated more than 3 times per growing season at 4 week intervals. Douglas fir can only be treated once per season. Note maximum use rates and other application restrictions.

Acequinocyl (20B)

Shuttle 15SC (Arysta)	66330-38	–	N, L	12	acf	cfk
Shuttle O (15SC, OHP)	66330-38-59807	–	N, L	12	acf	cfk

Reduced-risk miticide for twospotted and spruce spider mites in landscapes, interiorscapes, nurseries, shadehouses and greenhouses. Test first before use on miniature roses or impatiens. Toxic to aquatic invertebrates; do not apply within 75 feet of aquatic areas. Store in a dry place away from heat. Do not mix with phosethyl fungicides (Alliette, Avalon, Chipco Signature, Flanker, Fosetyl-Al).

Acetamiprid (4A)

*TriStar 8.5SL (0.76SL, Cleary)	8033-106-1001	–	N, L	12	acf	cfk
*Quasar 8.5SL (0.76L, Atticus)	91234-16	–	N, L	12	acf	cfk
*Retriever (0.76L, ArborSystems) ¹	69117-14	–	L		acf	

Reduced-risk insecticide labeled as a spray for control of aphids, adelgids, European pine sawfly, caterpillars, leafminers, mealybugs, leafhopper, plant bugs, psyllids, scale insects, whiteflies and certain other pests on greenhouse and outdoor ornamentals and vegetable transplants. 8.5SL formulations in NY labeled as a basal bark spray or injection for ornamental or non-bearing fruit and nut trees to control borers, scale insects and hemlock woolly adelgid. Translaminar activity; addition of a spreader-type adjuvant may improve control. Maximum four (SL) or five (SG) applications/year. Toxic to wildlife, very toxic to bees exposed to direct treatment. Store cool and dry. Not for use in woodlands or forest management. ¹Trunk injection for borers (including flatheaded apple but not emerald ash or Asian longhorned beetles), hemlock woolly adelgid, scale insects (including azalea bark, calico, gloomy) on ornamental and non-bearing fruit and nut trees. Note supplemental 2(ee) label with additional pests and application directions at <http://www.dec.ny.gov/nyspad/products>. Store in cool, ventilated, dry, locked area and not for prolonged periods where temperatures frequently exceed 115°F.

3 Disease Management for Trees and Shrubs

3.1 General Measures for Disease Prevention

Because trees and shrubs live for many years, their susceptibility to disease is influenced not only by current climatic and environmental conditions but also by conditions and care during previous years. Maltreatment and lack of care favor many diseases. Many issues in nurseries and outplantings can be minimized by selection of proper planting sites, avoidance of unnecessary wounding, routine care including fertilization and timely watering and pruning, and preventive measures such as those described below.

Trees and shrubs on sites subject to deep soil freezing should be mulched to prevent root injury. Evergreens susceptible to unusual winter drying, such as those planted in exposed areas, should be treated with an antidesiccant.

Disinfect your tools regularly when pruning to control diseases. An easy, effective way to do this is to swab the cutting blades with an aqueous solution of denatured alcohol prepared by mixing 7 parts alcohol with 3 parts water. A vial or other pocket-sized container will hold a saturated cotton swab.

Discoloration and decay following pruning are minimized if exposed tissues are allowed to close of their own accord. Applications of shellac or another wound dressing can be used where wound invasion by canker-causing fungi or bacteria is likely to occur.

For new plantings, choose pest-resistant plants where available. Named cultivars propagated in nurseries and offered for landscape use in the last 15 years have usually been monitored for insect and disease susceptibility in the nursery, and many highly susceptible individuals have been eliminated from production. Table 3.4.1 lists some disease-resistant selections.

3.2 Nursery Hygiene

Do not let sloppy nursery hygiene ruin your investment in clean plants and soil fumigation. Soilborne pathogenic fungi, bacteria, and nematodes are carried into the nursery and spread within it by dirty feet, implements, and machines; moving surface water; blowing soil; and infested or infected plants.

1. Insist on clean stock. Do not order or accept stock likely to be infested with nematodes, crown gall bacteria, the *Verticillium* wilt pathogen, or similar organisms.
2. Stabilize all open soil and maintain windbreaks. Cover dirt roads with gravel or oil.
3. Require equipment moving between nursery blocks to pass through a central area where soil is washed off.

The equipment can be parked on a bed of cobblestones, and the soil particles will be carried down through the cobbles. A steel grating over a pit is a better arrangement for a permanent wash-down area. If not possible to clean equipment between blocks, make sure to work in any infected or infested blocks last, and clean equipment at the end of the day.

4. Clean boots and hand tools as you do other equipment.
5. When roguing diseased plants or pruning diseased parts of plants, bag and dispose of, destroy or bury the discards.
6. Do not allow surface water to run from one nursery block to another. Divert it into ditches or culverts.
7. Remember that irrigation water can carry pests and pathogens. Select a clean source and keep it clean.
8. Allow no direct traffic from outdoor areas to indoor propagation areas. Use properly maintained foot baths containing a germicidal agent at entrances if possible.
9. When collecting cuttings in the field, inspect stock plants carefully, and avoid any plants showing disease symptoms or abnormalities. For many leaf diseases, inspect stock plants late in the growing season before cuttings are actually to be taken, when leaf diseases are most apparent.

3.3 Diseases of General Importance or Occurrence

Because of the large number of crops covered in this document, and the wide variety of diseases that affect them, this section covers those diseases that have a broad host range and are most common in nurseries and landscapes.

3.3.1 Crown Gall

Crown gall, caused by *Agrobacterium tumefaciens*, occurs in nurseries and outplantings throughout New York State. The list of woody plants susceptible to the disease includes plants in at least 77 genera and 32 families.

The disease becomes established in nursery crops when clean stock is planted in infected soil and when infected stock is planted in previously clean soil. Once in the soil, the bacteria can persist indefinitely in decomposing debris from galls on susceptible plants. The wounds necessary for entry of the pathogen occur during planting, cultivating, grafting, and pruning.

Table 3.3.1. Provisional List Of Woody Plant Genera Not Susceptible To Crown Gall

Scientific Name	Common Name
<i>Berberis</i>	Barberry
<i>Buxus</i>	Boxwood
<i>Carpinus</i>	Hornbeam
<i>Catalpa</i>	Catalpa
<i>Cedrus</i>	True Cedars

3.4.1. Disease control guide

NOTE: See Section 3.5 for pesticide trade names containing the active ingredients noted below. Pesticides listed in this table may not be registered for both nursery and landscape use. Always confirm that the site you plan to treat and the pest you wish to control are listed on the label before using any pesticide.

Symbols Used: * = Restricted-use pesticide; † = Not for use in Nassau and Suffolk Counties; ‡ = Trade names are listed when: (a) two active ingredients are combined into one product or (b) where only one or two labels within a larger list of products are registered for that pest and host.

Plant and Disease ¹	Control
<i>Kalmia</i> (laurel)	
Leaf spots caused by <i>Pseudocercospora kalmiae</i> (syn.= <i>Cercospora</i> sp.) (Plate 16)	Handpick infected leaves and prune infected shoots if practical; destroy or compost fallen leaves. If disease has been severe, spray with mancozeb, triadimefon, thiophanate-methyl, myclobutanil, or chlorothalonil at budbreak and again 10 and 20 days later.
<i>Koelreuteria</i> (goldenrain tree)	
Coral spot canker caused by <i>Nectria cinnabarina</i> (Plates 99, 100, 87, 88)	Prune back to sound wood and cover pruning wound with a dressing. Fertilize and water to maintain vigor.
<i>Ligustrum</i> (privet)	
Anthracnose caused by <i>Glomerella cingulata</i> (syn. = <i>Colletotrichum gloeosporioides</i>) (Plate 56)	Prune and destroy infected branches during dry weather. Spray with chlorothalonil, mancozeb, thiophanate-methyl, *Spectro 90 WDG‡, potassium bicarbonate, or *Junction‡ weekly as long as disease is active, or per label directions. Amur privet (<i>Ligustrum amurense</i>), Ibota privet (<i>L. ibota</i>), Regal privet (<i>L. obtusifolium</i> var. <i>regalianum</i>), and California privet (<i>L. ovalifolium</i>) are reported to be resistant.
Alternaria leaf spot caused by <i>Alternaria alternata</i>	Alternaria leaf spot was found to be prevalent on California Privet in Long Island during the 2009 and 2010 growing seasons, and appears to be causing leaf spot, yellowing and leaf drop. Do not confuse this with Anthracnose (see above). Although it is not yet known if other factors are contributing to this problem, several fungicides are registered for leaf spot diseases on privet and may be useful in managing the disease where it has become severe and include: potassium bicarbonate, thiophanate-methyl + iprodione, trifloxystrobin, Daconil Weather Stik, *Junction‡, Protect DF, and Terraguard SC. Make applications at 7-28 day intervals during the first half of the growing season as directed on product labels.
<i>Lonicera</i> (honeysuckle)	
Leaf blight caused by <i>Insolibasidium deformans</i> (syn.= <i>Herpobasidium</i> sp.) (Plate 42, 126)	Remove and destroy fallen leaves. Spray with mancozeb, or *Junction‡ at 10-day intervals beginning in late May and continuing until late June.
<i>Malus</i> (apples, flowering crab)	
<i>See following list of disease-resistant varieties and cultivars. For home orchard guidelines, see other publications.</i>	
Powdery mildew caused by <i>Podosphaera leucotricha</i> (Plate 4, 5)	Apply propiconazole, triadimefon, copper sulfate pentahydrate, myclobutanil, thiophanate-methyl, *Spectro 90 WDG‡, trifloxystrobin, neem oil, or potassium bicarbonate at two-week intervals when mildew first appears on twigs or foliage.
Fire blight caused by <i>Erwinia amylovora</i> (Plates 76, 77, 187)	Avoid overfertilization, especially heavy spring applications of nitrogen. Cut out cankers and blighted branches in mid-January when tree is dry, making cuts at least 1 ft. below the visible limits of infection. Cover wounds with shellac or other wound dressing. Disinfect tools between cuts. Remove worthless pear, apple, quince, and similar plants from the vicinity. Where disease has just begun to appear, apply copper sulfate pentahydrate or CuPRO 5000‡, use an appropriate formulation of one of the mono- and di-potassium salts of phosphorus acid for the site, or inject Tree Tech OTC‡ per label directions.
Rust caused by <i>Gymnosporangium</i> spp. (Plates 118, 119, 129-133)	Eliminate nearby red cedar and common juniper to whatever extent practical. Spray with myclobutanil, triadimefon, thiophanate-methyl, chlorothalonil, trifloxystrobin, propiconazole, (*Alamo or *Shepherd Fungicide‡), *Spectro 90 WDG‡, or mancozeb. Make three applications at 7- to 14-day intervals or per label directions beginning when orange rust masses develop on junipers (around mid-May).

Table 3.5.1. Some fungicides, bactericides, and nematocides registered for use on trees and shrubs in New York State

Symbols Used: * = Restricted-use pesticide; † = Not for use in Nassau or Suffolk Counties; ‡ = Site use: N = Nursery (may include field grown and plantation-grown), L = landscape (may include residential or commercial landscapes); § = REI = restricted-entry interval; applies to nursery (or plantation) uses under the Worker Protection Standard, 40 CFR part 170; NA = not applicable

Active Ingredient (Mode of Action Group)

Example Trade Names, Formulation (Company)	EPA Reg. No.	Use ‡	REI§
Debacarb (NC)+ Carbendazim (1)			
*Fungisol (contains Debacarb) (J.J. Mauget)	7946-14	L	NA
Systemic fungicide used by injection for control of specific diseases of ornamentals.			
Etridiazole (14)			
*Terrazole 35% WP (Chemtura)	400-416	N	12
*Terrazole L (OHP)	400-422-59807	N	12
*Truban 30% WP (Scott's-Sierra)	58185-7	N	12
Apply to soil for control of <i>Pythium</i> and <i>Phytophthora</i> root rots, damping off, and stem rot on labeled species of woody ornamentals in planting beds, containers, or at transplant. Not for residential use (or sod farms or municipal parks). See labels.			
Fluoxastrobin (11)			
*†Disarm 480 SC (Arysta LifeScience)	66330-64	N, L	12
*†Fame SC (FMC)	66330-64-279	N, L	12
For control of foliar, stem and root diseases in commercial ornamental production and in the landscape.			
Fosetyl-AI (33)			
Aliette Fung. (Bayer)	432-890	N, L	12
Aliette WDG Fung. (Bayer)	432-890	N, L	12
*Fosal Select (Prime Source)	89442-8	N, L	12
Soil drench for control of <i>Phytophthora</i> and <i>Pythium</i> root diseases on azalea, rhododendron, boxwood, juniper, and Pieris. Foliar spray for suppression of fire blight on pear, pyracantha & hawthorn. Fosal Select and Aliette are also for use in conifer nurseries (pine, spruce, Douglas-fir) to prevent <i>Phytophthora</i> root rot.			
Horticultural Oil (NC)			
JMS Stylet Oil (JMS Flower Farms)	65564-1	N, L	4
Usually used for control of insect pests on many crops in greenhouses and outdoors. Also registered for control of powdery mildew on rose and other ornamentals. Note: See label for various precautions against using Stylet Oil within two weeks of making other pesticide applications.			
Iprodione (2)			
*Chipco 26019 Flo (Bayer)	432-888	N, L	12
*Chipco 26019 N/G (OHP)	432-889-59807	N, L	12
*Iprodione 2SE Select (Prime Source)	89442-13	N, L	12
*Quali-Pro Ipro 2SE (Makhteshim Agan)	66222-214	N, L	12
*26 GT Fungicide (Bayer)	432-888	N, L	12
*Lesco 18 Plus T&O Fung. (Lesco)	432-888-10404	N, L	12
Broad-spectrum fungicides for control of <i>Botrytis</i> on labeled plants. Some products are not for residential landscape use. See labels.			
Mancozeb (M3)			
*Dithane 75DF Rainshield (Dow AgroSciences)	62719-402	N	24
*Dithane DF Rainshield (Dow AgroSciences)	62719-402**	N	24
Dithane M-45 (Dow AgroSciences)	62719-387**	N, L	24
*Fore 80WP Rainshield T&O (Dow AgroSciences)	62719-388	N, L	24
*Lesco Mancozeb DG (Lesco)	62719-402-10404	N, L	24
*Pentathlon DF Fungicide (SePRO)	67690-39	N	24
*Pentathlon LF (SePRO)	67690-38	N, L	24
Protect DF (Cleary Chemical)	1001-77	N, L	24

Broad-spectrum fungicide effective against many foliar diseases and flower and twig blights. **Note:** Much label variation exists and some labels contain recommendations for management of pathogens of ornamentals that are not found on other

4 Weed Management in Nursery Crops

4.1 Establishing a Weed Management Program

4.1.1 The Need for a Weed Management Program

Weeds compete with crop plants for water, fertilizer, light, carbon dioxide, and other resources essential for plant growth. Weeds also harbor insect pests; reduce air flow around desirable plants, resulting in a microclimate more conducive to disease; and in some instances serve as alternate hosts to pathogenic organisms. In addition, the aesthetic quality of the landscape (and perceived quality of nursery stock) is reduced by weed growth. Consequently, weed management is an essential part of any nursery crop production or landscape management system.

4.1.2 Weed Identification

The first step in developing any pest management plan is to identify the pest, and a weed management program is no exception. The importance of proper identification cannot be overemphasized. Correct identification not only includes knowing the proper name but also provides information about the weed, particularly its life cycle. Weeds that infest ornamental plantings have one of four life cycles. Becoming familiar with the life cycle allows us to determine at what time of year the most susceptible growth stage is occurring. **Summer annuals** emerge in the spring, flower, and set seed before the first frost in the fall. **Winter annuals** germinate at the end of summer and overwinter as small, dormant seedlings. **Biennials** are similar to winter annuals but germinate earlier in the summer. As days lengthen and temperatures rise in the spring, both winter annuals and biennials are stimulated to flower, set seed, and die before the end of the summer. **Perennials**, as the name suggests, survive more than two seasons and generally can propagate by seed or by vegetative means. Weeds can also be classified into broad categories based on their growth types—grasses, sedges, and broadleaves—that are often useful in determining herbicide selectivity. Several weed and wild flower identification guides are available to assist in this identification effort. For a list of such resources appropriate to your region or for help in identifying unknown species, contact your local Cornell Cooperative Extension office (cce.cornell.edu/localoffices).

4.1.3 Weed Scouting

Scouting fields for weeds should begin the year before planting, paying particular attention to species that will be difficult or impossible to control after planting. These species must be controlled before planting. Integrating crop planting maps with weed maps has provided optimal weed control and reduced crop injury from inappropriate herbicide use, excessive cultivation, or weed competition for crop and weed management groupings.

After planting, fields should be scouted at least twice a year: **early summer** and **early autumn**. In early summer, any summer annual weeds that escaped control are still small but identifiable and may be controlled with cultivation or selective postemergent herbicides. Also at this time, many winter annuals and biennials are flowering so there still may be time to control them before seeds ripen. Perennial weeds may be identified and mapped early in the season to allow optimal timing of control procedures. Some perennials, such as quackgrass, are best controlled early in the season, whereas others are best controlled at other times. (See Table 4.2.1 for specific guidelines for perennial weed control.) In early autumn, winter annual seedlings, perennial weeds, and summer annuals that escaped control procedures are identifiable. Winter annuals will be easier to control postemergently at this time, before they have overwintered. The results of the autumn scouting are also useful in evaluating the effectiveness of your overall weed management program.

The actual scouting process can be accomplished in a fairly simple manner. The first and most important aspect is to map the areas, noting the species and locations of weeds as well as the species of ornamentals present. Many nurseries have already developed planting maps that may be adapted to this purpose. Using this map, conduct a weed inventory of each growing area or block. Walking fields in a wide zigzag pattern is an efficient way to do this. Note the general weed population and record relative densities. Take particular note of heavy infestations of a single species, perennial weeds, species you do not know (could this be a serious weed in the future?), and weeds that may be new to the area. As this inventory of information builds, notice which species are not controlled by your current management program, for these species will become more numerous unless you alter your management program to compensate.

4.1.4 Weed Management Options

Plan your weed management strategy based on the scouting report. Perennial weeds and other difficult-to-control species should be controlled before planting. Also before planting, consider the postplanting weed management strategies to be employed. Doing this before planting may help avoid costly weed problems later on. After planting, weeds may be controlled with cultivation, mulches, cover cropping (or living mulches), or herbicides. A combination of these control strategies, coupled with cultural programs that minimize weed infestations and introductions, is generally the most practical and effective option. When selecting the most appropriate options, consider the economics, crop safety, efficacy, environmental stewardship, and “fit” within your overall crop management program.

***Asulox**

Common Name: sodium salt of asulam

Formulation: 3.34SC

Uses: Postemergent weed control in some ornamentals, turf, Christmas tree plantings, and non-cropland. For agricultural or commercial use only; not for use by homeowners.

	<i>Amount of active ingredient</i>	<i>Amount by formulation</i>
	3.34SC	
<i>Per Acre</i>	3.34 lb.	1 gal.
<i>Per 1,000 sq. ft.</i>		3 oz.

Major Weeds Controlled: Difficult to control grasses, including barnyard grass, crabgrass, fall panicum, foxtails, goosegrass, and horseweed (*Coryza canadensis*) and bracken fern. Field Horsetail (*Equisetum arvensis*) is controlled under a 2(ee) recommendation.

Major Weeds Not Controlled: Most broadleaf and perennial weeds.

For Best Results: Use a minimum of 20 gallons of solution per acre. Apply a single postemergent broadcast application per season.

Cautions and Precautions: Do not use surfactant in ornamental applications. Low temperature and humidity decrease absorption.

Residual Activity: Residual control of grasses germinating from seed will persist for 6 to 10 weeks, depending on field conditions.

Volatility and Leaching Potential: Leaching potential is high.

Symptoms and Mode of Action: Asulam is a carbamate herbicide; primary mode of action is to inhibit DHP synthase, an enzyme involved in folic acid synthesis. Asulam also appears to be a mitotic inhibitor preventing function in meristematic tissues. Symptoms include chlorosis in young weeds and plant stunting followed by necrosis.

Manufacturer: United Phosphorus, Inc.

EPA Reg. No.: 70506-139

*Restricted-use pesticide; may be purchased and used only by certified applicators or used by someone under the direct supervision of a certified applicator.

Table 4.9.1. Weed susceptibilities to PREemergence herbicides

Genus, species	Common name	KEY:																	
		*Barricade	Biathlon	*BroadStar*/SureGuard	Casoron	*†Dacthal	Devrinol	*ΔDimension	Goal 2XL	*Kerb	*†Marengo/*†Specticle	OH2	Pendulum	*†Pennant Magnum	Princep	*Ronstar	*Rout	Surflan	Treflan
<i>Sisymbrium irio</i>	rocket, London					no	ful	ful	ful			ful						ful	ful
<i>Solanum nigrum</i>	nightshade, black			ful		par		ful	ful				ful	ful				par	par
<i>Solanum nodiflorum</i>	nightshade, Am. black													ful					
<i>Solanum sarachiodes</i>	nightshade, hairy							ful	ful	ful			par	ful					
<i>Sonchus arvensis</i>	sowthistle		ful															ful	
<i>Sonchus oleraceus</i>	sowthistle, annual			ful			ful			ful	ful				ful	ful	par		par
<i>Spergula arvensis</i>	spurry, corn							ful											
<i>Spergularia rubra</i>	sandspurry, red							ful											
<i>Stellaria media</i>	chickweed, common	ful	ful	ful	ful	ful	ful	ful		ful	ful	ful	ful	ful	ful	ful	ful	ful	ful
<i>Taraxicum officianale</i>	dandelion		ful	ful	ful						ful	ful					ful		
<i>Trifolium pratense</i>	clover, red							par											
<i>Trifolium procumbens</i>	clover, hop											ful							
<i>Trifolium repens</i>	clover, white							par		ful						ful			
<i>Urtica dioica</i>	nettle, stinging																		ful
<i>Urtica urens</i>	nettle, burning					ful		ful	ful										
<i>Veronica arvensis</i>	speedwell, corn							ful		ful		ful							
<i>Veronica persica</i>	speedwell, Persian/birdeye	ful						ful											
<i>Veronica spp.</i>	speedwell species													ful	ful				
<i>Xanthium strumarium</i>	cocklebur, common							ful											
<i>Avena fatua</i>	oats, wild						ful	ful	ful	ful				ful	ful		ful	ful	ful
<i>Avena sativa</i>	oats, volunteer									ful									
<i>Barbarea vulgaris</i>	rocket, yellow			ful	ful														
<i>Bromus catharticus</i>	rescuegrass	par						ful											
<i>Bromus mollis</i>	brome, soft						ful	ful											
<i>Bromus rigidus</i>	brome, ripgut						ful	ful							ful				
<i>Bromus secalinus</i>	brome, cheat						ful	ful		ful								ful	
<i>Bromus tectorum</i>	brome, downy						ful	ful		ful				ful					
<i>Cynodon dactylon</i>	bermudagrass																		
<i>Cyperus compressus</i>	sedge, annual									par			ful		ful				
<i>Cyperus esculentus</i>	nutsedge, yellow				ful	no				par			ful						
<i>Dactylis glomerata</i>	orchardgrass				ful					ful									
<i>Digitaria ischaemum</i>	crabgrass, smooth	ful		ful	ful	ful	ful	ful		ful		ful	ful	ful	ful	ful	ful	ful	ful
<i>Digitaria sanguinalis</i>	crabgrass, hairy/large	ful	ful	ful	ful	ful	ful	ful	par	ful	ful	ful	ful	ful	ful	ful	ful	ful	ful
<i>Echinochloa crus-galli</i>	barnyardgrass	ful	ful	ful		par	ful	ful	par	ful	ful	ful	ful	ful	ful	par	ful	ful	ful
<i>Eleusine indica</i>	goosegrass	ful	ful	ful		par	ful	ful	par	ful	ful		ful	ful	ful	ful	ful	ful	ful
<i>Elytrigia repens</i>	quackgrass				ful					ful									
<i>Eragrostis spp.</i>	lovegrass/stinkgrass	ful				ful	ful			ful	ful		par					ful	ful
<i>Festuca arundinacea</i>	fescue, tall				ful														
<i>Hordeum jubatum</i>	barley, foxtail							ful		ful									
<i>Hordeum leporinum</i>	barley, wild/hare				ful		ful	ful											ful
<i>Hordeum pusillum</i>	barley, little							ful										ful	ful
<i>Hordeum vulgare</i>	barley, volunteer							ful		ful									
<i>Leptochloa uninervia</i>	sprangletop, red	ful	ful				ful				ful	ful	ful					ful	ful
<i>Lolium multiflorum</i>	ryegrass, Italian/annual						ful	ful		ful	ful				ful				ful
<i>Lolium perenne</i>	ryegrass, perennial							ful		ful	ful								
<i>Panicum capillare</i>	witchgrass	ful			ful		ful	ful					ful	ful	ful			ful	ful

Table 4.9.2. Weed susceptibilities to POSTemergence herbicides

Genus, species	Common name	AcclaimExtra	*Asulox	Basagran	*ΔEnvoy	†Finale	Fusilade II	Goal 2XL	*Gramoxone	*†ΔLontrel	*Diquat SPC	21* Jiftora	Roundup Pro	Scythe	SedgeHammer 75WDG	Segment	*SureGuard
		<i>Phalaris canariensis</i>	canarygrass	par		no	ful				par	no	par	ful	par		
<i>Phleum pratense</i>	timothy	par		no					par	no	par	ful	par				
<i>Phragmites</i> spp.	reed, common	par		no					par	no	par	par	par				
<i>Poa annua</i>	bluegrass, annual	par		no	ful	ful		par	ful	no	ful	ful	par				
<i>Poa bulbosa</i>	bluegrass, bulbous	par		no					ful	no	ful	ful	par				
<i>Rottbellia exaltata</i>	itchgrass	par		no	ful		ful		ful	no	ful	ful	par		ful		
<i>Secale cereale</i>	rye, volunteer	par		no	ful		ful		ful	no	ful	ful	par		ful		
<i>Setaria faberi</i>	foxtail, giant	par		no	ful	ful	ful	par	ful	no	ful	ful	par		ful		
<i>Setaria luteocens/glauca</i>	foxtail, yellow	par		no	ful	ful			ful	no	ful	ful	par		ful	ful	
<i>Setaria</i> spp.	foxtail species	par	ful	no		ful			ful	no	ful	ful	par				
<i>Setaria viridis</i>	foxtail, green	par		no	ful	ful	ful		ful	no	ful	ful	par		ful		
<i>Sorghum bicolor</i>	shattercane	par		no	ful	ful	ful		ful	no	ful	ful	par		ful		
<i>Sorghum halepense</i>	johnsongrass (mature)	par	ful	no	ful	ful	ful		par	no	par	par	par		ful		
<i>Sorghum halepense</i>	johnsongrass (sdlg)	par		no	ful		ful		ful	no	ful	ful	par		ful		
<i>Triticum aestivum</i>	wheat, volunteer	par		no	ful	ful	ful		par	no	par	ful	par		ful		
<i>Vulpia myuros</i>	fescue, rattail	par		no					par	no	par	ful	par				
<i>Zea mays</i>	corn, volunteer			no	ful		ful		ful	no	ful	ful	par		ful		

*Restricted-use pesticide; may be purchased and used only by certified applicators or used by someone under the direct supervision of a certified applicator.

†Not for use in Nassau and Suffolk Counties. Pesticide labels that indicate "Not for use on Long Island, N.Y." mean that use is prohibited in Nassau and Suffolk Counties only.

ΔRate or other application restrictions apply. See label for more information.

4.10. Registered Herbicides

Table 4.10.1 Herbicides registered for use on ornamentals in New York

Key: Ornamental Species: Several = 6 species or more registered; Few = 1-4 species registered; None = 0 species registered f/c = field and container c = container use only f = field * Restricted-use pesticide † = Not for use in Nassau or Suffolk Counties											
Application Type	Long Island Use?	Trade Name	Ornamental species registered								
			Shade Trees	Narrow Leaf (Needle) Ever-greens	Broad-leaf Ever-greens	Decid-uous Shrubs	Ground-covers (Woody & Semi -Woody)	Peren-nials (Herba-ceous)	Orna-mental Grasses	Bulbs	Annuals (Bedding Plants)
post (over top)	yes	Acclaim Extra	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Few (f/c)	Several (f/c)	Few (f/c)	None	Several (f/c)
post (over top)	yes	*Asulox	None	Several (f)	None	None	None	None	None	None	None
pre	yes	*Barricade	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Few (f/c)	Few (f/c)
post (over top)	yes	Basagran	Few (f/c)	Few (f/c)	Several (f/c)	None	Few (f/c)	Few (f/c)	None	None	Few (f/c)
pre	yes	Biathalon	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Few (f/c)	Few (f/c)	Few (f/c)	None	None
pre	yes	*Broadstar	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Few (f/c)	None	None	None	None

5 Vertebrate Pest Management

5.1 Integrated Pest Management (IPM)

No single, simple remedy can be relied on to solve rodent problems in a sustainable way. Rodent control must be considered in terms of the environment in which the pest is active. Control activities must have as an overriding principle the biology and behavior of the animal in concert with its whole environment. Integrated pest management (IPM) is a holistic, decision-making system – a process in which all interventions are brought to bear on a pest problem with the goal of providing the most effective, economical, and safe program possible. In short, IPM is a process for determining if, where, when, and what pest management intervention(s) are needed or justified.

5.2 Nonchemical Wildlife Damage Management Alternatives

A nursery owner can use a variety of nonchemical alternatives to reduce wildlife damage to nursery stock and ornamental shrubs. These techniques fall into several broad categories: exclusion, habitat modification, and wildlife population reductions. Although exclusion and habitat modification appear to be more expensive than population control, where possible, they may provide the greatest efficacy and longer-term relief from damage problems.

5.2.1 Exclusion

Fencing is the most reliable exclusion technique for preventing wildlife damage to nursery stock. Woven-wire designs are the most effective physical barrier to wildlife, with high-tensile woven-wire fencing providing the ultimate in protection and durability. Deer can be successfully eliminated from large areas (>50 acres) with an 8- to 10-foot woven-wire fence. The advantages of this design are its effectiveness and low maintenance requirements after construction. Disadvantages include the high initial cost and the difficulty in repairing damaged sections.

A variety of multi-strand, high-tensile, vertical or sloped, electric fence designs effectively exclude wildlife. Electric high-tensile fences may be complete physical barriers or, more commonly, may act as a behavioral deterrent. Deer can be excluded from crops with a 5- to 6-foot electric fence, even though they can easily jump over woven-wire fences of this height. The most frequent reasons why electric fences fail to prevent wildlife damage include the selection of an unsuitable fence design, failure to install fencing according to manufacturers' specifications, and inadequate maintenance. Electric fences will not exclude wildlife unless adequate voltage is constantly maintained on the wires. High-tensile electric fences are easily repaired and may cost half as much as 8- to 10-foot woven-wire designs. Disadvantages include frequent monitoring and the need for vegetation control to maintain shocking power.

Other physical barriers that can prevent wildlife damage include wire cages, plastic tubing, bud caps, and bird netting. Large-scale use of these materials may be uneconomical because of the labor required to apply and remove these barriers. Wire or plastic tree guards can be used to protect trees from trunk girdling by rodents or rabbits. The more expensive wire guards provide longer-term damage prevention.

5.2.2 Habitat Modification

Habitat modifications can make areas less suitable for nuisance wildlife. Damage prevention with cultural manipulations should begin with site selection and plant establishment. In nurseries, plowing or disking reduces vole populations, facilitates the establishment of the desired cover crop between rows, and simplifies future vegetation control. Removal of brush, stone piles, and nonmowable wet areas will reduce the attractiveness of sites to rodents and rabbits. Mowing in established plantings can reduce preferred wildlife foods, remove protective cover, enhance predation, and expose animals to severe weather conditions. Sites adjacent to croplands should also be mowed to reduce pest numbers.

5.2.3 Population Reduction

Wildlife population reductions may be necessary to reduce damage to tolerable levels. Snap-back or cage traps are effective for capturing small mammals. Larger rodents or carnivores can be caught with foothold or body-gripping traps. When trapping, care and experience are necessary to reduce captures of nontarget species. In more urban areas, live-capture cage traps are recommended to protect pets. In rural locations, shooting can be used to effectively remove problem animals.

A trapping license, small game license, or special permit may be required from the New York State Department of Environmental Conservation (DEC) for lethal control or transport of vertebrate pests. County and local laws vary in New York State, and some areas have trapping or shooting restrictions. Contact state and local officials before implementing any lethal or trapping and removal program for nuisance wildlife.

Reducing animal numbers by lethal methods may fail to provide long-term relief from damage. Where habitat conditions are suitable and exclusion is not attempted, most pest species will repopulate the site soon after control efforts have ceased, as animals will move into the control area from adjacent lands. Habitat modification and exclusion methods often require more initial effort and expense, but these techniques may provide longer-term damage prevention, especially when a few pest individuals can inflict substantial losses.