2019
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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Abbreviations and Symbols Used in This Publication

A .....acre, aerosol	EC, EW emulsifiable concentrate	ULV..... ultra-low volume
ACS.....microencapsulated in aqueous suspension	F, FL ... flowable	W ..... wettable
AI .....active ingredient	G, GR .. granular	WDG.... water-dispersible granule
CS .....concentrate suspensión	L .....liquid	WG ..... water-dispersible granule
D .....dust	P .....pellets	WP ..... wettable powder
DF .....dry flowable	S .....soluble	WSB .... water soluble bag
DG .....dispersible granule	SC.....soluble concentrate	WSP..... water soluble packet, water soluble powder
E .....emulsion, emulsifiable	SP .....soluble powder	

* .....Restricted-use pesticide; may be purchased and used only by certified applicators
† .....Not for use in Nassau and Suffolk Counties
Δ.....Rate or other application restrictions apply. See label for more information.

Cover photo: Pot-in-pot nursery in the spring. (*Photo: Andrew Senesac, Cornell Cooperative Extension – Suffolk County, Riverhead, NY*)

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 (https://www.cornellstore.com/books/cornell-cooperative-ext-pmep-manuals), 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.

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. Consult the product label for more information on using engineering controls in place of PPE.

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/books/cornell-cooperative-ext-pmep-guidelines).

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

In addition to or instead of sex pheromones, some insect traps employ other chemicals, a distinctive shape, an attractive color or some knowledge of insect behavior. Examples include Lindgren funnel traps baited with alpha-pinene and ethanol or frontalin 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

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

Plant	Pest	Page No.	Plate No.
Cherry (Wild) and Chokecherry	eastern tent caterpillar	168	**76**
	fruittree leafroller	172	
Cotoneaster	lace bugs	426	
	oystershell scale	370	**177**
Deutzia	twobanded Japanese weevil	244	**114**
Dogwood	cottony maple leaf scale	342–346	**163, 165**
	dogwood borer	262	**123**
	dogwood sawfly	126	**55**
Douglas-Fir	Cooley spruce gall adelgid	112	**49, 76**
	Douglas-fir needle midge	44	**15**
	spruce spider mite	118	**52, 53**
Elm	bark beetles	246–248	**115, 116**
	cankerworms	142–144	**63, 64**
	clover mite	472	
	elm case bearers	186	**85**
	elm cockscomb gall aphid	464	**224**
	elm leaf beetle	220	**103**
	elm leafminer	186	**85**
	European elm scale	368	**176**
	European red mite	472	**228**
	forest tent caterpillar	168	**76**
	gypsy moth	138–140	**61, 62**
	lecanium scales	354, 364, 169	**174**
	linden looper	144	**64**
	twig pruner	264	**124**
	twospotted spider mite	476	
	woolly elm aphid	306, 316	**145**
Euonymus	black vine weevil	240	**112, 113**
	euonymus scale	388	**186**
	twobanded Japanese weevil	244	**114**
Fir	balsam gall midge	116	**51**
	balsam twig aphid	80	**33**
	balsam woolly adelgid	74	**30**
	spruce budworm	28	**7**
Flowering Fruits (cherry, peach, almond)	aphids	292, 300, 308	
	cankerworms	142, 144	**63, 64**
	European red mite	472	**228**
	fall webworm	166	**75**
	Japanese beetle	236	**110**
	leafrollers	172, 216–218	**100, 101**
	lecanium scales	354, 364	**169, 174**
	peachtree borers	258	**121**
	roundheaded appletree borer	278	**131**
	twospotted spider mite	476	
	white prunicola scale	392	**188**
Hackberry	hackberry psylla	450, 452	**217, 218**
	twig pruner	264	**124**
Hawthorn	apple blotch leafminer	196	
	cherry and hawthorn leafminer	188	**86**
	lace bugs	426	**205**
	pear sawfly	130	**57**

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)
May (late): Plants in bloom: ruby horsechestnut, Laburnum alpinum, black locust, ninebark *(continued)*			
Sassafras	sassafras weevil	adult/egg	363–618
Shade trees	fruittree leafroller	larva	300–618
Spruce	pine eriophyid mites	immature	298–533
	sawflies	larva	248–?
	spruce spider mite	immature/adult	190–363
	white pine weevil	adult	Not Available
Sycamore	lace bugs	adult/egg	239–363
Taxus	black vine weevil	adult	148–400
	taxus bud mite	immature/adult	148–448
	taxus mealybug	immature	246–325
Walnut	lace bugs	adult/egg	239–363
	walnut blister mite	immature	363–707
White pine	white pine weevil	—	
Willow	imported willow leaf beetle	adult	192–448
	oystershell scale	crawler	363–707
	willow flea weevil	adult	363–618
June (early): Plants in bloom: Kousa dogwood, cranberry bush, beautybush			
Andromeda	azalea whitefly	immature	448–700
	lace bugs	adult/immature	448–618
Apple (crab)	oystershell scale	settled crawler	363–707
Arborvitae	arborvitae leafminer	larva/adult	245–360
	arborvitae weevil	adult	150–260
	spruce spider mite	adult/immature	250–363
Azalea	azalea leafminer	moth	450–800
	azalea whitefly	immature	448–700
	lace bugs	egg/immature	448–618
	rhododendron stem borer	adult	298–802
Beech	woolly beech aphid	nymph/adult	363–707
Birch	birch leafminer	adult	190–290
	bronze birch borer	adult	440–800
Bittersweet	euonymus scale	egg/crawler	533–600
Black locust	locust leafminer	adult/eggs	298–533
Boxwood	boxwood leafminer	adult	350-600
	boxwood mite	immature/adult	245–600
Butternut	walnut blister mite	immature/adult	363–707
Cedar	spruce spider mite	immature/adult	363–?
Deciduous plants	Redbanded leafroller	larva	298–618
	periodical cicada	adult	363–618
	Redbanded leafroller	larva	298–618
	rust mite	immature/adult	533–802
Dogwood	dogwood borer	moth	148–700
Elm	elm casebearer	larva	300–533
	elm leaf beetle	adult/egg	363–912
	elm leafminer	adult/larva	363–530
	European red mite	immature	240–810
	twospotted spider mite	immature	363–618
Euonymus	euonymus scale	egg/crawler	533–600
Flowering fruit trees	European red mite	immature/adult	240–810
	redbanded leafroller	larva	300–618

Table 2.9.1 Insect and mite management[1]

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.

Honeylocust pod gall midge (225), *Dasineura gleditschiae* (fly) *(continued)*	
IPM considerations:	Eggs often laid on newly opening buds. Use sticky traps to monitor adults.
Honeylocust spider mite (228), *Platytetranychus multidigituli*	
Plant abnormalities:	Stippled, yellow discoloration of leaflets, especially underside. Browning and dropping of leaflets.
Management options:	Predatory mites are usually active. Abamectin, bifenazate, bifenthrin, fenazaquin, fenpyroximate, fluvalinate, hexythiazox, horticultural oil, insecticidal soap, neem oil.
When to treat:	June, 912–1514 GDD. Late September to early October.
IPM considerations:	Adults overwinter in clusters in bark.
Honeysuckle aphid (149), *Hyadaphis tataricae* (also see aphids)	
Plant abnormalities:	Witches'-brooms on new shoots, leaves distorted, folded, and dwarfed.
Management options:	Several predators, but not effective. Acephate, acetamiprid, bifenthrin, cyfluthrin, diazinon, dimethoate (soil injection), flonicamid, fluvalinate, horticultural oil, imidacloprid (foliar or soil application), malathion, permethrin, pymetrozine, spirotetramat.
When to treat:	April, GDD not available, PPI-silver maple, pussy willow. Make soil applications in very early spring. Do not use dimethoate on plants established less than 3 years.
IPM considerations:	To stop witches'-brooms, must apply treatment before foliage appears. Resistant honeysuckle cultivars are available. Prune off and destroy witches'-brooms.
Imported willow leaf beetle (106), *Plagiodera versicolora* (chrysomelid or leaf-feeding beetle)	
Plant abnormalities:	Skeletonized and notched leaves.
Management options:	Several parasites. The pupal parasite is effective in population control. Bifenthrin, carbaryl, chlorpyrifos, gamma-cyhalothrin, spinosad.
When to treat:	Last half of May and early June, 192–448 GDD. PPI-Tatarian honeysuckle, cranberry bush.
IPM considerations:	Avoid pesticide treatment during pupal stage.
Japanese beetle (110), *Popillia japonica* (scarab beetle, white grub)	
Plant abnormalities:	Skeletonized foliage.
Management options:	Several parasites. For adults: acephate, bifenthrin, carbaryl, chlorpyrifos, cyfluthrin, imidacloprid (soil drench or injection), gamma-cyhalothrin, lambda-cyhalothrin, malathion, permethrin, phosmet, thiamethoxam (soil application, Christmas trees only). For foliar sprays, may need several applications.
When to treat:	July through mid-August, 1029–2154 GDD for foliar sprays. Imidacloprid soil application late fall or early spring (trees) or spring (shrubs).
IPM considerations:	See Oriental beetle for grub control. Pheromone and other attractants are available yet counterproductive unless used over a community-wide area. *Tilia tomentosa* is somewhat resistant.
Japanese maple scale (NA*), *Lopholeucaspis japonica* (armored scale)	
Plant abnormalities:	Yellowing foliage, dieback in heavy infestations; large numbers on bark and twigs.
Management options:	Acephate, acetamiprid (8.5SL, trunk spray or injection), bifenthrin, carbaryl, cyfluthrin, flonicamid, horticultural oil, insecticidal soap, lambda-cyhalothrin, neem oil, spirotetramat (Kontos spray, container drench).
When to treat:	Mid-April to early May for dormant (oil) treatment, 22–148 GDD, PPI-pussy willow. Late June to early July for first-generation crawlers, 816–1143 GDD, PPI-Chinese lilac, purple smoketree (*Cotinus coggyria*). Check for second-generation crawlers mid-September to early October, 2508–3022 GDD.
IPM considerations:	Populations can build to high levels on bark before noticed. Eggs likely begin to hatch about late June in SE NY but can occur over a long period (crawler timings are for initial and peak hatch), so multiple applications may be needed. One generation in Pennsylvania, possibly two in SE NY. Scales can also be physically removed with high-pressure water or brush. Hosts include many broadleaf deciduous and some evergreen plants.

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 (*Mode of Action Group*)[A] Trade Name(s), Formulation, and Company	EPA Reg. No.	Organic Listed[B]	Use‡	REI§ (hrs.)	PPE *Applicator*	PPE *Early Entry*
Deltamethrin (*3A*)						
Suspend SC (0.42 SC, Bayer)	432-763	–	L	NA		
Pyrethroid insecticide, controls a broad spectrum of insect pests. For commercial and residential landscape ornamebntals. Extremely toxic to fish and aquatic invertebrates. Highly toxic to bees exposed to direct treatment. Do not apply or allow it to drift to crops or weeds on which bees are actively foraging.						
Diazinon (*1B*)						
*[F]Diazinon AG600 WBC (Loveland)	66222-103-34704	–	N	2 days	efgil	efgj
Do not combine with copper. Only registered for use on commercial ornamentals grown outdoors in nurseries. Highly toxic to fish, birds, and other wildlife; highly toxic to bees exposed to direct treatment.						
Dicrotophos (*1B*)						
*[F]Inject-A-Cide B (82%, Mauget)	7946-11	–	L	NA		
Micro-inject system. Toxic to wildlife; highly toxic to bees. Use on trees at least 2" diameter. Do not inject trees within two weeks of any other spray or soil chemical treatment.						
Diflubenzuron (*15*)						
*[F]Dimilin 4L Non-Crop (Chemtura)[1]	400-474	–	N, L	12	acf	cfk
*[F]Dimilin 25W (Chemtura)[1]	400-465	–	N, L	12	acf	cfk
Disrupts insect molting process. Effects may not be observed until several days after treatment. Extremely toxic to aquatic invertebrates. Store in a dry location.						
[1]Not for use in greenhouses, shadehouses, or interiorscapes.						
Dimethoate (*1B*)						
*Dimethoate 400 (4E, Loveland)[3]	34704-207	–	N	10 days[1]	acfhil	efgj
*Cheminova Dimethoate 4E (4E, Cheminova)[3]	34704-207-67760	–	N	10 days[1]	acfhil	efgj
*Dimethoate 400 EC (FMC)[3]	34704-207-279	–	N	10 days[1]	acfhil	efgj
*Drexel Dimethoate 4EC (Drexel)	19713-231	–	N	10 days[2]	acfilm	efgj
*Dimate 4E (Winfield)	9779-273	–	N	10 days[1]	afghijl	efgj
*Dimethoate LV-4 (4E, Drexel)	19713-665	–	N	10 days[2]	acfinm	efgj
Systemic insecticide/miticide for soil or foliar application. For use on non-greenhouse grown ornamental plants, Christmas tree and conifer plantations, landscapes, or other listed sites. Do not use on ornamentals not listed on the label. Can injure elm; andromeda; somevarieties of azalea; aspen; Burford, Chinese (not Japanese) and some hybrid (e.g. 'China Girl' and 'Blue Maid' have shown sensitivity) hollies; hawthorn; honeylocust; honeysuckle; ornamental *Prunus*; dogwood; crabapple; river birch; Japanese maple; and other maples particularly in early growth stages. Do not: use with oil, tank mix with alkaline materials, or apply in greenhouses. 4E formulations should not be used on stock plants grown as a source of propagating material. Some labels include soil injection uses (hackberry psyllids, aphids on ornamental trees and honeysuckle, elm leaf beetle) and soil drench (camellia). Highly toxic to bees. Toxic to birds, aquatic invertebrates, and other wildlife. Flammable – keep away from heat or open flame. Store in a cool, dry area between 45°F and 90°F. Do not freeze. Do not use on sensitive plants that have not been established for at least 3 years or as a soil injection on Japanese maples or red-leaved ornamentals. Double notification (oral and posting) of workers is required.						
[1]REI: 10 days for woody ornamentals and Christmas tree nurseries, and 48 hr for herbaceous plants. [2]REI: 10 days for woody ornamentals and Christmas tree nurseries: 14 days for cottonwood (grown for pulp) and 48 hr for herbaceous plants and conifer seed orchards. [3]Do not use on Japanese maples or red leaf ornamentals.						
Dinotefuran (*4A*)						
*Zylam Liquid Systemic Insecticide (0.89S, PBI/Gordon)	2217-937 (SLN NY-120020)	–	L		ac	
*Safari 20SG (Valent)	86203-11-59639 (SLN NY-120008, SLN NY-120009)	–	L			
*Transtect 70 WSP (Rainbow)	59639-170-74779 (SLN NY-170007)	–	L			
Approved for use only under New York Special Local Needs registrations as a basal trunk spray for control of emerald ash borer on ash (SLN NY-120008), hemlock woolly adelgid and elongate hemlock scale (SLN NY-120009) and hemlock woolly adelgid (SLN NY-120020) on Eastern and Carolina hemlocks, or all of these pests (SLN NY-170007). User must have SLN labels in their poession when making applications. Certain greenhouse uses for *Safari are also permitted under another SLN label. *Zylam is only for use on landscape plants; no forestry uses permitted in NY. See http://www.dec.ny.gov/nyspad/products for labels. Toxic to shrimp; highly toxic to bees. Note pollinator protection labeling.						

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 also 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 dieases 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
Berberis	Barberry
Buxus	Boxwood
Carpinus	Hornbeam
Catalpa	Catalpa
Cedrus	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
***Kalmia* (laurel)**	
Leaf spots caused by *Pseudocercospora kalmiae* (syn.=*Cercospora* 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, *Armada‡, *Pageant Intrinsic‡, or thiophanate-methyl, myclobutanil, or chlorothalonil at budbreak and again 10 and 20 days later.
***Koelreuteria* (goldenrain tree)**	
Coral spot canker caused by *Nectria cinnabarina* (Plates 99, 100, ***87, 88***)	Prune back to sound wood and cover pruning wound with a dressing. Fertilize and water to maintain vigor.
***Ligustrum* (privet)**	
Anthracnose caused by *Glomerella cingulata* (syn. = *Colletotrichum gloeosporioides*) (Plate ***56***)	Prune and destroy infected branches during dry weather. Spray with chlorothalonil, mancozeb, thiophanate-methyl, *Pageant Intrinsic‡, or *Spectro 90 WDG‡, potassium bicarbonate, or *Junction‡ weekly as long as disease is active, or per label directions. Amur privet (*Ligustrum amurense*), Ibota privet (*L. ibota*), Regal privet (*L. obtusifolium* var. *regalianum*), and California privet (*L. ovalifolium*) are reported to be resistant.
Alternaria leaf spot caused by *Alternaria alternata*	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, *Pageant Intrinsic‡, *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.
***Lonicera* (honeysuckle)**	
Leaf blight caused by *Insolibasidium deformans* (syn.=*Herpobasidium* 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.
***Malus* (apples, flowering crab)**	
See following list of disease-resistant varieties and cultivars. For home orchard guidelines, see other publications.	
Powdery mildew caused by *Podosphaera leucotricha* (Plate ***4, 5***)	Apply propiconazole, triadimefon, copper sulfate pentahydrate, myclobutanil, thiophanate-methyl, *Armada‡, *Pageant Intrinsic‡, *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 *Erwinia amylovora* (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 *Gymnosporangium* 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‡, *Armada‡, *Pageant Intrinsic‡, *Mural‡ ,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 nematicides 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

Example Trade Names, Formulation (Company)	EPA Reg. No.	Use ‡	REI§
Active Ingredient (*Mode of Action Group*)			
Copper Octanoate (*M1*)			
Camelot O (SePRO)	67702-2-67690	N	4
General protectant fungicide and bactericide. Camelot O is for organic crop production, not for landscape use.			
Copper Sulfate Pentahydrate (*M1*)			
Phyton 27 (Phyton Corp.)	49538-2	N, L	24/48
General protectant fungicide and bactericide. **Note:** Additional precautions required when used in greenhouses; see label for details.			
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 (Everris NA)	58185-7	N	12
Apply to soil for control of Pythium and Phytophthora 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-Al (*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 *Phytophthora* and *Pythium* 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 ~~is~~ also for use in conifer nurseries (pine, spruce, Douglas-fir) to prevent Phytophthora 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 (OHP)	59807-16	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 *Botrytis* 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

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.

Barricade

Common Name: prodiamine

Formulations: *65WG, 4FL

Uses: Selective preemergence residual control of many annual grasses and broadleaf weeds in landscapes, field-grown nursery stock, container-grown nursery stock, Christmas trees, and established turfgrass (excluding golf course putting greens), lawns, and sod nurseries.

	Amount of active ingredient	***Amount by formulation***	
		*65WG	4FL
Per Acre	0.325 to 1.5 lb.	0.5 to 2.3 lb.	21 to 48 oz.
Per 1,000 sq. ft.		0.185 to 0.83 oz.	0.5 to 1.1 oz.

Major Weeds Controlled: Annual grasses such as crabgrass, goosegrass, foxtails, barnyardgrass, and johnsongrass (from seed). Some annual broadleaf weeds such as carpetweed, chickweed, shepherdspurse, prostrate spurge, lambsquarters, and pigweed.

Major Weeds Not Controlled: Established weeds, perennial grasses, and large-seeded broadleaf weeds. Weak on galinsoga, common groundsel, ragweed, nightshades, and velvetleaf. High application rates are required for prostrate knotweed control.

For Best Results: Incorporated with 1/2 inch of rainfall or irrigation or with shallow cultivation as soon as possible after application. Incorporation should not be delayed more than 14 days after application. Irrigation or rainfall soon after application is necessary to activate herbicide and to wash residual off foliage. May be applied to shadehouses and uncovered polyhouses (must remain uncovered for 7 days).

Cautions and Precautions: On landscape ornamentals, no more than 1.5 lb. AI per acre may be applied. In newly planted nursery stock or landscapes, delay applications until the soil has settled around the base of the plants. This is especially important in transplant beds.

Residual Activity: Season-long annual grass control is provided in many situations. Control of many broadleaf weeds will be shorter.

Volatility and Leaching Potential: Photodecomposition and volatilization occur when the product remains on the surface for prolonged periods without incorporation. Strongly adsorbed by soil; not readily leached.

Symptoms and Mode of Action: Absorbed through roots and inhibits root and shoot growth through interference with cell division.

Manufacturer: Syngenta

EPA Reg. No.: *Barricade 65WG: 100-834
Barricade 4FL: 100-1139

*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

KEY:
ful = full control is expected.
par = partial control is expected.
no = no control is expected.

Genus, species	Common name	*Barricade	Biathlon	*BroadStar/*SureGuard	Casoron	*†Dacthal	Devrinol	*ΔDimension	Goal 2XL	*Kerb	*†Marengo/*†Specticle	OH2	Pendulum	*†Pennant Magnum	Princep	*Ronstar	*Rout	Surflan	Treflan	XL
Euphorbia spp.	spurge				ful								ful							
Euphorbia supina	spurge, prostrate	ful			ful	par			ful			ful	ful			ful	ful			
Galinsoga ciliata	galinsoga, hairy			ful		no								ful		par				
Gallium aparine	bedstraw, catchweed								ful											
Gnaphalium falcatum	cudweed, narrowleaf				ful															
Gnaphalium spp.	cudweed		ful		ful						ful	ful	ful							
Helianthus tuberosus	artichoke, Jerusalem				par															
Hypochoeris radicata	catsear, spotted				ful											ful				
Ipomea hederacea	morningglory, ivyleaf			ful					par											
Ipomea purpurea	morningglory, tall			ful					par											
Ipomea spp.	morningglory, annual									ful					ful			par		par
Kochia scoparia	kochia	ful		ful							ful		ful						ful	
Lactuca serriola	lettuce, prickly						ful		ful						ful			par		par
Lamium amplexicaule	henbit	ful		ful	ful			ful	ful	ful	ful		ful		ful			ful		ful
Lamium purpureum	deadnettle				ful	par														
Lepidium perfoliatum	pepperweed, yellowflower				ful				ful						ful					
Lepidium virginicum	pepperweed, Virginia		ful		ful						ful	ful			ful					
Malva spp.	mallow			ful					ful	ful						ful		par		par
Marchantia spp.	liverwort			ful												par				
Matricaria matricarioides	pineappleweed			ful	ful		ful	ful							ful					
Medicago hispita	burclover			ful					ful						ful					
Medicago lupulina	medic, black							ful			par						ful			
Mollugo verticillata	carpetweed	ful		ful	ful	ful	ful	ful	ful	ful			ful	ful	ful	ful		ful	par	ful
Montia perfoliata	lettuce, miners				ful															
Moss (several genera)	moss			ful													ful			
Oenothera laciniata	eveningprimrose, cutleaf				ful						ful					par	ful			
Oenothera spp.	eveningprimrose				ful						ful		ful			par				
Oxalis corniculata	woodsorrel, creeping							ful												
Oxalis stricta	woodsorrel, yellow	ful	ful	ful	ful			ful	ful		par	ful	ful			ful	ful	ful		ful
Physalis spp.	groundcherry					par			ful											
Plantago spp.	plantain species			ful	ful						ful									
Polygonum aviculare	knotweed, prostrate	ful			ful	par	ful	ful	ful	ful	ful		ful					ful	ful	ful
Polygonum convolvulus	buckwheat, wild								ful		ful									
Polygonum pensylvanicum	smartweed, Penn.			ful	ful	no			ful				ful		ful	ful		par		par
Polygonum persicaria	ladysthumb/smartweed			ful		no			ful									par		par
Portulaca oleracea	purslane, common	ful		ful	ful	ful	ful	ful	ful	ful	ful		ful	par	ful	ful	ful	ful	ful	ful
Raphanus raphanistrum	radish, wild				ful															
Richardia scabra	pusley, Florida	ful		ful	ful	ful							ful	ful	ful			ful	par	ful
Rumex acetosella	sorrel, red				ful				ful	par										
Rumex crispus	dock, curly				ful						ful									
Sagina procumbens	pearlwort, birdeye		ful	ful								ful					ful			
Salsola kali	thistle, Russian			ful	ful				ful						ful				ful	
Senecio vulgaris	groundsel, common		ful	ful	ful		ful		ful		ful	ful		par	ful	ful	ful	ful		ful
Sida spinosa	sida, prickly			ful					ful		par									par
Sinapis arvensis/ Brassica kaber	mustard, wild				ful	no		ful	ful	ful	ful				ful			par		
Sisymbrium altissimum	mustard, tumble					no			ful											

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

			Ornamental species registered								
Application Type	**Long Island Use?**	**Trade Name**	*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)*
pre	yes/no	Simazine (several)	Several (f)	Several (f)	Several (f)	Few (f)	None	None	None	None	None
pre	yes	*Sureguard	Several (f/c)	Several (f/c)	None	None	None	None	None	None	None
pre	yes	Surflan	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Few (f/c)	Several (f/c)	Several (f/c)
pre	yes	Treflan	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)
pre	yes	Westar	None	Several (f)	None	None	None	None	None	None	None
pre	yes	XL 2G	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	None	Several (f/c)	Several (f/c)

Table 4.10.2. Herbicides registered for landscape use in New York State

Trade Name	**Common Name**	**Spray or Granular**	**Pre or Post**	**Plant Types that may be found on the Label ***Check Label for Species***					**Weeds Controlled**	**Application**	**Post-Plant Interval**	**Residential landscape restrictions[3]**
				Turf	**Annuals**	**Perennials**	**Trees & Shrubs**	**Orn. Grasses**				
Acclaim Extra	fenoxaprop	S	post	✓	✓	✓	✓		ann grasses	OT	Established	
*Barricade 4L	prodiamine	S	pre	✓	✓	✓	✓	✓	ann grass & bl weeds	OT	Newly planted (after soil settles)	
*Barricade 65WG	prodiamine	S	pre	✓	✓	✓	✓	✓	ann grass & bl weeds	OT	Newly planted (after soil settles)	
Barrier	dichlobenil	G	pre	can injure turf			✓		ann & per grass & bl weeds	D	Established	
BasagranT&O	bentazon	S	post	✓	✓	✓	✓	✓	bl weeds & sedges	D or OT	Label does not specify	
Biobarrier [1]	trifluralin	Geo-textile	pre	✓	✓	✓	✓	✓	roots	Under surface	None	
*BroadStar	flumioxazin	G	pre				✓		ann grass & bl weeds	OT	Established	
Devrinol	napropamide	S	pre	warm season	✓	✓	✓	✓	ann grass & bl weeds	OT	Label does not specify	
*ΔDimension 2EW	dithiopyr	S	pre	✓	✓	✓	✓	✓	ann grass & bl weeds	D or OT	Established	
*Diquat SPC 2l	diquat dibromide	S	post	directed	directed	directed	directed	directed	ann grass & bl weeds	D		
Dithopyr (various trade names)	dithiopyr (plus fert)	G	pre	✓					ann grass & bl weeds	D		
*ΔEnvoy	clethodim	S	post		✓	✓	✓		ann & per weeds	D or OT	Newly planted (after soil settles)	

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. 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.