2020
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.

2020 Cornell Pest Management Guide for Commercial Production and Maintenance of Trees and Shrubs

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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.

Every effort has been made to provide correct, complete, and up-to-date pest management information for New York State at the time this publication was released for printing (February 2020). Changes in pesticide registrations, regulations, and guidelines occurring after publication are available in county Cornell Cooperative Extension offices or from the Pesticide Management Education Program web site (pmep.cce.cornell.edu).

Trade names used in this publication are for convenience only. No endorsement of products is intended, nor is criticism of unnamed products implied.

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The guidelines in this bulletin reflect the current (and past) authors' best effort to interpret a complex body of scientific research, and to translate this into practical management options. Following the guidance provided in this bulletin does not assure compliance with any applicable law, rule, regulation or standard, or the achievement of particular discharge levels from agricultural land.

Cover photo: Summer cover cropping (Buckwheat) in field nursery on Long Island. (*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 https://www.cornellpress.cornell.edu.

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 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.
Hemlock	elongate hemlock scale	104	**45**
	hemlock looper	24	
	hemlock rust mite	122	**54**
	hemlock scale	102	**44**
	spruce budworm	28	**7**
	spruce spider mite	118	**51, 53**
Hickory	hickory leaf stem gall phylloxera	460	**222**
	twig pruner	264	**124**
	walnut caterpillar	150	**67**
Holly	cottony scales	342–346	**163, 164**
	holly leafminers	206–208	**95**
	southern red mite	475	**229**
	twig pruner	264	**124**
Honeylocust	honeylocust plant bug	404	**194**
	honeylocust podgall midge	466	**225**
	honeylocust spider mite	474	**228**
Honeysuckle	clover mite	472	
	honeysuckle aphid	314	**149**
Juniper	arborvitae leafminer	42	**14**
	arborvitae weevil	240, 244	
	bagworm	176	**80**
	juniper scale	106	**46**
	juniper webworm	30	**8**
	spruce spider mite	118	**52, 53**
Larch	larch casebearer	36	**11**
	larch sawfly	18	**1**
	spruce budworm	28	**7**
	woolly larch adelgid	78	**32**
Lilac	European hornet	494	**238**
	lilac/ash borer	260	**122**
	lilac leafminer	196	**90**
	oystershell scale	370	**177**
	twobanded Japanese weevil	244	**114**
	white prunicola scale	392	**188**
Linden	aphids	302, 310	**110**
	cankerworms	142, 144	**63, 64**
	gypsy moth	138, 140	**61, 62**
	Japanese beetle	236	**110**
	lace bugs	426	**205**
	linden looper	144	**64**
	twospotted spider mite	476	
Locust, Black	locust borer	274	**129**
	locust leafminer	190	**87**
London Plane Tree	American plum borer	252	**118**
	lecanium scales	354, 364	**169, 174**
	sycamore lace bug	428	**206**
	sycamore plant bug	400	**192**
Magnolia	magnolia scale	354	**169**
	sassafras weevil	210	**97**
Maples	aphids	304	**144**
	cottony maple leaf scale	342–346	**163, 165**
	cottony maple scale	340	**162**

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 (mid-): Plants in bloom: redbud, Sargent crabapple, flowering almond, Tatarian honeysuckle *(continued)*			
Mountain laurel	rhododendron borer	moth	192–298
Oak	cankerworms	larva	148–290
	lace bugs	immature	239–363
	linden looper	larva	192–363
	oak leaf gall maker	adult	Not Available
	tent caterpillars	larva	192–363
Pine	pine bark adelgid	immature	190–618
	pine sawflies	larva	246–?
	pine spittlebug	nymph	148–298
	spruce spider mite	adult/immature	192–363
	Zimmerman pine moth	larva	121–246
Privet	lilac leafminer	moth/egg	246–363
Rhododendron	rhododendron borer	moth	192–298
Spruce	eastern spruce gall adelgid	immature	170–?
	pine sawflies		246–?
	spruce spider mite	adult/immature	292–363
	woolly larch adelgid	immature	121–192
Sycamore	lace bugs	immature	239–363
Viburnum	snowball aphid	nymph/adult	148–298
	viburnum leaf beetle	larva	60–120
Walnut	butternut gall mite		68–215
	lace bugs	immature	239–363
White pine	white pine aphid	nymph/adult	121–246
Willow	imported willow leaf beetle	adult	192–448
Yew	taxus bud mite	adult	148–448
	taxus mealybug	immature	246–325
May (late): Plants in bloom: ruby horsechestnut, Laburnum alpinum, black locust, ninebark			
Apple (crab)	oystershell scale	crawler	363–707
Arborvitae	arborvitae leafminer	larva/adult	245–360
	arborvitae weevil	adult	150–260
	spruce spider mite	adult/immature	250–363
Ash	lace bugs	adult/immature	239–363
Azalea	rhododendron stem borer	adult	298–400
Beech	cankerworms	larva	148–290
	woolly beech aphid	eggs/nymphs	363–707
Birch	birch leafminer	adult	190–290
Black locust	locust leafminer	adult	298–533
Boxwood	boxwood mite	immature/adult	245–600
	boxwood psyllid	nymph/adult	290–440
Butternut	walnut blister mite	immature/adult	363–707
Chamaecyparis	arborvitae weevil	adult	150–260
Cherry	tent caterpillars	larva	190–?
Deciduous plants	forest tent caterpillar	larva	192–363
	gypsy moth	larva	90–448
	tussock moths	larva	92–298
Elm	cankerworm	larva	148–290
	elm casebearer	larva	300–533
	elm leaf beetle	adult	363–912

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.

Cankerworms (63, 64), *Alsophila pometaria*, *Paleacrita vernata* (moths) *(continued)*	
When to treat:	Last three weeks of May, 148–290 GDD, PPI-Tatarian honeysuckle, ruby horsechestnut.
IPM considerations:	Young larvae are dispersed by wind currents. Eggs may be killed by horticultural oil sprayed to trunk and branches. See also Linden looper.
Cherry and hawthorn leafminer (86), *Profenusa canadensis* (sawfly)	
Plant abnormalities:	Leafminer blotches on distal half of leaf.
Management options:	Two wasp parasite species often provide control. Abamectin, bifenthrin, chlorpyrifos, cyantraniliprole, cyclaniliprole, emamectin benzoate (trunk injection), imidacloprid (soil drench or injection), permethrin.
When to treat:	Foliar sprays last two weeks of May, first two weeks of June, 295–610 GDD, PPI-Tatarian spring honeysuckle, ruby horsechestnut. Imidacloprid soil application late fall or early spring.
IPM considerations:	*Crataegus mollis* rarely mined. Leaves should be fully expanded before pesticide application.
Clover mite (228), *Bryobia praetiosa*	
Plant abnormalities:	Leaves appear bronzish or silvery.
Management options:	Many predators. Most important pesticide applications are made early in the season. Abamectin, bifenazate, bifenthrin, chlorpyrifos, cyfluthrin, diazinon, fluvalinate, horticultural oil, insecticidal soap, neem oil.
When to treat:	Mid- to late May, 192–298 GDD, PPI-redbud, *Laburnum alpinum*.
IPM considerations:	The clover mite, as now understood, is a species complex. Some species feed on grasses; others feed on woody ornamental plants. Many generations occur each year.
Cooley spruce gall adelgid (49), *Adelges cooleyi*	
Plant abnormalities:	Pineapple-shaped galls at tip of spruce shoot, crooked needles on Douglas-fir.
Management options:	No effective parasites. Some trees are resistant to adelgids. Acetamiprid, carbaryl, chlorpyrifos, cyantraniliprole (drench), cyclaniliprole, horticultural oil, imidacloprid (foliar spray or soil application), insecticidal soap, spirotetramat, thiamethoxam (25WG, Christmas trees only).
When to treat:	Spruce: Mid- to late April, 22–81 GDD, PPI-Japanese quince. Again in mid-September, 1850–1950 GDD, PPI-Hydrangea paniculata. Douglas-fir: early May, 120–190 GDD. Again late July to early August, 1500–1775 GDD. Imidacloprid soil application late fall or early spring.
IPM considerations:	On small spruce, prune out galls before July and bury or burn them. To help prevent galls on spruce, avoid planting near Douglas-fir. Best chemical control should be directed toward the overwintering stage. Whether on spruce or Douglas-fir, do not fertilize infested trees. Addition of 1% oil to carbaryl or chlorpyrifos enhances control on Douglas-fir. When using oil on Douglas-fir, apply immediately before budbreak; later applications may result in greater phytotoxicity. In some trials 1–2 percent oil applied during late-dormant stage has caused yellowing to foliage.
Cottony camellia scale—see Cottony taxus scale	
Cottony maple scales (162, 163), *Pulvinaria innumerabilis* and *P. acericola* (soft scales)	
Plant abnormalities:	Honeydew and sooty mold on leaves of branches, twig dieback, premature loss of foliage. Cottony egg masses on twigs (*P. innumerabilis*) or under leaves (*P. acericola*).
Management options:	Several effective parasites and predators, including lady beetles. Acephate, acetamiprid (trunk spray or injection), carbaryl, chlorpyrifos, cyantraniliprole, cyclaniliprole, cyfluthrin, diazinon, flonicamid, horticultural oil, imidacloprid (soil injection), insecticidal soap, lambda-cyhalothrin, neem oil, pyriproxyfen (Distance, Defiance), spirotetramat (Kontos spray, container drench).
When to treat:	Spring dormant with oil. Late June and July, 802–1265 GDD for crawlers. PPI-*Philadelphus*, *Tilia cordata*. Fall or early spring soil treatment with imidacloprid has been effective for some soft scales.
IPM considerations:	Cottony maple scale (*P. innumerabilis*) favors soft maples (e.g., silver), but it and cottony maple leaf scale (*P. acericola*) have a wide host range. Both overwinter on bark. Maples sensitive to oil should not be treated during the dormant season. One treatment with good coverage should be adequate.

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*
Metaldehyde (*1A*)						
*Durham Metaldehyde Granules 3.5 (Amvac)[2]	5481-91	–	N	12	ac	cfk
*Durham Metaldehyde Granules 7.5 (Amvac)[2]	5481-103	–	N	12	ac	cfk
*Deadline Bullets (4%, Amvac)[2]	5481-507	–	N	12	acf	cfk
Deadline Ornamental [1]	5481-511	–	L			
Bait. For control of slugs and snails. Apply only to soil around affected plants during evening, best after a rain or watering. Do not apply to turf. Avoid contaminating lakes, streams, etc., or breathing dust. Keep pets out of treated area. [1]For ornamental plantings. [2]Agricultural production use only.						
***Metarhizium anisopliae* (*M*)**						
Met52 EC (Novozymes)	70127-10	–	N, L	4	abchl	bchkl
Met52 Granular (Novozymes)[1]	70127-8	–	N, L	0	abchl	bchkl
Biopesticide.Formulation of spores (conidia) of insect-killing fungus. Labeled for foliar and drench application to control thrips, weevils, and mites in nursery, greenhouse, and outdoor sites including ornamental plants, turf, and certain food crops. Store below 73°F in dry, locked area away from sunlight. Use within one year and by expiration date. [1]Labeled for incorporation into growing media.						
Methiocarb (*1A*)						
*[F]Mesurol 75W (Gowan)	10163-231	–	N	24	bdghijl	bdghjl
Controls aphids, mites, snails, and slugs. Very highly toxic to birds; highly toxic to fish and toxic to bees. Do not apply with foliar fertilizers. Store in a cool, dry place.						
Neem Oil (*nonspecific mode of action*)						
Triact 70EC (OHP)	70051-2-59807	OMRI	N, L	4	acf	cfk
Rango (70EC, Terramera)	88760-10	OMRI	N, L	4	ac	ac
Insecticide/miticide/fungicide; biopesticide. For use on ornamentals, trees and shrubs in and around greenhouses, nurseries, and other structures. Do not apply to wilted or otherwise stressed plants or to newly transplanted materials before root establishment. Some plants are sensitive (see label); test on new plants. Labeled for whiteflies, mealybugs, aphids, leafhoppers, mites, scales. Rango also lists other pests and foliar diseases. Toxic to bees exposed to direct treatment.						
Orthoboric Acid						
Niban (5G, Nisus)	64405-2	–	L		acf	
For control of snail, slugs and other pests in flower gardens and around ornamentals, groundcovers, and shrubs.						
Permethrin (*3A*)						
*Astro (3.2E, FMC)[1]	279-3141	–	L	NA		
*[F]Perm-Up 3.2EC (UPI)[1]	70506-9	–	N, L	12	acfi	cfk
*[F]Arctic 3.2EC (Winfield)[3]	1381-187	–	N	12	acfi	cfk
*[F]Permethrin (3.2EC, Loveland)[3]	34704-873	–	N	12	efgh	cfk
*Prelude (2EC, Amvac)[1]	5481-550	–	L	NA		
*[F]Permastar AG (3.2EC, LG)[3]	71532-15-91026	–	N	12	acfi	cfk
Labeled for a wide variety of ornamentals. Highly toxic to bees; extremely toxic to fish and aquatic invertebrates. Do not use or store near heat or open flame. Store above 40°F. Do not apply when wind exceeds 15 mph. [1]Includes uses as a bark spray for borers. For Perm-Up, see supplemental label. [2]Nursery uses: label indicates only for borers on ornamental trees and certain pests on conifers. [3]Nursery uses: for various pests on field-grown nursery stock, Nantucket pine tip on conifers, certain pests in pine seed orchards and leafminer in chrysanthemums. Harvesting of conifer seed cones if prohibited within 30 days of application.						
Phosmet (*1B*)						
*Imidan 70W WSB (Gowan)	10163-169	–	N, L	24 hr-13 days	abcjl	bcjk
For ornamental plants and non-bearing fruit and nut trees and vines in nurseries and established landscape plantings. Also labeled for Christmas trees, conifer seedlings and conifer seed orchards. Label includes uses to control slugs and snails on ornamentals. Toxic to fish, wildlife and bees. Maintain spray pH below 7; do not mix with alkaline materials. Do not store above 113°F.						
Pymetrozine (*9B*)						
Endeavor 50WDG (Syngenta)	100-913	–	N, L	12	acf	acf
Devenir 50WDG (Atticus)	91234-97	_	N, L	12	acf	acf
Reduced-risk pesticide for aphids and whiteflies on landscape, field and container-grown ornamentals, non-bearing nursery fruit and nut trees, Christmas trees, groundcovers, ornamentals in greenhouses, lath and shadehouses and interiorscapes. Store in a cool, dry place.						

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
***Pyrus* (pear)** *(continued)*	
Fire blight caused by *Erwinia amylovora (continued)*	salts of phosphorus acid for the site. Tree Tech OTC‡ is labeled for use as an injection to suppress this disease.
Scab caused by V*enturia pyrina* (= *Fusicladium* sp.) (Plate 44, ***43***)	Spray with *Pageant Intrinsic‡, thiophanate-methyl, myclobutanil or mancozeb per label directions.
Pear trellis rust caused by *Gymnosporangium sabinae*	Spray with mancozeb, myclobutanil, *Pageant Intrinsic‡, *Mural‡, or thiophanate-methyl on a 7-21 day interval or as per label directions.
Other rust caused by *Gymnosporangium* spp. (Plates 117–120, ***129-133***)	Eliminate nearby red cedar and *Juniperus chinensis* to whatever extent practical. Spray with myclobutanil or thiophanate-methyl when orange rust masses appear on juniper and thereafter at 7- to 14-day intervals or per label directions.
***Quercus* (oak)**	
Anthracnose of white oak caused by *Apiognomonia* sp. (Plate 50, ***49***) (conidial state = *Discula* sp.)	Destroy fallen leaves in autumn. Spray with Protect DF‡, elemental copper (with lime), *Junction‡, or *Spectro 90 WDG‡ once before budbreak, once at budbreak, and once when leaves are half of full size, or use *Fungisol w/debacarb‡ for injection in the spring.
Leaf spot caused by *Tubakia dryina* (Plate ***21***)	This disease develops late in the growing season and rarely threatens tree health. Where management must be undertaken, use *Junction‡ or CuPRO 5000‡, or spray with propiconazole once at budbreak and twice thereafter at 10- to 14-day intervals.
Leaf blister caused by *Taphrina caerulescens* (Plate 6, ***2***)	This disease rarely is severe enough to affect host health or appearance. Where it has become so, spray once in spring before bud swell with mancozeb, *Junction‡, or *Spectro 90 WDG‡.
Oak Wilt caused by *Ceratocytis fagacearum* (Plate ***118***)	Although white oak and bur oak are considered to be somewhat resistant, this disease can infect all oak species common in NYS and may kill trees in the red oak group within weeks or months of infection. If Oak Wilt is confirmed, take the following steps to minimize the spread of the fungus. 1. Examine oaks on your property regularly, paying special attention to red oaks with rapidly wilting leaves in June or July. 2. Remove diseased trees immediately and take steps to ensure that the wood dries quickly enough to minimize formation of sporulating mycelial mats. 3. Use a backhoe, trencher, or vibratory plow to disrupt root grafts between diseased and healthy trees. 4. Do not prune oaks in the spring (April 15 – July 15 in NY State) unless they pose an imminent danger to life or property! 5. In sites with a history of oak wilt, cover all new wounds – including pruning wounds, lawnmower dings, weed whacker abrasions and any other injury that exposes fresh wood - with paint. 6. Inject currently healthy red oaks in the vicinity of diseased trees with propiconazole (*Alamo) per label instructions. This product is registered in New York State for control of several tree diseases, including oak wilt, but it must be applied by a professional arborist.*Quali-Pro Propiconazole 14.3 is also labeled for injection. Follow label directions. 7. Dispose of diseased trees by chipping small branches and burying or burning larger debris. Logs split for firewood should be <u>completely</u> sealed with vinyl tarp for 12 months.
Shoestring root rot caused by *Armillaria* sp. (Plate 148, ***162-164***)	This disease most frequently affects trees weakened by defoliation or other factors. Restore tree vigor via watering and fertilization and control of defoliators.

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§
Potassium Bicarbonate (*NC*) *(continued)*			
Milstop SP (BioWorks)	68539-13	N, L	1
Milstop Broad Spectrum (BioWorks)	70870-1-68539	N, L	1
Kaligreen (Otsuka Agritechno)	11581-2	N	4
Fungicide for control of powdery mildew and Botrytis on a wide variety of plants and additional pathogens per individual labels. Kaligreen labeled for powdery mildew only.			
Propamocarb Hydrochloride (*28*)			
Banol T&O Fungicide (Bayer)	432-942	N	24
Fungicide for control of *Phytophthora* on woody ornamentals grown in greenhouses or in pots in nurseries. Not for use on field grown ornamentals.			
Propiconazole (*3*)			
*Alamo Fungicide (Syngenta)	100-741	L	NA
Dorado Fungicide (Syngenta)	100-741	N, L	12
*Quali-Pro Propiconazole 14.3 (Makhteshim Agan)	66222-41	N, L	12
*Shepherd Fungicide (ArborSystems)	69117-3	N	NA
Spectator T&O Fung. (Lesco)	228-633	N, L	24
Systemic fungicide for control of many foliar diseases. Alamo and Shepherd usually applied via specific trunk injection systems. Special training in injection techniques required. Root flare injections of Spectator Ultra 1.3 are not registered for use in NY.			
Pyraclostrobin (11) + Boscalid (7)			
*Pageant Intrinsic (BASF)	7969-251	N, L	12
Warning: Pyraclostrobin is of the strobilurin chemical class. To discourage development of resistant pests, alternate sprays with another product that has a different mode of action as directed on the label.			
Thiabendazole Hypophosphite (*1*)			
*Arbotect 20-S (Syngenta)	100-892	N, L	0
*Thiazol 20-S (Arborjet)	100-892-74578	N, L	0
Systemic fungicides for injection into elms for Dutch Elm Disease, and Sycamore Anthracnose control. Special training in injection techniques required.			
Thiophanate-Methyl (*1*)			
*ArmorTech TM 462 (NuFarm)	228-626	N, L	12
*3336 F (Cleary Chemical)	1001-69	N, L	12
*3336 EG (Nufarm)	1001-89	N, L	12
*T-Methyl SPC 4.5 F (Nufarm)	228-626	N, L	12
*T-Storm Flowable (Lesco)	228-626	N, L	12
Broad-spectrum systemic fungicide for control of many leaf diseases and shoot blights. **Note:** Labels vary; some labels contain recommendations for management of pathogens that are not found on other thiophanate-methyl labels. If purchasing a product to treat a specific pest, be certain that product is labeled for that pest.			
Thiophanate-Methyl (*1*)+ Iprodione (*2*)			
*ArmorTech TMI 2020 XL (United Turf Alliance)	53883-323-86064	N, L	24
*26/36 Fungicide (Nufarm)	228-630	N, L	24
*Twosome (Lesco)	228-630-10404	N	24
*26/36 Fungicide and *Twosome are labeled for Fusarium on nursery grown boxwood. *Armortech TMI 2020 XL and *26/36 Fungicide not for residential landscape use.			
Triadimefon (*3*)			
*Bayleton 50 T&O in WSP** (Bayer)	432-1360	N, L	12
Bayleton 50% DF (Amvac)**	264-737-5481	N	12
Broad-spectrum fungicide with some systemic activity for control of foliage diseases and some rusts. **Both Bayleton 50% DF products are labeled for specific diseases on Christmas trees (excluding concolor fir).			

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.

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

Major Weeds Controlled: Difficult to control grasses, including barnyard grass, crabgrass, fall panicum, foxtails, goosegrass, and horseweed (*Conyza 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

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	Fuerte	Goal 2XL	*Kerb	*†Marengo/*†Specticle	OH2	Pendulum	*†Pennant Magnum	Princep	*Ronstar	*Rout	Surflan	Treflan	XL
Senecio vulgaris	groundsel, common		ful	ful	ful		ful		ful	ful		ful	ful		par	ful	ful	ful	ful		ful
Sida spinosa	sida, prickly			ful					ful	ful		par									par
Sinapis arvensis/ Brassica kaber	mustard, wild				ful	no		ful		ful	ful	ful				ful			par		
Sisymbrium altissimum	mustard, tumble					no				ful											
Sisymbrium irio	rocket, London					no		ful		ful	ful			ful					ful		ful
Solanum nigrum	nightshade, black			ful		par			ful	ful	ful				ful	ful			par		par
Solanum nodiflorum	nightshade, Am. black															ful					
Solanum sarachiodes	nightshade, hairy									ful	ful	ful			par	ful					
Sonchus arvensis	sowthistle		ful															ful			
Sonchus oleraceus	sowthistle, annual			ful			ful		ful	ful		ful	ful				ful	ful	par		par
Spergula arvensis	spurry, corn									ful											
Spergularia rubra	sandspurry, red									ful											
Stellaria media	chickweed, common	ful	ful	ful	ful	ful	ful	ful	ful		ful	ful	ful	ful		ful		ful	ful	ful	ful
Taraxicum officianale	dandelion		ful	ful	ful				ful			ful	ful					ful			
Trifolium pratense	clover, red									par											
Trifolium procumbens	clover, hop													ful							
Trifolium repens	clover, white									par		ful						ful			
Urtica dioica	nettle, stinging																			ful	
Urtica urens	nettle, burning					ful				ful	ful										
Veronica arvensis	speedwell, corn							ful	ful			ful		ful							
Veronica persica	speedwell, Persian/birdeye	ful							ful	ful											
Veronica spp.	speedwell species															ful	ful				
Xanthium strumarium	cocklebur, common									ful											
Avena fatua	oats, wild						ful	ful		ful	ful					ful	ful		ful	ful	ful
Grasses																					
Avena sativa	oats, volunteer										ful										
Barbarea vulgaris	rocket, yellow			ful	ful																
Bromus catharticus	rescuegrass	par						ful													
Bromus mollis	brome, soft						ful	ful													
Bromus rigidus	brome, ripgut						ful	ful									ful				
Bromus secalinus	brome, cheat						ful	ful				ful								ful	
Bromus tectorum	brome, downy						ful	ful			ful					ful					
Cynodon dactylon	bermudagrass																				
Cyperus compressus	sedge, annual											par			ful		ful				
Cyperus esculentus	nutsedge, yellow				ful	no						par			ful						
Dactylis glomerata	orchardgrass				ful						ful										
Digitaria ischaemum	crabgrass, smooth	ful		ful	ful	ful	ful	ful	ful			ful		ful	ful	ful	ful		ful	ful	ful
Digitaria sanguinalis	crabgrass, hairy/large	ful	ful	ful	ful	ful	ful	ful	ful	par	ful	ful	ful	ful	ful	ful	ful	ful	ful	ful	ful
Echinchloa crus-galli	barnyardgrass	ful	ful	ful		par	ful	ful	ful	par	ful	ful	ful	ful	ful	ful	par	ful	ful	ful	ful
Eleusine indica	goosegrass	ful	ful	ful		par	ful	ful	ful	par	ful	ful		ful	ful	ful	ful	ful	ful	ful	ful
Elytrigia repens	quackgrass				ful						ful										
Eragrostis spp.	lovegrass/stinkgrass	ful				ful	ful		ful		ful	ful		par					ful	ful	ful
Festuca arundinacea	fescue, tall				ful																
Hordeum jubatum	barley, foxtail							ful			ful										
Hordeum leporinum	barley, wild/hare				ful		ful	ful												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) Evergreens*	*Broadleaf Evergreens*	*Deciduous Shrubs*	*Groundcovers (Woody &Semi - Woody)*	*Perennials (Herbaceous)*	*Ornamental Grasses*	*Bulbs*	*Annuals (Bedding Plants)*
pre	yes	*Ronstar (G)	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Few (f/c)	Few (f/c)	None	None
post directed	yes	Roundup Pro	Several (f)	Several (f)	Several (f)	Several (f)	None	None	None	None	None
pre	yes	*Rout	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Few (f/c)	None	None	None
post directed	yes	Scythe	Several (f)	Several (f)	Several (f)	Several (f)	Several (f)	Several (f)	Several (f)	Several (f)	Several (f)
post directed	yes	Sedgehammer+	Several (f)	Several (f)	Several (f)	Several (f)	Several (f)	None	None	None	None
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	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 <u>for landscape use</u> 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	Geotextile	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	

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.