2024
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.

2024 Cornell Pest Management Guide for Commercial Production and Maintenance of Trees and Shrubs

Authors

Elizabeth Lamb (New York State Integrated Pest Management Program, Ithaca, NY; *Editor*)

Paul D. Curtis (Department of Natural Resources, Cornell University, Ithaca, NY; *vertebrate pest management*)

Daniel O. Gilrein (Cornell Cooperative Extension – Suffolk County, Riverhead, NY; *insect pest management*)

Michael Helms (Cornell Pesticide Safety Education Program, Cornell University, Ithaca, NY; *pesticide information*)

Sandra Jensen (Section of Plant Pathology /Plant Microbe Biology, Cornell University, Ithaca, NY; *disease management)*

Andrew F. Senesac (Cornell Cooperative Extension – Suffolk County, Riverhead, NY (retired); *weed management*)

Special Appreciation

Special appreciation is extended to the late Warren T. Johnson and to Irene Tsontakis-Bradley for their significant contributions to this publication.

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 suspension	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
*[F] ..... Indicates a federally restricted use pesticide
† ..... Not for use in Nassau and Suffolk Counties

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 (May 2024). Changes in pesticide registrations, regulations, and guidelines occurring after publication are available in county Cornell Cooperative Extension offices or from the Cornell Pesticide Safety Education Program (psep.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.

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

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 by: *Dawn Dailey O'Brien.*

1 Pesticide Information

1.1 Pesticide Classification and Certification

Pesticides can be classified as general use or restricted use. **General use pesticides** may be purchased and used by anyone. **Restricted use pesticides** can only be purchased and used by a certified applicator or used by someone under a certified applicator's supervision. In some cases, the pesticide label may limit use of a restricted use pesticide to only a certified applicator.

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. If a private applicator wants to use or supervise the use of restricted use pesticides, they need to be a **certified private applicator**. Certified private applicators are also allowed to purchase restricted use pesticides. Certification is not needed if a private applicator uses general use pesticides.

In New York State, a **certified commercial applicator**, **certified commercial technician**, or **commercial apprentice** working under the supervision of a certified commercial applicator is allowed to apply any type of pesticide on property that is not a private application (described above) or is a residential application. (A residential application is the use of general use pesticides on property owned or rented by the applicator, excluding establishments selling or processing food and residential structures other than where the applicator lives.) Certified commercial applicators are allowed to purchase restricted use pesticides.

Information on pesticide certification and classification is available from your Cornell Cooperative Extension office (cce.cornell.edu/localoffices), regional NYSDEC pesticide specialist (dec.ny.gov/about/contact-us/statewide-office-information), the Pesticide Applicator Training Manuals (www.cornellstore.com/books/cornell-cooperative-ext-pmep-manuals), or the Cornell Cooperative Extension Pesticide Safety Education Program (psep.cce.cornell.edu).

1.2 Use Pesticides Properly

Using pesticides requires the user to protect their health, the health of others, and the environment. Keep in mind "pesticide use" is more than just the application. It 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 also require you to comply with state and federal laws and regulations intended to protect human health and the environment from the adverse effects pesticides may cause.

1.2.1 Plan Ahead

Many safety precautions should be taken *before* you begin using pesticides. Most pesticide accidents can be prevented with informed and careful practices. **Always read the label on the pesticide container before using the pesticide.** Make sure you understand and can follow all label directions and precautions. 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

Transporting pesticides carelessly can result in broken containers, spills, and contamination of people and the environment. Accidents can occur even when transporting pesticides 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 (PPE) needs depend on the pesticide being handled. **Required PPE are listed on pesticide labels.** Any required PPE is based on the pesticide's toxicity, route(s) of exposure, and formulation. Label-listed PPE are the minimum that must be worn when using a pesticide. You can always use more than what's listed!

The type of PPE used depends on the type and duration of the activity, where pesticides are being used, and the user's exposure. For example, mixing/loading procedures often require more PPE than when applying a pesticide. Studies show you are at a greater risk of accidental poisoning when handling pesticide concentrates. Pouring pesticide concentrates is the most hazardous activity.

Engineering controls are devices that help reduce a pesticide user's exposure. An example is a closed transfer system that reduces the exposure risk when dispensing pesticide concentrates. 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 non-target areas, and harm the environment. Choose weather conditions, pesticides, application equipment, pressure, droplet size, formulations, and adjuvants to minimize drift and runoff potential. Product labels may have specific application and/or equipment requirements to reduce issues with drift and runoff.

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 *New York and New England Management Guidelines for Greenhouse Floriculture and Herbaceous Ornamentals*. 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 roguing of sick plants. Traps using food baits, light, and

2.7 Insects and Mites Destructive to Woody Ornamentals

The following table lists some of the common or key insect and mite pests of woody ornamentals. Look under the host plant involved and find the correct common name of the pest. Check Tables 2.9.1 and 2.10.1 for monitoring and management information. Numbers following the insect name indicate where additional information can be found in *Insects That Feed on Trees and Shrubs,* second edition. Illustrations (plate numbers) are in boldface type. Book is available from Cornell University Press, 800-848-6224 (U.S. & Canada) or at www.cornellpress.cornell.edu.

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

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

Table continues on next page.

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.

Aphids (leaf and twig forms) (34, 35, 138, 140, 150)

Plant abnormalities:	Plant unthrifty, honeydew and sooty mold present, distorted or pale green foliage, reduced shoot growth.
Management options:	Many natural enemies, ladybird beetles, syrphid fly larvae, internal parasites. Abamectin (trunk injection), acephate, acetamiprid (foliar spray or [##]basal bark application *TriStar 8.5SL), bifenthrin, cyantraniliprole, cyclaniliprole + flonicamid, cyfluthrin, diazinon, dimethoate (arborvitae, birch, camellia, euonymus, honeysuckle, juniper, rose), flonicamid, flupyradifurone (foliar spray or container drench), fluvalinate, horticultural oil, imidacloprid (foliar spray or soil application), malathion, neem oil, pymetrozine, spirotetramat, thiamethoxam (Christmas trees only). [##]2(ee) recommendation of *TriStar 8.5SL for unlabeled application method. The 2(ee) recommendation must be in the applicator's possession when using.
When to treat:	Dormant oil GDD: spring 7-120 or when aphids are found.
IPM considerations:	Predators usually found with high aphid populations. Pesticides applied to foliage kill predators. Insecticidal soap controls some species. Where practical, wash off aphids with a strong stream of water.

Apple blotch leafminer (90), *Phyllonorycter crataegella* (moth)

Plant abnormalities:	Blotch leaf mines. Plant appears scorched or ragged.
Management options:	Parasites and predators do not provide adequate control. Abamectin, cyantraniliprole, cyclaniliprole, emamectin benzoate, imidacloprid (soil drench or injection (excluding Long Island).
When to treat:	Foliar sprays early May, 121-192 GDD, PPI-Japanese quince. Again in late May through early June, 363-553 GDD, PPI-ruby horsechestnut, beautybush. Soil application probably most effective in fall or early spring.
IPM considerations:	Mine is apparent from underside of leaf. Apple, hawthorn, cherry, plum, and quince are hosts. Only unfolding leaves are attacked.

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

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

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

Plant abnormalities:	Honeydew and sooty mold, yellowing leaves and dieback.
Management options:	One important chalcid wasp parasite. Acephate, acetamiprid (8.5SL, trunk spray or injection), carbaryl, cyfluthrin, horticultural oil, insecticidal soap, lambda-cyhalothrin, malathion, pyriproxyfen [Distance (2(ee))[##], Defiance)], spirotetramat (Kontos spray, container drench). [##]2(ee) recommendation for use on unlabeled pest. The 2(ee) recommendation must be in the applicator's possession when using Distance for control of azalea bark scale. See 2(ee) at extapps.dec.ny.gov/nyspad/products.

Table continues on next page.

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*	 *Early Entry*
Acephate (*1B*)						
Acecap Systemic Tree Implants (98.9%, Creative Sales)[1]	37979-1	–	N, L	NA	acf	
*Dendrex (97% Florida Silvics)[1]	64014-1	–	L	NA	acf	
*Ace-Jet (97.4%, Arborjet)[2]	74578-2	–	N, L	NA	acfh	
*Acephate 97 UP (UPL NA)	70506-8	–	N, L	24	acfi	cfk
*Lepitect Infusible (97.4%, Rainbow Treecare)[3]	74779-5	–	N, L	NA	acfh	
*Lepitect (97.4%, Rainbow Treecare)[4]	74779-6	–	N, L	24	acfl	bck
*Orthene Turf, Tree & Ornamental 97 Spray (97S, Amvac)	5481-8978	–	N, L	24	acfl	cfk
*Orthene Turf, Tree & Ornamental WSP (75%, Amvac)	5481-8971	–	N, L	24	acfl	cfk
*Acephate 97 WDG (ADAMA)	66222-266	–	N, L	24	acfl	cfk
*Acephate 90 Prill (90S, ADAMA)	66222-123	–	N	24	acfm	cfk
*Acephate 90 WDG (Loveland)[5]	34704-1051	–	N	24	acfl	cfk
*Tide Acephate 90WDG (Tide)	84229-7	–	N, L	24	acfl	cfk
*Acephate 90% Prills (90S, Control Solutions)	53883-253	–	N, L	24	acfl	cfk
*Livid 90 Prill (90S, Innvictis)[6]	89167-27-89391	–	N, L[6]	24	acfl	cfk
*Acephate 90 Prill Select (90S, Prime Source)[5]	89442-40	–	N, L	24	acf	cfk
*Omni Brand Acephate 97 SG (Helena)	5905-620	–	N, L	24	acfl	cfk

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

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

Acephate (*1B*) + Imidacloprid (*4A*)						
*Avatar PLX (0.5+0.05DF, Aquatrols)	94396-29	–	N, L	24	acfl	acf

Except to produce an agricultural commodity, imidacloprid use after 2026 allowed only under environmental emergency or for invasive species affecting woody plants and on completion of annual neonicotinoid course. Labeled as a drench for black vine weevil and strawberry root weevil in certain container-grown nursery stock, for foliar application to ornamental trees and shrubs, and for bark application to crepe myrtle. Airblast (air-assist), aerial, and ULV application prohibited. Do not apply with low pressure handwand equipment except for non-agricultural or non-commercial uses. Note vegetative filter strip requirements around aquatic areas and other application restrictions. Highly toxic to aquatic invertebrates and to honey bees exposed to direct treatment or residues. Label includes specific pollinator protection restrictions. Toxic to birds and wildlife. Do not apply to Balm of Gilead, cottonwood, Lombardy poplar or *Viburnum suspensum*. Injury has been seen on crabapples *Malus tschonoskii*, *M. floribunda*, 'Hopa,' 'Pink Perfection,' 'Red Wine,' and 'Snowcloud.' There is a 14-day spray interval except for flowering crabapples and Douglas fir. Flowering crabapples cannot be treated more than 3 times per growing season at 4 week intervals. Douglas fir can only be treated once per season. Note maximum use rates and other application restrictions.

Acequinocyl (*20B*)						
Shuttle 15SC (1.25SC, Arysta)	66330-38	–	N, L	12	acf	cfk
Shuttle O (1.25SC, OHP)	66330-38-59807	–	N, L	12	acf	cfk
Shuttle-O (1.25SC, OHP)	70506-447-59807	_	N, L	12	acf	cfk

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

Acetamiprid (*4A*)						
*TriStar 8.5SL (0.76SL, Cleary)	8033-106-1001	–	N, L	12	acf	cfk
*Quasar 8.5SL (0.76L, Atticus)	91234-16	–	N, L	12	acf	cfk
*Retriever (0.76L, ArborSystems)[1]	69117-14	–	L		acf	

Except to produce an agricultural commodity, acetamiprid use after 2026 allowed only under environmental emergency or for invasive species affecting woody plants and on completion of annual neonicotinoid course. Reduced-risk insecticide labeled for control of aphids, adelgids, European pine sawfly, caterpillars, leafminers, mealybugs, leafhopper, plant bugs, psyllids, scale insects,

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 plantings 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 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 plantings 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

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
***Buxus* (boxwood)** *(continued)*	
Canker caused by *Fusarium* spp. or *Volutella buxi*	Prune infected branches back to healthy wood, and fertilize and protect from winter injury; avoid wounding plants. Apply lime sulfur for Fusarium or Volutella stem canker. Daconil WeatherStik, Daconil Ultrex and *Spectro 90 WDG are labeled for Volutella, but do not list boxwood. Prior to making any broad-scale application, the user should test for possible phytotoxic responses, using recommended rates on any ornamental plant type not shown on this label, but found in a similar use site with a listed disease problem. *Lesco Twosome is labeled for Fusarium on nursery grown plants only. Follow label directions.
Phytophthora root rot caused by *Phytophthora* spp.	Rogue diseased plants. Treat remaining plants with metalaxyl-m (mefenoxam), Banol Fungicide or fosetyl-Al or *Pageant Intrinsic‡ per label directions or use an appropriate formulation of one of the mono-and di-potassium salts of phosphorus acid labeled for the site.
***Carpinus* (hornbeam)**	
Anthracnose caused by *Apiosporopsis carpinea* (Plate 53, ***55***) (formerly *Gnomoniella carpinea*; conidial state=*Monostichella robergei*)	Disease is occasionally severe in wet years but rarely threatens tree health unless cankers occur on main stems on first- or second-year stock. Excess fertilization, especially with nitrogen, may increase disease incidence.
***Carya* (hickory)**	
Gnomonia Leaf Spot caused by *Gnomonia caryae* (Plate 49, ***51***)	Destroy or compost fallen leaves in autumn. Symptoms occur so late in the season that tree health is not threatened and sprays are usually not necessary. In unusually severe cases, apply mancozeb or *Junction‡ at budbreak and twice thereafter at two-week intervals to reduce disease incidence.
Downy leaf spot caused by *Microstroma juglandis* (Plate 54, ***125***)	Apply *Junction‡ at first sign of disease and again at 7- to 14-day intervals as needed.
***Catalpa* (catalpa)**	
Leaf spots caused by several fungi	Sprays usually not necessary. Destroy or compost fallen leaves.
***Celtis* (hackberry)**	
Witches'-broom caused by *Podosphaera phytoptophila* (syn. *Sphaerotheca phytoptophylla* and an eriophyid mite (Plate 5, ***6***)	Myclobutanil, or neem oil may be used to control the powdery mildew. *C. jessoensis*, *C. sinensis*, and *C. laevigata* are reported to be resistant.
***Cercis* (redbud)**	
Canker caused by *Botryosphaeria* spp. (Plate 81, ***59-62***)	Prune and destroy affected branches during dry weather. Avoid injuries by humans and insects.
***Chaenomeles* (quince)**	
Fire blight caused by *Erwinia amylovora*	Destroy nearby neglected pear, apple, and quince. Prune out infected parts when plants are dry, making each cut several inches below areas of visible discoloration. Disinfect pruning tools between each cut.
Leaf spot caused by *Entomosporium* sp. (Plate ***38***) (Fabraea leaf spot)	Rake and destroy fallen leaves. Apply thiophanate-methyl, Camelot O‡, chlorothalonil, *Spectro 90 WDG‡, myclobutanil, or mancozeb per label directions.

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*)			
Thiophanate-Methyl (*1*)			
*ArmorTech TM 462 (NuFarm)	228-626	N, L	12
*ArmorTech TM 462F (NuFarm)	86064-9	N, L	12
*3336 F (Cleary Chemical)	1001-69	N, L	12
*3336 EG (Cleary Chemical)	1001-89	N, L	12
*T-Methyl SPC 4.5 F (Nufarm)	228-626	N, L	12
*Lesco T-Storm Flowable (Nufarm)	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*)			
Tide Triadimefon 43 SC (Tide)	84229-55	N, L	12
Broad-spectrum fungicide with some systemic activity for control of foliage diseases and some rusts. Product is also labeled for specific diseases on Christmas trees (excluding concolor fir).			
Trichoderma (*T. harzianum* var. Rifai and/or *T. virens*) (*NC*)			
Rootshield Granules (BioWorks)	68539-3	N, L	4
Rootshield WP Biological Fungicide (BioWorks)	68539-7	N	4
Rootshield Plus WP (BioWorks)	68539-9	N. L	4
Rootshield Plus Granules (BioWorks)	68539-10	N	4
Biological fungicide for use in nursery planting mix, when transplanting ornamentals, or as a nursery soil drench to protect plants from roots pathogens such as *Cylindrocladium, Fusarium, Pythium, Rhizoctonia,* and *Thielaviopsis*. See labels for detailed description of REI requirements.			
Trifloxystrobin (*11*)			
Compass Fungicide (Bayer)	432-1371	N, L	12
Trifloxystrobin acts mainly as a preventive fungicide. **Warning:** Trifloxystrobin is of the strobilurin chemical class. To discourage development of resistant pests, alternate sprays with another product with a different mode of action between every one or two treatments, as directed on the label.			

NOTES: W or WP = wettable powder; E or EC = emulsifiable concentrate; F, FL, Flo = flowable, LF = liquid flowable; DF = dry flowable; DG or WDG = water-dispersible granules; WSP or WSB = water-soluble packet or bag; G = granular; S = soluble; AS = aqueous suspension, T/O or T&O = turf and ornamental.

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 means 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.

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: UPL NA

EPA Reg. No.: 70506-139

*Restricted use pesticide.

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	Devrinol	*Dimension	Fuerte	Goal 2XL	*Kerb	*† Marengo/*† Specticle	OH2	Pendulum	*† Pennant Magnum	Princep	*Ronstar	Surflan	Treflan	XL
Broadleaves *(continued)*																			
Euphorbia hirta	spurge, garden					ful		ful			ful	ful			ful				
Euphorbia maculata	spurge, spotted		ful	ful		ful		ful		ful	ful	ful				par		par	
Euphorbia spp.	spurge						ful					ful							
Euphorbia supina	spurge, prostrate	ful						ful			ful	ful			ful				
Galinsoga ciliata	galinsoga, hairy			ful			ful						ful		par				
Gallium aparine	bedstraw, catchweed							ful											
Gnaphalium falcatum	cudweed, narrowleaf																		
Gnaphalium spp.	cudweed		ful							ful	ful	ful							
Helianthus tuberosus	artichoke, Jerusalem																		
Hypochoeris radicata	catsear, spotted														ful				
Ipomea hederacea	morningglory, ivyleaf			ful			ful	par											
Ipomea purpurea	morningglory, tall			ful			ful	par											
Ipomea spp.	morningglory, annual						ful		ful					ful		par		par	
Kochia scoparia	kochia	ful		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																		
Lepidium perfoliatum	pepperweed, yellowflower							ful						ful					
Lepidium virginicum	pepperweed, Virginia		ful							ful	ful			ful					
Malva spp.	mallow			ful			ful	ful	ful						ful	par		par	
Marchantia spp.	liverwort			ful			par								par				
Matricaria matricarioides	pineappleweed			ful	ful	ful	ful							ful					
Medicago hispita	burclover			ful			ful	ful						ful					
Medicago lupulina	medic, black					ful				par									
Mollugo verticillata	carpetweed	ful		ful	ful	ful	ful	ful	ful			ful	ful	ful	ful	ful	par	ful	
Montia perfoliata	lettuce, miners																		
Moss (several genera)	moss			ful			ful												
Oenothera laciniata	eveningprimrose, cutleaf									ful					par				
Oenothera spp.	eveningprimrose									ful		ful			par				
Oxalis corniculata	woodsorrel, creeping					ful	ful												
Oxalis stricta	woodsorrel, yellow	ful	ful	ful		ful	ful	ful		par	ful	ful			ful	ful		ful	
Physalis spp.	groundcherry							ful											
Plantago spp.	plantain species			ful			ful			ful									
Polygonum aviculare	knotweed, prostrate	ful			ful	ful		ful	ful	ful		ful				ful	ful	ful	
Polygonum convolvulus	buckwheat, wild							ful		ful									
Polygonum pensylvanicum	smartweed, Penn.			ful				ful				ful		ful	ful	par		par	
Polygonum persicaria	ladysthumb/smartweed			ful			ful	ful								par		par	
Portulaca oleracea	purslane, common	ful		ful	ful	ful	ful	ful	ful	ful		ful	par	ful	ful	ful	ful	ful	
Raphanus raphanistrum	radish, wild																		
Richardia scabra	pusley, Florida	ful		ful								ful	ful	ful		ful	par	ful	
Rumex acetosella	sorrel, red							ful	par										
Rumex crispus	dock, curly									ful									
Sagina procumbens	pearlwort, birdeye		ful	ful			ful				ful								
Salsola kali	thistle, Russian			ful	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 *[F] Indicates a federally 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	no	*†Pennant Magnum	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Several (f/c)	Few (f/c)	Few (f)	Several (f)
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
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 (Surflan XL)	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 Gran-ular**	**Pre or Post**	**Plant Types that may be found on the Label ***Check Label for Species***					**Weeds Controlled**	**Appli-cation**	**Post-Plant Interval**	**Residential landscape restrictions[3]**
				Turf	**An-nuals**	**Peren-nials**	**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	

Table 4.10.3. Selected Approved Uses in NYS Under FIFRA Section 2(ee) Recommendations

Always review and follow label directions, restrictions, and precautions. The FIFRA 2(ee) label must be in the possession of the user at the time of application. Permits and possession of other publications may be required as well; see 2(ee) label for all requirements. See Section 1.10 for more information.

Trade Name	EPA Reg. No.	Target	Site(s)	Comments
Roundup Pro	524-475	Cup Plant	All labeled sites	
Roundup Pro	524-475	Hardy Kiwi	All labeled sites	
Roundup Pro	524-475	Japenese Stiltgrass	All labeled sites	
Roundup Pro	524-475	Kiwifruit & Silver Vine	All labeled sites	
Roundup Pro	524-475	Saphire Berry	All labeled sites	
Roundup Pro	524-475	Scotch Broom	All labeled sites	
Roundup Pro	524-475	Sticky Sage	All labeled sites	
Roundup Pro	524-475	Wisteria	All labeled sites	
Roundup Pro	524-475	Yellow Archangel	All labeled sites	
Roundup Pro	524-475	Black Jetbead	All labeled sites	
Roundup Pro Concentrate	524-529	Giant Hogweed	All labeled sites	Apply 1.6 to 4 qt. per acre as a foliar spray.
Roundup Pro Concentrate	524-529	Ferns, Striped Maple, Hophornbeam	All labeled sites	
Roundup Pro Concentrate	524-529	Five-leaf Aralia	All labeled sites	
Roundup Pro Concentrate	524-529	Japanese Tree Lilac	All labeled sites	
Roundup Promax	524-579	Katsura trees	Non-crop and others	
Roundup Promax	524-579	Giant Hogweed	All labeled sites	Apply 1.5 to 3.3 qt. per acre as a foliar spray.
Roundup Promax	524-579	Black Swallow-wort, Pale Swallow-wort	Forests and non-crop sites	Apply a 2% solution with hand-held equipment.
Sightline	74779-8	Japanese & Giant Knotweed	Industrial, non-crop	
*†Stinger	62719-73	Mugwort	Rangeland, pasture, Conservation Reserve Program areas, non-crop areas	0.25lb./A a.i. max/year
*†Stinger	62719-73	Brown Knapweed, Meadow Knapweed	Rangeland, pasture, Conservation Reserve Program areas, non-crop use areas	Do not apply more than 2/3 pint per acre per year.
*Vastlan	62719-687 (SLN NY-160004)	Japanese Tree Lilac, Five-leaf Aralia, Wineberry	All labeled sites	Must be used only in conjunction with SLN NY-160004
*Vastlan	62719-687 (SLN NY-160004)	Wild Parsnip and several unlabeled woody weeds	All labeled sites	Must be used only in conjunction with SLN NY-160004

* = Restricted use pesticide.
† = Not for use in Nassau and Suffolk Counties.

4.11 Scientific Name Cross-references

Table 4.11.1. Cross-reference for ornamental scientific names

Common name	Genus, species
Abelia, glossy	*Abelia grandiflora*
almond, flowering	*Prunus glandulosa*
andromeda species	*Pieris* spp.
andromeda, Japanese	*Pieris japonica*
apple	*Malus* spp.
arborvitae species	*Thuja* spp.
arborvitae, American	*Thuja occidentalis*
arborvitae, oriental	*Thuja orientalis*

Table 4.11.1. Cross-reference for ornamental scientific names

Common name	Genus, species
ash species	*Fraxinus* spp.
ash, green	*Fraxinus pennsylvanica*
ash, mountain	*Sorbus* spp.
ash, white	*Fraxinus americana*
azalea species	*Rhododendron* spp. (azalea)
azalea, Carolina	*Rhododendron carolinianum*
azalea, Chinese	*Rhododendron molle*
azalea, indica	*Rhododendron indicum*

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.