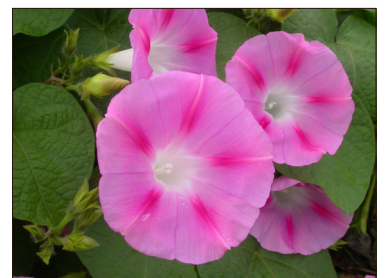




2017 Southeastern U.S. **Pest Control Guide for Nursery Crops and Landscape Plantings**



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Cover photo credits: Azalea lace bug photo by Dr. Matt Bertone, North Carolina State University. Azalea foliage damaged by gramoxone spray drift, container nursery, and morningglory flowers by Joseph C. Neal.



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Preface

This pest control guide was a project of the Southern Nursery IPM Working Group (SNIPM) and collaborators. It is intended to provide up to date information about pest control products used in nursery crops and ornamental landscape plantings, and as a supplement to the more comprehensive integrated pest management (IPM) manuals for trees and shrubs available for download from the SNIPM web site, <https://wiki.bugwood.org/SNIPM>. Recommendations for the use of agricultural chemicals are included in this publication as a convenience to the reader. The use of brand names and any mention or listing of commercial products in this publication does not imply endorsement by SNIPM, the authors, or their respective universities, nor discrimination against similar products not mentioned. Individuals who use agricultural chemicals are responsible for ensuring that the intended use complies with current regulations and conforms to the product label. Recommendations of specific chemicals are based on information on the manufacturer's label and performance in a limited number of trials. Because environmental conditions and methods of application by growers may vary widely, performance of the chemical will not always conform to the safety and pest control standards indicated by experimental data. The information provided in this publication is, as much as possible, up to date at the time of publication. However, product registrations can differ between states and labels can change. Thus, this information is intended as a guide to aid in pest control decision-making and not a substitute for reading and following the directions and guidelines on the pesticide label.

USEFUL PHONE NUMBERS

Chemical Transportation Emergency Center (CHEMTREC)

800-262-8200

CHEMTREC offers 24-hour information and help to aid in responding to emergencies involving hazardous chemicals.

National Pesticide Information Center

800-858-7378

NPTN provides information by phone about pesticides Monday through Friday, 8 a.m. to 6 p.m., Central Time.

POISON CENTERS

Poison Centers can provide advice on diagnosis and treatment of human illness resulting from toxic substances.

Alabama Poison Center	https://www.childrensal.org/rpcc	1-800-222-1222
Carolinas Poison Center	http://www.ncpoisoncenter.org/	1-800-222-1222
Florida Poison Center	http://floridapoisoncontrol.org/	1-800-222-1222
Georgia Poison Center	http://www.georgiapoisoncenter.org/	1-800-222-1222
Kentucky Poison Center	http://www.krpsc.com/	1-800-222-1222
Mississippi Poison Center	https://www.umc.edu/poisoncontrol/	1-800-222-1222
Tennessee Poison Center	https://ww2.mc.vanderbilt.edu/poisoncenter/	1-800-222-1222
Texas (Central) Poison Center	http://poisoncontrol.org/home/	1-800-222-1222
Virginia Poison Center	http://poison.vcu.edu/	1-800-222-1222 Local: (804) 828-9123

MISUSE OF PESTICIDES

It is illegal to use any pesticide in a manner not permitted by its labeling. All recommendations for pesticide use included in this manual were legal at the time of publication, but the status of registration and use patterns are subject to change by actions of state and federal regulatory agencies.

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1. Principles of Integrated Pest Management

What Is IPM?

Integrated Pest Management (IPM) can be defined as a sustainable approach to managing pests by combining cultural, biological, and chemical tools in a way that minimizes economic, aesthetic, health, and environmental risks. A first step in implementing an effective IPM program is to maintain healthy, vigorous plants, which are much less likely to have pest problems. Therefore, an integrated pest management program will also consider cultural practices that lead to healthy and resilient plantings.

When pest outbreaks occur, one key element of IPM is “managing pests” rather than “eradicating pests.” Each grower or landscape maintenance professional must realize that one cannot completely eradicate all pests. Instead, the aim is to reduce pest levels to less than damaging populations. Another key element of IPM is to combine different management and control strategies. Reliable pest control rarely depends on a single control strategy. Rather, integrating cultural and chemical control practices into a comprehensive management plan will result in better control and reduced impacts on the environment. Part of this integration is to conserve beneficial organisms, such as predatory and parasitic arthropods, that can suppress pest populations. However, chemical control measures (pesticides) are often needed to produce and maintain quality crops. Pesticides should be applied only when needed, based on scouting results. Pest scouting should be a formalized process with appropriate record-keeping. Maintaining good records of pest outbreaks can assist in planning improved management strategies.

The decision to take some action against a pest, such as applying a pesticide, is based on an understanding of the level of damage a plant can tolerate without an unacceptable economic loss. Ornamentals can withstand little pest damage because of the aesthetic qualities they must possess, as well as their need to pass plant inspections when being shipped out of state. For pest regulated pest species, a single individual may be enough to justify the application of a pesticide. However, for most pests such as aphids, spider mites, and caterpillars, many individuals must be present to justify the cost of a pesticide application.

When pesticide treatments are needed, select effective products. First, accurately identify the pest(s) and use the information included in this guide to help select a pesticide that is efficacious. Ensure also that the pesticide is applied at the proper developmental growth stage or season to achieve the desired outcomes. It is important to choose the least-toxic pesticide, especially if beneficial species or pollinators are present. In addition to information about other environmental hazards and precautions, pesticide labels now include guidelines for pollinator protection. Apply the pesticide in a manner consistent with the label and in a manner that avoids off-target deposition. To prevent pesticide resistance from developing, rotate pesticides with different modes of action when multiple applications are required. Different brand names and active ingredients do not ensure different modes of action. Two pesticides with different active ingredients may have the same mode of action; using these products consecutively to the same area is not rotating. The Fungicide Resistance Action Committee (FRAC, www.frac.info), Insecticide Resistance Action Committee (IRAC, www.irac-online.org), and Weed Science Society of America (WSSA, <http://www.wssa.net>) have grouped pesticides into mode of action categories, which are listed in this guide to aid in the development of resistance management programs.

Pollinator Protection

Before making insecticide applications, monitor insect populations to determine if treatment is needed. If insecticide application is necessary, follow these guidelines:

- Use selective pesticides to reduce risk to pollinators and other non-target beneficial insects.
- Read and follow all pesticide label directions and precautions. The label is the law! The Environmental Protection Agency (EPA) now requires the addition of a “Protection of Pollinators” advisory box on certain pesticide labels. Look for the bee hazard icon in the Directions for Use and within crop specific sections for instructions to protect bees and other insect pollinators.
- Minimize in-field exposure of bees to pesticides by avoiding applications when bees are actively foraging in the crops. Bee flower visitation rate is highest in early morning. Apply pesticides in the late afternoon or early evening to allow for maximum residue degradation before bees return the next morning. Bee foraging activity is also dependent upon time of year (temperature) and stage of crop growth. The greatest risk of bee exposure is during bloom.
- Minimize off-target movement of pesticide applications by following label directions to minimize off target movement of pesticides. Do not make pesticide applications when the wind is blowing towards bee hives or off-site pollinator habitats.

Additional details about nursery crop and landscape IPM are available from your local Cooperative Extension Service and in the following publications from the Southern Nursery IPM Working Group.

IPM for Select Deciduous Trees in Southeastern US Nursery Production

https://wiki.bugwood.org/IPM_book

IPM for Shrubs in Southeastern US Nursery Production: Vol. I

https://wiki.bugwood.org/IPM_Shrub_Book

IPM for Shrubs in Southeastern US Nursery Production: Vol. II (coming soon)

<https://wiki.bugwood.org/SNIPM>

2. Pesticide Use and Safety Information

Wayne Buhler

NC State University

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The Safe Use of Pesticides

Wayne Buhler, Pesticide Education Specialist

General Safety Instructions

Guidelines for pesticide safety and use are available from the Pesticide Environmental Stewardship Alliance
<http://pesticidestewardship.org/Pages/default.aspx>

- Use pesticides only when needed.
- Always ask the advice of an expert on problems of pests and pesticides.
- Use the correct pesticide for the problem.
- Know any hazards that the pesticide might present.
- Read and follow the label.
- Commercial pest control operators, farmers, and other applicators of organophosphate and carbamate pesticides should contact their physician at the beginning of the season. At this time, you should inform the physician of the types of pesticides you will be using. The physician will determine the level of enzymes in your blood that may be affected by the use of certain pesticides. While discussing the pesticides to be used, review the signs and symptoms of pesticide poisoning.
- Know what to do in the event of an accident. *Plan ahead.* Call your physician or 911 immediately in the event of an accident.
- Have your physician's phone number programmed into your phone. In an emergency, time is extremely important.
- Take time to explain safe pesticide use to employees.
- Check your application equipment for leaks or clogged lines, nozzles, and strainers.
- Calibrate equipment frequently for proper output, using water.
- Check respirator for cleanliness, clean filter, and proper fit.
- Check gloves and other protective clothing for holes and cleanliness before each use.
- Make sure plenty of clean water, detergent, towels, and a clean change of clothing are available.
- Do not permit delivery of pesticides unless a responsible representative is on hand to receive and properly store them.
- Make sure that people have been warned and livestock and pets that may be exposed have been removed from the area to be treated.
- Notify beekeepers who maintain beehives in the vicinity of a pesticide application.
- Cover food and water containers.
- Never eat, drink, or smoke when handling pesticides.
- Wash your hands before eating, smoking, or drinking.
- Make sure the time intervals between date of application and reentry, harvest, slaughter, or milking will comply with those given on the label.
- Rinse pesticide containers before recycling or disposal. (Put rinsate in sprayer tank.)

Select the Appropriate Product

Pesticides are classified according to their hazard potential to humans, animals, and the environment. Hazard potential to humans is based on animal test results and/or use experience. Each pesticide is identified with one of the following signal words: "**DANGER**," "**WARNING**," or "**CAUTION**."

"**DANGER**" on the label tells you the product has the highest toxicity to humans. The word "**POISON**" (in red) and the skull and crossbones are also required on the label of highly toxic materials. If "**DANGER**" is printed on the label without the word "**POISON**" and the skull and crossbones symbol, the pesticide can cause severe skin injury or irreversible eye damage.

"**WARNING**" identifies products with moderate toxicity.

"**CAUTION**" identifies those pesticides that are least toxic to humans.

Table 2-1 further defines pesticide label signal words.

Signal Word on Container	Toxicity to Humans	Amount Required to Kill an Adult if Swallowed
CAUTION	Slightly toxic	An ounce to a pint
WARNING	Moderately toxic	A teaspoon to an ounce
DANGER*	Very toxic	A taste to a teaspoon

*DANGER with the word "poison" and the skull and crossbones symbol means the pesticide is very toxic if swallowed or inhaled. Without the word "poison" and the skull and crossbones symbol, DANGER usually means that a pesticide has a high potential as a skin or eye irritant.

Contrary to common belief, the signal word **DOES NOT** tell you how well a pesticide will control a pest. For example, “**DANGER**” means the pesticide can be more dangerous to *you*, not that it is more toxic to pests than a product labeled “**CAUTION**.”

Because of the risks involved in handling, many of the very hazardous pesticides have been “**RESTRICTED**” and can be bought and applied only by or under the direct supervision of certified or licensed individuals. These pesticides bear the words “**RESTRICTED USE PESTICIDE**” on the label.

Follow Label Directions

The label tells you how to use the pesticide properly and safely. Use a pesticide only on crops, animals, or other sites as the label directs. **Use the recommended rate, and apply the pesticide at the time and in the manner stated.**

Obey all precautions for using a pesticide safely, such as “Keep out of reach of children;” “Keep away from pets;” “Do not use near fire, sparks, or flame;” “Do not inhale, ingest, or allow to get on skin;” “Do not store near food, feed, seed, or animals;” “Do not contaminate water supplies;” and any other warnings on the label.

Wear Protective Clothing Called for on the Label

While people generally realize the danger in getting pesticides in the mouth or eyes or breathing gaseous fumes, they are frequently unaware of how harmful many pesticides are when absorbed through the skin. Anytime you handle or apply pesticides, wear at least a long-sleeved shirt and long-legged trousers made of a closely woven fabric, socks, and liquid-proof shoes. Wear personal protective equipment listed on the label.

With most **DANGER**- and **WARNING**-labeled pesticides, a respirator covering the nose and mouth and goggles or a face shield protecting the eyes are necessary. Again, the label will tell you the kind of protective equipment you need.

Use Proper Application Equipment

You cannot apply a pesticide properly or safely unless you have the correct equipment. Small jobs around the home with less hazardous pesticides may be done with simple equipment such as a pump-up sprayer, hose attachment sprayer, granular applicator, or hand duster. Larger jobs and those where more hazardous materials are used often require specially designed equipment. Contact your county Cooperative Extension Service agent, pesticide dealer, or equipment dealer if you need further advice on proper equipment for applying pesticides.

Know Emergency First-Aid Procedures

In case of suspected poisoning — stomach cramps, dizziness, vomiting, heavy sweating — follow the label’s first-aid advice and **IMMEDIATELY** call a doctor or take the person to a hospital. Take the pesticide label with you because the doctor needs it to prescribe the proper treatment.

If you spill a pesticide on yourself, remove any contaminated clothing immediately. Wash skin immediately with soap and water. **DO NOT USE AN ABRASIVE OR PETROLEUM-BASED CLEANER**, as this would allow the pesticide to penetrate your skin more easily. If an individual is exposed to pesticide vapors, get him to fresh air. Start artificial respiration if the person has stopped breathing. If a pesticide is splashed in the eyes or mouth, rinse it out with large quantities of clean water for at least 15 minutes. If swallowed, read the label to see if you should induce vomiting (this could be harmful, depending on the pesticide). Never give anything by mouth to an unconscious individual.

The doctor may want to call a poison control center for specific treatment of pesticide poisoning. (The number of the Carolinas Poison Center is **1-800-222-1222**.)

Hazard and Toxicity of Pesticides

Do not depend on toxicity values as the *only* factor to be considered regarding the hazards of a chemical to people or other animals. Pesticide users should be concerned with the *hazard(s)* associated with exposure to the chemical and not the *toxicity* of the material itself. Hazard and toxicity are not synonymous.

Toxicity is the inherent capacity of a substance to produce injury or death.

Hazard is a function of two primary variables, *toxicity* and *exposure*, and is the potential threat that injury will result from the use of a substance in a given formulation or quantity. Some hazards do not involve toxicity to people or other animals. For example, sulfur, oils, and numerous other chemicals are considered relatively non-hazardous to animals, but may pose considerable hazard to some plants (phytotoxicity).

A pesticide may be extremely toxic but present little hazard to the applicator or others when used:

- in a very dilute formulation;
- in a formulation that is not readily absorbed through the skin or readily inhaled;
- under conditions to which humans are not exposed;
- only by experienced applicators who are properly equipped to handle the chemical safely.

However, a chemical may exhibit a relatively low mammalian *toxicity* but present a *hazard* because it is normally used in a concentrated form, which may be readily absorbed or inhaled.

Pesticide Toxicity to People

Most pesticides are harmful to people if they are handled or applied in an unsafe way. A pesticide may harm a person if it is:

- swallowed (oral toxicity);
- breathed (inhalation toxicity);
- allowed to get on the skin or in the eye (dermal toxicity).

Children may be poisoned if a pesticide is left where they can eat it, play in it, or drink it. Pesticides should not be stored in unlabeled containers, such as soft drink bottles. A few pesticides give off harmful vapors that must not be breathed. Some applicators are poisoned when they allow pesticides to contact their skin. Oil-based pesticides (such as emulsifiable concentrates) penetrate the skin in greater quantity and more quickly than dusts, granules, or wettable powders. Sun-burnt or hot, sweaty skin with cuts or abrasions allows more rapid penetration.

Pesticide Hazards to the Environment

A pesticide may not affect people the same way it does the environment. Some pesticides may not harm the environment, even though they are moderately to highly hazardous to people. And some pesticides that are only slightly hazardous to people may cause greater environmental damage. A restricted use pesticide may be hazardous to people, the environment, or both.

A given pesticide may be hazardous in the air (particle or vapor drift), soil, or water. It may leave harmful residues in food or injure non-target plants and animals, such as fish, bees, birds, other wildlife, and domestic animals.

Some pesticides are potentially more harmful to the environment because they last for a long time once they are applied. Others may accumulate in the body and cause poisoning. Most uses for persistent, accumulative pesticides (such as DDT) have been cancelled in the U.S. Some uses of other persistent pesticides are now restricted.

Wildlife Exposure: Managing the Risk

Wildlife may contact residues of pesticides applied to forests, aquatic habitats, farmland, rights-of-way, turf, and gardens. Pesticide poisonings to wildlife may be caused by runoff to surface water during rainfall, spray drift, foraging on pesticide-treated vegetation or insects, or consumption of pesticide-treated granules, baits, or seeds. Also, secondary poisoning occurs when an animal eats prey species that contain pesticide residues.

Fortunately, not all pesticides have detrimental effects on all wildlife, nor do pesticide residues necessarily have serious consequences for wildlife. Before using pesticides, get advice from wildlife, conservation, and pesticide professionals at universities and state and federal agencies on the choice and proper use of pesticides and alternative pest control strategies. Also, consider strategies to improve wildlife habitats.

Implementing the following suggestions will benefit wildlife while allowing you to control pests. As you look over the suggestions, keep in mind that you must also be in compliance with all pesticide product labels. North Carolina Pesticide Law of 1971 Article 52 G.S. 143, and 2 NCAC 9 L regulations.

Be Careful Around Natural Areas

- All wildlife need natural areas in which to feed, rest, reproduce, raise young, and take shelter. Create habitats by encouraging and promoting the growth of native vegetation. This also reduces the need for mowing.
- Plant disease- and insect-resistant trees and shrubs, thereby reducing the need for pesticides.
- Always store pesticides and wildlife feed separately, and do not feed wildlife near pesticide storage and mixing areas.

Wildlife Benefit When You Understand and Follow Pesticide Labels

- Keep wildlife habitats in mind when reading pesticide labels.
- Compare labels and select highly specific products that pose less risk to nontarget species. Read the label carefully, and use the lowest effective rate.
- Calibrate equipment carefully to assure that the pesticide is applied at labeled rates.
- Get the EPA *Endangered Species Protection* county bulletin from the Web at <http://www.epa.gov/espp> (click on "Bulletins Live! Two") or by calling 1-800-447-3813. Follow the limitations in the bulletin. Also, check regulation 2 NCAC 9L .2200 on pesticide use limitations to protect the Carolina heelsplitter freshwater mussel.
- Take heed of the label. The environmental wildlife precautions on labels are based on scientific and regulatory actions. They must be followed. It's the law, it's good business, and it's the right thing to do.
- Consult the NCDA&CS Structural Pest Control and Pesticides Division or your county Cooperative Extension center for label clarification or to determine potential pesticidal impacts on wildlife. Consult natural resource agencies, natural heritage programs, and the Nature Conservancy for additional information about wildlife, native vegetation, and endangered species.

Be Alert for Wildlife Before and During Pesticide Application

- Avoid spraying near areas frequented by wildlife, especially flocks of birds, or, if possible, reduce the application rates.
- Homeowners should search for bird and mammal nests before spraying fruit or ornamental trees, shrubs, or lawns, and then avoid applications near those areas.
- Use mechanical, cultural, and biological pest control tactics when available and practical. For example, tillage, crop rotation, pest-resistant plants, natural predators, and trapping can help control pests.
- Scouting and pest identification are critical components of wise pesticide use. To save money and reduce impacts on wildlife, apply pesticides only when pests are present at unacceptable levels.
- Remember to guard against pesticide drift and runoff. Apply pesticides under low, directional wind conditions, and use adjuvants when appropriate. Buffer zones of unsprayed crops or grass strips adjacent to important habitats will help protect wildlife.
- Do not apply pesticides when heavy rain is imminent. Surface runoff may move some pesticides into ponds, streams, and wetlands inhabited by wildlife. In urban areas, such runoff may flow into storm drains leading directly to streams and rivers.
- Multiple pesticide applications may have cumulative effects, especially during breeding season. Reduce application frequency when possible, and target each application to the specific site of the pest instead of making applications over entire fields or lawns. Spot treating weeds and insects in lawns and gardens will reduce the amount of pesticide applied.

- Where practical, do not apply pesticides in and around field edges and corners, fencerows, set-aside acreage, nesting sites, vegetation near streams and wetlands, and areas dedicated to wildlife except to spot treat state-listed noxious weeds. Especially sensitive areas include endangered species habitats, native plant communities, and sinkholes.
- Check the label for instructions on incorporating or watering pesticide granules into the soil. These techniques allow the pesticide to reach the target pests more readily, and foraging birds are less likely to ingest them.
- Never spray leftover pesticides or wash equipment near wetlands, rivers, streams, creeks, potholes, ponds, marshes, sinkholes, wildlife habitats, or drains leading to these areas. Dispose of leftover pesticide as specified on the label.
- For rules and guidelines on protecting honey bees, see section on Bee Protection below and in Chapter 5, Reducing the Risk of Pesticides Poisoning to Honey Bees.
- For additional information, contact your county Cooperative Extension center or call the NCDA&CS Structural Pest Control and Pesticides Division at 919-733-3556. You may also be interested in the Extension publication AG-463, *Pesticides and Wildlife* and the AG-463 fact sheet series on using integrated pest management on specific crops, including soybeans, tobacco, cotton, and peanuts. Publications are available through county Extension centers.

This section was written by Henry Wade, Environmental Programs Manager, NCDA&CS, Structural Pest Control and Pesticides Division.

Hazardous Chemicals Right-to-Know Act

The Hazardous Chemicals Right-To-Know Act (N.C.G.S. 95-173 *et seq.*) was adopted by the N.C. General Assembly in 1985. The purposes of this act are (1) to see that firefighters have all the information they need to respond to chemical emergencies and (2) to ensure that citizens have access to sufficient information to make informed judgments about hazards in their communities.

Public and private employers who normally use or store at least 55 gallons or 500 pounds of any hazardous chemical must comply with this law. Although the full requirements of this act do not apply to farms with 10 or fewer full-time employees, the employer must tell fire departments whom to contact in case of emergency.

If you receive a Safety Data Sheet (SDS) with a product you purchase, you will know the material has been classified as hazardous. The SDS gives health-related information, emergency and first-aid procedures, and other information needed to use, store, and dispose of the chemical properly.

Restricted Use Pesticides

Wayne Buhler, Pesticide Education Specialist

Because of their potential to cause adverse effects on human health and the environment, many very hazardous pesticides are classified **RESTRICTED USE** by the U.S. Environmental Protection Agency (EPA). For an updated list of these pesticides, visit <https://www.epa.gov/pesticide-worker-safety/restricted-use-products-rup-report> and click on the link for "RUP Updated List." The label states **RESTRICTED USE PESTICIDE**, as indicated below.

Restricted Use Pesticide

For retail sale to and use only by certified applicators or by persons under their direct supervision and only for those uses covered by the certified applicator's certification.

Pesticide formulations labeled RESTRICTED USE PESTICIDE can only be sold in North Carolina by licensed dealers and purchased or used by licensed commercial applicators, public operators, certified or licensed structural pest control applicators, and certified private pesticide applicators, or by persons working under their direct supervision.

Local Need — 24 (c) Registrations

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Section 24(c) authorizes each state pesticide regulatory agency to register an additional use of a federally registered pesticide product or a new end use product to meet a special local need if certain conditions exist... These products can be used for the purposes listed and as detailed on the supplemental labels.

North Carolina Worker Protection Standard Regulations

The Worker Protection Standard (WPS) requires the agricultural employer to reduce the risks of pesticide exposure for farmworkers by providing them with specific pesticide safety training, personal protective equipment, application notification, and a means to mitigate pesticide exposure through emergency assistance. The primary requirements for compliance are listed below.

- Provide annual pesticide safety training to both workers and handlers.
- Provide label-specified personal protective equipment to the appropriate employees, including respirators, fit tests, and training
- Ensure no entry into treated area or the application exclusion zone (AEZ), which is an area up to 100 feet surrounding application equipment, during pesticide application on farms, forests, and nurseries.
- Post warnings, oral notification, or both to inform employees of pesticide applications, restricted entry intervals (see below), and restricted areas.
- Provide the following safety information at a central location and at sites where decontamination supplies are located (if the decontamination supplies are at a permanent site).
 1. Emergency medical information (name, telephone numbers, and address of nearest medical facility);
 2. SDS sheets and pesticide-specific information (location of the area to be treated, product name, EPA registration number, active ingredient(s) of pesticide, time and date the pesticide is scheduled to be applied and time and date the application was completed, and the restricted-entry interval for the pesticide). Each day of application must be recorded as a separate application record. Recorded information must be retained for a period of 2 years and made available to any employee, treating medical professional, or designated representative who requests it.
 3. The WPS pesticide safety information poster. This no longer needs to be displayed as a poster as long as the following information is included: 7 concepts for preventing pesticides from entering your body; instructions for employees to seek medical help immediately if they have been poisoned, injured or made ill by pesticides; name, address and phone of state or tribal pesticide regulatory authority; and name, telephone and address of nearby medical facility.
- Provide ample supplies at designated decontamination stations (single-use towels, soap, water, and clean change of clothing).

Restricted Entry Intervals

The restricted entry interval (REI) is the time after the end of a pesticide application when entry into the treated area is prohibited. The agricultural employer must not allow or direct any worker to enter or remain in the treated area before the REI has expired except under the conditions of *early entry*.

Early entry provisions of the Worker Protection Standard (WPS) allow trained and label-specified early entry PPE-equipped workers with a minimum age of 18 to enter a treated area during the REI to perform short-term activities with "limited contact", such as moving irrigation equipment or opening ventilation systems.

The following conditions must be met for "limited contact" early entry activities.

1. Worker's contact with the treated surfaces is minimal and limited to the feet, lower legs, hands, and forearms.
2. Pesticide product does not have a statement in the labeling requiring double notification.
3. PPE for early entry conforms with the label requirements or includes at least coveralls, chemical resistant gloves, socks, chemical resistant footwear, and eyewear, if eyewear is required by the label.
4. No hand labor, such as hoeing, picking, or pruning is performed.
5. The time in the area under REI for any worker does not exceed 8 hours in a 24-hour period.
6. Workers do not enter the area during the first 4 hours after application and not until applicable ventilation criteria and label specified inhalation exposure levels are reached.
7. Agricultural employer must give an oral or written notification of the specifics of the early entry. Notification must be given in a language that workers understand.

Preharvest Intervals

The preharvest interval is the time in days that must pass between the last application of a pesticide and harvesting a food or feed crop. The interval varies with the pesticide, depending largely on its persistence (how long the pesticide lasts) on or in the crop as well as on the pesticide's toxicity.

For example, one insecticide label for peach tree borer on peaches states: "Make only one application per season. Do not apply within 14 days before harvest." Fourteen days is the preharvest interval, and it means peaches cannot be harvested from an orchard where this pesticide has been applied until at least 14 days have passed. If harvested sooner, the peaches cannot be legally sold.

If you do not obey the preharvest interval, your crop can be seized and destroyed, and you can be fined. Most importantly, if crops are harvested and consumed before the preharvest interval has passed, people or animals may be poisoned.

Aerial Application Limitations

If you expect to have your crops sprayed by an aerial applicator, in order to obey N.C. Pesticide Regulations, you must carefully *plan the location of these crops*. Certain areas are restricted, and aerial pesticide applications cannot be made to these areas unless certain rules are followed.

DO NOT SPRAY (or otherwise allow pesticides to be deposited):

1. In any congested area unless permission is granted by appropriate authorities;
2. Within 300 feet of the premises of schools, hospitals, nursing homes, churches, or any building used for business or social activities if either the premises or the building is occupied by people;
3. Within 100 feet of a residence;
4. On a right-of-way of a public road or within 25 feet of the road, whichever is the greater distance;
5. In or near any body of water, if the pesticide is labeled as toxic or harmful to aquatic life, unless such aquatic life is the target of the pesticide.

Farmers can prevent potential problems by not planting crops near those areas just described and by always following directions on the pesticide label concerning the spraying of crops, especially near sensitive and restricted areas. The Bee Protection

section below also reviews the limitations on aerial application.

Bee Protection

Anyone who hires an aerial applicator to apply a pesticide **labeled as toxic to bees shall notify all beekeepers with registered apiaries** located within 1 mile of the area to be treated. This notification must not take place less than 48 hours nor more than 10 days before the application.

A list of beekeepers with registered apiaries may be obtained in one of the following ways.

1. The NCDA&CS Plant Protection Section mails a list of registered apiaries to aerial applicators licensed in North Carolina quarterly. They will also provide the list on request (call 919-233-8214). This list will have the names of any beekeepers who have registered apiaries located within the required 1 mile from the target area.
2. The NCDA&CS Pesticide Section will mail a list of registered apiaries to farmers who have been identified by the beekeeper on the Apiary Registration Form as having farms within 1 mile of the applicable apiary. The failure of a beekeeper to list a farmer on the Apiary Registration Form does not relieve the farmer of responsibility for notifying the beekeeper of an aerial application of a bee-toxic pesticide within 1 mile of the registered apiary.

The list of registered apiaries is mailed on the first day of each quarter. Revised lists will be issued on the first day of each successive quarter. The lists of revised registered apiary locations will become effective on the fifth day of the first month of that quarter. The registration period will be effective for the calendar year and applies only to the listed apiary locations. Moving an apiary to a new site does not provide protection under the law, unless the new site is also registered.

The farmer can notify the beekeeper digitally, orally, or in writing of the approximate time the pesticide application will be made and the type of pesticide to be used. Digital communication may take place thru email or by texting. Oral notification can be by telephone or in person to the beekeeper or the alternate person designated on the apiary registration list. Acceptable written notification is by mail or by notice left at the beekeeper's residence or at an alternate location designated on the apiary registration list.

NCDA&CS has also initiated a free voluntary beehive registration program in coordination with FieldWatch. Growers may register at <http://www.fieldwatch.com> as an applicator and view maps of the area surrounding their farms to help identify local beekeepers. Contact information is available for these beekeepers, and this tool may be used to enhance communication with beekeepers to reduce the adverse effects of pesticide to bees. Growers may also see additional flags or signs to designate the location of apiaries.

Beekeepers who wish to voluntarily map and register their apiaries for free should first go to FieldWatch.com, then complete the registration process thru BeeCheck. Apiaries registered thru Plant Industry will automatically be mapped and registered on BeeCheck.

Growers should be aware of upcoming label changes to 75 active ingredients that have been classified as acutely toxic to bees (products with an LD 50 of <11 micrograms per bee). New labels may place restrictions on pesticide applications when contract pollinators are on site. There are also application restrictions for neonicotinoid products being applied to crops and ornamentals that are blooming and attractive to bees.

Protecting Surface and Groundwater

Groundwater makes up 96 percent of the world's total water resources. Ninety percent of rural residents and 50 percent of the people in the United States depend on groundwater as their source of drinking water. Although only very small amounts of pesticides have been detected in North Carolina's groundwater, we must reduce the likelihood of pesticides entering groundwater and surface water in order to avoid future water quality problems.

What can pesticide users do to prevent groundwater and surface water contamination?

Follow Label Directions Exactly

Pesticide labels provide valuable information concerning the pesticide's potential dangers of contaminating water and the environment. When applying a pesticide, the timing and placement instructions on the label must be followed correctly to ensure that the pesticide is applied properly. Applying a pesticide when heavy rains are predicted could lead to water contamination. Likewise, placing a pesticide on top of the soil, when it should be incorporated, not only minimizes pest control but could lead to unnecessary runoff to surface water and perhaps groundwater.

Use Integrated Pest Management Practices

Cultural practices, such as crop rotation and cover crops, not only reduce pest populations, they also maintain and improve good soil and water conditions. Careful pest monitoring will also ensure that pesticides are used only when needed.

Prevent Spills and Back Siphoning

Pesticides spilled near wells, sinkholes, surface waters, or anywhere else can move into surface water and groundwater. Avoid mixing and loading pesticides near wells and other water sources. Use a long hose from the water source to the sprayer so if any spills occur, they will be farther away from the clean water supply. If a spill occurs, be sure to clean it up and move the contaminated soil to a place where it will not seep into the water or otherwise harm the environment. If contaminated soil cannot be applied to a labeled site that does not exceed the rate of application described on the product label, it must be disposed of at an approved waste disposal facility. When using water from a hose to dilute pesticides in a spray tank, do not allow the hose to be submerged in the spray tank, which can lead to a backflow situation where pesticides may be siphoned back into the water supply. The Chemigation section of this chapter also stresses regulations required to prevent the backflow of pesticides into water supplies.

Dispose of Wastes Properly

It's illegal and dangerous to dispose of pesticides improperly. If pesticides, their containers, or other hazardous materials are discarded where they can contaminate the water supply or environment, you (and your family) could drink pesticide-contaminated water. This contamination could move into your neighbors' or livestock's water supply as well as affect wildlife and conditions of soil and air. Don't take it for granted; many pesticides don't just disappear. Your responsibility for these hazardous materials includes proper disposal.

The guidelines for disposing of such materials can be found first on the pesticide label. Follow these instructions for disposal carefully. (See the sections in this chapter on Disposal of Pesticides and Disposal of Empty Pesticide Containers.)

Surface Water Protection

If there is more water in the soil than the soil can absorb, water (with pesticides in it) may flow into the groundwater or run off into streams, rivers, and lakes. Prolonged heavy rains and too much irrigation will also produce excess surface water. Pay attention to

weather forecasts, maintain proper irrigation scheduling, and use strip crops to restrict potential surface water problems. The chemigation regulations in this manual are also designed to reduce both surface water and groundwater contamination.

Land Characteristics

Geology plays a key role in protecting groundwater and surface water. If groundwater is within a few feet of the soil surface, pesticides are much more likely to reach groundwater. If pesticides are applied to an area that drains into a sinkhole, irrigation or moderate rainfall may carry some of the pesticides directly into groundwater. You must select pesticides carefully when either groundwater is close to the soil surface or soil permeability is great (see Evaluating the Potential for Groundwater Contamination section).

N.C. Well Construction Standards — and in some cases more stringent local regulations relating to well location, casing, grouting, and other requirements — help ensure that groundwater is not contaminated. For example, N.C. regulations require that well casings be at least 12 inches above the soil surface and that casings be cemented at least 20 feet below the soil surface.

Soil Characteristics

Soil texture (sand, silt, clay), soil permeability, and soil organic matter all play a major part in pesticide movement. Soils containing large amounts of organic matter and clay, for example, will hold (absorb) some pesticides before they reach groundwater. But pesticides are more likely to move into groundwater through sandy soils — low in organic matter and clay — and loose, porous soils. Table 2-3 gives the relative leaching potential ratings for Southeastern U.S. soils.

Pesticide Characteristics

Some pesticides move into the soil more easily than others. Those with high water solubility are more likely to seep into the soil than those pesticides with extremely low water solubility.

Table 2-2 gives the relative mobility (movement) of certain pesticides, listed by common and brand names, in soils.

Other sources of groundwater contamination include abandoned and uncontrolled waste sites, landfills, holding pits and ponds, leaking storage tanks, and septic tanks.

Chemigation

Applying pesticides to land, crops, or plants through an irrigation system is called chemigation. A limited number of pesticides are cleared for chemigation application. **Chemigation is only legal when the pesticide label has directions for such uses.**

The North Carolina Pesticide Board has adopted chemigation regulations to protect water resources from pesticide pollution by reducing the potential for backsiphoning or direct injection of pesticides into water sources. Farmers, greenhouse operators, nurserymen, golf course operators, turf growers, and others must comply with these regulations.

The types of irrigation equipment covered by these regulations include, but are not limited to, drip or trickle, center pivot, lateral move, traveler gun, and solid set systems. The regulations do not apply to hand-held hose-end sprayers that are constructed so that an interruption in water flow automatically prevents any backflow to the water supply. Protected water resources include, but are not limited to, private ponds, lakes, rivers, streams, canals, wells, and public water systems.

The following antipollution devices must be installed and maintained on an irrigation system used to apply any pesticide. Safety devices must meet the following qualifications.

Automatic low pressure drain—located on the bottom of the horizontal irrigation pipeline between the discharge side of the

irrigation pump and the inlet side of the double check valves. This device shall be level and have an orifice size at least 3/16 the diameter of the irrigation pipe. The top of the drain shall not exceed beyond the inside surface of the bottom of the irrigation pipeline and shall be at least 2 inches above grade. The drain shall discharge at least 20 feet from any water supply.

Furthermore, the discharge must be controlled to prevent it from reentering the water supply. In the event that the mainline check valves leak slowly, solution will drain away from rather than flow into the water supply.

Inspection port—located between the irrigation pump discharge side and the inlet side of the mainline check valves. The inspection port may be part of the vacuum relief valve. The purpose of the inspection port is to allow an individual to observe whether or not the mainline check valves are leaking.

Vacuum relief valve—located on the top of the horizontal irrigation pipeline between the discharge side of the irrigation pump and the inlet side of the double check valves. The orifice size of the valve shall be 3/16 of the diameter of the irrigation pipe. The purpose of the vacuum relief valve is to allow air into the pipeline when the water flow stops, preventing the creation of a vacuum that could lead to backsiphoning.

Double check valves—located between the irrigation pump discharge (or pressure side) and the point of pesticide injection into the irrigation pipeline. These valves must be within 10 degrees of horizontal. Double check valves prevent solution from draining or backsiphoning into the irrigation water source and polluting groundwater or surface water. Check valves must have positive closing action and a watertight seal. Note: For irrigation systems that contain media filters, refer to the section below entitled Chemigation Systems that Contain Media Filters.

Check valve—located on the pesticide line between the point of pesticide injection into the irrigation system and the pesticide injection unit. The check valve stops the flow of water from the irrigation system into the chemical supply tank. It should be constructed of chemically resistant materials. The check valve should always be flushed with clean water after injecting a chemical to prevent the deposition of chemical precipitates. Whenever a Dosatron, DosmaticPlus, or a similar metering device is used, the check valve needs to be positioned near the metering device on its outlet side. If this metering device is on a bypass line, the check valve must be located on the main irrigation line immediately downstream of the bypass line.

Flow interruption device, solenoid valve—located in the pesticide supply line between the pesticide injection unit and the pesticide supply tank or container. The solenoid valve provides a positive shut off on the chemical injection line. This prevents both chemical and water from flowing in either direction if the chemical pump is stopped. Because this valve will be subjected to different chemicals, it must be compatible with the chemicals being injected. The valve should be inspected often to assure that it is performing properly. A solenoid valve is not required with the Dosatron, DosmaticPlus, or a similar hydraulic injection device.

Functional systems interlock—The irrigation pump and the chemical injection pump must be interlocked or connected so that if the irrigation pump stops, the chemical injection pump will stop. The functional systems interlock ensures that a pesticide is applied with water through the irrigation system. The Dosatron, DosmaticPlus or a similar hydraulic injection device does not require the functional systems interlock.

Illegal Techniques

1. Some pesticide product labels prohibit application of the product by any irrigation system. Others prohibit applications through certain specific irrigation systems.

2. It is illegal to inject a pesticide into an irrigation system on the suction (or inlet) side of the irrigation pump.
3. It is illegal to connect an irrigation system directly to a public water system when applying any pesticide.

NOTE: When a public water system is used, the water must first be discharged into a reservoir tank. An air gap at least twice the inside diameter of the fill pipe must exist between the end of the fill pipe from the public water system and the top rim of the reservoir tank.

Chemigation Systems that Contain Media Filters

Some chemigators are using chemigation systems that have one or more sand-containing media filters. Surface water, and in some cases, groundwater, flows through these filters to remove debris that would clog the small orifices of the emitters on drip irrigation systems. **The injection of pesticides into the irrigation line must be on the outlet side of all media filters.** This prevents pesticide from passing through the media filters and contaminating the debris, which will be discharged into the environment whenever the media filters are backflushed.

Any water dumping or open dumping of pesticide dilutions is an illegal discharge of a pesticide in violation of NC Pesticide Board rule 2 NCAC 9L .0604. Further, pesticide product labels have enforceable language on the illegal disposal of pesticides.

Additionally, a check valve is required between the outlet side of all media filters and the point of pesticide injection into the irrigation line. If the injection system has bypass piping, a check valve would be positioned between the outlet side of all media filters and the inlet side of the bypass on the irrigation pipeline.

The purpose of the check valve mentioned above is to reduce the risk of media filter contamination if a backsiphonage occurs. Systems operating without this safeguard could dispose of pesticides unintentionally during a backflush cycle. This would be illegal. The chemigator can be fined for any illegal disposals.

Any chemigation system that is not in compliance with pesticide regulations will be issued a stop-use order. This order can only be released when a follow-up inspection indicates that the appropriate antipollution devices have been installed.

Hand-Held Hose-End Sprayers

Hand-held hose-end sprayers are allowed on the outlet side of a water hose. This device must contain a check valve that will prevent any backsiphoning from the pesticide reservoir into the water hose. The use of devices connected to a faucet or spigot that siphon pesticide from a reservoir or container is not permitted in North Carolina.

System Inspections

One of the requirements of the regulations is that the system operator must inspect the antisiphon devices and the functional systems interlock during periods of chemigation to ensure that they are functioning properly. If components of the system are defective, they must be repaired or replaced before any chemigation is employed with a pesticide.

Representatives of the NCDA&CS, Pesticide Section, may inspect an irrigation system used for chemigation at any time. If the system is not in compliance with the regulations, a stop-use order will be issued by the department, and the system must be inspected again by the departmental representative before the stop-use order can be removed.

For Additional Information

For a copy of regulation 2 NCAC 9L .2000—Chemigation or the chemigation and fertigation brochure, visit the NCDA&CS Web site at <http://www.ncagr.com/SPCAP/pesticides/sitemap.htm>, or call the Structural Pest Control and Pesticides Division at 919-733-3556.

The chemigation section was written by Henry Wade, Environmental Programs Manager, NCDA&CS, Structural Pest Control and Pesticides Division.

Evaluating the Potential for Groundwater Contamination

When estimating the groundwater contamination potential (GWCP) index for a pesticide at a given site, the characteristics of the soil at the site must also be evaluated. Soil properties are as important as a pesticide's chemical properties in determining mobility and risk to groundwater. See Table 2-3. Soil Leaching Potential (SLP) Indices. The GWCP index for a pesticide on a given soil is the mean of the PLP index and the SLP index, i.e.; $GWCP = (PLP + SLP)/2$. More detailed formulas are given at the end of the following table.

Table 2-2. Relative Pesticide Leaching Potential (PLP) Indices and Ratings for Commonly Used Pesticides

The PLP value will change with changes in application rate. Values in this table are calculated using average rates.*
KEY: Very High (VH) = 90 to 100, High (H) = 70 to 89, Moderate (M) = 50 to 69, Low (L) = 30 to 49, Very Low (VL) = 0 to 29

Common Name	Brand Name	Application Method	PLP	Rating
Herbicides				
asulam	Asulox	foliage	47	L
bensulide	Prefar	soil	57	M
bentazon	Basagran	foliage	48	M
carfentrazone	Aim	foliage	26	VL
carfentrazone	Aim	soil	23	VL
clethodim	Envoy	foliage	40	L
clopyralid	Lontrel	foliage	46	L
DCPA	Dacthal	soil	47	L
dichlobenil	Carson	soil	55	M
dimethenamid	Tower	soil	46	L
diquat	Diquat	foliage	15	VL
dithiopyr	Dimension	foliage	45	L
diuron	Karmex	soil	65	M
EPTC	Eptam	soil	53	M
fenoxaprop	Acclaim	foliage	24	VL
fluzafop	Fusilade	foliage	30	L
flumioxazin	Sureguard	soil	45	L
flumioxazin	Sureguard	foliage	29	VL
fluroglycofen	Compete	foliage	18	VL
fluthicet-me	Action	foliage	17	VL
glufosinate	Ignite	foliage	8	VL
glyphosate	Roundup	foliage	20	VL
halosulfuron-methyl	Sedgehammer	foliage	23	VL
imazaquin	Image	foliage	44	L
isoxoben	Gallery	soil	47	L
metolachlor	Pennant Magnum	soil	63	M
napropamide	Devrinol	soil	52	M
oryzalin	Surflan	soil	41	L
oxadiazon	Ronstar	soil	39	L
oxyfluorofen	Goal	soil	24	VL
paraquat	Gramoxone	foliage	6	VL
pendimethalin	Pendulum	soil	20	VL
prodiamine	Barricade	foliage	28	VL
pronamide	Kerb	soil	48	L
sethoxydim	Segment	foliage	29	VL
simazine	Princep	soil	62	M
sulfentrazone	Dismiss	soil	54	M
sulfosulfuron	Certainty	foliage	23	VL
triclopyr	Garlon	foliage	54	M
trifluralin	Treflan	soil	25	VL

Table 2-2. Relative Pesticide Leaching Potential (PLP) Indices and Ratings for Commonly Used Pesticides

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KEY: Very High (VH) = 90 to 100, High (H) = 70 to 89, Moderate (M) = 50 to 69, Low (L) = 30 to 49, Very Low (VL) = 0 to 29

Common Name	Brand Name	Application Method	PLP	Rating
Growth Regulators, Defoliant, Desiccants				
chlormequat	Cycocel	foliage	4	VL
clofencet	Genesis	foliage	62	M
dimethipin	Harvade	foliage	72	H
ethephon	Super Boll	foliage	71	H
fumetrain	Prime+	foliage	22	VL
mefluidide	Embark	foliage	25	VL
mepiquat	PIX	foliage	4	VL
MH	Royal MH	foliage	49	L
pyraflufen	Ecopart	foliage	1	VL
sodium chlorate	Defol	foliage	80	H
thidiazuron	Dropp	foliage	30	L
tribufos	DEF	foliage	25	VL
Fungicides, Biocides				
azoxystrobin	Heritage	foliage	42	L
benomyl	Benlate	foliage	43	L
captan	Captan	foliage	54	M
carboxin	Evershield V	seed	13	VL
chlorothalonil	Bravo	foliage	33	L
copper hydroxide		foliage	41	L
DCNA	Botran	foliage	29	VL
dimethomorph	Acrobat	foliage	37	L
dodine	Syllit	foliage	1	VL
ethoprop	Mocap	soil	60	M
etridiazole	Terrazole	soil	17	VL
fenarimol	Rubigan	foliage	59	M
fenbutatin oxide	Vendex	foliage	38	L
fenhexamid	Elevate	foliage	14	VL
flutolanil	Moncut	foliage	39	L
fosetyl-Al	Alliette	foliage	9	VL
Iprodione	Rovral	foliage	27	VL
mancozeb	Dithane	foliage	38	L
maneb	Manzate	foliage	40	L
metalaxyl	Ridomil	soil	59	M
metiram	Polyram	foliage	4	VL
myclobutanil	Nova	foliage	32	L
oxamyl	Vydate	foliage	46	L
oxythioquinox	Morestan	foliage	24	VL
PCNB	Terrachlor	seed	28	VL
penconazole	Topaz	foliage	28	VL
propamocarb	Previcur	foliage	17	VL
propiconazole	Tilt	foliage	30	L

Table 2-2. Relative Pesticide Leaching Potential (PLP) Indices and Ratings for Commonly Used Pesticides

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Common Name	Brand Name	Application Method	PLP	Rating
tebuconazole	Folicure	foliage	27	VL
terbufos	Counter	seed	31	L
thiabendazole	Mertect	foliage	37	L
thiophanate	Topsin	foliage	18	VL
thiophanate-methyl	Cercorbin	foliage	41	L
trifloxystrobin	Stratego	foliage	8	VL
triflumizole	Procure	foliage	27	VL
triphenyltin acetate	Fentin Acetate	foliage	20	VL
triphenyltin chloride	Fentin Chloride	foliage	20	VL
triphenyltin hydroxide	Super Tin	foliage	20	VL
vinclozolin	Ronilan	foliage	18	VL
zineb	Dithane	foliage	35	L
ziram	Zirex	foliage	41	L
Insecticides, Acaricides, Miticides, Nematicides				
acephate	Orthene	foliage	52	M
acetamiprid	Assail	foliage	27	VL
aldicarb	Temik	soil	67	M
aldoxycarb	Standak	foliage	72	H
amitraz	Mitac	foliage	11	VL
azinphosmethyl	Guthion	foliage	22	VL
bendiocarb	Turcam	seed	26	VL
bifenthrin	Biflex	foliage	0	VL
carbaryl	Sevin	foliage	37	L
carbofuran	Furadan	foliage	54	M
carbofuran	Furadan	soil	73	H
carbosulfan	Advantage	foliage	11	VL
chlordimeform	Galecron	foliage	6	VL
chlorfenvinphos	Birlane	soil	40	L
chlorfenvinphos	Birlane	foliage	35	L
chlorobenzilate	Folbex	foliage	26	VL
chlorpyrifos	Lorsban	foliage	27	VL
chlorpyrifos	Lorsban	soil	30	L
clofentezine	Ovation	foliage	1	VL
cyfluthrin	Baythroid	foliage	0	VL
cyhalothrin	Karate	foliage	11	VL
cypermethrin	Ammo	foliage	0	VL
cyromazine	Trigard	foliage	39	L
deltamethrin	Decis	foliage	1	VL
diazinon	Diazinon	foliage	41	L
dicofol	Kelthane	foliage	33	L
dicrotophos	Bidrin	foliage	39	L
dietholate	Eradicane-Extra	soil	26	VL
diflubenzuron	Dimilin	foliage	0	VL
dimethoate	Dimethoate	foliage	47	L

Table 2-2. Relative Pesticide Leaching Potential (PLP) Indices and Ratings for Commonly Used Pesticides

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Common Name	Brand Name	Application Method	PLP	Rating
disulfoton	Di-syston	foliage	33	L
endosulfan	Thiodan	foliage	18	VL
esfenvalerate	Asana	foliage	2	VL
ethion	Ethion	foliage	34	L
ethoprop	Mocap	soil	61	M
fenamiphos	Nemacur	soil	58	M
fenoxycarb	Logic	soil	0	VL
fenpropathrin	Danitol	foliage	0	VL
fenthion	Baytex	foliage	27	VL
fenvalerate	Asana XL	foliage	9	VL
flucythrinate	Pay-Off	foliage	0	VL
fluvalinate	Spur	foliage	0	VL
fonofos	Dyfonate	soil	29	VL
formetanate	Carzol	foliage	28	VL
hexythiazox	Hexygon	foliage	9	VL
hydramethylnon	Amdro	foliage	0	VL
imidacloprid	Timax	foliage	1	VL
indoxacarb	Steward	foliage	4	VL
lambda-cyhalothrin	Karate	foliage	0	VL
lindane	Lindane	foliage	55	M
malathion	Cythion	foliage	13	VL
methamidophos	Monitor	foliage	53	M
methidathion	Supracide	foliage	27	VL
methomyl	Lannate	foliage	43	L
methoxychlor	Marlate	foliage	7	VL
methoxyfenozide	Intrepid	foliage	20	VL
methyl parathion	PennCap-M	foliage	11	VL
mevinphos	Phosdrin	foliage	30	L
monocrotophos	Azodrin	foliage	61	M
naled	Dibrom	foliage	25	VL
oxamyl	Vydate	foliage	46	L
oxydemetonmethyl	Metasystox-R	foliage	49	L
parathion	Ethyl-Parathion	foliage	19	VL
PCNB	Terraclor	soil	37	L
permethrin	Ambush	foliage	0	VL
phorate	Thimet	soil	48	L
phosmet	Imidan	foliage	37	L
phosphamidon	Dimecron	foliage	53	M
profenophos	Curacron	foliage	15	VL
propargite	Comite	foliage	39	L
propoxur	Baygon	foliage	49	L
pymetrozine	Fulfill	foliage	7	VL
spinosad	Tracer	foliage	11	VL
sulprophos	Bolstar	foliage	27	VL
temephos	Abate	aquatic	0	VL
terbufos	Counter	soil	31	L

Table 2-2. Relative Pesticide Leaching Potential (PLP) Indices and Ratings for Commonly Used Pesticides

The PLP value will change with changes in application rate. Values in this table are calculated using average rates.*
KEY: Very High (VH) = 90 to 100, High (H) = 70 to 89, Moderate (M) = 50 to 69, Low (L) = 30 to 49, Very Low (VL) = 0 to 29

Common Name	Brand Name	Application Method	PLP	Rating
thiamethoxam	Platinum	seed	54	M
thiamethoxam	Centric	foliage	12	VL
thiodicarb	Larvin	foliage	24	VL
tralomethrin	Scout	foliage	0	VL
trichlorfon	Dylox	foliage	38	L
trimethacarb	Landin	soil	38	L
zetamethrin	Fury	foliage	1	VL

Fumigants

1,3-dichloropropene	Telone-2	soil	79	H
chloropicrin	Larvacide	soil	65	M
dazomet	Basamid	soil	92	VH
metam sodium	Vapam	soil	94	VH
methyl bromide	Brom-O-Gas	soil	100	VH

Molluscicides

metaldehyde	Deadline Bullets	soil	41	L
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*Formulae used to determine the values in Table 2-2 include the following:

$$PLP_{value} = \frac{(\text{Application rate of kg. ai/ha.})(\text{fraction hitting the soil})(T/2)}{K_{oc}}$$

Where $T \frac{1}{2}$ = half life of the parent compound under field conditions

K_{oc} = soil organic carbon binding value

$$PLP_{INDEX} = (\text{Log } PLP_{value})(14.3) + 57$$

Table 2-3. Relative Soil Leaching Potential (SLP) Indices and Ratings for Soils in the Southeastern U.S.

The SLP index will change slightly for the site where the soil series is located. Values in this table are calculated using the profile description of the original site where the soil was named. **KEY: Very High (VH) = 90 to 100, High (H) = 70 to 89, Moderate (M) = 50 to 69, Low (L) = 30 to 49, Very Low (VL) = 0 to 29**

Soil	SLP	Rating	Soil	SLP	Rating	Soil	SLP	Rating	Soil	SLP	Rating
Alamance	69	M	Corolla	95	VH	Johnston	22	VL	Plummer	79	H
Alpin	84	H	Coxville	36	L	Kalmia	77	H	Ponzer	08	VL
Altavista	73	H	Craven	66	M	Kenansville	84	H	Portsmouth	26	VL
Appling	62	M	Creedmoor	64	M	Kureb	100	VH	Pungo	00	VL
Arapahoe	39	L	Croatan	14	VL	Lakeland	84	H	Rains	45	L
Argent	58	M	Cullowhee	77	H	Leaf	35	L	Rimini	84	H
Augusta	66	M	Dare	09	VL	Lenoir	32	L	Rion	64	M
Autryville	68	M	Davidson	55	M	Leon	84	H	Roanoke	57	M
Aycock	68	M	Deloss	29	VL	Liddell	47	L	Roper	16	VL

Ballahack	20	VL	Dogue	67	M	Lignum	63	M	Rosman	55	M
Barclay	77	H	Dorovan	10	VL	Louisburg	81	H	Rumford	84	H
Bayboro	04	VL	Dothan	66	M	Lumbee	53	M	Seabrook	84	H
Baymeade	87	H	Dragston	80	H	Lynchburg	40	L	Stallings	58	M
Belhaven	10	VL	Duckston	98	VH	Lynn Haven	61	M	State	73	H
Bibb	75	H	Dunbar	35	L	Madison	68	M	Stockade	35	L
Blaney	73	H	Duplin	62	M	Mandarin	89	H	Tarboro	90	VH
Blanton	82	H	Durham	72	H	Marlboro	63	M	Tate	46	L
Bojac	82	H	Echaw	84	H	Marvyn	44	L	Tatum	64	M
Bonneau	70	H	Edneyville	54	M	Masada	37	L	Toisnot	68	M
Braddock	64	M	Emporia	67	M	Mayodan	63	M	Tomahawk	86	H
Bragg	64	M	Enon	77	H	Mccoll	24	VL	Tomotley	52	M
Brookman	07	VL	Evard	70	H	Mecklenburg	69	M	Torhunta	29	VL
Buncombe	87	H	Exum	69	M	Meggett	29	VL	Vance	66	M
Butters	83	H	Faceville	58	M	Munden	81	H	Varina	62	M

Table 2-3. Relative Soil Leaching Potential (SLP) Indices and Ratings for Soils in the Southeastern U.S.

The SLP index will change slightly for the site where the soil series is located. Values in this table are calculated using the profile description of the original site where the soil was named. **KEY: Very High (VH) = 90 to 100, High (H) = 70 to 89, Moderate (M) = 50 to 69, Low (L) = 30 to 49, Very Low (VL) = 0 to 29**

Soil	SLP	Rating	Soil	SLP	Rating	Soil	SLP	Rating	Soil	SLP	Rating
Byars	21	VL	Fanin	70	H	Nahunta	41	L	Vaucluse	76	H
Cainhoy	89	H	Foreston	81	H	Nankin	63	M	Wagram	71	H
Candor	79	H	Fork	72	H	Nason	41	L	Wahee	43	L
Cape Fear	13	VL	Fuquay	73	H	Nimmo	78	H	Wakulla	85	H
Caroline	64	M	Gaston	63	M	Nixonton	82	H	Wando	87	H
Cecil	60	M	Georgeville	59	M	Norfolk	67	M	Wasda	18	VL
Centenary	85	H	Gilead	62	M	Ocilla	53	M	Watauga	46	L
Chandler	47	L	Goldsboro	70	H	Onslow	70	H	Wedowee	64	M
Charleston	83	H	Goldston	78	H	Orangeburg	67	M	Weeksville	34	L
Chastain	40	L	Grantham	44	L	Ousley	84	H	Wehadkee	48	L
Chester	44	L	Grifton	61	M	Pacolet	63	M	White Store	61	M
Chewacla	47	L	Gritney	34	L	Pactolus	85	H	Wickham	75	H
Chipley	61	M	Hayesville	40	L	Pamlico	53	M	Wilbanks	43	L
Chowan	35	L	Helena	66	M	Pantego	12	VL	Wilkes	82	H
Clifton	40	L	Herndon	63	M	Pasquotank	52	M	Winnsboro	82	H
Colvard	88	H	Hullete	62	M	Paxville	40	L	Winton	72	H
Conaby	23	VL	Hyde	17	VL	Pender	69	M	Woodington	58	M
Conetoe	85	H	Invershield	70	H	Perquimans	44	L	Worsham	43	L
Congaree	28	VL	Johns	78	H	Pinkston	73	H	Yaupon	72	H
									Yonges	57	M

SAMPLE CALCULATION FOR GWCP INDEX: Acetochlor (PLP index = 55 M) applied to an Alamance soil (SLP index = 69 M).
 GWCP index = $55 + 69 / 2 = 62$ M.

Table 2-4. Groundwater Contamination Potential (GWCP) Risk of Pesticide-Soil Combinations

Obtain numbers for PLP and SLP for your soil and pesticide from Tables 2-2 and 2-3, respectively.

Pesticide Leaching Potential (PLP) Rating	Soil Leaching Potential (SLP) Rating				
	0–29 Very Low	30–49 Low	50–69 Moderate	70–89 High	90–100 Very High
0–29 Very Low	Very Low Risk	Very Low Risk	Low Risk	Low Risk	Moderate Risk
30–49 Low	Very Low Risk	Low Risk	Low Risk	Moderate Risk	Moderate Risk
50–69 Moderate	Low Risk	Low Risk	Moderate Risk	Moderate Risk	High Risk
70–89 High	Low Risk	Moderate Risk	Moderate Risk	High Risk	High Risk
90–100 Very High	Moderate Risk	Moderate Risk	High Risk	High Risk	Very High Risk

Proper Pesticide Storage

Safe and proper storage can extend the shelf (storage) life of your pesticides, keep the containers in good condition, and keep the labels clean and legible.

Only rules for storing pesticides on the farm and in household situations are presented here. If you store restricted use pesticides in commercial storage facilities, you must meet additional requirements as outlined in Regulation 2 NCAC 9L.1903-.1913. Details on these requirements can be obtained at your county Cooperative Extension center or by calling the NCDA&CS Pesticide Section at 919-733-3556.

Household and Farm Situation Storage Rule (simplified)

1. This rule applies to all pesticides.
2. Store pesticides to prevent leaking and to aid inspection.
3. Do not store formulated pesticides in unlabeled containers. The following minimum information must be shown clearly and prominently on any containers of formulated pesticides:
 - a. common chemical name (such as carbaryl for the product Sevin)
 - b. percentage of each active ingredient
 - c. EPA registration number
 - d. signal word (DANGER, WARNING, CAUTION)
 - e. use classification (restricted use or general use).
4. Do not store pesticides (formulated products or dilutions) in any food, feed, beverage, or medicine container that has previously been used for such purposes or that is specifically designed to contain only those products.
5. Do not store pesticides in a way that could contaminate foods, feeds, beverages, eating utensils, tobacco, or tobacco products, or otherwise result in accidental ingestion by people or domestic animals. In addition, pesticides should not be stored in such a way that could contaminate other pesticides, seeds, or fertilizers.
6. Store pesticides based on the following:
 - a. storage recommendations, if any, on their labels, and
 - b. labels on all other products, including nonpesticide products held in the same storage area.
7. When unattended, store pesticides to prevent unauthorized access.
8. Store pesticides in an area that is dry (does not accumulate water) and well-ventilated.
9. Pesticide storage areas should be free of combustible materials—such as gasoline, kerosene, or petroleum solvents other than those associated with pesticide application—and debris like waste paper, rags, or used cardboard boxes that may provide an ignition source. They must also be separated from other operations that present a fire hazard, such as welding or burning. Take appropriate care to reduce fire hazards when providing supplemental heating to storage areas during the winter.

Disposal of Pesticides

Reduce the Need for Disposal of Unwanted Pesticides

Because of the expenses, environmental hazards, and legal responsibilities associated with the disposal of pesticides and other hazardous waste, the best solution is to minimize or eliminate the need for disposal altogether. Careful planning of spray programs is essential in order to avoid purchasing more pesticides than will actually be needed for a particular application or season. However, in spite of careful planning, farmers (and

homeowners) will occasionally need to dispose of unwanted pesticides. In addition, there are old, obsolete, or banned pesticide products in storage throughout the state that require disposal. Some of these materials are in containers that are structurally unsound and have incomplete or no labeling. The following information will aid in accomplishing disposal in the safest, most economical, and environmentally acceptable manner possible.

Donation of Excess Pesticides

If no longer needed, unopened containers of recently purchased pesticides may possibly be returned to the local dealer or manufacturer/formulator for a refund. If this cannot be arranged, the pesticide may be sold or donated to a neighbor or to someone who can and will use it properly. If donation is a possibility, there are two important factors that must be taken into consideration.

1. A pesticide designated **RESTRICTED USE** on the label must not be given to someone who is not a certified applicator.
2. A pesticide that has been banned or one for which all uses have been cancelled should not be donated to another person.

NCDA&CS Disposal Systems Program for Excess Pesticides

If donation of unwanted pesticides is not a possibility, two other options are available. The NCDA&CS has a Pesticide Disposal Assistance Program for farmers and homeowners. This service is provided on an individual request basis with no fees charged. Specific requests for assistance should be made to Derrick Bell, NCDA&CS Pesticide Waste Specialist, (919) 733-7366, ext. 327 or 328.

Commercial Hazardous Waste Disposal

In some situations the NCDA&CS may not be able to provide the disposal assistance that is needed. Commercial disposal companies, permitted by the U.S. Environmental Protection Agency (EPA) through the Resource Conservation Recovery Act (RCRA) program are available to dispose of pesticide wastes.

While all pesticides are hazardous substances, not all are legally classified as RCRA hazardous wastes. However, because pesticides cannot be legally disposed of at county landfills, a permitted disposal facility is an option that may have to be used.

The NCDA&CS will furnish a listing of hazardous waste disposal companies upon request. Anyone contemplating this option is advised to contact several firms, compare costs, and ask for and check references. All paper work (manifests) generated by the disposal should be retained permanently.

One must not assume that disposal of a pesticide (which is also a RCRA hazardous waste) at an EPA permitted facility eliminates all further legal responsibility for that product. The person who generates a hazardous waste (farmer/homeowner) is legally and financially responsible for that material for as long as it remains in existence. Therefore, even though destructive disposal (incineration) may cost more than nondestructive disposal (landfilling), there are worthwhile, long-term benefits for using the incineration method.

In summary, the disposal of some pesticides via commercial disposal companies involves RCRA regulations. There are stringent requirements for storage, transport, and disposal of hazardous waste and severe penalties for failure to comply with the regulations. For information regarding hazardous waste management and disposal contact:

Division of Waste Management, Hazardous Waste Section, N.C. Department of Environment and Natural Resources, P.O. Box 27687, Raleigh, NC 27611-7687.

Disposal of Excess Spray Solution from Tank and Equipment Rinses

As already indicated, proper planning and careful calculations should eliminate the need for disposal of large quantities of excess spray solutions. Small quantities should be sprayed out along field borders or on the row ends. Care must be taken not to exceed the labeled application rate.

Tank and equipment rinses should also be applied along field borders or on the row ends. If decontamination solutions, cleaners, detergents, ammonia, chlorine bleaches, etc., are used to remove residues, adequate dilution may be necessary to prevent soil and plant injury.

Disposal of Empty Pesticide Containers

Metal, Plastic, or Glass Containers of Liquid Formulations (5 Gallons or Fewer)

Before pesticide containers can be accepted for recycling or disposed of properly, they must be rinsed by one of the following methods.

Pressure rinsing

1. Drain the container into the spray tank for 30 to 60 seconds after the last amount starts to drip.
2. Insert tip of the pressure nozzle through the side of the pesticide container near its base.
3. While holding the container so the opening can drain into the spray tank, spray the inside of the container for at least 30 seconds.
4. Drain all rinse water into the spray tank.

Triple rinsing

1. Drain the container into the spray tank for 30 to 60 seconds after the last amount starts to drip.
2. Fill the containers 1/3 full with water, cap, and shake thoroughly. Empty this rinse water into the spray tank.
3. Repeat the above rinse procedure at least two more times, adding each amount of rinsate to the spray tank.
4. Punch holes in the bottom and sides of metal and plastic containers. The holes will prevent the containers from being reused and will indicate that they are indeed empty.

Properly-rinsed plastic pesticide containers can be delivered to a container recycling collection site. Nearly every North Carolina county has one or more of these sites. Call your county Extension center for directions to the nearest collection site. Properly rinsed metal or glass pesticide containers can be taken to a county solid waste collection system or to a county landfill.

Metal or Plastic Drums (30- to 55-Gallon)

1. Rinse and drain these containers into the spray tank.
2. Attempt to return drums to dealer or distributor (recycling).
3. If you are not successful, attempt to donate drums to a drum reconditioner (contact Pesticide Disposal Specialist, NCDA&CS, Derrick Bell, 919-733-7366 ext. 327 for information on drum reconditioners operating in the state).
4. If steps 2 or 3 above fail, attempt to dispose of rinsed drums in the county sanitary landfill. This may not be possible in some cases because of the difficulty for landfill personnel to verify that the drums have been properly rinsed.
5. If the above procedures fail, contact the Solid and Hazardous Waste Management Branch, 919-733-2178, for assistance with pesticide drum disposal.

Containers of Non-Liquid Pesticides

1. Shake container into the applicator tank until all the pesticide has been removed.
2. Tear open the container to make sure it is completely empty.
3. If the pesticide is a wettable powder and the container can be triple rinsed with water, do so. Add the rinsate to the tank.
4. Puncture, crush, or otherwise render the container incapable of being reused and then place in the solid waste collection system or carry to a county sanitary landfill facility.
5. If large containers can be returned for recycling, do so.

Controlling Pesticide Drift

Once discharged from the application equipment, pesticides may drift through the air and injure susceptible plants or sensitive animal life before the pesticides actually reach the target area. Movement through the air may be by spray drift, vapor, or dust.

If herbicides are allowed to drift, they can often cause extensive damage to susceptible crops. Drift of other pesticides—although not as likely to injure nearby crops—can damage livestock, bees, fish, and people, in addition to leaving illegal residues on crops.

Spray drift is the movement of airborne spray particles beyond the target. The amount of spray drift is influenced by the (1) droplet size, (2) amount of wind, and (3) height from which the spray is released.

When using ground equipment certain precautions can reduce spray drift.

1. Select nozzles that produce a minimum proportion of small droplets in relation to overall droplet size. The droplet size is influenced by pounds of pressure per square inch (psi) and the nozzle's design (opening size). Lower pressures and larger openings, for example, tend to produce larger droplets and less drift. Standard fan nozzles operate at 30 to 40 psi. Whirl chamber nozzles and low-pressure fan nozzles work at 15 to 20 psi. Select the largest nozzle opening that will provide enough gallons per acre for penetration, uniform coverage, mixing with the pesticide, and effective control.
2. Spray when wind velocity is at a minimum, when temperatures are moderate, and preferably before adjacent susceptible crops emerge. Where a susceptible crop has emerged, spray when the wind is moving away from the crop or consider leaving an untreated strip along the edge of the field.
3. Adjust the boom as close as possible to the target without losing uniform distribution of the pesticide. To bring the boom closer to the target, space the nozzles closer together or use wide-angle nozzles. The boom's height above the ground affects how long it takes a spray droplet to reach the ground. Wind velocities are usually lower closer to the ground.

Special nozzles that produce large droplets have been developed to control this drift from aerial application. Also, invert emulsions and drift control agents can be used.

Vapor drift occurs when vapor or fumes move from the area of application. Vapor drift may damage susceptible crops or may simply reduce the effectiveness of the herbicide or pesticide.

Ester formulations of 2,4-D may volatilize in hot weather and drift to susceptible crops. Therefore, select amine and sodium salts of 2,4-D that are less prone to volatilize and continue to take steps to prevent spray particle drift.

Fumigants like methyl bromide and chloropicrin drift after they turn into a gas. Make sure the covers or buildings where these chemicals are applied are airtight and application equipment lines and tanks do not leak.

Mixing and Loading Pesticides

People often get into trouble when mixing and loading pesticides. Some common problems are discussed briefly here.

Tank Mixes

Tank mixes (combinations of two or more pesticides in the spray tank at time of application) may fall into one of two categories.

- Instructions provided for such use on one or more labels of registered products.
- Tank mixes that are recommended by Cooperative Extension or are common agricultural practices.

Tank mixes recommended on labels are obviously consistent with the label.

Tank mixes will not be deemed "use inconsistent with the label" if:

- The products in the mix are applied at a dosage rate not to exceed the label instructions for use of any product in the mix used singly for the same set of pests on the same crop; and
- The label on one or more of the products does not explicitly instruct against such mixture.

The only mixtures proven effective and safe are those specified on product labels. The user applies all other mixtures at his or her own risk with respect to effects on crops and application equipment, applicator safety, environmental effects, and preharvest interval tolerances.

Compatibility

Some pesticides will not mix (are not compatible) with other pesticides or with liquid fertilizers in spray-tank mixtures. For example, wettable sulphur cannot be mixed with Lorsban or Morestan. Some herbicides are not compatible with liquid fertilizers and herbicide oils. Any time you plan to mix two or more pesticides, first make sure they are compatible. Follow the specific directions on the label to test for compatibility if you still have questions. Also remember that a pesticide may mix physically with another pesticide, but the activity of one or both may be altered (based on their chemical or biological incompatibility).

Adjuvants

Adjuvants are inert ingredients that are added to pesticide formulations or tank mixes to increase the effectiveness of the pesticide's active ingredients. Adjuvants may be wetting agents, emulsifiers, spreaders, stickers, penetrants, drift reduction agents, thickeners, buffers, and compatibility agents just to name a few. Adjuvants should not be used unless needed. Often, the pesticide formulation already contains the adjuvants needed for the application.

Many herbicide and other pesticide formulations require that a surfactant, penetrating agent, or other adjuvant be added to the spray tank to increase the pesticide's effectiveness. Read the label to find out what should or should not be added to the pesticide formulation to give you the best possible control.

Formulation Sequence

If you use more than one pesticide formulation (WP, WDG, DF, L, EC) in a spray tank, there is a proper order for adding them.

1. Add a small amount of water or other liquid carrier to the spray tank.
2. Dry materials go into the spray before liquid chemicals. If a wettable powder (WP) is used, put it in first as follows: Make a slurry with the wettable powder by adding a small amount of water to it until it forms a gravy-like consistency. Slowly add this slurry to the tank with the spray tank agitator (mixer) running.

3. Dry flowables (DF) or water-dispersible granules (WDG) go in second. Flowables should be premixed (1 part flowable to 1 part water) and poured slowly into the tank.
4. Liquid flowables (F or L) should be added third. Exception: When using Furan 4F, this material should be put in last. Liquids should also be premixed (1 part liquid chemical to 2 parts water or liquid fertilizer) before blending in the tank. Many labels will give you the proper pesticide mixing sequence.
5. Emulsifiable concentrates (EC), should be combined last.

Safety Warning

When mixing and loading pesticides, you usually work with concentrated pesticides. Accident reports have shown that the danger of being poisoned may be greatest at this time. Wear the appropriate gloves and other protective clothing to avoid getting a pesticide on you or your clothing.

If a pesticide gets into your eyes, immediately rinse them with plenty of clean water; continue for at least 15 minutes. (The label on some pesticides calls for longer flushing times). If pesticides get on your skin, wash them off with water. Remove contaminated clothing and wash it separately from the family laundry before wearing any of it again. Clothing saturated with a highly hazardous pesticide (labeled DANGER) should be disposed of the same way you would discard the pesticide. Remember: Injuries from most pesticide accidents can be prevented if you know what to do and do it FAST. Take the person to a doctor if you suspect pesticide poisoning.

Cleaning Sprayer Systems

Most people are aware that spraying sensitive crops with a sprayer that has been used earlier to apply certain pesticides can lead to crop damage. Most pesticides can be washed out of sprayers. Dicamba (Banvel), 2,4-D, 2,4-DB, and MCPP are more difficult to wash out, however, and many crops are very sensitive to these herbicides. So it is best to have a separate sprayer to apply these herbicides. Certain crops are very sensitive to sulfonyleurea herbicides (Classic, Canopy, Gemini, Glean, Harmony), but these can easily be washed out of sprayers if the proper procedure is used.

Before applying a pesticide with a sprayer that was previously used for some other pesticide, always wash out the sprayer thoroughly. It is best to wash out the sprayer immediately after use. Some pesticide labels give instructions on how to properly clean that pesticide out of the sprayer. If the label does not contain this information, that does not imply that residues of that particular pesticide in a sprayer will not harm other crops.

Pesticide Record-Keeping Requirements

The U.S. Department of Agriculture (USDA), through the 1990 Farm Bill, and the North Carolina Pesticide Board, through the N.C. Pesticide Law of 1971 (NCPL), require that applicators, dealers, and agricultural employers record certain pesticide information. The NCDA&CS, Structural Pest Control and Pesticides Division administers and enforces record keeping provisions. Records must be kept for certain lengths of time and made available to representatives of the NCDA&CS and USDA upon request.

Table 2-5 summarizes the pesticide application records required by federal and state regulations for certain pesticides and for compliance with the Worker Protection Standard (WPS). Readers are encouraged to read the actual laws and regulations for more detailed information. Dealers, certified applicators, licensed aerial and ground applicators, and agricultural employers all have some responsibilities for recording pesticide information.

Agricultural employers who hire pesticide handlers, workers, or

both must display application information as required by the WPS. This information must be posted at a central location accessible by employees prior to application and kept for 30 days after the expiration of the restricted-entry interval (REI). Under state law, the time when the application was completed must be recorded. This and all other required record-keeping items must be maintained for a period of two years after the REI expires.

Pesticide dealers in North Carolina are required to keep sales records for all restricted-use pesticides. The 10 elements that are required for each restricted-use pesticide sale are:

1. Date of sale;
2. Initials of sales clerk;
3. Name of certified or licensed applicator;
4. Certification or license number from card;
5. Expiration date as shown on the card;
6. Product brand name;
7. EPA registration number;
8. Number of individual containers;
9. Size of individual containers;
10. Total quantity sold.

Table 2-5. Summary of Pesticide Record-Keeping Requirements for Growers and Applicators

Required Items	USDA Requirements for Private & Commercial Applicators (Restricted Use Pesticides)	NCPL ¹ Requirements for Commercial Applicators & Public Operators (Restricted Use Pesticides)	NCPL ¹ Requirements for Aerial Applicators (All Pesticides)	Federal & State Requirements for Agricultural Employers (WPS*) (Agricultural Use Pesticides)
Brand name/product name	✓	✓	✓	✓
EPA registration number	✓	✓	✓	✓
Total amount of pesticide used	✓	✓ amount/unit of measure (e.g. acre)	✓ amount of formulated product or active ingredient/acre PLUS amount of tank mix/acre	—
Date of application	✓	✓	✓	✓
Time of application		✓ Time completed	✓ Time completed	✓ Start time and completed
Description/location of treated area	✓	✓	✓	✓
Crop, commodity, or stored product	✓	✓	✓	✓
Size of area treated	✓	✓	✓	—
Name and address of property owner or operator	—	✓	✓	—
Name of applicator	✓	✓	✓	—
Name of licensee	✓ or name of supervisor	✓	✓ name of contractor and signature of record keeper	—
Certification number	✓	—	—	—
Active ingredients	—	—	—	✓
Restricted entry interval	—	—	—	✓
Record must be:	completed within 14 days of application and kept 2 years (commercial applicator, only, must furnish records to customer within 30 days)	kept 3 years	completed within 72 hours after application and kept 3 years	displayed, along with SDS, within 24 hours after end of application, posted for 30 days after the Restricted-Entry Interval expires and kept for 2 years after the REI expires.
For these records, each day of application must be recorded as a separate application.				

*The federal Worker Protection Standard has been adopted by reference by the N.C. Pesticide Board. This standard requires that pesticide information be posted in a central location on an agricultural establishment.

¹ NCPL = North Carolina Pesticide Law

Source: North Carolina Department of Agriculture and Consumer Services

Record-keeping forms for the USDA restricted-use pesticide regulation and the Worker Protection Standard are available online at <http://pesticidesafety.ces.ncsu.edu/>.

3. Pesticide Application – Calibrating Chemical Application Equipment

Modified from the “Southeastern U.S. 2016 Vegetable Crop Handbook” by the Southeastern Vegetable Extension Workers (SEVEW) Group.

Calibrating Field or Backpack Sprayers

Preparing to Calibrate

For calibration to be successful, several items need to be taken care of before going to the field. Calibration will not be worthwhile if the equipment is not properly prepared. Calibration should be performed using water only. Follow the steps outlined below to prepare spraying equipment for calibration.

1. Inspect the sprayer. Be sure all components are in good working order and undamaged. On backpack sprayers, pay particular attention to the pump, control wand, strainers, and hoses. On boom sprayers, pay attention to the pump, control valves, strainers, and hoses. On air blast sprayers, be sure to inspect the fan and air tubes or deflectors as well. Be sure there are no obstructions or leaks in the sprayer. Be sure all components are in good working order and undamaged.
2. Check the label of the product or products to be applied and record the following:
 - *Application Rate.* Gallons per Acre (GPA)
 - *Nozzle Required.* Type, droplet size and shape of pattern
 - *Nozzle Pressure.* Pounds per Square Inch (PSI)
 - *Type of Application.* Broadcast, band, or directed.
3. Next, determine some information about the sprayer and how it is to be operated.
 - *Type of Sprayer:* Backpack, boom, or air blast. The type of sprayer may suggest the type of calibration procedure to use.
 - *Nozzle Spacing (Inches):* For broadcast applications, nozzle spacing is the distance between nozzles.
 - *Nozzle Spray Width (Inches):* For broadcast applications, nozzle spray width is the same as nozzle spacing – the distance between nozzles. For band applications, use the width of the sprayed band if treated area is specified; use nozzle spacing if total area is specified. For directed spray applications, use the row spacing divided by the number of nozzles per row. Some directed spray applications use more than one type or size of nozzle per row. In this case, the nozzles on each row are added together and treated as one. Spray width would be the row spacing.

In most cases, a backpack sprayer uses a single nozzle. Some sprayers use mini-booms or multiple nozzles. The spray width is the effective width of the area sprayed, being sure to account for overlap. If a sweeping motion from side to side is used, be sure to use the full width when walking forward. If spraying on foliage in a row, use the row spacing. Dyes are available to blend with the spray to show what has been covered.
 - *Spray Swath (Feet):* The width covered by all the nozzles on the boom of a sprayer. For air blast or other boomless sprayers it is the effective width covered in one pass through the field.
 - *Ground Speed, Miles per Hour (MPH).* Careful and accurate control of ground speed is important for any type of sprayer application. Ground speed can be calculated using a test course and stop watch. For this procedure, measure a suitable test course in the field and record the time it takes to cover the course. Speed can be calculated with the following equation.

$$\text{Ground Speed (MPH)} = \frac{\text{Distance} \times 60}{\text{Seconds} \times 88}$$

When using a backpack sprayer, you want to walk a comfortable pace that is easy to maintain. Choose a safe, comfortable speed that will enable you to finish the job in a timely manner. On tractor mounted sprayers, select a ground speed appropriate for the crop and type of sprayer used. Slow speeds will require more time to complete the task while high speeds may be difficult to control and unsafe. Choose a safe, controllable speed to finish the job in a timely manner.

- The *discharge rate*, Gallons per Minute (GPM), required for the nozzles must be calculated in order to choose the right nozzle size. Discharge rate is dependent upon application rate; ground speed; and nozzle spacing, spray width, or spray swath.

For applications using nozzle spacing or nozzle spray width (Inches):

$$\text{Discharge Rate} = \frac{\text{Application Rate} \times \text{Ground Speed} \times \text{Spray Width}}{5940}$$

For applications using the spray swath (Feet):

$$\text{Discharge Rate} = \frac{\text{Application Rate} \times \text{Ground Speed} \times \text{Spray Swath}}{495}$$

- Choose an appropriate nozzle or nozzles from the manufacturer's charts and install them on the sprayer. Check each nozzle to be sure it is clean and the proper strainer is installed with it.
- Fill the tank half full of water and adjust the nozzle pressure to the recommended pressure. Measure the discharge rate for the nozzle. This can be done by using a flow meter or by using a collection cup and stopwatch. The flow meter should read in gallons per minute (GPM). If you are using the collection cup and stopwatch method, the following equation is helpful to convert ounces collected and collection time, in seconds, into gallons per minute.

$$\text{Discharge Rate} = \frac{\text{Ounces Collected} \times 60}{\text{Collection Time} \times 128}$$

- On boom sprayers or sprayers with multiple nozzles, average the discharge rates of all the nozzles on the sprayer. Reject any nozzle that has a bad pattern or that has a discharge rate 10% more or less than the overall average. Install a new nozzle to replace the rejected one and measure its output. Calculate a new average and recheck the nozzles compared to the new average. Again, reject any nozzle that is 10% more or less than the average or has a bad pattern. When finished, select a nozzle that is closest to the average to use later as your "quick check" nozzle.

On backpack sprayers or sprayers with a single nozzle, compare the discharge rate of the nozzle on the sprayer to the manufacturer's tables for that nozzle size and pressure. Reject any nozzle that has a bad pattern or that has a discharge rate 10% more or less than the advertised rate. Install a new nozzle to replace the rejected one and measure its output.

Once the sprayer has been properly prepared for calibration, the operator must select a calibration method. When calibrating a sprayer, changes are often necessary to achieve the application rates needed. The sprayer operator should understand what changes can be made to adjust rate and what the limits of each adjustment are. The adjustments and the recommended approach are:

Pressure: if the error in application rate is less than 10%, adjust the pressure.

Ground speed: if the error is greater than 10% but less than 25%, change the ground speed of the sprayer.

Nozzle Size: if the error is greater than 25%, change nozzle size.

The goal should be to have application rate errors less than 5%.

Calibration Methods

There are four methods commonly used to calibrate a sprayer:

- Basic
- Nozzle
- 128th acre and
- Area

The *basic*, *nozzle*, and 128th acre methods are “time” based methods which will require using a stopwatch or watch with a second hand to insure accuracy. The *area* method is based on a test distance measured in the field. Each method offers certain advantages. Some are easier to use with certain types of sprayers. For example, the basic and area methods can be used with any type of sprayer. The 128th acre and nozzle methods work well for boom and backpack sprayers. Choose the most comfortable method and use it whenever calibration is needed.

Basic Method

1. Accurate ground speed is very important to good calibration with the basic method.

For tractor mounted sprayers, set the tractor for the desired ground speed and run the course at least twice. For backpack sprayers, walk the course and measure the time required. Walk across the course at least twice. Average the times required for the course distance and determine ground speed from the equation below.

$$\text{Ground Speed (MPH)} = \frac{\text{Distance} \times 60}{\text{Seconds} \times 88}$$

If the tractor or sprayer is equipped with a true ground speed indicator such as radar, ultrasonic, or GNSS, this speed can be used for calibration. Tractor tachometers and transmission speed charts are often not accurate enough for calibration purposes.

2. Calculate the application rate based on the average discharge rate measured for the nozzles, the ground speed over the test course, and the nozzle spacing, spray width, or spray swath on the sprayer.

For nozzle spacing or nozzle spray width applications (measured in inches):

$$\text{Application Rate} = \frac{5940 \times \text{Discharge Rate}}{\text{Ground Speed} \times \text{Spray Width}}$$

For spray swath applications (measured in feet):

$$\text{Application Rate} = \frac{495 \times \text{Discharge Rate}}{\text{Ground Speed} \times \text{Spray Swath}}$$

3. Compare the application rate calculated to the rate required. If the rates are not the same, choose the appropriate adjustment and reset the sprayer.
4. Recheck the system if necessary. Once you have acceptable accuracy, calibration is complete.

Nozzle Method

1. Accurate ground speed is very important to good calibration with the nozzle method.

For tractor mounted sprayers, set the tractor for the desired ground speed and run the course at least twice. For backpack sprayers, walk the course and measure the time required. Walk across the course at least twice then average the times required for the course distance and determine ground speed from the equation below.

$$\text{Ground Speed (MPH)} = \frac{\text{Distance} \times 60}{\text{Seconds} \times 88}$$

If the tractor or sprayer is equipped with a true ground speed indicator such as radar, ultrasonic, or GNSS, this speed can be used for calibration. Tractor tachometers and transmission speed charts are often not accurate enough for calibration purposes.

2. Calculate the nozzle discharge rate based on the application rate required, the ground speed over the test course, and the nozzle spacing, spray width, or spray swath of the sprayer.

$$\text{Discharge Rate} = \frac{\text{Application Rate} \times \text{Speed} \times \text{Spray Width}}{5940}$$

For nozzle spacing or spray width applications (inches):

For spray swath applications:

$$\text{Discharge Rate} = \frac{\text{Application Rate} \times \text{Speed} \times \text{Spray Swath}}{495}$$

3. Compare the rate calculated to the average rate from the nozzles. If the two don't match, choose the appropriate adjustment and reset the system.
4. Recheck the system if necessary. Once you have acceptable accuracy, calibration is complete.

128th Acre Method

1. The distance for one nozzle to cover 128th of an acre must be calculated. The nozzle spacing or spray width in inches is used to determine the spray distance. Spray distance is measured in feet. On backpack sprayers, be sure to measure the full width sprayed as you walk forward.

$$\text{Spray Distance, Ft} = \frac{4084}{\text{Spray Width, In}}$$

2. Measure the spray distance on a test course in the field. Check the ground speed as you travel across the course. Be sure to maintain an accurate and consistent speed. Travel the course at least twice and average the time to cover the course.
3. For backpack sprayers, collect the output from the nozzle for the time measured in step 2. For tractor mounted sprayers, park the sprayer, select the nozzle closest to the average, and collect the output for the time determined in step 2. Ounces collected will indicate application rate in GPA.

4. Compare the application rate determined in step 3 to the target rate required for the job. If the rates are not the same, choose the appropriate adjustment and reset the system.
5. Recheck the system if necessary. Once you have acceptable accuracy, calibration is complete.

Area Method

1. Determine the distance that can be sprayed by one tank using the full spray swath measured in feet.

$$\text{Tank Spray Distance (FT)} = \frac{\text{Tank Volume (Gal)} \times 43,560}{\text{Application Rate (GPA)} \times \text{Swath (Ft)}}$$

2. Lay out a test course that is at least 10% of the tank spray distance. Mark the level in the tank and travel the course. Be sure to maintain an accurate and consistent speed across the course. Carefully measure the volume required to refill the tank to the original mark.
3. Calculate application rate.

$$\text{Application Rate (GPA)} = \frac{\text{Volume Sprayed (Gal)} \times 43,560}{\text{Test Course Distance (Ft)} \times \text{Swath (Ft)}}$$

4. Compare the application rate measured to the rate required. If the rates are not the same, choose the appropriate adjustment method and reset the sprayer.
5. Recheck the system. Once you have acceptable accuracy, calibration is complete.

Calibrating Granular Application Equipment

Preparing to Calibrate

Granular application calibration is usually done with the chemical to be applied. It is difficult to find a blank material that matches the granular product. Extra care should be taken in handling this product. Worker exposure should be minimized and precautions taken against spills during calibration. Granular applicators are used to apply product to a crop row.

1. Before calibrating, equipment should be carefully inspected to ensure all components are in proper working order. Check the hopper, the metering rotor, the orifice, and the drop tubes. Be sure there are no leaks or obstructions.
2. Determine the type of application required for the product:
 - Broadcast: treats the entire area.
 - Band: treats only the area under the band.
 - Row: treats along the length of the row.

3. Determine the application rate needed:

- Broadcast: Pounds per acre.
- Band: Pounds per acre of treated band width.
- Row: Pounds per 1000 feet of row length.

4. Determine the type of drive system the applicator uses:

- Independent: uses PTO, hydraulic, or electric motor drive.
- Ground Drive: use ground driven wheel.

5. Regardless of how the application rate is expressed or type of application, calibration is easier if the rate is expressed in terms of pounds per foot of row length. Use one of the following equations to determine the correct row rate in pounds per foot.

For Broadcast Applications (Application Rate = Lb/Ac):

$$\text{Row Rate } \frac{\text{Lb}}{\text{Ft}} = \frac{\text{Application Rate } \frac{\text{Lb}}{\text{Ac}} \times \text{Row Width (Ft)}}{43,560}$$

For Banded Applications (Application Rate = Lb/Ac of Band Width)

$$\text{Row Rate, } \frac{\text{Lb}}{\text{Ft}} = \frac{\text{Application Rate } \frac{\text{Lb}}{\text{Ac}} \times \text{Band Width (Ft)}}{43,560}$$

For Directed (Row) Applications (Application Rate = Lb per 1000 Ft.)

$$\text{Row Rate } \frac{\text{Lb}}{\text{Ft}} = \frac{\text{Application Rate } (\frac{\text{Lb}}{1000\text{Ft}})}{1000}$$

6. Choose a calibration distance to work with and measure a test course of this distance in the field you will be working in. Choose an area that is representative of field conditions. The calibration distance should be at least 50 feet but not over 500 feet. Longer distances are generally more accurate.

7. Calculate the weight of material that should be collected for the calibration distance chosen.

$$\text{Weight} = \text{Row Rate } \frac{\text{LB}}{\text{FT}} \times \text{Calibration Distance (FT)}$$

8. Select a ground speed appropriate for the crop and type of equipment used. Slow speeds take longer to finish the task while high speeds may be inefficient and unsafe. Consult your equipment manual for a recommended speed. Even ground driven application equipment can be sensitive to changes in speed. Maintaining an accurate and consistent speed is very important. Choose a safe, controllable speed that will enable you to complete the job in a timely and efficient manner.

9. Set the equipment according to recommendations from the equipment or chemical manufacturer. Most equipment manufacturers and chemical manufacturers provide rate charts to determine the correct orifice setting or rotor speed for each applicator. Fill the hopper at least half full to represent average capacity for calibration.
10. Attach collection container to each outlet on the applicator that collect all material discharged from the applicator. Locate a scale capable of weighing the collected samples. Some samples may be very small so a low capacity scale may be needed. Accuracy is very important when selecting a scale.

Calibration Methods

Two methods for calibrating granular applicators are commonly used. The first is the distance method. This method is preferred by many operators because it applies to any type of granular machine and is easy to perform. The second method is the time method. This method is similar to sprayer calibration and can be used for applicators driven by PTO, hydraulic, or electric motors.

Distance Method

1. On the test course selected in the field, collect the output from the applicator in a container as you travel the course and weigh the material collected. Record the time required to travel the course. Weigh the material collected. Run the course twice, once in each direction, and average the results for both weight and time.
2. Calculate ground speed to confirm you have the correct speed and can keep the speed constant.

$$\text{Ground Speed (MPH)} = \frac{\text{Distance (ft)} \times 60}{\text{Time (Sec)} \times 88}$$

With a true ground speed indicator, such as radar or GNSS, use the speed indicated.

3. Determine the weight of the product that should be collected for the calibration distance.

$$\text{Weight (Lb)} = \text{Row Rate} \frac{\text{Lb}}{\text{Ft}} \times \text{Calibration Distance (Ft)}$$

4. Compare the weight of the product actually collected (step 1) to the weight expected for the calibration distance (step 3). If the rates differ by more than 10%, adjust the orifice, rotor speed, or ground speed and repeat. Bear in mind, speed adjustments are not effective for ground driven equipment.
5. Repeat the procedure until the error is less than 10%.

Time Method

1. Accurate ground speed is very important to good calibration with the time method. On a test course, set the tractor for the desired ground speed and run the course twice. Average the times required for the course and determine ground speed in miles per hour from the equation below.

$$\text{Ground Speed} = \frac{\text{Distance} \times 60}{\text{Seconds} \times 88}$$

If the tractor or sprayer is equipped with a true ground speed indicator such as radar, ultrasonic, or GNSS, this speed can be used for calibration. Tachometers and transmission speed charts are not accurate enough for calibration.

2. Set the orifice control as recommended and run the applicator for the time measured to travel the calibration distance.
Determine the weight of the product that should be collected for the calibration distance.

$$\text{Weight (Lb)} = \text{Row Rate} \frac{\text{Lb}}{\text{Ft}} \times \text{Calibration Distance (Ft)}$$

3. Compare the weight of the product actually collected for the time to cover the calibration distance to the weight expected for the calibration distance. If the rates differ by more than 10%, adjust the orifice, rotor speed, or ground speed and repeat. Bear in mind, speed adjustments are not effective for ground driven equipment.
4. Repeat the procedure until the error is less than 10%.

Calibrating a Broadcast Spreader

Preparing to Calibrate

Broadcast spreaders are machines designed to apply materials broadcast across the surface of the field. They include drop, spinner, and pendulum spreading devices. Calibration of a broadcast spreader is usually done using the product to be applied. Blank material is available and can be used, but may be hard to find. Use extra care and preparation when calibrating with the chemical.

To begin, follow these steps:

1. Carefully inspect all machine components. Repair or replace any elements that are not in good working order.
2. Determine the type of drive system is used: ground drive or independent PTO. This may help determine the method of calibration.
3. Determine the application rate and the bulk density of the product to be applied.
4. Determine the spreader pattern and swath of the spreader. The pattern should be checked to insure uniformity. To check the pattern, place collection pans across the path of the spreader. For drop spreaders, be sure to place a pan under each outlet. For spinner and pendulum spreaders, space the pans uniformly with one in the center and an equal number on each side. The pattern should be the same on each side of the center and should taper smoothly as you go to the outer edge. The swath would be set as the width from side to side where a pan holds 50% of the maximum amount collected in the center pan.
5. Fill the hopper half full to simulate average conditions.
6. Set the ground speed of the spreader. To determine accurate ground speed, use a true ground speed indicator such as radar, ultrasonic or GNSS or time the travel across a test course and calculate ground speed.

$$\text{Application Rate, } \frac{\text{Lb}}{\text{Ac}} = \frac{\text{Weight Collected, Lb} \times 43,560}{\text{Distance, Ft} \times \text{Swath, Ft}}$$

7. Set the spreader according to manufacturer recommendations and begin calibration.

Calibration Methods

There are two methods often used to calibrate broadcast spreaders. The first method is the discharge method. In this procedure, collect and measure the total discharge from the spreader as it runs across a test course. The second method, the pan method, is used on centrifugal and pendulum spreaders. The pattern test pans used to determine pattern shape and swath are used to determine application rate.

Discharge Method

1. Determine the test distance to use. Longer distances may give better accuracy but may be difficult to manage. A distance of 300 to 400 feet is usually adequate. Use shorter distances if necessary to avoid collecting more material than you can reasonably handle or weigh.
2. Set the ground speed. Be sure to maintain a constant ground speed at all times.
3. If using a ground drive spreader, attach a collection bin to the discharge chute or under the outlets and collect all the material discharged from the spreader as it runs across the test distance. If using an independent drive spreader, record the time required to run the test course. Park the spreader at a convenient location and measure the discharge from the spreader for the time measured on the test distance. The course should be run twice and the times averaged for better accuracy.
4. Calculate the application rate:

$$\text{Application Rate, } \frac{\text{Lb}}{\text{Ac}} = \frac{\text{Weight Collected, Lb} \times 43,560}{\text{Distance, Ft} \times \text{Swath, Ft}}$$

5. Compare the application rate measured to the rate required. Adjust and repeat as necessary.

Pan Method

1. Place pans in the field across the swath to be spread. Pans should be uniformly spaced to cover the full swath. One pan should be at the center of the swath with equal numbers of pans on each side. Use enough pans, eleven or more, to get a good measurement.
2. Make three passes with the spreader using the driving pattern to be used in the field. One pass should be directly over the center pan and the other passes at the recommended distance, or lane spacing, to the left and right of the center pass.
3. Combine the material collected in the pans and determine the weight or volume collected. Divide by the number of pans used to determine the average weight or volume per pan.
4. Calculate the application rate.

If you are measuring the weight in the pans in pounds:

$$\text{Application Rate, } \frac{\text{Lb}}{\text{Ac}} = \frac{13,829 \times \text{Weight, lbs}}{\text{Pan Area, Inches}^2 \times \text{Collector Efficiency}}$$

Collector efficiency is an estimate of how much product that lands in the pans will actually stay in the pan. If you do not know, assume 100%.

If you are measuring the amount collected in the pans as a volume in cubic centimeters, use the following to calculate an estimate of weight in pounds for each pan.

$$\text{Weight, LB} = \left(\frac{\text{Bulk Density, } \frac{\text{Lb}}{\text{Ft}^3} \times \text{Volume, cm}^3}{62.4} \right) \times \frac{1 \text{ Lb}}{453.6 \text{ Grams}}$$

5. Compare the rate measured to the rate required. Adjust and repeat as necessary.

Using a Hand-Cranked, Hand-Held Spreader to Apply Herbicides in Container Nurseries

Weed management in nursery crops can be one of the most costly components of crop production. Producers of container nursery crops rely primarily on two methods of weed control—multiple applications of preemergence herbicides and hand-weeding. Regardless of which herbicide is applied, the product must be applied accurately and uniformly to achieve effective weed control and to avoid over-application, which may injure crops. Most preemergence herbicides used in container nurseries are formulated on granular carriers. The standard application method is with a hand-held, hand-cranked “belly-grinder” type of rotary spreader. Two of the more commonly used models are the Warren T7-II and the Solo 421S, but other models are available.



Photo 1. Example of variable granule distribution

The uniformity of spread using these devices has been shown to be quite variable. We have measured granular herbicide applications at nurseries and found up to 250% variability from one pot to another within a container block. Increasing the uniformity of herbicide distribution will improve weed control and decrease the potential for crop damage. When using these granular spreaders, the most important factors affecting the distribution pattern and dose include: walking and cranking speed, swath width, rudder setting, amount of granule in the hopper, spreader output setting, wind speed, and walking patterns.

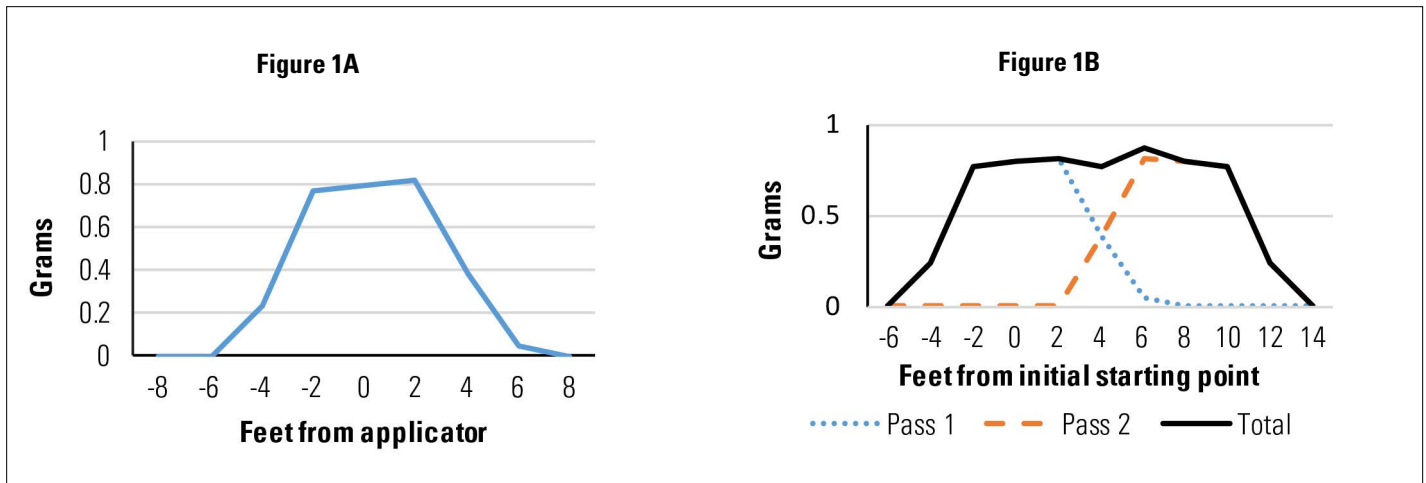
Granular Distribution Patterns

Granular spreaders typically have a distribution pattern in which the largest amount of granules is deposited directly in front of the applicator, with lesser amounts falling to the sides (Figure 1-A). To apply a uniform amount over an area, some overlap between passes is required.

Overlapping each side of the distribution pattern by 30 to 35% for a total of 60 to 70% overlap creates the most even application (Figure 1-B.) How close together the passes are, and as a result how much the passes overlap, is called the effective swath width.



Photo 2. Uniform herbicide distribution will result in better weed control.



Figures 1-A and 1-B. Figure 1-A is a typical pattern of granular distribution from a “belly-grinder” spreader. Overlapping passes by 30 to 35% will result in more uniform granular distribution, as shown in Figure 1-B.

Walking and Cranking Speed

The amount of granules applied to a given area is influenced by the applicator’s walking speed. The faster you walk, the fewer the granules put out (Figure 2). A comfortable speed for most people is 3 mph, or 100 feet in 23 seconds. How fast you turn the spreader crank also influences the distribution of granules (Figure 3). When calibrating your spreader, make sure to use a speed that is comfortable. Then be consistent. You may use a metronome (Photo 3) to maintain constant walking and handle-cranking speeds. When using a metronome, try 99 to 103 beats for the walking speed and 60 for the handle-cranking speed.

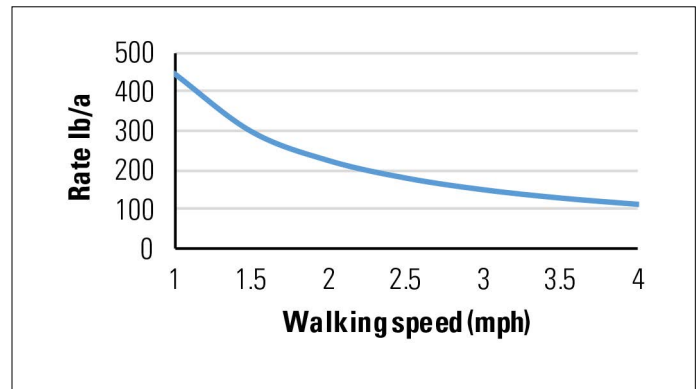


Figure 2. The faster you walk, the lower the application rate. Maintaining the speed you used while calibrating the spreader is important in maintaining a uniform application rate.

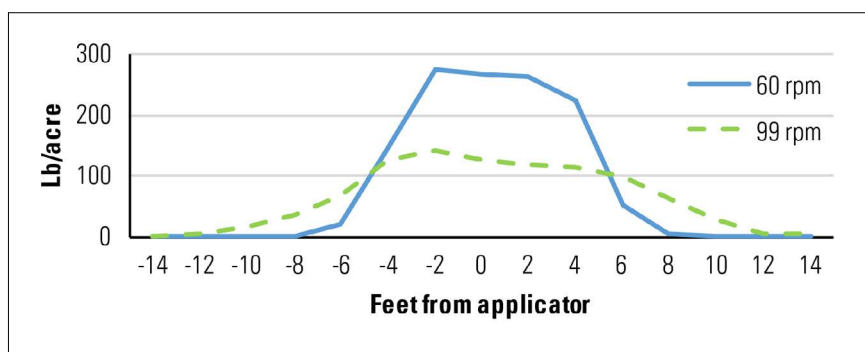


Figure 3. Comparison of two handle-cranking speeds. The faster speed resulted in a wider spread and lower rate than the slower cranking speed. Maintaining the handle-cranking speed used when calibrating the spreader helps keep the application rate and swath width consistent. Handle speeds are expressed as rotations per minute (rpm).



Photo 3. A portable metronome like this can help you maintain a consistent walking pace and cranking speed.

Swath Width

The distance between passes with a granular spreader (the swath width) has a large impact on application uniformity. For instance, with a 12-foot swath width, the average distribution pattern of

FreeHand granules using a Warren T7-II spreader is very uneven (Figure 4). The gaps can be greatly reduced by using an 8-foot swath width instead (Figure 5). A swath width of about 8 to 10 feet works best for the average granule carrier.

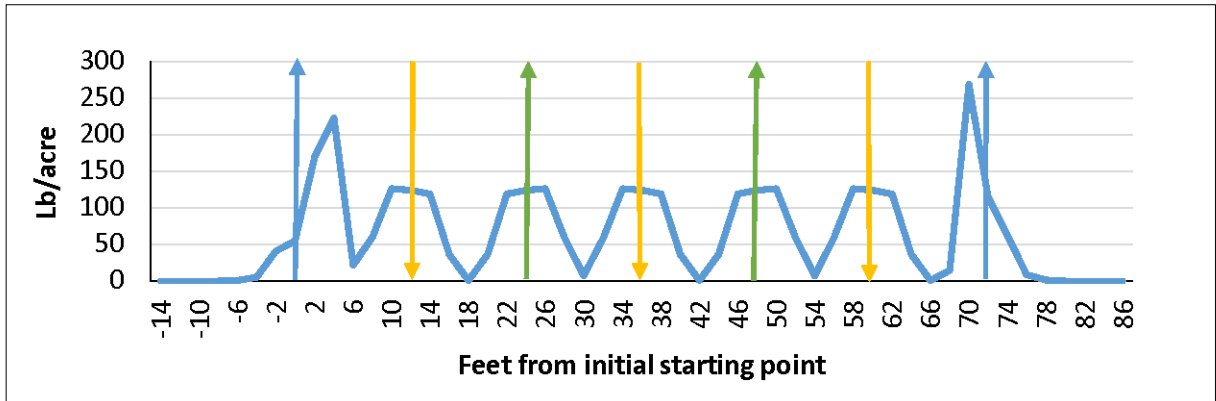


Figure 4. This spreader pattern reflects a 12-foot swath width; right, center, and left rudder positions; and the typical back and forth spreading pattern.

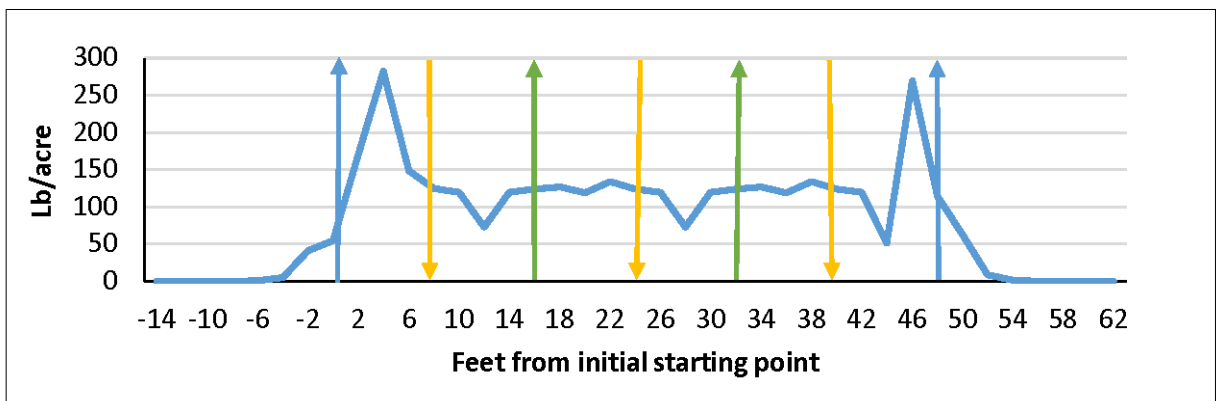


Figure 5. Having a narrower swath width improves application uniformity. This spreader pattern reflects an 8-foot swath width; right, center, and left rudder positions; and the typical back and forth spreading pattern.

Rudder Setting

Some spreaders can be adjusted to throw granules more to the right or the left, reducing the amount of product applied outside the container beds (Photo 4). However, using these rudder positions creates spikes in the amount of product applied to the outer edge of the application area (Figures 4, 5, and 6). This can be avoided by using only the center rudder position on spreaders with multiple rudder options (Figure 7). Holding the spreader at an angle while using the center rudder position also creates spikes in application and is not recommended.



Photo 4. Adjustable rudder positions on a Warren T-7 II spreader.

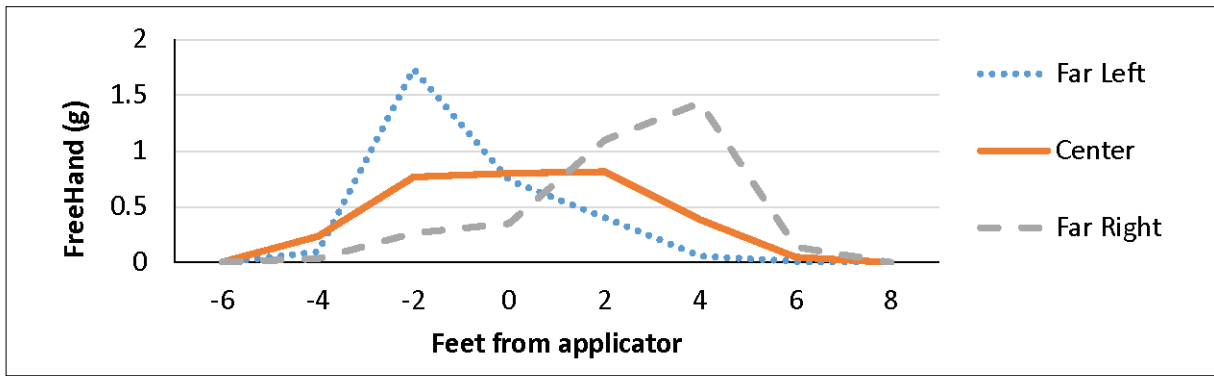


Figure 6. This typical granular distribution pattern was created from a Warren spreader by using the far left, center, and far right rudder positions. Using the left and right rudder positions created peaks in the amount of granules applied.

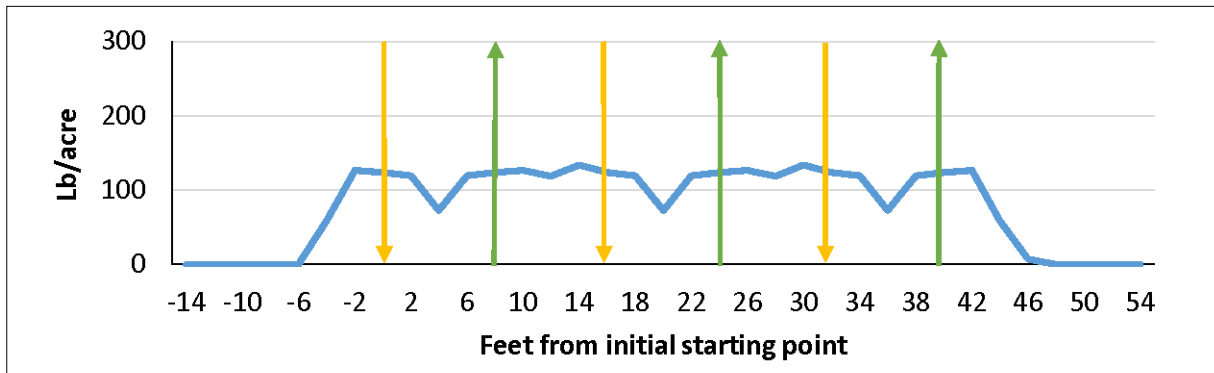


Figure 7. Using only the center rudder position improved spreader uniformity. This spreader pattern reflects an 8-foot swath width, center rudder position only, and the typical back and forth spreading pattern.

Amount of Granule in Hopper



Photo 5. Keep the spreader at least 25% full, as shown by the arrow.

The amount of product in the hopper at any given time affects the rate of application. Application rates can be as much as 45% lower when the hopper is only 10% full than when the hopper is completely full. Don't wait until the spreader is empty to refill. Add more

granules when the level in the hopper drops to about 25% full (Photo 5).

Start Walking Before You Begin Spreading

Start walking and cranking the handle before opening the hopper. Otherwise, the spreader tends to drop a large amount of granules at the beginning (Photo 6). Waiting to open the hopper also helps prevent the spreader from jamming and dropping granules in one spot.



Photo 6. This pot received a HUGE dose of herbicide when the applicator opened the hopper before cranking the handle.

Wind Speed

If there are greater than 5 mph winds, do not use the granular spreader. Wind interferes with the uniformity of application. In Photo 7, notice how wind blew granules to the edge of the pot. This will inhibit root growth where the excessive herbicide is deposited and provide poor weed control where little or no herbicide is present.

Application Pattern (The Direction You Walk Can Make a Difference)

Applicators commonly walk a back-and-forth pattern (up one side and back the other) (Figure 8). This pattern provides an acceptable, balanced distribution only when the spreader is fully open (setting 6 on the Warren T7-II or Solo 421S spreaders), and only with a few herbicide granules (notably the clay granule used to make FreeHand G and Pendulum 2G). The fully opened setting may be appropriate for some herbicide applications, but lower settings are often required to achieve the desired application dose. When the lower settings are used, the distribution pattern is skewed more to the right (Figure 9-B). This will dramatically affect the uniformity of application (see Figure 10-A).



Photo 7. Wind blew granules to pot edge.

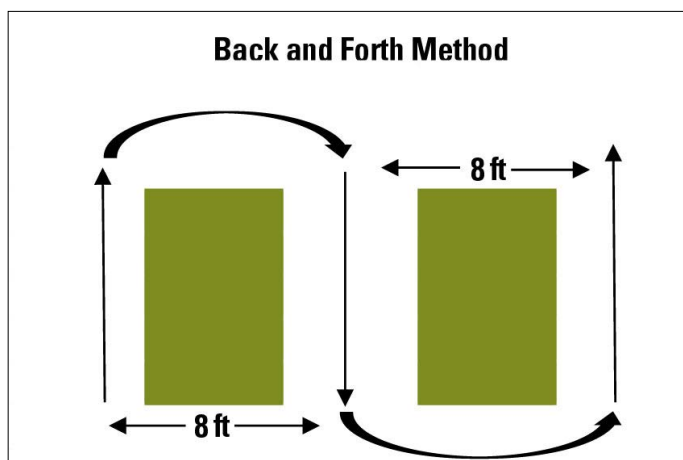
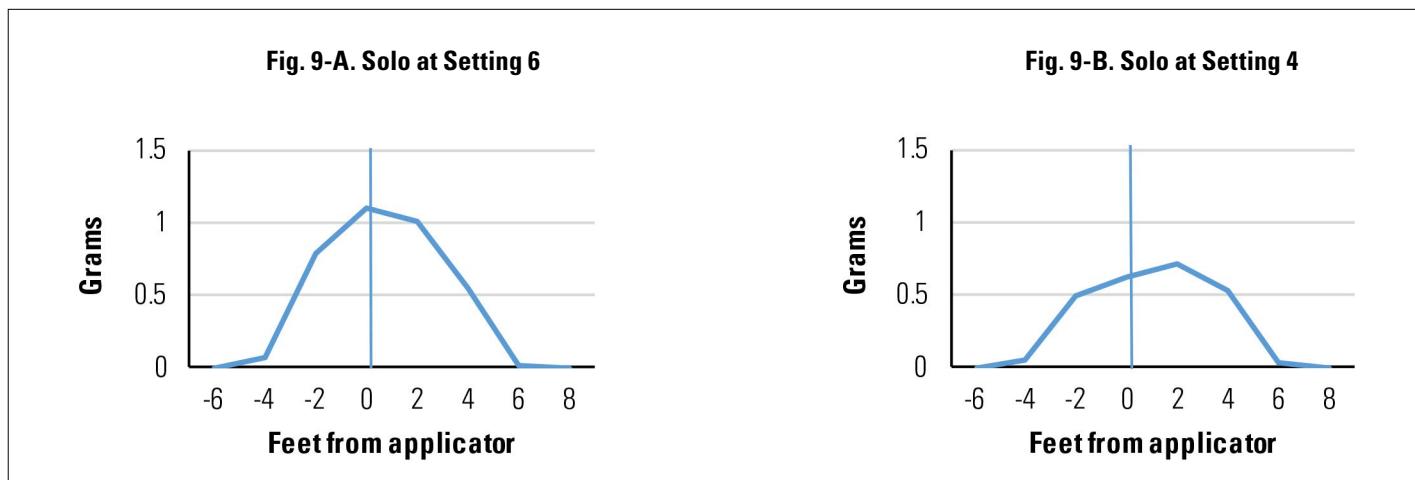


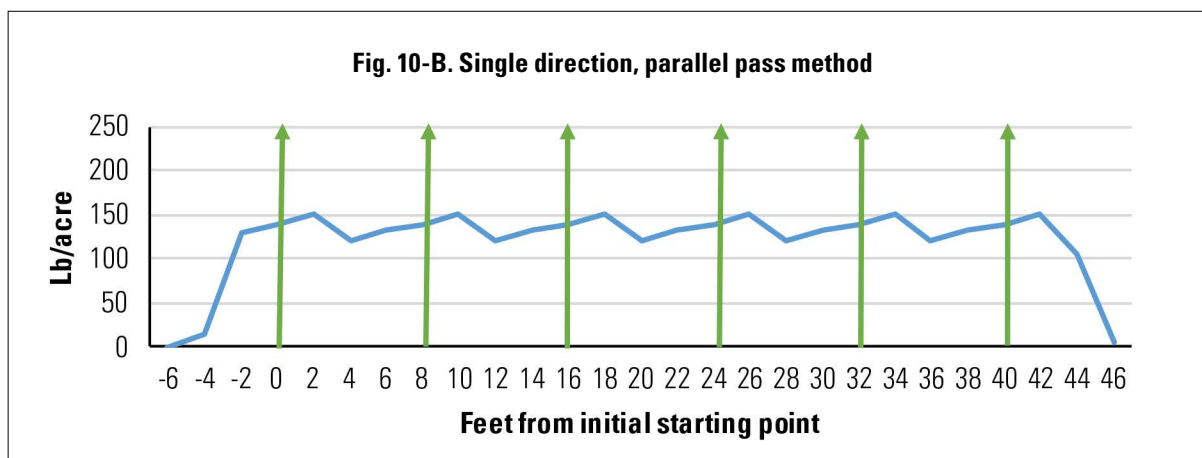
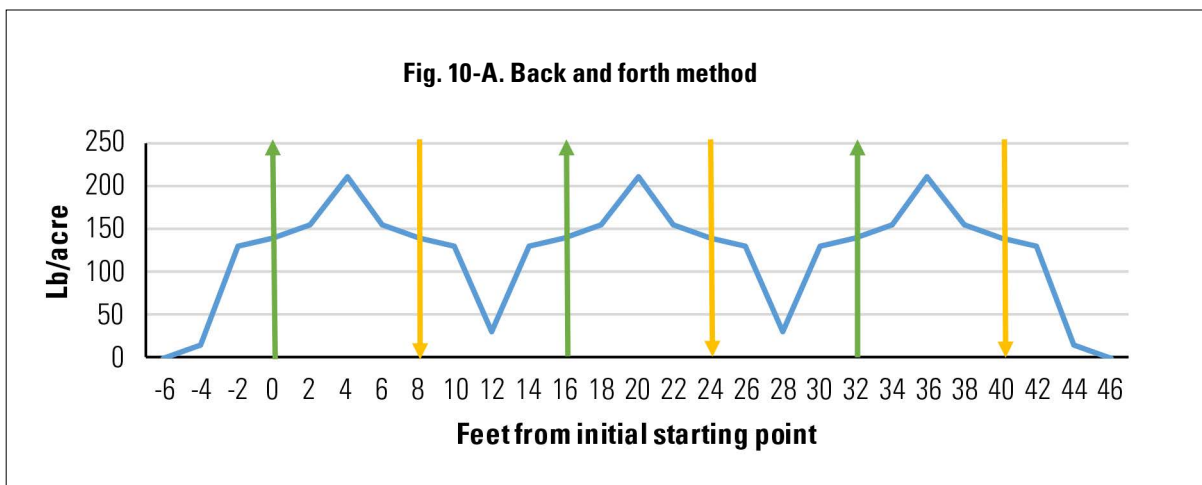
Figure 8. Typical back and forth application method.



Figures 9-A and 9-B. Sample granular distribution patterns at two spreader output settings. When the spreader is at the highest setting (Figure 9-A), the pattern is relatively uniform. But at lower settings, the spreader distribution is skewed to the right. Instead of being centered, the peak dose is 2 to 3 feet to the right of the applicator. The vertical lines mark the “center” position (where the applicator is walking).

There are two ways to compensate for this skewed pattern—change the direction of travel, making all applications while walking in the same direction (Figure 11-A), or make two passes over the same path in opposite directions (Figure 11-B). If you have

calibrated your spreader to apply the full dose in one pass, then applicators must walk in the same direction (Figure 11-A). This might be most easily accomplished by having multiple applicators working together. Alternatively (and preferably), calibrate



Figures 10-A and 10-B. Sample granular distribution with a Solo spreader at Setting 4 with an 8-foot swath width, center rudder position, and a middle output setting. Figure 10-A illustrates the distribution pattern created when making parallel passes in two directions (back and forth). Figure 10-B illustrates the greater uniformity achieved when all passes are made in the same direction.

your spreader to apply half the target dose and walk the area twice in opposite directions (Figure 11-B). Remember—if you make two passes over the same path, you must calibrate your spreader to apply only half of the labeled dose each time.

Calibration

It is also important to know how much product your spreader is putting out. Great uniformity will still produce poor results if you're putting out too much or too little product. Test your application rate and adjust your walking speed and spreader setting as needed. More details on calibration can be found in *Calibrating Hand-Held Granular Spreaders for Nursery Weed Control*, <https://content.ces.ncsu.edu/calibrating-hand-held-granular-spreaders-for-nursery-weed-control>.

Tips for using Warren T-7 II and Solo 421S spreaders

- Maintain a consistent walking speed. Use a metronome.
- Maintain consistent cranking speeds. Use a metronome.
- The size of the beds matters! Keep nursery beds between 6 and 8 feet wide (for an 8- to 10-foot swath width).
- Only use the center rudder position. Do not hold the spreader at an angle.
- Refill the hopper when the level drops to about 25% full. Don't wait until it runs out.
- Start walking and cranking before opening the hopper.
- If the wind is 5 mph or more, don't make the application. Wait for a calmer day.
- When using lower spreader settings, spread granules using the single direction, parallel pass method.
- Calibrate your spreader!

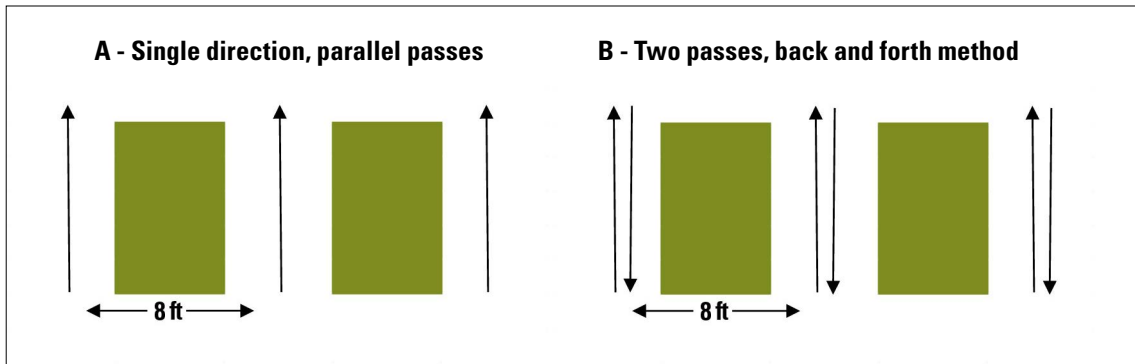


Figure 11. The single direction, parallel pass method involves walking up and down between each bed, but only spreading in one direction. The arrows represent walking while spreading granules. The other option is to make two passes by walking up and down between each bed, spreading in both directions at half the labeled rate.

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<https://content.ces.ncsu.edu/using-a-hand-cranked-hand-held-spreader-to-apply-herbicides-in-container-nurseries>

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Calibrating Hand-Held Granular Spreaders for Nursery Weed Control

NC STATE

EXTENSION



Even the best herbicides will not provide effective weed control if they are not applied accurately and uniformly. Too little product results in poor weed control and higher hand-weeding costs. Too much can injure crops, reducing the number available for sale. Most granular herbicide labels contain some recommended settings for common application equipment. However, these recommendations **are just starting points**. To obtain the correct dose, you need to calibrate the spreader. Spreader calibration is essentially a very simple process:

1. measure the width of spread;
2. apply the granules to a small area;
3. measure the amount applied to this area;
4. compare this amount to the desired dose and adjust the spreader settings until the desired output is obtained.

Simple, right? However, in practice, this is easier said than done. In this fact sheet we cover the steps required to determine the effective swath width and application rate.

THE IMPORTANCE OF MAINTAINING A CONSISTENT SPEED

Both your walking speed and the speed at which you turn the spreader handle will influence the rate at which the product is applied. A consistent speed will help maintain a uniform application rate and distribution. See the fact sheet [AG-826](#), Using a Hand-Cranked, Hand-Held Spreader to Apply Herbicides in Container Nurseries for more information on how walking speed affects spreader output.

Walking Speed

- Measure a distance of 100 feet in an area that is similar to the location where you will be applying the granules.
- Using a stopwatch, determine how long it takes to walk 100 feet. Most spreader manufacturers recommend walking about 2 to 3 mph. At 3 mph it takes about 23 seconds to walk 100 feet. A 2 mph pace requires about 34 seconds per 100 feet.
- You may use a metronome to help keep a consistent walking speed (Figure 1). Experiment with a few different settings until you find one that allows you to walk at the desired pace. To achieve a 3 mph pace, a good starting point is between 99 and 103 beats per minute. But this number will be different for different applicators. A mobile phone application metronome also works.
- The metronome can be clipped to the spreader while applying the granules.



Figure 1. A portable metronome like this can help you maintain a consistent walking pace and cranking speed.

Handle Cranking Speed

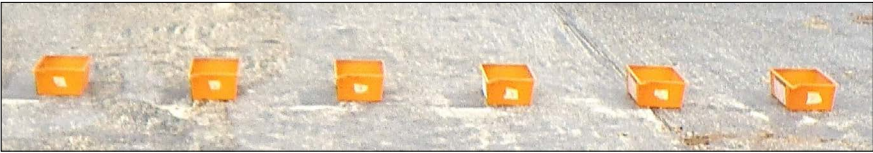
- Turn the spreader crank at a consistent speed that is easy to maintain — generally one rotation per second.
- You can practice with the metronome set to 60 beats per minute until you can walk with a consistent pace.

SPREADER CALIBRATION STEP 1: DETERMINING THE EFFECTIVE SWATH WIDTH AND DISTRIBUTION PATTERN

Granular spreaders do not distribute the same amount of material across the width of the treated area. More granules are deposited directly in front of the applicator than at the edges. Consequently, the applicator will have to overlap each pass when applying herbicides. For this reason, you need to determine the *effective swath width*. The effective swath width will be narrower than the entire width of spreader throw. Here are the supplies you will need:

- Granular spreader
- Herbicide of choice
- 7 to 9 containers such as catch bins, trays, or 1 gallon (3 or 4L) nursery pots lined with plastic bags
- Measuring tape
- A small scale (able to measure 1 gram)
- Metronome (battery operated, clip on)
- Stop watch
- Numbered bags/jars to hold herbicide granules
- Personal protective equipment

Steps

1. Set out the catch pans or bins 2 feet apart on center, perpendicular to the direction you will be walking (Figure 2 and Figure 3). Place the pans on a flat, dry, and empty nursery bed covered with landscaping fabric or plastic.
- 
- Figure 2. Layout of catch bins, two feet apart, on center.
2. Mark a starting point about 20 feet in front of the center box. Mark a point along your walking path to open the hopper (at least 12 feet in front of the center box).
 3. Practice walking toward the boxes at a consistent pace, using a steady handle cranking speed and stepping over the center box (use the metronome).

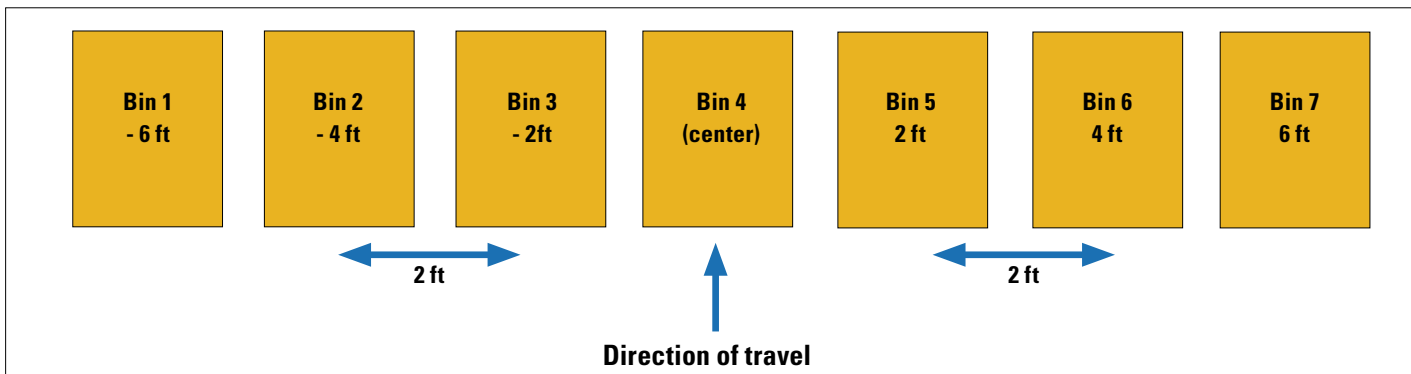


Figure 3. Calibration catch pan/tray setup. Set collection trays or bins 2 feet apart, on center. Walk down the center (carefully stepping over the center collection tray). Repeat at least three times.

4. Fill the spreader at least ½ full.
5. Use the center rudder position (or just right of center) as shown in Figure 4.
6. Adjust the spreader to the herbicide manufacturer’s recommended output setting and spread granules while walking toward and over the boxes. Open the hopper at least 12 feet in front of the center bin and always walk toward the bins from the same direction. Keep the hopper open until just past the catch bins. Repeat the process at least two more times. *NOTE: When spreading, start turning the handle before you open the spreader hopper and continue turning the handle after closing the hopper until no more granules spread out. This helps reduce spreader jamming.*
7. Weigh the granules collected in each bin.
8. Measure the weight of granules collected in the center bin. Divide this number by two and find the collection bins on either side of center that have about half as much product as the center bin. The distance between the two bins is the effective swath width (Example A).
9. To determine the distribution pattern (Example B), use a piece of graph paper to chart the amount of granules in each bin and draw a line through the center (Figure 5). If the pattern is lopsided, plan to spread granules in one direction or make two passes in opposite directions over the same path.
10. If the test site was dry, you can sweep up the granules and reuse them.

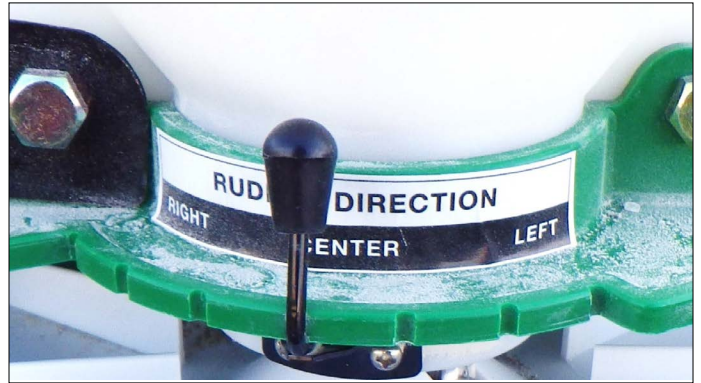


Figure 4. Use only the center rudder position (or just right of center) to achieve the most uniform pattern.

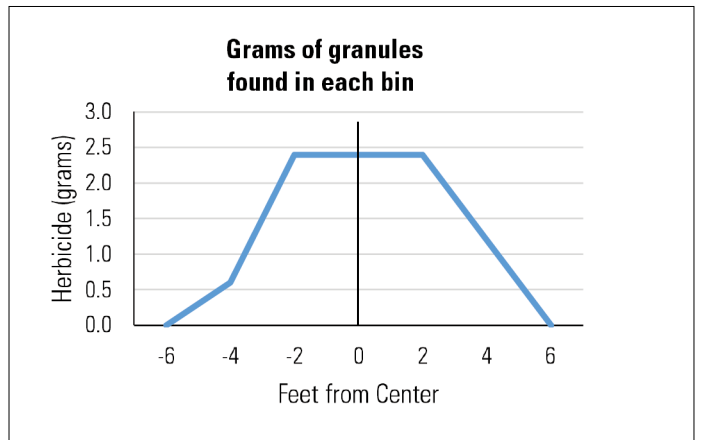


Figure 5. Distribution pattern created by graphing the amount of herbicide in each bin.

Example A: Determining the Effective Swath Width

In this example, the weight of the herbicide collected in each bin is recorded in the chart below.

	Collection tray or bin (by distance from center)						
	- 6 ft	- 4 ft	- 2 ft	0	2 ft	4 ft	6 ft
	(left of center)			(center)	(right of center)		
Grams collected	0.0	0.6	2.4	2.4	2.4	1.2	0.0

- 2.4 grams were collected in the center bin. Half that amount would be 1.2 grams.
- The bin 4 feet to the right of center contained this amount.
- On the left side, the area to receive 1.2 grams of material would be about halfway between the bins 2 and 4 feet left of center.

Thus, we would conclude that the effective swath width would be from about 3 feet left of center to 4 feet right of center, or 7 feet wide. This is the width used in Spreader Calibration Step 2: Determining the Application Rate.

Alternative Swath Width Method

If you don't have a scale, you can use a technique developed by Dr. Wayne Buhler, NC State University Pesticide Education Specialist. This approach uses a clear seven-day pill organizer to visually estimate swath width (Figure 6). *Caution: clearly label the box as having been used with pesticides and keep the box in the pesticide storage facility.*

- Label each compartment with the number of feet from the center. Keep left and right of center orientation clearly marked.
- After collecting granules as described in steps 1 through 6, use a funnel to put the contents of each collection bin into the corresponding sections of the pill box.
- Locate the compartments with about $\frac{1}{2}$ as much product in them as the center compartment. This allows you to find your swath width and basic distribution pattern.



Figure 6. A clear pill box can be used to determine the swath pattern. The numbers correspond to the distance from center (in feet) as in Example A.



Figure 7. A milk scale, or a similar scale, can be used to weigh the spreader.

Example B: Determining Distribution Pattern

Graph the amount of granules in each bin (Figure 5). This particular distribution pattern is balanced with similar amounts spread to the left and right. However, depending upon the granule, the spreader, and the dose applied, the amount spread to the right may be greater than the amount applied to the left.

SPREADER CALIBRATION STEP 2: DETERMINING THE APPLICATION RATE

Bins, trays, and pots are useful for collecting granules when determining swath width. However, our research indicates that they are not a reliable tool for calculating the application rate. Instead, it is better to weigh the amount of herbicide applied to a known area, and then adjust the spreader settings to obtain the desired dose.

1. Fill the hopper on the spreader at least $\frac{3}{4}$ full of product.
2. Weigh the filled spreader and record the weight (Figure 7).
3. Operate the spreader over a known distance (at least 25 feet).
4. Reweigh the spreader and subtract the current weight from the original weight to determine how much product was used.
5. Calculate the area covered (distance the granules were spread multiplied by the swath width of the spreader).
6. Calculate the dose (weight of granules used divided by the square feet of area covered).

7. Adjust the spreader output setting or your walking speed until your application dose is within 10% of the labeled (or target) dose.

For more information on determining application rates using granular spreaders, see North Carolina State University publication [AG-628](#), *The Calibration of Turfgrass Boom Sprayers and Spreaders*.

Example C: Determining the Dose

- Assumptions:
 - » Labeled (target) herbicide dose: 150 lb/A
 - » Effective swath width: 7 ft
 - » Length of walking area: 30 ft
 - » Area = 210 sq ft (swath width x length of area treated)
- Beginning weight of spreader with herbicide granules: 195 oz
- Ending weight of spreader with herbicide granules: 186 oz
 - » Difference: 9 oz applied
- Convert ounces to pounds: $9 \text{ oz} \div 16 \text{ oz per lb} = 0.56 \text{ lb applied}$
- Calculate the dose:
 - » Divide the amount applied by the area to obtain the amount per sq ft:
 $0.56 \text{ lb} \div 210 \text{ sq ft} = 0.0027 \text{ lb/sq ft}$
 - » Multiply by 43,560 (number of sq ft per acre) to obtain the dose in lb/A.
 $0.0027 \text{ lb/sq ft} \times 43,560 \text{ sq ft/ acre} = 118 \text{ lb/A}$
- This dose is more than 10% below the target dose of 150 lb/A. Adjust the spreader settings (or walking speed) to allow slightly more output and repeat the process until the rate falls within the acceptable range (135 to 165 lb/A).

You will need to follow this calibration procedure for each herbicide.

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4. Arthropod Pest Control

Juang-Horng Chong

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Modified from Clemson University's Landscape Contractor Certification Program, "Module 9. Integrated Pest Management," prepared by Juang-Horng "JC" Chong.

Healthy plants are important components of urban landscapes. These plants, however, are subjected to attacks by a myriad of pests while they are being grown in a nursery or maintained in a landscape. The ultimate goal of a successful ornamental plant pest management program is to improve the quality of plants (nurseries and greenhouses) and plant care services (landscape care operations) while minimizing pesticide use and the negative impacts of pesticide use to the environment, workers, clients, and other non-target organisms. To do so, ornamental plant growers and landscape care professionals have to understand the basic operating principles of integrated pest management, or IPM. The results of IPM can be spectacularly effective when well designed and executed.

We need to have a clear understanding of what a "pest" is. "Pest" is a general term used to describe broadly any organism that is unwanted at a given time and place, or one that cause damage to the object we desire. In the context of ornamental IPM, a pest can be a weed that grows in the flower bed, a pathogen that causes wilting of a plant in a greenhouse, a nematode that causes leaf spots, insects and mites that feed on and damage the plants, or wildlife that damage ornamental plants through their activities.

The presence of insects or mites on a valuable plant does not necessarily warrant management. The definition of a pest depends on its identity, its density, and the situation in which the species was found. Some arthropods may be transient or even beneficial. Management against these transient or beneficial arthropods is discouraged. An insect or mite species identified as a pest in another crop system may not be considered a pest in a nursery or landscape if it is not causing a noticeable or unacceptable level of damage. A species that is known to be a pest of a particular ornamental plant may not require management if its density is low enough that no damage was observed or their presence can be tolerated. Only an insect or mite species that has caused an unacceptable level of damage should be considered a pest. As such, the pest should be controlled at the appropriate (or most vulnerable) time with the safest and most effective management tools.

IPM is a systematic approach to pest management that uses several approaches to reduce the population and damage by pests to a tolerable level. The ultimate goal of IPM is to minimize impacts to the environment, non-target organisms, and workers. There are several important caveats to this general definition of IPM:

1. There is not a "cookie-cutter" or easily replicated approach to pest management. Although the principles of IPM can be applied to all pests and situations, the details of each IPM program should be tailored to the specific pest and situation. An IPM program is designed based on a unique combination of pest biology, the pest's impact on the affected plant, the host plant's susceptibility to the pest, and the selective management tools available for managing the pest population.
2. IPM does not produce "pest-free" plants. An IPM program only reduces the pest population to a non-damaging and tolerable level. Complete elimination of pest population is unrealistic ecologically and economically because a pest population can re-infest the plants, and the intensive care needed for complete elimination may result in significant inputs that (1) negatively impact the environment and safety, and (2) are prohibitively expensive.
3. IPM is a knowledge-intensive discipline that takes into consideration pest biology, plant health and susceptibility, the physical and environmental conditions, the ecological webs around the pest population, and the impacts of IPM management approach on these ecological interactions. That means pest managers will have to have a full and systematic understanding of the biological and non-biological aspects of the system and take these aspects into consideration when designing an IPM program.
4. IPM does not advocate for any particular control method, such as biological control. Instead, multiple management tactics are combined or integrated to create a system by which the pest population is challenged by multiple control methods. These multiple-stressor challenges are very difficult for pests to overcome through the development of resistance.

Scouting

Scouting is a crucial first step in any IPM program. A scouting plan is a careful and deliberately designed process for detecting pest population. The objectives of a scouting plan are as follows:

1. To detect the presence of, and damage by, a pest population. This information is important in determining if a pest is present and if damage is within an acceptable level.
2. To determine the life stage of a pest population. This information is important in determining the timing of application and the selection of treatment options. Each treatment option is most effective against a specific species or a specific life stage.
3. To determine the population density of the pest. This information is important in determining if the pest population has exceeded the tolerable level and if treatment is needed.
4. To determine the distribution of the pest population. Some pest species are only restricted to a specific host plant or area, which may be more appropriately managed with targeted spot treatments. An area-wide treatment plan that requires more materials and labor will be needed against species that can attack many plant species, or that the host plant of a pest is widely distributed in the area.
5. The presence, damage, density, and distribution of the pest should be monitored before and after the treatment so that the efficacy of the treatment can be determined. The same parameters should be monitored even when treatment is deemed unnecessary in order to detect any changes over time and whether treatment is warranted when the changes occur.

Ultimately, a scouting program provides information (detection, identification, density, life stage, and distribution) for making the most appropriate and effective management decisions.

There are 5 steps in a scouting plan:

Step 1: Plan.

An employee should be assigned as the dedicated scout, or a professional scouting service should be engaged. The primary duties of the scout are to carry out the scouting plan faithfully and to report findings to the pest manager promptly. The scout will also be responsible for record keeping, evaluating treatment efficacy, and be a part of the pest management decision team. No other duties should be assigned to this employee so that he or she is not distracted. The scout should receive training and be provided with the necessary tools before initiating a scouting plan. The scout should also receive continuing education offered through the Extension Service and trade associations.

Each scout and pest manager should develop a detailed scouting plan that reflects the objectives of each IPM program. The scouting plan should include a map of the landscape with placement of each plant species, a list of known pest hot spots or potential trouble areas, a list of pests of concern, frequency of visits, time when scouting will begin, tools that are needed, etc. Some of these elements will be discussed in greater detail in the following sections.

Step 2: Monitor.

Once a scouting plan is developed, it has to be implemented faithfully. The scout should visit the site at prescribed intervals and use the most appropriate monitoring tools, traps, or methods for monitoring the populations of the pests of concern.

Step 3: Identify.

Once an insect is detected or trapped, the scout should identify the insect in order to determine if it is a pest or a non-target species. A scout may also identify a problem by examining the damage. Pests must be identified correctly because an IPM program is species and situation specific, and pesticides are not effective against all pest species. The insect or mite should be identified to species if possible. If not, the insect should be identified to a general grouping or family (such as "soft scales") or to the best of the scout's ability. The life stage of the pests should also be identified and recorded. Resources, such as reference books, should be available to the scouts.

Following are some useful references for insect and mite diagnosis.

Print resources:

Insects that Feed on Trees and Shrubs by W. Johnson and H. Lyon (1991), Comstock Publishing Associates

IPM of Midwest Landscapes by V. Krischik and J. Davidson (2004). Minnesota Agricultural Experiment Station, University of Minnesota.

Digital resources:

IPMPro – iOS and Android app; <http://ipmproapp.com>

Purdue Plant Doctor – multiple apps in iOS and Android formats; <https://www.purdueplantdoctor.com>

IPM of Midwest Landscapes by V. Kruschik and J. Davidson, Center for Urban Ecology and Sustainability, University of Minnesota
<http://cues.cfans.umn.edu/old/ipmbook.htm>

Insect and Related Pests of Flowers and Foliage Plants by J. R. Baker (ed.), North Carolina State University
<http://ipm.ncsu.edu/AG136/ncstate.html>

Insect and Related Pests of Shrubs by J. R. Baker (ed.), North Carolina State University
<http://ipm.ncsu.edu/AG189/html/>

If the scout could not provide correct identification, samples should be collected and sent for identification by university or private diagnosis services:

Clemson University, Plant Problem Clinic
http://www.clemson.edu/public/regulatory/plant_industry/pest_nursery_programs/plant_prob_clinic/

North Carolina State University Plant Disease and Insect Clinic
<https://projects.ncsu.edu/cals/plantpath/extension/clinic/>

University of Florida Insect ID Lab
<http://entnemdept.ufl.edu/insectid/>

University of Georgia Insect Identification Services
<https://ugaurbanag.com/uga-insect-identification-services/>

University of Tennessee Plant Pest Diagnostic Center
<https://ag.tennessee.edu/EPP/Pages/HS-CAPS/Plant-Pest-Diagnostic-Center.aspx>

Step 4: Record.

A scouting report is a document of the findings of scouting visits and a tool of communication among the scout, the pest manager, and the client. These records should be kept, and could be referred to in the future to predict the development and occurrence of pest problem and treatment efficacy. The scouting report, at a minimum, should contain the following information:

- Site information. This would include, but not be limited to, the name of the client or the identification number of the site, the address, and the GPS coordinates.
- Name of the scout.
- A site map, which should be produced in the first scouting visit and include all information on the plant species, cultivars, numbers, and their placement.
- Pests (to species when possible) and life stage that are detected and identified, and their pictures when applicable.
- The presence, density, or damage level of the pests.
- The sampling or trapping methods used.
- The location of each infestation (also marked on-site if possible).

Step 5: Report.

Promptly communicate the scouting results to the pest manager, pesticide applicator, and client, so that management decisions can be made in time. A clear line of communication should be established and adhered to among all parties of concern.

When to initiate scouting

There are two approaches to determining when a scouting plan should be initiated:

1. If the objective of the scouting plan is to detect any pest problem that may appear, a scheduled, year-round scouting plan should be developed. This scouting plan depends on frequent visits and the deployment of traps or other monitoring methods. Often, inspection focuses on several key plant species that are either susceptible to pest infestation or suffer perennial infestations. The experience of the scout is often important in alerting the scout to potential problems after observing subtle changes in plant appearance.
2. For a scouting plan that targets pest species with specific activity periods, the plan should be initiated at the right time to capture the beginning of the increase in pest population or damage.

The right time to initiate a scouting plan may be informed by existing biological information or by predictive models (e.g., degree-day models or plant phenological indicators).

The biological and life cycle information of some commonly encountered pest species can be found among the publications of university extension services. The information is often available in the form of bulletins, and it is provided as calendar-based information. It is, however, important to understand that the life cycle of pests does not depend on calendar but on environmental factors, particularly ambient temperature. Because temperature changes slightly from year to year, the activity period of the target pests also changes from year to year. A reliance on calendar-based information may cause a scout to miss the beginning of pest population growth and fail to prevent damage.

A better way to initiate a scouting plan is to use some form of predictive models that are pegged to relevant environmental information. *Degree-day models* and *plant phenological indicators* are the most commonly used predictive tools.

The operating principle of predictive models is the fact that temperature controls the developmental rates of most animals and plants. Each species requires a certain amount of energy to develop from one life stage to another, and the energy may be expressed as heat units. This amount of required heat units does not change from year to year. Therefore, if we can develop a mathematical formula to express the accumulation of the heat units, we can predict the number of days required to complete development of one life stage or the entire life cycle. The accumulated heat units are called the physiological or developmental time, and it is often expressed as Celsius degree-days or Fahrenheit degree-days. The calculation of degree-days is very simple. However, it is beyond the scope of this chapter to provide detailed procedure in calculating degree-days. Please consult Dan Herms (2004) "*Using Degree-Days and Plant Phenology to Predict Pest Activity*" for more information (<http://cues.cfans.umn.edu/old/Web/049DegreeDays.pdf>).

Temperature is the common currency between insect and plant development. Certain plant phenological events often coincide with certain insect phenological events. These plant phenological events, therefore, can be used to predict the development of insects, and they are called plant phenological indicators. For more information on plant phenological indicators, please consult Dan Herms (2004) "*Using Degree-Days and Plant Phenology to Predict Pest Activity*" (<http://cues.cfans.umn.edu/old/Web/049DegreeDays.pdf>).

Scouting or sampling techniques

There are many sampling techniques commonly used in monitoring pests of ornamental plants. Each sampling technique has numerous variations depending on the target pests, pest biology, use site, and the data that are to be collected. This introduction will only provide a brief discussion of the most commonly employed techniques.

1. **Visual inspection** — Visual inspection is the most commonly used sampling technique. Visual inspection involves careful examination of foliage (particularly the underside), branches, and roots for the presence and damage by pests, or signs of their infestation (such as honeydew and sooty mold). Often other associated animals, such as honeydew-collecting ants, also alert a scout to the presence of pest population. A scout should pay attention and look for abnormal growth or damage symptoms at each site. Plants that look unhealthy or suspicious, as well as those that grow in and around the trouble areas, should be examined more frequently and more thoroughly. A hand lens or a magnifying glass is an indispensable tool for a scouting by conducting visual inspection.

2. **Sweep net** — A sweep net is best suited for sampling large, mobile insects that are active in a shrub canopy. First, the scout marks an area he or she wishes to sample. The scout walks forward and swings the net from side to side through the canopy. The contents of the net are poured into a container, and the insects collected by the sweep net can then be identified and counted, and the life stage can be determined. If the area where the net was swept is known, the density of the insects can be determined by dividing the number of insects collected by the area.
3. **Beat sheet** — A beat sheet is frequently used for sampling small sessile insects and mites that are active in shrubs and tree canopies. The beat sheet can be purchased from a pest management supplier, or made by placing a piece of white paper over a clipboard. Put the beat sheet under a branch or a potted plant, then shake or tap the branch gently with hand or a stick to dislodge the insects and mites. Examine the insects and mites that fall onto the beat sheet, using a hand lens or magnifying glass if necessary. The scout can identify the pests and their life stage, and count the number to determine the density.
4. **Colored sticky card** — Many insects are attracted to colors, particular yellow (most insects), blue (thrips), and purple (flatheaded borers). By coating colored cards or cardboard with a sticky tanglefoot material, a scout can make sticky traps that are specific to the target pests. These sticky traps are also widely available from pest management suppliers. The traps are effective in sampling for flying insects, but not effective against sessile insects. The sticky traps should not be used to control the insect population through mass trapping, although they are sometimes suggested or marketed as such. The traps should be deployed just above the canopy. Because these traps often capture a large number of insects, many of them non-target, careful identification should be done to determine the number of the target pests captured. The traps should also be changed every 2 weeks or as needed. Do not allow the traps to get too dirty, either from the insects captured or other materials.
5. **Sticky band** — There are several variations of sticky bands, all of them based on the technique of applying a layer of sticky materials to a branch. The sticky band made with electrician's tape (with the sticky side facing outward) or a double-sided sticky tape wrapped around a branch is useful for monitoring the emergence of scale insect crawlers. Tanglefoot applied to the trunk of a shrub also can form a sticky band to monitor for adult beetles that crawl up the canopy, such as black vine weevils.
6. **Kairomone traps** — Some insects are attracted to scents of food or potential mates. These scents are collectively called kairomones. A large number of traps and lures impregnated with kairomones are available for purchase. Some of the lures contain a sex pheromone, such as those for sampling clearwing borers, which are very effective in capturing males and to determine the emergence of adults. Some lures are based on food scent or scents associated with food. For example, ambrosia beetles are attracted to ethanol. A soda-bottle trap baited with ethanol can be an effective tool in detecting the flight of adult ambrosia beetles and in determining the timing of preventive insecticide spray. Japanese beetle traps are often baited with a combination of sex pheromone and food scent. These traps should be collected weekly or biweekly. The number of insects collected in the traps can be plotted over time to detect trend in population dynamics.

IPM starts at planting

IPM does not start with the detection of a pest; IPM starts with the planting of a tree or shrub. It is important to understand that good planting or establishment practices followed by good cultural or maintenance practices are essential to growing healthy plants. Healthy plants are the foundation of IPM. A healthy plant can tolerate and even resist pest infestation and competition; therefore, they suffer less or no damage from the pests. Treatment or management program is not needed when a pest problem does not occur. A grower or a landscape care professional can remain competitive in the market by minimizing inputs and maintaining a lower management costs.

Five planting concepts are particularly relevant to IPM:

1. **Right plant, right place** – What “right plant, right place” means is that you should select plant species and cultivars that are most suited to the conditions at a particular site. The conditions may include but are not limited to soil type, compaction, cold hardiness, sun and wind exposure, and the needs for maintenance, irrigation, and fertilization. Planting the wrong plant species or cultivar for a site, or selecting a site that is not suitable for a plant species, can only produce stressed and weakened plants, which are susceptible to pest attack and damage.
2. **Resistant host plant** – Beside suitable plant species, a landscape contractor can also avoid future pest problems by planting insect- or disease-resistant plant species or cultivars. Resistant host plant species or cultivars are those that do not show symptoms or show only minimal symptoms when attacked by an insect or disease. A large number of insect- or disease-resistant plant species are available.

3. **Start with clean, healthy plants** – A nursery should purchase liners from reputable producers only. A landscape contractor should only buy plants from reputable nurseries that produce trees and shrubs that meet established industry standards, such as those outlined by the American Nursery and Landscape Association in the “American Standard for Nursery Stock.” The plants should also be inspected for obvious signs of insect infestations, diseases, and weeds before planting. If the plants are not up to these standards or requirements, reject them. Do not plant these unhealthy or infested trees because they will grow slowly and suffer from pest problems.
4. **Proper planting and site preparation practices** – Follow proper site preparation, planting, and pruning practices (<https://www.extension.purdue.edu/extmedia/fnr/fnr-433-w.pdf>). Trees and shrubs should be planted at the depth of root flare. Planting too deep will, in a way, “suffocate” the trees and shrubs. The synthetic materials (e.g., burlap and other root ball packing materials) buried in the ground can severely limit root growth. These synthetic materials should be removed before planting.
5. **Fertilization and irrigation** – Proper fertilization and irrigation soon after the planting will encourage vigorous growth, reduce transplant stress, and improve long-term plant health. However, it is important to understand that each plant species has its own requirement on irrigation and fertilization. These requirements should be followed. Continuous fertilization is often not necessary once a tree or shrub is established and has matured.

Pest Management Options

Cultural Control

Whereas good planting practices ensure the growth of a healthy plant, good maintenance practices will keep the healthy plants from declining and become more susceptible to pest infestation. The foundation of landscape IPM is a healthy plant. Routine cultural practices, when done well, can be an important IPM strategy in preventing and avoiding pest infestation.

Some common cultural control tactics:

Pre-planting soil sterilization with steam or other chemicals, as well as solarization, can be the first step in preventing pest problem. These sterilization practices can kill pathogens, insects, and weed seeds that may become a problem in the future.

Some seeds, bulbs, and bare-root cuttings can also be sterilized in a hot water bath before planting. These hot water baths can kill tiny pathogens, insects, or mites that are hiding or dormant on the plant tissues. However, it is important to monitor the water temperature because heat can also kill the plants. Check with your plant supplier for the proper hot water bath procedure.

Sanitation is extremely important. Cleaning up infested plant tissues and the causal agents can go a long way in reducing the incidence of pests in the next growing season. Some pests, such as bagworms, are very easy to remove by hand. Others may require equipment for removal.

Mass trapping is not an effective way of reducing a pest infestation in outdoor production systems or landscapes. This tactic may be used in greenhouses where the pathways for insect pests to invade the growing areas are well defined and easily controlled. Other sticky traps or sticky barriers, although more appropriately used as monitoring tools, may also be used as management tools in some circumstances.

Pruning has been a long-practiced pest management and sanitation tactic used to remove infested or infected branches. When done properly, pruning can produce a healthy and beautiful tree, open up the canopy so that the microclimate favorable to population development can be eliminated, reduce protected places where insects and mites can hide from the environment and predators, allow better access for scouts, improve penetration of pesticide spray, and remove infected or infested plant parts directly. Injury caused by improper pruning or other mechanical impacts, such as open wounds on a trunk caused by a hit from a mower or a weed eater, can create entry points for some insects and pathogens. Similarly, stakes and straps that are left in place may eventually girdle and injure the bark as the tree grows. The injury will allow insects and pathogens to invade the wounded trees. Straps can also create shelter for the pathogens and insects.

Established, mature trees and annual herbaceous plants have very different *irrigation and fertilization* requirements. These plants should be grown in different areas so that the irrigation and fertilization needed are tailored to the specific plants. Water and nutrients applied to annual plants under a tree may be excessive and stressful to the mature tree, and could predispose the tree to pest problems.

Biological Control

Biological control is the IPM strategy that relies on the natural ecological interactions among the pests and their natural enemies. Most pest populations in the landscapes are already under some form of biological control. For example, many soft scale species are attacked by a large number of parasitoids, predators, and diseases. When the activities of these natural enemies are not hindered by other factors (such as adverse environmental conditions) and pest management activities (such as the application of broad spectrum insecticides), natural enemies can often significantly reduce pest populations and eliminate the need for further pest management activities.

A pest manager should understand that biological control may not be the most logical solution to a pest problem because environmental conditions may not be conducive to the release and establishment of natural enemies, or there is no natural enemy available for the target pest. Biological control is a part of a comprehensive IPM program that may include cultural or environmental management and compatible pesticides. A biological control program is best used as a preventive tool, but rarely a curative one. That means that scouts and pest managers will have to be able to correctly identify the pests and their life stages (natural enemies are very specific in attacking host species and life stage) and quantify the pest density (use biological control agents when the pest density is low).

Natural enemies are any organisms that can parasitize, kill, consume, compete, or cause disease in a pest population. Natural enemies can be broadly categorized into the following groups:

1. *Predators* are free-living organisms that feed on the pests.
2. *Parasites* are organisms that live on or within the pest (in this case, the pest is called a host). Usually a parasite only requires one host to reach maturity, and it usually does not kill the host during the process of parasitism or infection.
3. *Parasitoids* are insects that parasitize other insects. A parasitoid is usually parasitic in its immature stage but becomes free-living in its adult stage. A parasitoid usually kills the host during development.
4. *Pathogens* are micro-organisms that cause diseases in the pest population. Pathogens may include bacteria, fungi, protozoa, nematodes, viruses, and other microorganisms.
5. *Competitors* are organisms that compete with the pests for nutrients or shelter. The process of competition can weaken and reduce the pest population.

Biological control programs can be grouped into the following categories:

1. **Classical biological control** — Classical biological control is also known as introduction or importation biological control. In this type of biological control, a foreign natural enemy is imported or introduced into a country or area to control a pest species that is also introduced from another country or area. The uses of *Pseudoscymnus* beetles to control the woolly hemlock adelgids and *Anagyrus kamali* parasitoid to control the pink hibiscus mealybug are two examples of classical biological control programs. Typically, classical biological control programs are very expensive and require a lot of testing and regulatory authorizations to accomplish. Therefore, only government agencies have the budget and authority to conduct classical biological control programs. This type of program is not economically feasible for individual landscape care companies.
2. **Augmentation biological control** — Augmentation biological control is the program in which an introduced or domestic natural enemy is released with the purpose of either establishing a permanent population in an area in which the natural enemy does not already exist, or enhancing the impact of an existing natural enemy population. The release to establish a population is called inoculative release, whereas the release to enhance the distribution, density, and impact of an existing natural enemy population is called inundative release. A large number of natural enemies, including predators, parasitoids, fungal pathogens, and nematodes, have been developed and marketed for augmentative biological control in greenhouses and nurseries. Augmentative biological control has immense potential in urban landscapes. However, its employment and practice are more difficult than releases in the greenhouses. To practice biological control in outdoor situations, a pest manager needs to understand the biology and ecology of the pests and the natural enemies. Biological control agent producers often provide recommendations, instructions, and consultation in selecting, purchasing, and releasing biological control agents. Biological control agents are released in large number or in the fashion of biopesticides.
3. **Conservation biological control** — Conservation biological control includes activities that could preserve and enhance the impact of an existing natural enemy population. Conservation biological control may be the most practical and promising option for urban landscapes since the existing natural enemy populations are well suited for managing the pest populations. Conservation biological control operates

through manipulation of management practices and environmental conditions at the site, which may be achieved with relatively little disruption to the operation and little addition to the cost.

There are two main methods of conserving natural enemies and enhancing their impacts:

Habitat manipulation to attract and preserve natural enemies is a conservation biological control approach that could be considered during the landscape design and installation process. This approach is based on the fact that natural enemies are living organisms, so they also require food, water, and shelter to increase their numbers and impacts. A landscape that is designed to provide diverse habitats in terms of planting or providing a large number of different plant species can provide more resources to attract, preserve, retain, and increase natural enemy populations, and to enhance their impacts. A simple or less diverse landscape can support few natural enemies. For this conservation approach to be successful, a design team including the landscape architect, pest manager, and biologists will have to be assembled.

The natural enemy conservation approach that could be put into practice immediately is *selective and judicious use of pesticides*. Natural enemies can be killed or their activities interfered with by pesticides applied in the landscape. However, pesticides are an important component of an IPM program, and they can complement biological control by reducing the initial pest population so that the natural enemies can be more effective in suppressing the remaining pests, or by killing other pests that are not controlled by the biological control agents. How do we resolve the conflict between chemical and biological control? The only way is to use only pesticides that would not kill or interfere with the natural enemies. Extensive research has been conducted and is on-going to identify pesticides that are compatible with biological control. Consult with your biological control agent suppliers and state extension specialists for information and guidance in selecting the compatible pesticides.

Chemical Control

Chemical control is the pest management strategy that relies on pesticides to reduce pest population and damage. All managers, supervisors, and staff should be trained and licensed in pesticide use by the appropriate agency in each state. There are good reasons to receive the training and apply for a pesticide applicator license. First, a staff member who has received training and tested for a license projects professionalism to his or her clients and colleagues. A staff member must be recertified through continuing education to maintain the license, which is a process that allows the staff to keep up with the latest technologies and knowledge on pest management. Lastly, commercial licenses require that an operation be bonded, which helps to protect the company from financial and legal liabilities.

Pesticide application is not as simple as mixing a sprayer of pesticide solution and spraying that onto pests that a grower wants to kill. Chemical control is a strategy that requires serious consideration. There are several important questions you should ask before deciding if an application is warranted and appropriate.

- “How significant is the pest problem?” A pest manager has to know if the organisms are indeed causing damage, and to decide if a pest is an immediate problem that requires pesticide application to reduce its population to below the tolerance level. If the damage will likely dissipate without treatment, then there is no justification for using a pesticide.
- “Can the pesticide reduce pest damage or population?” It is important to understand that some pests cannot be controlled by pesticide, or that another management strategy, such as pruning or biological control, is more appropriate and cost effective.
- “Is the pesticide labeled for the pest?” No insecticide or miticide is created to control every insect or mite pest species. Some products are more effective against a specific group of pests than others. Therefore, it is important for pest management staff to know what chemicals are on hand and what they are used for.
- “Is the pesticide safe for the plants you want to protect?” A pest manager and pesticide applicator should always read the pesticide label to determine whether the pesticide will cause phytotoxicity to the plant species they intend to protect. Know that the label does not list all plant species that are sensitive to the pesticide because the manufacturer may not have tested all the common plant species. It is always a good idea to spray a small number or a section of the plant and observe for phytotoxicity in the next few days.
- “Is this the right or most effective time for pesticide application?” Each pesticide is more effective against a specific life stage. A pest manager should also know if he or she is applying the pesticide at the right time.
- “Is this pesticide compatible with biological control?” This question is particularly important for operations that practice biological control. Some pesticides can kill or interfere with the activities of natural enemies or biological control agents. Therefore, knowing if the pesticide is compatible with the existing biological control agents and knowing how to minimize the detrimental impact are important.

- “Is this pesticide safe for non-targets?” A pest manager has to consider the potential impacts of the selected pesticides on non-target organisms (including pollinators, <http://growwise.org/wp-content/uploads/2017/01/HRI-Pollinator-BMPs-January2017.pdf>), pests, clients, workers, and the environment) when deciding if a pesticide application is warranted and appropriate. The least toxic but effective product should be used whenever possible.
- “Do I know how to apply the pesticide safely?” Different pesticide products have specific application instructions or precautions. These instructions are outlined on the pesticide label. A pest manager should consider the conditions at the job site and the environment surrounding the site and decide if the selected pesticide is most appropriate and safest for the site. Some pesticides may be effective against the target pest, but the application methods and the equipment may not be suitable or available. For example, if the spray application carries a significant risk of drift during a windy day, the application should not be made, or the pest manager should use a different application method that can reduce the risk of drift. Similarly, a pest manager should also determine if the selected pesticide could be used safely at the site. For example, some pesticides have restrictions on the minimal distance of the intended target site to a water body. Such restrictions may limit whether a product can be used. Related to this topic is the consideration of the weather conditions at the time. Rain that has fallen immediately after the application may wash off the pesticide residue, strong winds may increase the risk of drift, higher temperatures may increase the risk of phytotoxicity, and extensive sun exposure or UV light can quickly degrade the residue of some pesticides.

Many of the concerns above must be taken into consideration before applying a pesticide. The information that can help with making those decisions is contained within the pesticide label and the safety data sheet. A pesticide label is a legal document providing directions on how to mix, apply, store, and dispose of a pesticide. Therefore, an applicator should read the label before he or she mixes, applies, stores, and disposes of a pesticide. Because a pesticide label is a legal document, using a pesticide in a manner inconsistent with its labeling is a violation of federal law.

Insecticides and miticides can be broadly categorized based on their modes of action or chemical classes, their sources or nature of active ingredients, whether they are a contact or stomach poison, and their modes of exposure. Understand that these categories are not mutually exclusive, i.e., each insecticide or miticide may possess one characteristic of each category. These categories are as follows:

1. **Mode of action and chemical class** — Insecticides and miticides may be classified based on their chemical structures and properties into distinct chemical classes. “Mode of action” refers to the physiological and biochemical processes by which an insecticide kills an insect. Several active ingredients may be contained within a chemical class, and several chemical classes may have the same mode of action. See Table 4-1 at the end of this chapter for the modes of action of each active ingredient used in ornamental industry.
2. **Source**
 - *Synthetic* insecticides and miticides are made from organic or inorganic matters through an artificial chemical processes. The majority of insecticides and miticides used on ornamental plants are synthetic in nature. These products are very effective at low doses. Most synthetic insecticides and miticides are considered non-organic.
 - *Natural* insecticides and miticides contain naturally occurring compounds, such as sulfur, salts, oil, and soap. Although natural insecticides and miticides often require higher application rates, they can be combined with other management tactics to achieve successful management. These products are often labeled as organic insecticides.
 - *Microbial* insecticides are products that contain dormant or live entomopathogenic fungi, bacteria, nematodes, and other microorganisms. Some microbial insecticides are broad spectrum and some are relatively narrow in target spectrum. Because microbial insecticides are formulated with living organisms, their storage and use should be conducted properly and according to label instructions. Microbial insecticides and miticides are generally considered organic products.
 - There is another group of insecticides and miticides that contain chemicals or metabolites extracted from microorganisms or their products, instead of the microorganisms themselves. These are called *microbial derived* pesticides. This group includes products such as spinosad and abamectin, which are metabolites produced by bacterial fermentation. The microbial-derived products typically have a broad target pest spectrum. These products could be considered organic or inorganic products.
 - *Botanical* insecticides and miticides are extracted from plants. Botanically derived insecticides and miticides contain a large group of compounds, each of which can have different modes of action. Many plant derived compounds, such as essential oils, azadirachtin, and pyrethrum, have relatively low risk to humans and the environment. But some botanically derived insecticides and miticides, such as nicotine and rotenone, can be extremely toxic to humans.

3. **Poison type**

- *Contact poisons* are insecticides and miticides that require the insects or mites to be in direct contact with the insecticide solution or residue to be effective.
- *Stomach poisons* are those that take effect only after the target pest ingested the residue.
- *Repellents* are chemicals that discourage insects and mites from landing, moving, or feeding on the plant surface where the chemicals are applied.
- *Fumigants* are gaseous pesticides applied to a sealed area to suffocate or poison the pest contained within the area.

4. **Mode of exposure**

- *Contact* insecticides are applied directly onto the target pest or plant surface, where the insecticide solution or residue is in contact with the target pests and cause the desirable effects.
- *Systemic* insecticides have the ability to move through leaf or bark surface into the vascular tissues, from which the active ingredients are distributed to the rest of the plant. Systemic insecticides are typically stomach poisons, but some also have contact activities.
- *Translaminar* insecticides and miticides only move across the leaf surface to nearby tissues. Different from systemic insecticides, translaminar insecticides are not distributed throughout the plant via the vascular tissues.

When selecting the most appropriate insecticides and miticides, consider these factors:

1. Gather as much information as possible about the target pests through correct identification and biological information research. Correct identification is paramount to selecting the most effective pesticides, while biological information can inform the pest manager on when to apply pesticides.
2. Understand the characteristics of the insecticides or miticides, whether they are systemic, translaminar, or contact, as well as their modes of action. Knowing the modes of action can help with developing a pesticide rotation program.
3. Consider the characteristics of the areas that will be treated. Make sure that the selected insecticide is registered for the use site and against the target insect species. Also, identify any sensitive plant species and how to avoid potential phytotoxicity. Consider the weather conditions to reduce the risk of pesticide drift and phytotoxicity. Find out whether an adjuvant is recommended by the manufacturer. All of this information can be found on the fungicide labels. Therefore, pesticide applicators should read the labels and follow label instructions.

Pesticide Resistance

Pesticide resistance describes the phenomenon of reduced susceptibility of a pest population to a pesticide that was previously effective at controlling the pest population. The foundations of pesticide resistance are genetic mutations and natural selection. In any given pest population, there exist various genetic traits. At times, some of these traits can confer ability to individuals to tolerate or resist an active ingredient. Before the application of a pesticide, the pest population likely contains only a small fraction of the resistant traits. However, after the pesticide application, the susceptible individuals die and their population decreases. The resistant individuals do not die after pesticide application and continue to reproduce. In the next generation, the proportion of resistant individuals in the pest population increases. As the application of the same pesticide is repeated, the selection process is also repeated. The proportion of resistant individuals continues to increase until the pest population is made up of mainly resistant individuals. Pesticide resistance develops through repeated use of the same mode of action. Pests can develop genetic mutations or other mechanism to bypass the target site of one particular mode of action, thus leading to reduced sensitivity or outright resistance.

Pesticide resistance can be managed through a pesticide resistance management program. The three basic approaches to managing pesticide resistance follow:

1. **Reduce:** The best strategy to avoid the development of pesticide resistance is to reduce the reliance on pesticides by practicing IPM.

2. Delay: The development of pesticide resistance can also be delayed by using pesticides only when needed and rotating among pesticides of different modes of action.
3. Reverse: Pesticide resistance is not permanent. A resistant pest population can revert back to being susceptible against the pesticide after a certain period of time during which the mode of action in question is not used.

To make the task of selecting the most appropriate rotation alternatives easier, the Insecticide Resistance Action Committee (IRAC) has developed a numbering system for each mode of action (see Table 4-1). Each mode of action is given a unique group number; within each number there may be subcategories representing different chemical classes. The classification systems simplify the selection of rotation alternatives. An applicator who wants to switch to another mode of action only has to use a product that is listed under a different mode of action number.

Some pesticide labels display the IRAC numbers prominently, often next to the brand name. This clear display helps inform the applicator of the mode of action of the pesticide, and helps develop a pesticide rotation program. It is important to remember that several products may contain the same active ingredient. When developing a pesticide rotation program, a pest manager should rotate among different modes of action or group numbers, not among different brand names.

Arthropod Pest Control Tables

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Footnotes for Arthropod Pest Control Tables 4-1 through 4-4

¹ Trade names are provided as examples only. No endorsement of products is intended, nor is criticism of unnamed products implied.

² Allectus = imidacloprid + bifenthrin
Aloft = clothianidin + bifenthrin
Discus N/G = imidacloprid + cyfluthrin
Extinguish Plus and Amdro Firestrike = hydramethylnon + s-methoprene
Pyreth-It = pyrethrins + piperonyl butoxide
Sirocco = abamectin + bifenazate
Tandem = thiamethoxam + *lambda*-cyhalothrin
Triple Crown T&O = imidacloprid + bifenthrin + *zeta*-cypermethrin

³ Use site codes: L = Landscape; N = Nursery; G = Greenhouse; I = Interiorscapes.

⁴ Armored or hard scales include members of one family, the Diaspididae.

⁵ In addition to the true soft scales (Coccidae), the label term "soft scales" may include several soft scale-like families such as the bark scales, felt scales, and cottony cushion scale, among others.

⁶ Some labels, e.g., Mesurol, may have "mites" as a general cover-all labeling. However, this does not mean they are effective against all mite groups.

Table 4-1. IRAC (Insecticide Resistance Action Committee) classification and selected trade names of insecticides used on ornamental plants in greenhouses, nurseries, landscapes, and interiorscapes

See key to footnotes on page 56.

IRAC Group	Mode of Action	Chemical Classes	Active Ingredient	Trade Name ¹
1A	Acetylcholine esterase inhibitors	Carbamates	carbaryl	Sevin
			methiocarb	Mesurool
1B		Organophosphates	acephate	Orthene, Precise
			chlorpyrifos	Dursban
			dicrotophos	Inject-A-Side B
			dimethoate	Dimethoate
			malathion	Malathion
			methidathion	Supracide
			oxydemeton methyl	Harpoon, MSR Spray Concentrate
trichlorfon		Dylox		
2B	GABA-gated chloride channel blockers	Phenylpyrazoles	fipronil	CeaseFire fire ant bait, TopChoice
3A	Sodium channel modulators	Pyrethroids	bifenthrin	Attain, Bifen, Menace, Onyx, Talstar, etc.
			cyfluthrin	Decathlon, Discus N/G ² , Tempo
			<i>beta</i> -cyfluthrin	Tempo Ultra
			<i>lambda</i> -cyhalothrin	Demand, Scimitar, Tandem ²
			cypermethrin	Demon
			<i>zeta</i> -cypermethrin	Triple Crown T&O ²
			deltamethrin	DeltaGard
			fenpropathrin	Tame
			<i>tau</i> -fluvalinate	Mavrik
			permethrin	Astro, Permethrin, Perm-Up
			pyrethrin	Pyganic, Pyreth-It ² , Tersus
pyrethrum	Pyrethrum TR			
4A	Nicotinic acetylcholine receptor competitive modulators	Neonicotinoids	acetamiprid	TriStar
			clothianidin	Arena, Aloft ²
			dinotefuran	Safari, Transtect, Zylam Liquid
			imidacloprid	Allectus ² , Discus Tablets, Marathon, etc.
			thiamethoxam	Flagship, Tandem ²
4C		Sulfoxaflor	sulfoxaflor (+ spinetoram)	XXpire
5	Nicotinic acetylcholine receptor allosteric modulators	Spinosyns	spinosad	Conserve, Entrust
			(sulfoxaflor +) spintoram	XXpire

Table 4-1. IRAC (Insecticide Resistance Action Committee) classification and selected trade names of insecticides used on ornamental plants in greenhouses, nurseries, landscapes, and interiorscapes (continued)

See key to footnotes on page 56.

IRAC Group	Mode of Action	Chemical Classes	Active Ingredient	Trade Name ¹
6	Glutamate-gated chloride channel allosteric modulators	Avermectins	abamectin	Avid, Aracinate TM, Award II, Sirocco
			emamectin benzoate	Arbomectin, Enfold, Tree-äge
			milbemectin	Ultiflora
7A	Juvenile hormone mimics	Junevile hormone analogues	s-kinoprene	Enstar AQ
s-methoprene			Amdro Firestrike ² , Extinguish, Extinguish Plus ²	
7B		Fenoxycarb	fenoxycarb	Preclude TR
7C		Pyriproxyfen	pyriproxyfen	Distance IGR, Distance fire ant bait
8C	Miscellaneous non-specific (multi-site) inhibitors	Fluorides	sodium aluminofluoride (cryolite)	Kryocide
8D		Borates	sodium tetraborohydrate decahydrae (borax)	Prev-AM Ultra
9B	Chordotonal organs TRPV channel modulators	Pyridine azomethine derivatives	pymetrozine	Endeavor
			pyrifluquinazon	Rycar
10A	Mite growth inhibitors	Clofentezine	clofentezine	Ovation SC
		Hexythiazox	hexythiazox	Hexygon
10B		Etoxazole	etoxazole	Beethoven TR, TetraSan
11A	Microbial disruptors of insect midgut membranes	<i>Bacillus thuringiensis</i>	<i>B.t. var. aizawai</i>	Xentari
			<i>B.t. var. galleriae</i>	grubGONE! G
			<i>B.t. var. israelensis</i>	Gnatrol
			<i>B.t. var. kurstaki</i>	Dipel
			<i>B.t. var. tenebrioni</i>	Novodor
12B	Inhibitors of mitochondrial ATP synthase	Organotin miticides	fenbutatin-oxide	ProMite
13	Uncouplers of oxidative phosphorylation via disruption of the proton gradient	Chlorfenapyr	chlorfenapyr	Pylon
15	Inhibitors of chitin biosynthesis, type 0	Benzoylureas	diflubenzuron	Adept, Dimilin
			novaluron	Pedestal
16	Inhibitors of chitin biosynthesis, type 1	Buprofezin	buprofezin	Talus
17	Molting disruptor, Dipteran	Cyromazine	cyromazine	Citation
18	Ecdysone receptor agonists	Diacylhydrazines	methoxyfenozide	Intrepid
			tebufenozide	Confirm
20A	Mitochondrial complex III electron transport inhibitors	Hydramethylnon	hydramethylnon	Amdro Pro, Extinguished Plus ² , etc.
20B		Acequinocyl	acequinocyl	Shuttle
20D		Bifenazate	bifenazate	Floramite, Sirocco

Table 4-1. IRAC (Insecticide Resistance Action Committee) classification and selected trade names of insecticides used on ornamental plants in greenhouses, nurseries, landscapes, and interiorscapes (continued)

See key to footnotes on page 56.

IRAC Group	Mode of Action	Chemical Classes	Active Ingredient	Trade Name ¹
21A	Mitochondrial complex I electron transport inhibitors	METI acaricides and insecticides	fenazaquin	Magus
			fenpyroximate	Akari
			pyridaben	Sanmite
			tolfenpyrad	Hachi-Hachi SC
22A	Voltage-dependent sodium channel blockers	Oxadiazines	indoxacarb	Advion fire ant bait, Provaunt
22B		Semicarbazones	metaflumizone	Siesta fire ant bait
23	Inhibitors of acetyl CoA carboxylase	Tetronic and tetramic acid derivatives	spiromesifen	Forbid, Judo
			spirotramat	Kontos
25	Mitochondrial complex II electron transport inhibitors	Beta-ketonitrile derivatives	cyflumetofen	Sultan
28	Ryanodine receptor modulator	Diamides	chlordaniliprole	Acelepryn
			cyantraniliprole	Mainspring
29	Chordotonal organ modulators – undefined target site	Flonicamid	flonicamid	Aria
Unknown	Unknown MOA	Azadirachtin	azadirachtin	Azatin, Azatrol, Ornazin, etc.
		Pyridaryl	pyridaryl	Overture
Unclassified	Unclassified MOA	Bacteria	<i>Chromobacterium subtsugae</i>	Grandevo PTO
		Nematodes	<i>Heterorhabditis bacteriophora</i>	Nemasys G, Nemashield HB, etc.
			<i>Steinernema carposapsae</i>	Millenium, Nematac, etc.
			<i>Steinernema feltiae</i>	Nemasys, NemaShield, EntoNem, etc.
			<i>Steinernema kraussei</i>	Nemasys L
		Fungi	<i>Beauveria bassiana</i>	Botanigard, Naturalis
			<i>Isaria formosorosea</i> (= <i>Paecilomyces fumosoroseus</i>)	NoFly, Preferal
			<i>Metarhizium anisopliae</i>	Met52, Tick-Ex
		Horticultural oil	petroleum or paraffin oils	Ultra-Pure Oil, etc.
		Insecticidal soap	potassium salts of fatty acids	M-Pede, etc.
		Neem oil	clarified hydrophobic extract of neem oil	Trilogy, Triact
		Botanical oils and extracts	capsicum oleoresin extract, garlic oil, soybean oil	Captiva

Read pesticide labels and follow label instructions and precautions when handling, mixing, applying, and storing pesticides.

Table 4-2. Insecticides registered for control of sucking insects, thrips, and mites

See key to footnotes on page 56.

IRAC #	Active ingredients	Selected trade names ¹	Use site ³	REI (hours, unless noted otherwise)	Sucking insects											Thrips	Mites			
					Adelgids	Aphids	Psyllids	Armored scales ⁴	Soft scales ⁵	Mealybugs	Leafhoppers	Planthoppers	Plant bugs	Lace bugs	Whiteflies		Broad mite	Eriophyid mites	Spider mites	Mites ⁶
1A	carbaryl	Sevin SL	L,N,G	12	X	X	X	X	X	X	X		X	X	X	X		X		
	methiocarb	Mesurol 75W	N,G	24		X									X	X	X	X	X	
1B	acephate	Orthene	L,N,G	24		X		X	X	X	X		X	X	X					
		Lepitect	L,N,G	24		X		X	X	X	X		X	X	X			X		
		Precise GN	N,G	12		X				X				X						
	chlorpyrifos	Dursban 50W	N	24	X	X	X	X	X	X	X		X	X	X	X			X	
		DuraGuard ME	N,G	24		X		X	X	X	X		X		X				X	
	dicrotophos	Inject-A-Cide B	L	N/A		X	X	X	X		X		X						X	
	dimethoate	Dimethoate 4E,4EC	N	10-14 days		X	X	X	X	X	X			X		X	X	X	X	
	malathion	Malathion 5EC	L	12		X		X	X	X	X		X	X		X			X	
	methidathion	Supracide 2E	N	3 days				X	X											
	oxydemeton methyl	Harpoon	L	0	X	X		X	X											X
MSR Spray Concentrate		N	10 days	X	X									X					X	
3A	bifenthrin	Attain TR	G	12		X		X	X	X			X		X				X	
		Menace GC	L,N,G	12		X		X	X	X	X		X	X	X	X	X	X	X	
		Onyx	L	N/A		X	X	X	X	X	X		X	X		X	X		X	
		Onyx Pro	L,N,I	12	X	X	X	X	X	X	X		X	X		X	X		X	
		Talstar S Select	N,G	12		X		X	X	X	X			X			X	X	X	
		Talstar Nursery G	N	12						X										
	cyfluthrin	Decathlon	L,N,G,I	12		X		X	X	X	X		X	X		X				
	<i>beta</i> -cyfluthrin	Tempo Ultra WP	L,I	N/A		X		X	X	X	X		X	X		X				
		Tempo SC Ultra	L,I	N/A		X		X	X	X	X		X	X		X				
	<i>lambda</i> -cyhalothrin	Demand	L	N/A		X		X	X	X	X		X	X	X	X	X		X	
		Scimitar CS	L	N/A		X		X	X	X	X		X	X		X	X		X	
		Scimitar GC	L, N, G	24		X		X	X	X	X		X	X		X	X		X	
cypermethrin	Demon WP	L,I	N/A		X															
deltamethrin	DeltaGard G	L,I	N/A						X	X										

Table 4-2. Insecticides registered for control of sucking insects, thrips, and mites (continued)

See key to footnotes on page 56.

IRAC #	Active ingredients	Selected trade names ¹	Use site ³	REI (hours, unless noted otherwise)	Sucking insects											Thrips	Mites				
					Adelgids	Aphids	Psyllids	Armored scales ⁴	Soft scales ⁵	Mealybugs	Leafhoppers	Planthoppers	Plant bugs	Lace bugs	Whiteflies		Broad mite	Eriophyid mites	Spider mites	Mites ⁶	
3A (continued)	fenpropathrin	Tame 2.4 EC	N,G,I	24		X		X		X	X		X	X		X			X		
	<i>tau</i> -fluvialinate	Mavrik Aquaflow	L,N,G,I	12	X	X	X			X	X		X			X			X		
	permethrin	Astro	L,G,I	12		X					X	X		X	X		X				
		Permethrin Pro	L,I	N/A		X					X	X		X	X		X				
		Perm-Up 3.2 EC	L,N,G,I	12		X					X	X		X	X		X				
	pyrethrins	Tersus	N,G	12		X	X	X	X	X	X	X	X	X	X		X	X	X	X	
Pyganic		N,G	12		X		X	X	X	X						X			X		
pyrethrum	Pyrethrum TR	N,G	12		X		X	X	X	X						X			X		
3A+4A	bifenthrin + clothianidin	Aloft ² LC G, LC SC	L	N/A	X	X		X	X	X	X		X	X		X					
	bifenthrin + imidacloprid	Allectus ² SC	L,I	N/A	X	X	X	X	X	X	X		X	X		X	X		X		
	cyfluthrin + imidacloprid	Discus ² N/G	N,G,I	12	X	X	X	X	X	X	X		X	X		X					
	<i>lambda</i> -cyhalothrin + thiamethoxam	Tandem ²	L	N/A	X	X	X	X	X	X	X		X	X		X	X				
	<i>zeta</i> -cypermethrin + bifenthrin + imidacloprid	Triple Crown T&O ²	L,I	N/A	X	X	X	X	X	X	X		X	X	X	X	X		X		
3A+27A	pyrethrins + piperonyl butoxide	Pyreth-It ²	N,G	12		X	X				X		X			X					
4A	acetamiprid	TriStar 8.5 SL	L,N,G	12	X	X	X	X	X	X	X		X		X	X					
	clothianidin	Arena 0.25 G	L,I	12		X					X					X					
		Arena 50 WDG	L,I	12		X					X					X					
	dinotefuran	Safari 2G	L,N,G,I	12	X		X	X	X	X	X			X	X	X					
		Safari 20SG	L,N,G,I	12	X	X	X	X	X	X	X			X	X	X					
		Zylam Liquid	L	12	X	X	X	X	X	X	X		X	X	X	X					
		Transtect 70 WSP	L	N/A	X	X	X	X	X	X	X		X	X	X	X					
	imidacloprid	Xytect 75WSP; 2F	L,N,G,I	12	X	X	X	X	X	X	X	X	X	X	X	X					
		Marathon II	N,G,I	12	X	X	X	X	X	X				X	X	X					
Marathon 60WP		N,G,I	12	X	X	X	X	X	X				X	X	X						
Merit		L,I	N/A	X	X	X	X	X	X	X	X	X	X	X	X						

Table 4-2. Insecticides registered for control of sucking insects, thrips, and mites (continued)

See key to footnotes on page 56.

IRAC #	Active ingredients	Selected trade names ¹	Use site ³	REI (hours, unless noted otherwise)	Sucking insects											Thrips	Mites			
					Adelgids	Aphids	Psyllids	Armored scales ⁴	Soft scales ⁵	Mealybugs	Leafhoppers	Planthoppers	Plant bugs	Lace bugs	Whiteflies		Broad mite	Eriophyid mites	Spider mites	Mites ⁶
4A (continued)	imidacloprid	CoreTect	L,I	N/A	X	X	X	X	X	X	X	X		X	X	X				
		Discus Tablets	N,G,I	12	X	X	X	X	X	X	X	X		X	X	X				
	thiamethoxam	Flagship 25WG	N,G,I	12	X	X	X		X	X	X		X	X	X					
		Meridian 0.33G	L,I	N/A	X	X			X	X	X		X	X	X					
	Meridian 25WG	L,I	N/A	X	X	X		X	X	X		X	X	X	X					
4C + 5	sulfoxaflor + spinetoram	XXpire	L,N,G	12		X		X		X			X	X	X				X	
5	spinosad	Conserve	L,N,G	4											X				X	
		Entrust	L,N,G	4											X				X	
6	abamectin	Lucid, Avid	L,N,G	12		X								X	X	X	X	X	X	
		Aracinate TM	L,N,G,I	N/A	X	X		X	X				X		X	X	X	X	X	
		Award II	L,N	12																
	emamectin benzoate	Arbormectin	L	N/A			X		X				X							X
		Tree-äge	L	N/A					X				X							
		Enfold	N	12				X												X
milbemectin	Ultiflora	N	12															X		
6 + 20D	abamectin + bifenazate	Sirocco	L,N,G,I	12		X								X	X	X	X	X		
7A	s-kinoprene	Enstar AQ	G,I	4		X		X	X	X	X			X	X					
	s-methoprene	Extinguish	L,N	4																
7B	fenoxycarb	Preclude TR	G	12		X		X	X	X				X	X	X			X	
7C	pyriproxifen	Distance IGR	L,N,G,I	12		X		X	X	X				X						
		Distance	L,N	12																
		Fulcrum	L,N,G,I	12		X		X	X	X				X						
8D	sodium tetraborohydrate decahydrate	Prev-AM Ultra	N,G	12		X		X	X	X				X		X	X	X		
9B	pymetrozine	Endeavor	L,N,G,I	12		X								X						
	pyrifluquinazon	Rycar	G	12		X				X	X			X	X					
10A	clofentazine	Ovation SC	N,G	12															X	
	hexythiazox	Hexygon DF	L,N,G,I	12															X	

Table 4-2. Insecticides registered for control of sucking insects, thrips, and mites (continued)

See key to footnotes on page 56.

IRAC #	Active ingredients	Selected trade names ¹	Use site ³	REI (hours, unless noted otherwise)	Sucking insects											Thrips	Mites						
					Adeigids	Aphids	Psyllids	Armored scales ⁴	Soft scales ⁵	Mealybugs	Leafhoppers	Planthoppers	Plant bugs	Lace bugs	Whiteflies		Broad mite	Eriophyid mites	Spider mites	Mites ⁶			
10B	etoxazole	Beethoven TR	G	24												X				X			
		TetraSan 5 WDG	L,N,G,I	12																	X		
12B	fenbutatin-oxide	Meraz, ProMite 50WP	L,N,G	48																	X		
13	chlorfenapyr	Pylon	G	12												X	X	X	X				
15	diflubenzuron	Adept	G	12												X							
		Pedestal	N,G	12												X	X						
16	buprofezin	Talus 70DF	L,N,G	12				X	X	X	X	X			X								
20B	acequinocyl	Shuttle 15 SC	L,I	12																	X		
		Shuttle-0	N,G	12																		X	
20D	bifenazate	Floramite SC	L,N,G,I	12																		X	
		Floramite SC/LC	L	N/A																			X
21A	fenazaquin	Magus	L,N,G,I	12												X						X	
		fenpyroximate	Akari 5SC	N,G,I	12						X							X	X	X			
		pyridaben	Sanmite	N,G	12			X				X				X		X		X			
		tolfenpyrad	Hachi-Hachi SC	G	12		X		X	X	X	X				X	X						
22A	indoxacarb	Provaunt	L	N/A							X												
23	spiromesifen	Forbid 4F	L	N/A											X		X	X	X				
		Judo	N,G	12											X		X	X	X				
	spirotetramat	Kontos	N,G,I	24	X	X	X	X	X	X	X				X	X	X	X	X				
25	cyflumetofen	Sultan	L,N,G,I	12																	X		
28	chlorantraniliprole	Acelepryn	L,I	N/A	X	X			X						X								
	cyantraniliprole	Mainspring	G,I	4		X			X						X	X							
29	flonicamid	Aria	L,N,G	12		X		X	X	X	X			X	X								

Table 4-2. Insecticides registered for control of sucking insects, thrips, and mites (continued)

See key to footnotes on page 56.

IRAC #	Active ingredients	Selected trade names ¹	Use site ³	REI (hours, unless noted otherwise)	Sucking insects											Thrips	Mites			
					Adelgids	Aphids	Psyllids	Armored scales ⁴	Soft scales ⁵	Mealybugs	Leafhoppers	Planthoppers	Plant bugs	Lace bugs	Whiteflies		Broad mite	Eriophyid mites	Spider mites	Mites ⁶
Unknown	azadirachtin	Azatin 0	L,N,G,I	4	X	X	X	X	X	X	X		X		X	X				
		Azatin XL	N,G,I	4		X	X			X	X				X	X				
		Azatrol EC Insecticide	L,N,G,I	4		X	X	X	X	X	X			X	X	X			X	
		Ornazin EC	L,N,G,I	12		X	X	X	X	X	X			X	X	X				
		Tree-Azin	L,N,G	Until dry	X															
	pyridalyl	Overture 35 WP	G	12										X						
Unclassified	<i>Beauveria bassiana</i>	BotaniGard ES	L,N,G,I	4		X	X				X		X	X	X				X	
		BotaniGard 22 WP	L,N,G,I	4		X	X						X	X	X					
		Naturalis-L	L,N,G	4		X	X				X		X		X	X	X	X	X	
	<i>Chromobacterium subtugae</i>	Grandevo PTO	L,N,G	4		X							X	X	X	X	X	X	X	
	<i>Isaria formosorosea</i> (= <i>Paecilomyces fumosoroseus</i>)	NoFly	G	12		X	X					X		X	X					
		Preferal	L,N,G	4		X	X						X		X	X	X	X	X	
	<i>Metarhizium anisopliae</i>	Met52, Tick-EX	L,N,G	4											X					
	<i>Steinernema</i> sp.	TigraNem	L,N,G,I	N/A										X						
	<i>Steinernema carpocapsae</i>	Millenium	L,N,G,I	N/A																
		Nematac C	L,N,G,I	N/A											X					
	<i>Steinernema feltiae</i>	NemaShield	L,N,G,I	N/A											X					
		EntoNem	L,N,G,I	N/A											X					
	horticultural oil	Ultra-Pure Oil, TriTek	L,N,G,I	4		X	X	X	X	X	X		X	X	X	X		X	X	
insecticidal soap	M-Pede	L,N,G,I	12		X	X	X	X	X	X		X	X	X	X		X	X		
neem oil	Trilogy	L,N	4			X		X	X					X	X		X	X		
	Triact 70	L,N,G,I	4			X		X	X					X				X		
capsicum extract, garlic oil, soybean oil	Captiva	L, N	4			X				X	X		X	X	X		X			

Table 4-3. Insecticides registered for control of borers, foliage feeders, and leafminers

See key to footnotes on page 56.

IRAC #	Active ingredients	Selected trade names ¹	Use site ³	REI (hours, unless noted otherwise)	Borers					Foliage feeders						Leafminers			
					Ambrosia beetles	Bark and Pine beetles	Clearwing borers	Flatheaded borers	Longhorned (roundhead) borers	Flea beetles	Japanese beetles (adult)	Leaf beetles	Weevils	Caterpillars	Sawflies	Flies and midges	Moths	Wasps	
1A	carbaryl	Sevin SL	L,N,G	12		X			X	X	X	X	X	X	X	X	X	X	
1B	acephate	Orthene	L,N,G	24							X	X	X	X	X		X	X	
		Lepitect	L,N,G	24							X	X	X	X	X	X	X	X	
		Precise GN	N,G	12								X	X						
	chlorpyrifos	Dursban 50W	N	24	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		DuraGuard ME	N,G	24						X	X	X	X	X		X			
	dicrotophos	Inject-A-Cide	L	N/A			X	X	X			X		X	X			X	
	dimethoate	Dimethoate 4E,4EC	N	10-14 days								X		X	X	X	X	X	
	malathion	Malathion 5EC	L	12							X			X		X	X	X	
	oxydemeton methyl	Harpoon	L	0		X	X	X	X			X		X					
		MSR Spray Concentrate	N	10 days									X	X		X	X	X	
trichlorfon	Dylox 420 SL	L	N/A										X						
3A	bifenthrin	Attain TR	G	12										X					
		Menace GC	L,N,G	12	X	X				X	X	X	X	X					
		Onyx	L	N/A	X	X	X	X		X	X	X		X	X	X	X		
		Onyx Pro	L,N,I	12	X	X	X	X		X	X	X		X	X	X	X		
		Talstar S Select	N,G	12						X	X	X	X	X					
	Talstar Nursery G	N	12									X							
cyfluthrin	Decathlon	L,N,G,I	12						X	X	X	X	X	X					
<i>beta</i> -cyfluthrin	Tempo Ultra WP	L,I	N/A				X		X	X	X	X	X	X					
	Tempo SC Ultra	L,I	N/A				X		X	X	X	X	X						
<i>lambda</i> -cyhalothrin	Demand	L	N/A		X				X	X	X	X	X	X	X	X	X		
	Scimitar CS	L	24						X	X	X	X	X	X	X	X			
	Scimitar GC	L, N, G	24						X	X	X	X	X	X	X	X			
cypermethrin	Demon WP	L,I	N/A								X		X						
deltamethrin	DeltaGard G	L,I	N/A						X	X		X	X						
fenpropathrin	Tame 2.4 EC	N,G,I	24							X		X	X			X			

Table 4-3. Insecticides registered for control of borers, foliage feeders, and leafminers (continued)

See key to footnotes on page 56.

IRAC #	Active ingredients	Selected trade names ¹	Use site ³	REI (hours, unless noted otherwise)	Borers					Foliage feeders						Leafminers		
					Ambrosia beetles	Bark and Pine beetles	Clearwing borers	Flatheaded borers	Longhorned (roundheaded) borers	Flea beetles	Japanese beetles (adult)	Leaf beetles	Weevils	Caterpillars	Sawflies	Flies and midges	Moths	Wasps
3A (continued)	<i>tau</i> -fluvalinate	Mavrik Aquaflow	L,N,G,I	12						X		X	X	X				
	permethrin	Astro	L,G,I	12		X	X	X			X		X	X	X	X	X	X
		Permethrin Pro	L,I	N/A		X	X	X			X		X	X	X	X	X	X
		Perm-Up 3.2 EC	L,N,G,I	12		X	X	X			X		X	X	X	X	X	X
	pyrethrins	Tersus	N,G	12	X		X	X	X	X	X	X	X	X		X	X	X
		Pyganic	N,G	12						X		X		X	X			
	pyrethrum	Pyrethrum TR	N,G	12						X		X		X	X			
3A + 4A	bifenthrin + clothianidin	Aloft ² LC G, LC SC	L	N/A						X	X		X	X		X	X	X
	bifenthrin + imidacloprid	Allectus ² SC	L,I	N/A				X	X	X	X	X	X	X	X	X	X	X
	cyfluthrin + imidacloprid	Discus ² N/G	N,G,I	12				X	X		X	X	X	X	X	X	X	X
	<i>lambda</i> -cyhalothrin + thiamethoxam	Tandem ²	L	N/A						X	X	X	X	X	X	X	X	X
	<i>zeta</i> -cypermethrin + bifenthrin + imidacloprid	Triple Crown T&O ²	L, I	N/A	X						X	X	X	X	X			
3A + 27A	pyrethrins + piperonyl butoxide	Pyreth-It ²	N,G	12						X		X		X				

Table 4-3. Insecticides registered for control of borers, foliage feeders, and leafminers (continued)

See key to footnotes on page 56.

IRAC #	Active ingredients	Selected trade names ¹	Use site ³	REI (hours, unless noted otherwise)	Borers					Foliage feeders					Leafminers		
					Ambrosia beetles	Bark and Pine beetles	Clearwing borers	Flatheaded borers	Longhorned (roundheaded) borers	Flea beetles	Japanese beetles (adult)	Leaf beetles	Weevils	Caterpillars	Sawflies	Flies and midges	Moths
4A	acetamiprid	TriStar 8.5 SL	L,N,G	12				X			X	X	X	X	X	X	
	dinotefuran	Safari 2G	L,N,G,I	12				X	X			X	X			X	
		Safari 20SG	L,N,G,I	12				X	X		X	X	X			X	
		Zylam Liquid	L	12				X	X			X	X	X	X	X	X
		Transtect	L	N/A			X	X	X		X	X	X	X	X	X	X
	imidacloprid	Xytect 75WSP; 2F	L,N,G,I	12				X	X		X	X	X		X		
		Marathon II	N,G,I	12				X	X		X	X	X		X	X	X
		Marathon 60WP	N,G,I	12					X		X	X	X		X	X	X
		Merit	L,I	N/A				X	X		X	X	X		X	X	X
	4A (continued)	imidacloprid	Discus Tablets	N,G,I	12				X	X		X	X	X		X	X
thiamethoxam			Flagship 25WG	N,G,I	12							X	X		X	X	X
			Meridian 0.33G	L,I	N/A						X	X	X	X	X	X	X
			Meridian 25WG	L,I	N/A						X	X	X	X	X	X	X
4C + 5	sulfoxaflor + spinetoram	XXpire	L,N,G	12							X		X	X			
5	spinosad	Conserve	L,N,G	4				X				X		X	X	X	
		Entrust	L,N,G	4				X				X		X	X	X	
6	abamectin	Lucid, Avid	L,N,G	12											X		
		Aracinate TM	L,N,G,I	N/A			X	X				X	X	X	X	X	
		Award II	L,N	12													
	emamectin benzoate	Arbormectin	L	N/A	X			X	X		X			X	X	X	X
		Tree-äge	L	N/A		X	X	X	X					X	X	X	X
		Enfold	N	12										X		X	
6 + 20D	abamectin + bifentazate	Sirocco	L,N,G,I	12										X			
7A	s-kinoprene	Enstar AQ	G,I	4										X	X		
7B	fenoxycarb	Preclude TR	G	12								X	X	X			
8C	cryolite	Kryocide	L	N/A						X		X	X				

Table 4-3. Insecticides registered for control of borers, foliage feeders, and leafminers (continued)

See key to footnotes on page 56.

IRAC #	Active ingredients	Selected trade names ¹	Use site ³	REI (hours, unless noted otherwise)	Borers					Foliage feeders					Leafminers			
					Ambrosia beetles	Bark and Pine beetles	Clearwing borers	Flatheaded borers	Longhorned (roundheaded) borers	Flea beetles	Japanese beetles (adult)	Leaf beetles	Weevils	Caterpillars	Sawflies	Flies and midges	Moths	Wasps
11	<i>Bt</i> var. <i>aizawai</i>	XenTari	L,N,G,I	4										X				
	<i>Bt</i> var. <i>kurstaki</i>	Dipel Pro DF	L,N,G,I	4										X				
	<i>Bt</i> var. <i>tenebrioni</i>	Novodor	N, L	4								X						
13	chlorfenapyr	Pylon	G	12										X				
15	diflubenzuron	Adept	G	12										X			X	
		Dimilin 25W	L,N	12									X	X	X		X	
		Dimilin 4L	L,N	12									X	X	X		X	
	novaluron	Pedestal	N,G	12									X		X	X		
17	cyromazine	Citation	L,N,G,I	12											X			
18	methoxyfenozide	Intrepid 2F	L,N,G,I	4										X				
	tebufenoxide	Confirm 2F	N	4										X				
21A	tolfenpyrad	Hachi-Hachi SC	G	12										X				
22A	indoxacarb	Provaunt	L	N/A										X	X			
28	chlorantraniliprole	Acelepryn	L, I	N/A			X					X			X	X		X
		Acelepryn G	L, I	N/A											X			
	cyantraniliprole	Mainspring	G,I	4							X	X		X				
Unknown	azadirachtin	Azatin O	L,N,G,I	4		X	X	X	X	X	X	X	X	X	X	X	X	X
		Azatin XL	N,G,I	4						X	X	X	X	X	X	X	X	
		Azatrol EC Insecticide	L,N,G,I	4		X			X	X	X	X	X	X	X	X	X	X
		Ornazin EC	L,N,G,I	12		X	X		X	X	X	X	X	X	X	X	X	X
	Tree-Azin	L,N,G	Until dry				X					X		X	X	X	X	
pyridalyl	Overture 35 WP	G	12										X					

Table 4-3. Insecticides registered for control of borers, foliage feeders, and leafminers (continued)

See key to footnotes on page 56.

IRAC #	Active ingredients	Selected trade names ¹	Use site ³	REI (hours, unless noted otherwise)	Borers					Foliage feeders					Leafminers			
					Ambrosia beetles	Bark and Pine beetles	Clearwing borers	Flatheaded borers	Longhorned (roundheaded) borers	Flea beetles	Japanese beetles (adult)	Leaf beetles	Weevils	Caterpillars	Sawflies	Flies and midges	Moths	Wasps
Not classified	<i>Beauveria bassiana</i>	BotaniGard ES	L,N,G,I	4						X		X	X					
		BotaniGard 22 WP	L,N,G,I	4									X					
		Naturalis-L	L,N,G	4						X		X	X	X				
	<i>Chromobacterium subtsugae</i>	Grandevo PTO	L,N,G	4										X				
		<i>Heterorhabditis bacteriophera</i>	LarvaNem	L	N/A								X					
			ExhibitlineH	N	N/A								X					
	<i>Isaria formosorosea</i> (= <i>Paecilomyces fumosoroseus</i>)	NemaShield	L,N,G,I	N/A								X	X					
		NoFly	G	12								X						
	<i>Metarhizium anisopliae</i>	Preferal	L,N,G	4									X	X		X	X	
		Met52, Tick-EX	L,N,G	4									X					
Millenium			L,N,G,I	N/A			X						X	X				
<i>Steinernema carpocapsae</i>	Nematac C	L,N,G,I	N/A										X					
	ExhibitlineSC	L,N,G,I	N/A										X					
	Carpocapsae-System	L,N,G,I	N/A										X					
Not classified (continued)	<i>Steinernema carpocapsae</i>	Capsanem	L,N,G,I	N/A									X					
		EntoNem	L,N,G,I	N/A									X					
		Nemasys L	L,N,G,I	N/A									X					
	<i>Steinernema kraussei</i>	Kraussei-System	N	N/A									X					
		horticultural oil	Ultra-Pure Oil, TriTek	L,N,G,I	4								X		X	X	X	X
	insecticidal soap	M-Pede	L,N,G,I	12								X		X	X	X		
	capsicum extract, garlic oil, soybean oil	Captiva	L,N	4										X				

Table 4-4. Insecticides registered for control of gall formers and pests that interact or feed within soil or soilless media

See key to footnotes on page 56.

IRAC #	Active ingredients	Selected trade names ¹	Use site ³	REI (hours, unless noted otherwise)	Gall formers					Pests that interact or feed within soil or soilless substrates				
					Aphids or adelgids	Psyllids	Mites	Flies or midges	Wasps	Fungus gnats	Shore flies	White grubs	Fire ants	
1A	carbaryl	Sevin SL	L,N,G	12		X	X	X	X			X		
1B	acephate	Orthene	L,N,G	24									X	
		Lepitect	L,N,G	24		X	X	X	X					
		Precise GN	N,G	12								X	X	
	chlorpyrifos	Dursban 50W	N	24				X				X	X	
		DuraGuard ME	N,G	24						X	X			
	dicrotophos	Inject-A-Cide	L	N/A		X			X					
trichlorfon	Dylox 420 SL	L	N/A								X			
2B	fipronil	CeaseFire	L	24									X	
		TopChoice	L,N	N/A									X	
3A	bifenthrin	Attain TR	G	12						X				
		Menace GC	L,N,G	12						X		X	X	
		Onyx	L	N/A						X			X	
		Onyx Pro	L,N,I	12						X			X	
		Talstar S Select	N,G	12						X			X	
		Talstar Nursery G	N	12						X			X	
	cyfluthrin	Decathlon	L,N,G,I	12						X				
	<i>beta</i> -cyfluthrin	Tempo Ultra WP	L,I	N/A						X				
		Tempo SC Ultra	L,I	N/A						X				
	<i>lambda</i> -cyhalothrin	Demand	L	N/A										X
		Scimitar CS	L	24									X	X
		Scimitar GC	L,N,G	24									X	X
	cypermethrin	Demon WP	L,I	N/A										X
	deltamethrin	DeltaGard G	L,I	N/A										X
	<i>tau</i> -fluvialinate	Mavrik Aquaflow	L,N,G,I	12										X
	permethrin	Astro	L,G,I	12							X			X
		Permethrin Pro	L,I	N/A							X			X
		Perm-Up 3.2 EC	L,N,G,I	12							X			X
pyrethrins	Tersus	N,G	12							X	X			
	Pyganic	N,G	12							X			X	
pyrethrum	Pyrethrum TR	N,G	12						X				X	
3A + 4A	bifenthrin + clothianidin	Aloft ² LC G, LC SC	L	N/A									X	X
	bifenthrin + imidacloprid	Allectus ² SC	L,I	N/A						X		X	X	
	cyfluthrin + imidacloprid	Discus ² N/G	N,G,I	12						X		X	X	
	<i>lambda</i> -cyhalothrin + thiamethoxam	Tandem ²	L	N/A	X	X	X	X	X				X	
	<i>zeta</i> -cypermethrin + bifenthrin + imidacloprid	Triple Crown T&O ²	L,I	N/A						X			X	X

Table 4-4. Insecticides registered for control of gall formers and pests that interact or feed within soil or soilless media (cont.)
See key to footnotes on page 56.

IRAC #	Active ingredients	Selected trade names ¹	Use site ³	REI (hours, unless noted otherwise)	Gall formers					Pests that interact or feed within soil or soilless substrates				
					Aphids or adelgids	Psyllids	Mites	Flies or midges	Wasps	Fungus gnats	Shore flies	White grubs	Fire ants	
3A + 27A	pyrethrins + piperonyl butoxide	Pyreth-It ²	N,G	12										X
4A	acetamiprid	TriStar 8.5 SL	L,N,G	12						X				
	clothianidin	Arena 0.25 G	L,I	12									X	
		Arena 50 WDG	L,I	12									X	
	dinotefuran	Safari 2G	L,N,G,I	12							X		X	
		Safari 20SG	L,N,G,I	12							X		X	
		Zylam Liquid	L	12						X	X		X	
		Transtect 70 WSP	L	N/A						X			X	
	imidacloprid	Xytect 75WSP; 2F	L,N,G,I	12		X	X	X	X	X			X	X
		Marathon II	N,G,I	12							X		X	
		Marathon 60WP	N,G,I	12							X		X	
		Merit	L,I	N/A									X	
		CoreTect	L,I	N/A									X	
		Discus Tablets	N,G,I	12									X	
	thiamethoxam	Flagship 25WG	N,G,I	12			X		X	X	X		X	X
Meridian 0.33G		L,I	N/A									X		
Meridian 25WG		L,I	N/A			X		X	X			X	X	
4C + 5	sulfoxaflor + spinetoram	XXpire	L,N,G	12				X			X			
5	spinosad	Conserve	L,N,G	4				X				X	X	
		Entrust	L,N,G	4				X				X	X	
	abamectin	Award II	L,N	12									X	
	emamectin benzoate	Arbormectin	L	N/A					X					
7A	s-kinoprene	Enstar AQ	G,I	4						X				
	s-methoprene	Extinguish	L,N	4									X	
7A + 20A	s-methoprene + hydramethylon	Amdro Firestrike ²	L	N/A									X	
		Extinguished Plus ²	N	12									X	
7C	pyriproxifen	Distance IGR	L,N,G,I	12						X	X			
		Distance fire ant bait	L,N	12									X	
		Fulcrum	L,N,G,I	12						X	X			
11	<i>Bt var. galleriae</i>	GrubGONE! G	N,G,L,I	4								X		
	<i>Bt var. israelensis</i>	Gnatrol WDG	N,G,I	4						X				
13	chlorfenapyr	Pylon	G	12						X				
15	diflubenzuron	Adept	G	12						X	X			
17	cyromazine	Citation	L,N,G,I	12						X	X			
20A	hydramethylon	Amdro Pro	L,N	12									X	

Table 4-4. Insecticides registered for control of gall formers and pests that interact or feed within soil or soilless media (cont.)

See key to footnotes on page 56.

IRAC #	Active ingredients	Selected trade names ¹	Use site ³	REI (hours, unless noted otherwise)	Gall formers					Pests that interact or feed within soil or soilless substrates					
					Aphids or adelgids	Psyllids	Mites	Flies or midges	Wasps	Fungus gnats	Shore flies	White grubs	Fire ants		
22A	indoxacarb	Advion bait	L	N/A										X	
22B	metaflumizone	Siesta	L,N	12										X	
28	chlorantraniliprole	Acelepryn	L,I	N/A									X		
		Acelepryn G	L,I	N/A									X		
Unknown	azadirachtin	Azatin O	L,N,G,I	4				X		X	X	X			
		Azatin XL	N,G,I	4						X	X	X			
		Azatrol EC Insecticide	L,N,G,I	4						X	X	X			
		Ornazin EC	L,N,G,I	12						X	X				
Not classified	<i>Beauveria bassiana</i>	BotaniGard ES	L,N,G,I	4									X		
		BotaniGard 22 WP	L,N,G,I	4									X		
		Naturalis-L	L,N,G	4							X	X			
	<i>Chromobacterium subtsugae</i>	Grandevo PTO	L,N,G	4									X		
	<i>Heterorhabditis bacteriophera</i>	B-Green, TerraNem	L	N/A										X	
		LarvaNem	L	N/A										X	
		ExhibitlineH	N	N/A										X	
		Nemasys G	L,N,G,I	N/A										X	
		Terranem-Nam	L,N,G,I	N/A										X	
		NemaShield	L,N,G,I	N/A										X	
	<i>Isaria formosorosea</i> (= <i>Paecilomyces fumosoroseus</i>)	NoFly	G	12											
		Preferal	L,N,G	4										X	
	<i>Steinernema carpocapsae</i>	Millenium	L,N,G,I	N/A									X		
		Capsanem	L,N,G,I	N/A										X	
	<i>Steinernema feltiae</i>	NemaSys, Steinernema-System	L,N,G,I	N/A							X				
NemaShield		L,N,G,I	N/A							X					
EntoNem		L,N,G,I	N/A							X					
horticultural oil	Ultra-Pure Oil, TriTek	L,N,G,I	4			X			X						
insecticidal soap	M-Pede	L,N,G,I	12						X				X		

5. Disease Control

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes

Jean L. Williams-Woodward

Extension Plant Pathologist, University of Georgia

This table includes a list of fungicides labeled for use on ornamental plants and trees to control specific diseases as noted. The table is organized alphabetically according to plant disease common name or a pathogen. Fungicides labeled to control the disease and their labeled rate are provided in the table as a general guide only. Not all information provided on the fungicide label is duplicated within this table. It is the user's responsibility to consult the current label for rates and restrictions and follow all directions provided on the label. This table is also not meant to be an all-inclusive listing of every fungicide name brand available to green industry professionals. It is impossible to include all brands, particularly generic brands.

Other information presented in the table includes: fungicide mode of action (MOA) referenced as the Fungicide Resistance Action Committee (FRAC) numerical code; whether a product has Contact or Systemic activity; the restricted entry interval (REI) in hours; general application rates; and remarks and restrictions on product use. For fungicide resistance management, rotate or tank mix products with different FRAC numerical codes.

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Alternaria leaf spot	<i>azoxystrobin</i> Heritage	11	ACTIVITY: Systemic 1-4 oz/100 gal	4	Repeat every 7-28 days. Apply at the first sign of disease. Use low rate (1-2 oz) at 7-14 day intervals for low disease pressure; Use higher rate (3-4 oz) at 14-28 day intervals under high disease pressure. Rotate after 2-3 applications with non-strobilurin fungicide.
	<i>Bacillus subtilis</i> QST 713 strain Cease	44	ACTIVITY: Contact 2-8 qt/100-300 gal/A 4 qt/100-300gal/A (typical)	4	Make applications on a 3- to 10-day schedule. Typical interval of 7-days. Shorten under severe disease pressure.
	<i>chlorothalonil + thiophanate methyl</i> Spectro 90WDG	M5 + 1	ACTIVITY: Contact/Systemic 1-2 lb/100 gal	12	Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Minimum 7-day re-treatment interval. Do not exceed 2.15 lbs/ acre of product.
	<i>chlorothalonil</i> Daconil Zn Daconil Ultrex Daconil Weather Stik Thalonal 64L Thalonal 90DF + many other formulations	M5	ACTIVITY: Contact 2 pt/100 gal 1.4 lb/100 gal 1 3/8 pt/100 gal 1.4 lb/100 gal 1 3/8 pt/100 gal See product label for rates.	12	Re-apply at 7-14 day intervals. Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Do not combine with pesticides, surfactants, or fertilizers in spray tank.
	<i>copper hydroxide</i> CuPRO T/N/O Nu-Cop 50 DF Nu-Cop HB Nu-Cop 3L Champ WG	M1	ACTIVITY: Contact 0.75-2 lb/A 1.0 lb/100 gal 0.5 lb/100 gal 1 1/3 pt/100 gal 0.5 lb/100 gal	24-48 (check label)	Do not apply in spray solutions having pH less than 6.5. Do not tank mix with Aliette or other phosphante fungicides. Begin application at the first sign of disease and repeat at 7-14 day intervals.
	<i>copper hydroxide +mancozeb</i> Junction	M1 + M3	ACTIVITY: Contact 1.5-3.5 lb/100 gal	48	Do not apply in spray solutions having pH less than 6.5. Reapply at 7-14 day intervals.
	<i>copper salts of fatty and rosin acids</i> Camelot O	M1	ACTIVITY: Contact 0.5-2 gal/100 gal/A	4	Discoloration of blooms may occur. Do not spray just before or during bloom periods. Apply at 7-10 day intervals.
	<i>cyprodinil + fludioxonil</i> Palladium	9 + 12	ACTIVITY: Systemic/Contact 2-4 oz/100 gal	12	Begin applications prior to the onset of disease, and repeat applications at 7-14- day intervals if conditions remain favorable for disease development.
	<i>fludioxonil</i> Medallion WDG	12	ACTIVITY: Contact 1-2 oz/100 gal	12	Re-apply at 7-28 day intervals. Application to impatiens at seedling stage may cause stunting and/or chlorosis.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Alternaria leaf spot (continued)	<i>fluoxastrobin</i> Disarm O	11	ACTIVITY: Systemic 1-4 oz/100 gal	12	Under light disease pressure, use lower rates (1-2 oz/100 gal) on a 7-14 day interval or the higher rates (3-4 oz/100 gal) on a 14-28 day interval. Under high disease pressure, use the higher rates on a 7-14 day interval.
	<i>fluxapyroxad + pyraclostrobin</i> Orkestra Intrinsic	7 + 11	ACTIVITY: Contact/Systemic 4-6 fl oz/100 gal	12	Do NOT apply to Ninebark or Wintercreeper.
	<i>iprodione</i> Chipco 26019 N/G Chipco 26019 FLO Iprodione Pro 2SE	2	ACTIVITY: Contact 1-2 lb/100 gal 1-2.5 qt/100 gal 1-2.5 qt/100 gal	12	Do not use on Spathiphyllum or as a drench on Impatiens or Pothos. Re-apply at 7-14 day intervals.
	<i>iprodione + thiophanate methyl</i> 26/36	2 + 1	ACTIVITY: Contact + Systemic 33-84 fl oz/100 gal	12	Spray plants to ensure thorough coverage. Repeat at 7-14 day intervals. Do not make more than 4 applications per crop per year. Do not use on Spathiphyllum or New Guinea Impatiens. Provides good Alternaria control.
	<i>kresoxim-methyl</i> Cygnus	11	ACTIVITY: Systemic 1.6-3.2 oz/100 gal	12	Apply as protective spray and continue on a 7-14 day interval.
	<i>mancozeb</i> Dithane 75DF Dithane WF Fore 80WP Mancozeb DG Pentathlon DF Protect DF	M3	ACTIVITY: Contact 1-2 lb/100 gal 1.5 lb/100 gal 1.5 lb/100 gal 1-2 lb/100 gal 0.8-1.6 qt/A/100 gal 1-2 lb/100 gal	24	Addition of a spreader sticker will improve performance. Do not use Fore on Pachysandra. Repeat application on 7-10 day intervals.
	<i>mancozeb + myclobutanil</i> Clevis	M3 + 3	ACTIVITY: Contact + Systemic 2 lb/100 gal (on viburnum)	24	Addition of a spreader sticker will improve performance. Repeat application on 7-10 day intervals. Begin application at first sign of disease or when plants are well leafed out. Spray at 7-10 day intervals.
	<i>polyoxin D Zn salt</i> Affirm WDG	19	ACTIVITY: Systemic 0.5 lb/100 gal	4	Apply as full coverage foliar spray every 7-10 days. Apply prior to disease development and when conditions are conducive for disease.
	<i>propiconazole</i> Banner Maxx II Fathom 14.3 MEC Propiconazole Strider	3	ACTIVITY: Systemic 5-8 fl oz/100 gal 5-8 fl oz/100 gal 5-8 fl oz/100 gal 5-8 fl oz/100 gal	12-24 (check labels)	Do not apply to African violets, begonias, Boston fern or geranium. Do not use in greenhouses. Apply every 14-21 days when conditions are favorable for disease development. Spray to drip.
	<i>potassium bicarbonate</i> MilStop	NC	ACTIVITY: Contact 2.5-5 lb/100 gal	1	Apply by increasing 0.25lb/application not exceeding 5 lb. Repeat applications at 1-2 week intervals. See label for precautions for use on poinsettia, impatiens, and pansy.
	<i>pyraclostrobin + boscalid</i> Pageant	11 + 7	ACTIVITY: Systemic 4-8 oz/100 gal	12	Use preventively. Begin applications when conditions are favorable for disease, prior to disease symptom development. Reapply at 7-14 day intervals.
	Anthracnose (<i>Colletotrichum</i> , <i>Glomerella</i> , <i>Elsinoe</i> , <i>Discula</i> , <i>Marssonina</i> , and others)	<i>trifloxystrobin</i> Compass O 50WGD	11	ACTIVITY: Systemic 2-4 oz/100 gal (spray)	12
<i>triflumizole</i> Terraguard SC		3	ACTIVITY: Contact 4-8 oz/100 gal	12	Apply foliar sprays at 7-14 day intervals. Use high rate for initial application.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Anthracnose (<i>Colletotrichum</i> , <i>Glomerella</i> , <i>Elsinoe</i> , <i>Discula</i> , <i>Marssonina</i> , and others) (continued)	<i>Bacillus subtilis</i> QST 713 strain Cease	44	ACTIVITY: Contact 2-8 qt/100-300 gal/A 4 qt/100-300 gal/A (typical)	4	Make applications on a 3-10-day schedule. Typical interval of 7-days. Shorten interval under severe disease pressure.
	<i>benzovindiflupyr</i> + <i>azoxystrobin</i> Mural	7 + 11	ACTIVITY: Contact/Systemic 4-7 oz/100 gal	12	Do NOT apply to apple, crabapple, flowering cherry, privet, leatherleaf fern or other fern used for cut foliage. Apply at 7-14 day intervals.
	<i>chlorothalonil</i> Daconil Zn Daconil Ultrex Daconil Weather Stik + many other formulations	M5	ACTIVITY: Contact 2 pt/100 gal 1.4 lb/100 gal 1 3/8 pt/100 gal See product label for rates.	12	Re-apply at 7-14 day intervals. Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Do not combine with pesticides, surfactants, or fertilizers in spray tank.
	<i>chlorothalonil</i> + <i>thiophanate methyl</i> Spectro 90WDG	M5 + 1	ACTIVITY: Contact/Systemic 1-2 lb/100 gal	12	Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Minimum 7-day re-treatment interval. Do not exceed 2.15 lb/A of product.
	<i>copper hydroxide</i> Champ WG CuPRO 2005 T/N/O Nu-Cop 50 DF Nu-Cop HB Nu-Cop 3L	M1	ACTIVITY: Contact 0.5 lb/100 gal 0.75-2 lb acre 1 lb/100 gal 0.5 lb/100 gal 1 1/3 pt/100 gal	24-48 (check label)	Do not apply in spray solutions having pH less than 6.5. Do not tank mix with Aliette or other phosphante fungicides. Begin application at the first sign of disease and repeat at 7-14 day intervals.
	<i>copper hydroxide</i> + <i>mancozeb</i> Junction	M1 + M3	ACTIVITY: Contact 1.5-3.5 lb/A	48	Do not apply in spray solutions having pH less than 6.5. Reapply at 7-14 day intervals.
	<i>copper salts of fatty and rosin acids</i> Camelot O	M1	ACTIVITY: Contact 0.5-2 gal/100 gal	4	Discoloration of blooms may occur. Do not spray just before or during bloom periods. Apply at 7-10 day intervals.
	<i>copper sulfate</i> Basicop	M1	ACTIVITY: Contact 2-4 lb/100 gal or 2-4 lb/A	24	Phytotoxicity may occur on certain plant species/cultivars. Limited ornamental plant labeling. Trees: Apply to swelling buds and repeat 2 times at 10-day intervals as needed. Shrubs/ Flowers: Apply preventively, and repeat at 7-10 day intervals and after rains.
	<i>cyprodinil</i> + <i>fludioxonil</i> Palladium	9 + 12	ACTIVITY: Systemic/Contact 2-4 oz/100 gal	12	Begin applications prior to the onset of disease, and repeat applications at 7-14- day intervals if conditions remain favorable for disease development.
	<i>fluxapyroxad</i> + <i>pyraclostrobin</i> Orkestra Intrinsic	7 + 11	ACTIVITY: Contact + Systemic 8-10 fl oz/100 gal	12	Do NOT apply to Ninebark or Wintercreeper.
	<i>kresoxim-methyl</i> Cygnus	11	ACTIVITY: Systemic 3.2-6.4 oz/100 gal	12	Apply strictly as a protective spray and continue on a 7-10 day interval.
	<i>myclobutanil</i> Eagle 20EW	3	ACTIVITY: Systemic 6-12 oz/100 gal	24	For dogwood anthracnose only. Repeat application at 10-14 day intervals.
	<i>fluoxastrobin</i> Disarm O	11	ACTIVITY: Systemic 4-8 oz/100 gal	12	Apply every 7-28 days. Under light disease pressure, use lower rates (4-5 oz/100 gal) on a 7-14 day interval or the higher rates (6-8 oz/100 gal) on a 14-28 day interval. Under high disease pressure, use the higher rates on a 7-14 day interval.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Anthracoze (<i>Colletotrichum</i> , <i>Glomerella</i> , <i>Elsinoe</i> , <i>Discula</i> , <i>Marssonina</i> , and others) (continued)	<i>mancozeb</i> Dithane 75DF Fore 80WP Mancozeb DG Pentathlon DF Pentathlon LF Protect DF	M3	ACTIVITY : Contact 1-2 lb/100 gal 1.5 lb/100 gal 1.5 lb/100 gal 1-2 lb/100 gal 0.8-1.6 qt/A/100 gal 1-2 lb/100 gal	24	Addition of a spreader sticker will improve performance. Repeat application on 7-10 day intervals. For dogwood, apply when buds begin to open, when bracts have fallen, 4 weeks later, and again in late summer after flower buds for next season have formed. Do not use Fore on <i>Pachysandra</i> .
	<i>mancozeb + myclobutanil</i> Clevis	M3 + 3	ACTIVITY : Contact + Systemic 2 lb/100 gal	24	Begin application at first sign of disease or when plants are well leafed out. Spray at 7-10 day intervals. Addition of spreader-binder or surfactant will improve performance.
	<i>metconazole</i> Tourney	3	ACTIVITY : Systemic 1-4 oz/100 gal	12	Apply to the point of drip at 14-28 day intervals.
	<i>polyoxin D Zn salt</i> Affirm WDG	19	ACTIVITY : Systemic 0.25-0.5 lb/100 gal	4	Apply as full coverage foliar spray every 7-10 days. Apply prior to disease development and when conditions are conducive for disease.
	<i>propiconazole + chlorothalonil</i> Concert II	3 + M5	ACTIVITY : Systemic + Contact 22-35 fl oz (1.4-2.2 pt)/100 gal	12	For outdoor and landscape use only. Do not use in greenhouses. Limited host plant labeling; check label. Do not apply to African Violets, Begonias, Boston fern, Geranium, Pittosporum, Schefflera. Reapply at 21 day intervals. Application to blooms or tender new growth may cause injury.
	<i>potassium bicarbonate</i> MilStop		ACTIVITY : Contact 2.5-5 lb/100 gal	1	Apply by increasing 0.25 lbs per application not exceeding 5.0 lbs. Repeat applications at 1-2 week intervals. See label for precautions for use on poinsettia, impatiens, and pansy.
	<i>pyraclostrobin + boscalid</i> Pageant	11 + 7	ACTIVITY : Systemic + Contact 18 oz/100 gal	12	Use preventively. Begin applications when conditions are favorable for disease, prior to disease symptom development. Reapply at 7-14 day intervals.
	<i>thiophanate methyl</i> Allban Flo 3336 F 3336 EG SysTec 1998 WDG OHP 6672 4.5F OHP 6672 50WP + many other formulations	1	ACTIVITY : Systemic 10.75-20 fl oz/100 gal 12-16 fl.oz /100 gal 12-16 oz/100 gal 20 fl oz/100 gal 10.75-20 fl oz/100 gal 12-16 oz/100 gal See labels for rates.	12	Not recommended for use on Boston fern, Swedish Ivy or Easter Cactus. Apply at bud break. Repeat application on 7-14 day intervals. Rotations or tank mix combinations of mancozeb or chlorothalonil can be utilized.
	<i>thiophanate methyl + mancozeb</i> Zyban WSB	1 + M3	ACTIVITY : Systemic/ Contact 24 oz (4 bags)/100 gal	24	Apply at weekly intervals. Limit to 20 applications per year.
	<i>Trifloxystrobin</i> Compass O 50WDG	11	ACTIVITY : Systemic/ Contact 2-4 oz /100 gal	12	Apply at first sign of disease and continue at 7-14 day intervals. Rotate with fungicide in different chemical class.
<i>trifloxystrobin + triadimefon</i> Trigo	11 + 3	ACTIVITY : Systemic 3-9 oz/100 gal	12	Apply to the point of drip and repeat at 7-14 day intervals. Do NOT use on Petunia, Violets, and New Guinea Impatiens.	
Bacterial leaf spots rots (<i>Xanthomonas</i> , <i>Pseudomonas</i> , <i>Acidovorax</i> , etc.)	<i>Bacillus subtilis</i> QST 713 strain Cease	44	ACTIVITY : Contact 2-8 qt/100-300 gal/A 4 qt/100-300 gal/A (typical)	4	Make applications on a 3-10 day schedule. Typical interval of 7-days. Shorten under severe disease pressure. Begin applications when conditions favor disease development prior to disease onset. Thorough coverage is essential.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Bacterial leaf spots rots (<i>Xanthomonas</i> , <i>Pseudomonas</i> , <i>Acidovorax</i> , etc.) (continued)	<i>copper hydroxide</i> CuPRO 2005 T/N/O Nu-Cop 50 DF Nu-Cop HB Nu-Cop 3L Champ WG	M1	ACTIVITY : Contact 0.75-2 lb A 1.0 lb/100 gal 0.5 lb/100 gal 1 1/3 pt/100 gal 0.5 lb/100 gal	24-48 (check label)	Do not apply in spray solutions having pH less than 6.5. Do not tank mix with Aliette or other phosphante fungicides. Begin application at the first sign of disease and repeat at 7-14 day intervals.
	<i>copper hydroxide + mancozeb</i> Junction	M1 + M3	ACTIVITY : Contact 1.5-3.5 lb/A	48	Do not apply in spray solutions having pH less than 6.5. Do not tank mixwith Aliette fungicide. Reapply at 7-14 day intervals.
	<i>copper salts of fatty and rosin acids</i> Camelot O	M1	ACTIVITY : Contact 0.5-2 gal/100 gal/A	4	Discoloration of blooms may occur. Do not spray just before or during bloom periods. Apply at 7-10 day intervals.
	<i>copper sulphate pentahydrate</i> Phyton 27	M1	ACTIVITY : Contact 1 ½-2 ½ oz/10 gal	24	Reapply at 3-5 day intervals.
	<i>fosetyl-AL</i> Aliette WDG	33	ACTIVITY : Systemic 2-4 lb/100 gal	12	Spray to wet using no more than 400 gallons of spray per acre. Repeat as necessary, but do not apply more than one application every 7 days.
	<i>phosphorous acid</i> Alude Fosphite + others	33	ACTIVITY : Systemic 2-4 pt/100 gal (<i>Xanthomonas</i>) 1-2 pt/100 gal (<i>Xanthomonas</i>)	4	Apply spray to thoroughly wet foliage. Repeat as needed at 7-14 day intervals.
	<i>streptomycin sulfate</i> Agri-mycin 17	25	ACTIVITY : Contact Between 50-200 ppm (4 oz – 1 lb/100 gal) ***See label for more specific rates	12	Philodendron only — Spray as preventive or at first signs of water-soaked areas on leaf. Apply every 4-5 days. For curative action, remove all rotted leaves from plant, then spray every 4 days. Dieffenbachia only — Soak cuttings for 20 minutes (200 ppm = 1 lb/100 gal). To stop spread of rot in stock plants, spray every 5-7 days with 100 ppm (8 oz/100 gal).
Black root rot (<i>Thielaviopsis</i> spp.)	<i>etridiazole + thiophanate methyl</i> Banrot 8G Banrot 40WP	14 + 1	ACTIVITY : Contact/Systemic 12 oz/cu yd Bedding: 4-8 oz/100 gal Woody/Foliage: 6-12 oz/100 gal	12	Apply in volume to saturate rooting medium. Irrigate immediately. Protects against Thielaviopsis and Pythium but is not as effective against Thielaviopsis as thiophanate methyl only products that have a higher concentration of active ingredient. Apply at 4-8 week intervals.
	<i>fludioxonil</i> Emblem Medallion WDG	12	ACTIVITY : Contact 2 pt/sq ft 2 pt/sq ft	12	Wet entire medium. Re-apply at 21-28 day intervals.
	<i>fludioxonil + mefenoxam</i> Hurricane (WP)	12 + 4	ACTIVITY : Contact 0.75 oz/100 gal (drench at seeding) 1.5 oz/100 gal (2 packets) as drench of cuttings and transplants + Add 1 oz Medallion WDG fungicide/100 gal solution	48	Application to Impatiens, New Guinea Impatiens, Pothos, Geranium, and Easter Lily may cause stunting and/or chlorosis. Do not use on leather leaf fern. Add Medallion fungicide at 1 oz/100 gal water as a tank mix. Make only one application to seedling crop prior to transplanting to larger containers. For cuttings or transplants, re-treat at 21-28 day intervals if needed. For use only in greenhouses, containers, and enclosed structures.
	<i>polyoxin D Zn salt</i> Affirm WDG	19	ACTIVITY: Systemic 0.5 lb/100 gal	4	Apply as a soil drench every 14-28 days.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Black Spot (<i>Diplocarpon rosea</i> , syn. <i>Marssonina rosea</i>)	<i>azoxystrobin</i> Heritage	11	ACTIVITY : Systemic 4-8 oz/100 gal	4	Apply at 7-day intervals; may be increased to 14 days when disease pressure is light. May be tank-mixed with another black spot control fungicide when disease pressure is severe.
	<i>Bacillus subtilis</i> QST 713 strain Cease	44	ACTIVITY : Contact 2-8 qt/100-300 gal/A 4 qt/100-300 gal/A (typical)	4	Make applications on a 3-10 day schedule. Typical interval of 7-day. Shorten under severe disease pressure.
	<i>chlorothalonil</i> Daconil Zn Daconil Ultrex Daconil WeatherStik + many other formulations	M5	ACTIVITY : Contact 1.5 pt/100 gal 1 lb/100 gal 1 pt/100 gal See product label for rates.	12	Re-apply at 7-14 day intervals. Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Foliage of Knock-Out and Double Delight roses may be injured under certain growing conditions. Do not combine with pesticides, surfactants, or fertilizers in spray tank.
	<i>chlorothalonil + thiophanate methyl</i> Spectro 90WDG	M5 + 1	ACTIVITY : Contact/Systemic 1-2 lb/100 gal	12	Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Minimum 7-day re-treatment interval. Do not exceed 2.15 lb/A of product.
	<i>copper hydroxide + mancozeb</i> Junction	M1 + M3	ACTIVITY: Contact 1.5-3.5 lb/A	48	Do not apply in spray solutions having pH less than 6.5. Reapply at 7-14 day intervals.
	<i>copper hydroxide</i> CuPRO T/N/O Nu-Cop 50 DF Nu-Cop HB Nu-Cop 3L	M1	ACTIVITY: Contact 0.75-2 lb A 1.0 lb/100 gal 0.5 lb/100 gal 1 1/3 pt/100 gal	24-48 (check label)	Do not apply in spray solutions having pH less than 6.5. Do not tank mix with Aliette or other phosphite/phosphante fungicides. Begin application at the first sign of disease and repeat at 7-14 day intervals.
	<i>copper salts of fatty & rosin acids</i> Camelot O	M1	ACTIVITY: Contact 0.5-2 gal/100 gal	4	Discoloration of blooms may occur. Do not spray just before or during bloom periods. Apply at 7-10 day intervals.
	<i>fluoxastrobin</i> Disarm O	11	ACTIVITY: Systemic 2-4 oz/100 gal	12	Apply every 7-21 days. Under light disease pressure, use lower rates on a 7-14 day interval or the higher rates on a 21-day interval. Under high disease pressure, use the higher rates on a 7-14 day interval.
	<i>kresoxim-methyl</i> Cygnus	11	ACTIVITY: Systemic 1.6-3.2 oz/100 gal	12	Apply as protective spray and continue on a 7-14 day interval.
	<i>mancozeb + myclobutanil</i> Clevis	M3 + 3	ACTIVITY: Contact + Systemic 2 lb/100 gal	24	Begin application at first sign of disease or when plants are well leafed out. Spray at 7-10 day intervals. Addition of spreader-binder or surfactant will improve performance.
	<i>metconazole</i> Tourney	3	ACTIVITY: Systemic 1-4 oz/100 gal	12	Apply to the point of drip at 14-28 day intervals.
	<i>myclobutanil</i> Eagle 20EW	3	ACTIVITY: Systemic 6-12 oz/100 gal	24	Repeat application at 10-14 day intervals.
	<i>propiconazole</i> Banner Maxx II Strider	3	ACTIVITY: Systemic + Contact 5-8 oz/100 gal 5-8 oz/100 gal	12 – 24 (Check label)	For outdoor use only. Tank mix with a contact fungicide. Reapply at 14-21 day intervals.
<i>propiconazole + chlorothalonil</i> Concert II	3 + M5	ACTIVITY: Systemic + Contact 22-35 fl oz (1.4-2.2 pt)/100 gal	12	For outdoor and landscape use only. Do not use in greenhouses. Limited plant labeling; check label. Do not apply to African violets, begonias, Boston fern, geranium, pittosporum, schefflera. Reapply at 14-21 day intervals. Application to blooms or tender new growth may cause injury.	

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Black Spot <i>(Diplocarpon rosea, syn. Marssonina rosea)</i> (continued)	<i>potassium bicarbonate</i> MilStop	NC	ACTIVITY: Contact 2.5-5 lb/100 gal	1	Apply by increasing 0.25 lb/application not exceeding 5 lb. Repeat applications at 1-2 week intervals. See label for precautions for use on poinsettia, impatiens, and pansy.
	<i>tebuconazole</i> Torque	3	ACTIVITY: Systemic 4-10 fl oz/100 gal	12	Apply every 14-21 days during the growing season, starting when leaves first appear. Rotate with a fungicide in a different class (different FRAC #) to reduce fungicide resistance development.
	<i>thiophanate methyl</i> Allban Flo 3336 F 3336 EG SysTec 1998WDG OHP 6672 4.5F OHP 6672 50WP	1	ACTIVITY: Systemic 10.75-20 fl oz/100 gal 12-16 fl oz /100 gal 12-16 oz/100 gal 20 fl oz/100 gal 10.75-20 fl oz/100 gal 12-16 oz/100 gal	12	Apply at bud break or at first sign of disease. Repeat application on 7-14 day intervals.
	<i>thiophanate methyl + mancozeb</i> Zyban WSB	1 + M3	ACTIVITY : Systemic/Contact 24 oz (4 bags)/100 gal	24	While disease is prevalent spray foliage at weekly intervals.
	<i>trifloxystrobin</i> Compass O 50WDG	11	ACTIVITY : Systemic 2-4 oz/100 gal	12	Apply to drip on 7-14 day intervals when conditions are favorable to disease development.
	<i>trifloxystrobin + triadimefon</i> Trigo	11 + 3	ACTIVITY : Systemic 1.2 oz/100 gal (winter) 2.4 oz/100 gal (summer)	12	Apply to the point of drip. Do not apply at intervals shorter than 30 days to avoid flower stalk length reduction.
	Botrytis blight (Gray Mold)	<i>azoxystrobin</i> Heritage	11	ACTIVITY : Systemic 4-8 oz/100 gal	4
<i>Bacillus subtilis</i> QST 713 strain Cease		44	ACTIVITY : Contact 2-8 qt/100-300 gal/A 4 qt/100-300 gal/A (typical)	4	Make applications on a 3-10 day schedule. Typical interval of 7-days. Shorten under severe disease pressure.
<i>captan</i> Captan 50WP		M4	ACTIVITY : 2 lb/100 gal (Chrysanthemum)	48	Apply at first sign of disease. Repeat applications at 7-10 day intervals.
<i>chlorothalonil</i> Daconil Zn Daconil Ultrex Daconil Weather Stik Exotherm Termil + many other formulations		M5	ACTIVITY : Contact 2 pt/100 gal 1.4 lb/100 gal 1 3/8 pt/100 gal 1 can/1,500 sq ft See labels for rates.	12	Re-apply at 7-day intervals. Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Exotherm—See label for method of application.
<i>chlorothalonil + thiophanate methyl</i> Spectro 90WDG		M5 + 1	ACTIVITY : Contact 1-2 lb/100 gal	12	Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Minimum 7-day re-treatment interval. Do not exceed 2.15 lb/A of product.
<i>copper hydroxide</i> CuPRO 2005 T/N/O Nu-Cop 50 DF Nu-Cop HB Nu-Cop 3L		M1	ACTIVITY : Contact 0.75-2 lb /A 1 lb/100 gal 0.5 lb/100 gal 1 1/3 pt/100 gal	24-48 (check label)	Do not apply in spray solutions having pH less than 6.5. Do not tank mix with Aliette or other phosphante fungicides. Begin application at the first sign of disease and repeat at 7-14 day intervals.
<i>copper hydroxide + mancozeb</i> Junction		M1 + M5	ACTIVITY : Contact 1.5-3.5 lb/A	48	Do not apply in spray solutions having pH less than 6.5. Do not tank mix with Aliette fungicide. Reapply at 7-14 day intervals.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Botrytis blight (Gray Mold) (continued)	<i>copper salts of fatty and rosin acids</i> Camelot O	M1	ACTIVITY : Contact 0.5-2 gal/100 gal/A	4	Discoloration of blooms may occur. Do not spray just before or during bloom periods. Apply at 7-14 day intervals.
	<i>copper sulphate pentahydrate</i> Phyton 27	M1	ACTIVITY : Contact 1 ½-2 ½ oz/10 gal	24	Reapply at 3-5 day intervals.
	<i>copper sulfate</i> Basicop	M1	ACTIVITY : Contact 2-4 lb/100 gal or 2-4 lb/A	24	Phytotoxicity may occur on certain plant species/cultivars. Limited ornamental plant labeling. Apply preventively, and repeat at 7-10 day intervals and after rains.
	<i>cyprodinil + fludioxonil</i> Palladium	9 + 12	ACTIVITY : Systemic/Contact 4-6 oz/100 gal	12	Spray at 7-14 day intervals while conditions are favorable for disease development.
	<i>dicloran</i> Botran 75-W	14	ACTIVITY : Contact 1 lb/150-200 gal (rose, geranium, chrysanthemum) 1 1/3 lb/100 gal (gladiolus) 1 lb/100 gal (rose, hydrangea) 2 lb/A (conifers)	12	Limited host labeling. Spray at the first sign of disease or preventively, repeat every 7-14 days. Spray plants prior to storage or shipment.
	<i>fenhexamind</i> Decree (50%)	17	ACTIVITY : Contact 0.75 lb/100 gal (preventative) 1-1.5 lb/100 gal (curative)	12	Do not make more than 2 consecutive applications or use more than 6 lb/A/ crop on plants grown outside or 0.14 lb/1000 sq ft/ crop cycle on plants grown in greenhouses. Re-apply at 7-14 day intervals preventively and 7 day intervals for curative.
	fluoxastrobin Disarm O	11	ACTIVITY : Systemic 4-8 oz/100 gal	12 H	Apply prior to infection. Under light disease pressure, use lower rates on a 7-14 day interval or the higher rates on a 14-21 day interval. Under high disease pressure, use the higher rates on a 7-14 day interval.
	<i>fludioxonil</i> Emblem Medallion WDG Mozart TR	12	ACTIVITY : Contact 2-4 oz/100 gal 2-4 oz/100 gal 1 can/4,500 sq. ft (1 can/1,500 sq ft under high disease pressure)	12	May stunt or yellow some impatiens, New Guinea impatiens, and some geranium cultivars. Do not use after bract formation on poinsettia. Re-apply at 7-14 day intervals. Rotate to different fungicide class after 2 applications.
	<i>fluxapyroxad + pyraclostrobin</i> Orchestra Intrinsic	7 + 11	ACTIVITY: Contact/Systemic 8 fl oz/100 gal	12	Do NOT apply to Ninebark or Wintercreeper. May discolor flowers of Impatiens and Petunia.
	<i>iprodione</i> Chipco 26019 N/G Chipco 26019 FLO Iprodione Pro 2SE	2	ACTIVITY : Contact 1-2 lb/100 gal 1-2.5 qt/100 gal 1-2.5 qt/100 gal	12	Do not use on Spathiphyllum or as a drench on Impatiens or Pothos. Re-apply at 7-14 day intervals.
	<i>iprodione + thiophanate methyl</i> 26/36	2 + 1	ACTIVITY : Contact + Systemic 33-84 fl oz/100 gal	12	Spray plants to ensure thorough coverage. Repeat at 7-14 day intervals. Do not make more than 4 applications per crop per year. Do not use on Spathiphyllum or New Guinea Impatiens.
<i>mancozeb</i> Dithane 75DF Fore 80WP Mancozeb DG Pentathlon DF Pentathlon LF Protect DF	M3	ACTIVITY : Contact 1-2 lb/100 gal 1.5 lb/100 gal 1.5 lb/100 gal 1-2 lb/100 gal 0.8-1.6 qt/100 gal 1-2 lb/100 gal	24	Addition of a spreader sticker will improve performance. Repeat application on 7-10 day intervals. Do not use Fore on Pachysandra.	

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Botrytis blight (Gray Mold) (continued)	<i>mancozeb + myclobutanil</i> Clevis	M3 + 3	ACTIVITY : Contact + Systemic 2 lb/100 gal	24	Begin application at first sign of disease or when plants are well leafed out. Spray at 7-10 day intervals. Addition of spreader-binder or surfactant will improve performance.
	<i>metconazole</i> Tourney	3	ACTIVITY : Systemic 1-4 oz/100 gal	12	Apply to point of drip at 14-28 day intervals.
	<i>polyoxin D Zn salt</i> Affirm WDG	19	ACTIVITY : Systemic 0.25-0.5 lb/100 gal	4	Apply as full coverage foliar spray every 7-10 days. Apply prior to disease development and when conditions are conducive for disease.
	<i>potassium bicarbonate</i> MilStop	NC	ACTIVITY : Contact 2.5-5 lb/100 gal	1	Apply by increasing 0.25lbs per application not exceeding 5 lb. Repeat applications at 1-2 week intervals. See label for precautions for use on poinsettia, impatiens, and pansy.
	<i>pyraclostrobin + boscalid</i> Pageant	11 + 7	ACTIVITY : Systemic + Contact 12-18 oz/100 gal	12	Use preventively. Begin applications when conditions are favorable for disease, prior to disease symptom development. Reapply at 7-14 day intervals.
	<i>thiophanate methyl</i> Allban Flo 3336 F 3336EG SysTec1998 WDG OHP 6672 4.5F OHP 6672 50W + many other formulations	1	ACTIVITY : Systemic 10-14.5 fl oz/100 gal 12-16 fl oz/100 gal 12-16 oz/100 gal 10 fl oz/100 gal 10-14.5 fl oz/100 gal 12-16 oz/100 gal See labels for rates.	12	** Fungicide resistance known. Rotate with fungicide with a different FRAC number. Not recommended for use on Boston fern, Swedish Ivy or Easter Cactus. Repeat application on 7-14 day intervals.
	<i>thiophanate methyl + mancozeb</i> Zyban WSB	1 + M3	ACTIVITY : Systemic/Contact 24 oz (4 bags)/100 gal	24	Apply on weekly intervals. Limit to 20 applications per year.
	<i>trifloxystrobin</i> Compass O 50WDG	11	ACTIVITY : Systemic 2-4 oz/100 gal (drip)	12	Apply at first sign of disease and continue at 7-14 day intervals. Rotate with fungicide in different chemical class.
	<i>triflumizole</i> Terraguard SC Terraguard SC/LS	3	ACTIVITY : Contact 4-8 oz/100 gal 4-8 oz/100 gal	12	Apply foliar sprays at 7-14 day intervals. Use high rate for initial application and heavy disease pressure. Do not use on impatiens plugs.
	<i>triticonazole</i> Trinity TR	3	ACTIVITY : Systemic 1 can/3,000 sq ft (greenhouse)	12	Elevate container above the plant canopy and clear a 6 ft area around can. Shut off exhaust and close vents. Repeat at 7-day intervals up to 3x per crop (2x for pansies).
Cercospora, Pseudocercospora, Passalora and Septoria leaf spots	<i>azoxystrobin</i> Heritage	11	ACTIVITY : Systemic 1-4 oz/100 gal	4	Apply to the point of drip at 7-28 day intervals.
	<i>Bacillus subtilis</i> QST 713 strain Cease	44	ACTIVITY : Contact 2-8 qt/100-300 gal/A 4 qt/100-300 gal/A (typical)	4	Make applications on a 3-10 day schedule. Typical interval of 7-days. Shorten under severe disease pressure.
	<i>benzovindiflupyr + azoxystrobin</i> Mural	7 + 11	ACTIVITY: Contact/Systemic 4-7 oz/100 gal	12	Do NOT apply to apple, crabapple, flowering cherry, privet, leatherleaf fern or other fern used for cut foliage. Apply at 7-14 day intervals.
	<i>captan</i> Captan 50WP	M4	ACTIVITY : 2 lb/100 gal (Chrysanthemum)	48	Apply at first sign of disease. Repeat applications at 7-10 day intervals.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
<i>Cercospora</i> , <i>Pseudocercospora</i> , <i>Passalora</i> and <i>Septoria</i> leaf spots (continued)	<i>chlorothalonil</i> Daconil Zn Daconil Ultrex Daconil Weather Stik + many other formulations	M5	ACTIVITY : Contact 2 pt/100 gal 1.4 lb/100 gal 1 3/8 pt/100 gal See labels for rates.	12	Re-apply at 7-14 day intervals. Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Foliage of Knock-Out and Double Delight roses may be injured under certain growing conditions. Do not combine with pesticides, surfactants, or fertilizers in spray tank.
	<i>chlorothalonil + thiophanate methyl</i> Spectro 90WDG	M5 + 1	ACTIVITY : Contact/Systemic 1-2 lb/100 gal	12	Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Minimum 7-day re-treatment interval. Do not exceed 2.15 lb/A of product
	<i>copper hydroxide</i> Champ WG CuPRO 2005 T/N/O Nu-Cop 50 DF Nu-Cop HB Nu-Cop 3L	M1	ACTIVITY : Contact 0.5 lb/100 gal 0.75-2 oz/100 gal 1 lb/100 gal 0.5 lb/100 gal 1 1/3 pt/100 gal	24-48 (check label)	Do not apply in spray solutions having pH less than 6.5. Do not tank mix with Aliette or other phosphante fungicides. Begin application at the first sign of disease and repeat at 7-14 day intervals.
	<i>copper hydroxide + mancozeb</i> Junction	M1 + M3	ACTIVITY : Contact 1.5-3.5 lb/100 gal	48	Do not apply in spray solutions having pH less than 6.5. Reapply at 7-14 day intervals.
	<i>copper salts of fatty and rosin acids</i> Camelot	M1	ACTIVITY : Contact 0.5-2 gal/100 gal/A	4	Discoloration of blooms may occur. Do not spray just before or during bloom periods. Apply at 7-10 day intervals.
	<i>cymodanil + fludioxonil</i> Palladium	9 + 12	ACTIVITY : Systemic/Contact 2-4 oz/100 gal	12	Begin applications prior to the onset of disease, and repeat applications at 7-14-day intervals if conditions remain favorable for disease development. Do not use on residential ornamentals.
	<i>fludioxonil</i> Emblem Medallion WDG	12	ACTIVITY : Contact 1-2 oz/100 gal 1-2 oz/100 gal	12	Re-apply at 7-14 day intervals.
	fluoxastrobin Disarm O	11	ACTIVITY: Systemic 1-4 oz/100 gal	12	Under light disease pressure, use lower rates (1-2 oz/100 gal) on a 7-14 day interval or the higher rates (3-4 oz/100 gal) on a 14-28 day interval. Under high disease pressure, use the higher rates on a 7-14 day interval.
	<i>kresoxim-methyl</i> Cygnus	11	ACTIVITY: Systemic 1.6-3.2 oz/100 gal	12	Apply as protective spray and continue on a 7-14 day interval.
	<i>mancozeb</i> Dithane 75DF Fore 80WP Mancozeb DG Pentathlon DF Pentathlon LF Protect DF	M3	ACTIVITY: Contact 1-2 lb/100 gal 1.5 lb/100 gal 1.5 lb/100 gal 1-2 lb/100 gal 0.8-1.6 qt/A/100 gal 1-2 lb/100 gal	24	Addition of a spreader sticker will improve performance. Apply at the first sign of disease. Repeat application on 7-10 day intervals.
	<i>mancozeb + myclobutanil</i> Clevis	M3 + 3	ACTIVITY: Contact + Systemic 2 lb/100 gal	24	Begin application at first sign of disease or when plants are well leafed out. Spray at 7-10 day intervals. Addition of spreader-binder or surfactant will improve performance.
	<i>metconazole</i> Tourney	3	ACTIVITY : Systemic 1-4 oz/100 gal	12	Apply to point of drip at 14-28 day intervals.
	<i>myclobutanil</i> Eagle 20EW	3	ACTIVITY: Systemic 6-12 oz /100 gal	24	Repeat application at 10-14 day intervals.
	<i>propiconazole + chlorothalonil</i> Concert II	3 + M5	ACTIVITY: Systemic + Contact 22-35 fl oz (1.4-2.2 pt)/100 gal	12	For outdoor and landscape use only. Do not use in greenhouses. Limited host plant labeling; check label. Do not apply to African violets, begonias, Boston fern, geranium, pittosporum, Schefflera. Reapply at 14-21 day intervals. Application to blooms or tender new growth may cause injury.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
<i>Cercospora</i> , <i>Pseudocercospora</i> , <i>Passalora</i> and <i>Septoria</i> leaf spots (continued)	<i>propiconazole</i> Banner Maxx II Propiconazole Strider	3	ACTIVITY: Systemic 8-12 fl oz/100 gal 8-12 fl oz/100 gal 8-12 fl oz/100 gal	12 -24 (Check Labels)	Do not apply to African violets, begonias, Boston fern or geranium. Do not use in greenhouses. Apply every 30 days to point of drip. Begin when conditions favor disease development (generally mid-July through September).
	<i>pyraclostrobin + boscalid</i> Pageant	11 + 7	ACTIVITY: Systemic + contact 8-12 oz/100 gal	12	Use preventively. Begin applications when conditions are favorable for disease, prior to disease symptom development. Reapply at 7-14 day intervals.
	<i>thiophanate methyl</i> Allban Flo 3336 F 3336 WP SysTec 1998 WDG OHP 6672 4.5F OHP 6672 50WP	1	ACTIVITY: Systemic 10-14.5 fl oz/100 gal 12-16 fl oz /100 gal 12-16 oz/100 gal 10 fl oz/100 gal 10-14.5 fl oz/100 gal 12-16 oz/100 gal See labels for rates.	12	Not recommended for use on Boston fern, Swedish Ivy or Easter Cactus. Begin application 14-21 days prior to when disease typically occurs or at the latest at the first sign of the disease. Repeat application on 7-14 day intervals. Rotations or tank mix combinations of mancozeb or chlorothalonil can be utilized.
	<i>thiophanate methyl + mancozeb</i> Zyban WSB	1 + M3	ACTIVITY: Systemic/Contact 24 oz (4 bags)/100 gal	24	While disease is prevalent, spray foliage at weekly intervals. Limit applications to 20 per year.
	<i>triadimefon</i> Bayleton 50	T3	ACTIVITY: Systemic 5.5 oz /275-550 gal	12	Application should begin at expanded bud stage (color showing). Repeat at 14-21 day intervals. Not for use on plants grown for sale.
	<i>trifloxystrobin</i> Compass Q 50WDG	11	ACTIVITY: Systemic 2-4 oz/100 gal	12	Do not apply to Petunia, Violet, or New Guinea Impatiens or on Poinsettia after bract formation. Apply at first sign of disease and continue at 7-14 day intervals. Rotate with fungicide in different chemical class.
	<i>triticonazole</i> Trinity TR Trinity	3	ACTIVITY: Systemic 2 cans/3,000 sq ft (greenhouse) 4-8 fl oz/100 gal	12	For Trinity TR: Elevate container above the plant canopy and clear a 6 ft area around can. Shut off exhaust and close vents. Repeat at 7 day intervals up to 3x per crop (2x for pansies).

Cercosporidium needle blight see Needle Blight (*Passalora sequioae*, syn. *Cercosporidium sequioae*)

Cristulariella leaf spot (Zonate leaf spot)	<i>propiconazole</i> Banner Maxx II Strider	3	ACTIVITY: Systemic 8-12 fl oz/100 gal 8-12 fl oz/100 gal	12 – 24 (Check labels)	For outdoor use only. Apply to drip at 14-21 day intervals.
<i>Cylindrocladium</i> (syn. <i>Calonectria</i>) root and stem rot	<i>benzovindiflupyr + azoxystrobin</i> Mural	7 + 11	ACTIVITY: Contact/Systemic 4-7 oz/100 gal	12	Do NOT apply to apple, crabapple, flowering cherry, privet, leatherleaf fern or other fern used for cut foliage. Apply at 7-14 day intervals.
	<i>chlorothalonil</i> Daconil Zn Daconil Weather Stik Daconil Ultrex	M5	ACTIVITY: Contact 2 pt/100 gal 1 3/8 pt/100 gal 1.4 lb/100 gal	12	Re-apply at 7-14 day intervals. Do not combine with pesticides, surfactants, or fertilizers in spray tank.
	<i>chlorothalonil + thiophanate methyl</i> Spectro 90 WDG	M5 + 1	ACTIVITY: Contact /Systemic 1-2 lb/100 gal	12	Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Minimum 7 day re-treatment interval. Do not exceed 2.15 lb/A of product.
	<i>cyprodinil + fludioxonil</i> Palladium	9 +12	ACTIVITY: Systemic/Contact 2-4 oz/100 gal	12	Begin applications prior to the onset of disease, and repeat applications at 7-14-day intervals if conditions remain favorable for disease development. Ensure full spray coverage of all stems and inner areas of plants to the soil/ media level.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
<i>Cylindrocladium</i> (syn. <i>Calonectria</i>) root and stem rot (continued)	<i>fludioxonil</i> Emblem Medallion WDG	12	ACTIVITY: Contact 2 pt/sq ft 2 pt/sq ft	12	Do not use on Leatherleaf fern.
	<i>fludioxonil</i> + <i>mefenoxam</i> Hurricane (WP)	12 + 4	ACTIVITY: Contact 3/4 oz/100 gal (drench at seeding) 1 ½ oz/100 gal (2 packets) as drench of cuttings and transplants + Add 1 oz of Medallion WDG fungicide/ 100 gal solution	48	Application to Impatiens, New Guinea Impatiens, Pothos, Geranium, and Easter Lily may cause stunting and/or chlorosis. Do not use on Leather leaf fern. Add Medallion fungicide at 1 oz/100 gal water as a tank mix. Make only one application to seedling crop prior to transplanting to larger containers. For cuttings or transplants, re-treat at 21-28 day intervals if needed. For use only in greenhouses, containers, and enclosed structures.
	<i>iprodione</i> Iprodione Pro 2 SE Chipco 26019 N/G Chipco 26019 FLO	2	ACTIVITY: Contact 1 qt/100 gal 1 qt/100 gal 1 qt/100 gal	12	Dip azalea and rhododendron cuttings for 5 minutes prior to planting.
	<i>iprodione</i> + <i>thiophanate methyl</i> 26/36	2 + 1	ACTIVITY: Contact + Systemic 66 fl oz/100 gal—DIP cuttings for 5 min 13.5 fl oz/100 gal – DRENCH 33-84 fl oz/100 gal – FOLIAR SPRAY	12	Dip cuttings for 5 minutes prior to planting. Repeat at 7-14 day intervals. Do not make more than 4 applications per crop per year. Do NOT use on Spathiphyllum or New Guinea impatiens or as a drench on Impatiens, Petunia or Pothos.
	<i>pyraclostrobin</i> + <i>boscalid</i> Pageant	11 + 7	ACTIVITY: Systemic + Contact 12-18 oz/100 gal	12	Use preventively. Begin applications when conditions are favorable for disease, prior to disease symptom development. The crown and base of the plant and potting medium surrounding the crown must be thoroughly covered. Reapply at 7-14 day intervals
	<i>thiophanate methyl</i> Allban Flo 3336 F 3336 WP SysTec 1998 WDG OHP 6672 4.5F OHP 6672 50WP + many others	1	ACTIVITY: Systemic 7.5-20 fl oz/100 gal 8-16 fl oz/100 gal (drench) 16-24 oz/100 gal (dip) 8-16 oz/100 gal (drench) 16-24 oz/100 gal (dip) 20 fl oz/100 gal 7.5-20 fl oz/100 gal 8-16 oz/100 gal (drench) 16-24 oz/100 gal (dip) See labels for rates.	12	Repeat application on 2-4 week interval. Apply as heavy spray or drench at 1-2 pt/sq ft (equates to 100 gal/800 sq ft). Does not control <i>Cylindrocladium spathiphylli</i> (on <i>Spathiphyllum</i>).
	<i>trifloxystrobin</i> Compass O 50WDG	11	ACTIVITY: Systemic 1-2 oz/100 gal (wet media)	12	Do not drench on pansy. Start application at time of planting and at 14-28 day intervals depending upon disease pressure. Rotate with fungicide in different chemical class.
	<i>triflumizole</i> Terraguard SC	3	ACTIVITY: Contact 4-8 oz/100 gal (<i>C. spathiphylli</i>) 6-12 oz/100 gal (<i>C. scoparium</i> , <i>C. theae</i>) 6-8 oz /100 gal (drench) 6-12 oz /100 gal for established plants	12	Apply at 2-4 week intervals. Use higher rate at heavier disease pressure. Lower rate may be used in subsequent applications. Do not exceed 8 ozs/600 sq ft of bed or bench area or inhibition of rooting may occur.
Downy Mildew (<i>Peronospora</i> , <i>Plasmopara</i> , <i>Pseudoperonospora</i> , etc.)	<i>azoxystrobin</i> Heritage	11	ACTIVITY: Systemic 2-4 oz/1 00 gal (on rose) 1-4 oz/100 gal (Bedding Plants)	4	Apply every 7-21 days during periods of active growth and prior to dormancy or severe infection

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Downy Mildew (<i>Peronospora</i> , <i>Plasmopara</i> , <i>Pseudoperonospora</i> , etc.) (continued)	<i>Bacillus subtilis</i> QST 713 strain Cease	44	ACTIVITY: Contact 2-8 qt/100-300 gal/A 4 qt/100-300 gal/A (typical)	4	Make applications on a 3-10-day schedule. Typical interval of 7-day. Shorten under severe disease pressure.
	<i>copper hydroxide</i> Champ WG CuPRO 2005 T/N/O Nu-Cop 50 DF Nu-Cop HB Nu-Cop 3L	M1	ACTIVITY: Contact 0.5 lb/100 gal 0.75-2 lb A 1 lb/100 gal 0.5 lb/100 gal 1 1/3 pt/100 gal	24-48 (check label)	Do not apply in spray solutions having pH less than 6.5. Do not tank mix with Aliette or other phosphante fungicides. Begin application at the first sign of disease and repeat at 7-14 day intervals.
	<i>copper hydroxide + mancozeb</i> Junction	M1 + M3	ACTIVITY: Contact 1.5-3.5 lb/A	48	Do not apply in spray solutions having pH less than 6.5. Reapply at 7-14 day intervals.
	<i>copper salts of fatty and rosin acids</i> Camelot	M1	ACTIVITY: Contact 0.5-2 gal/100 gal/A	4	Discoloration of blooms may occur. Do not spray just before or during bloom periods. Apply at 7-10 day intervals.
	<i>cyazofamid</i> Segway	21	ACTIVITY: Locally Systemic 6.12-12.25 fl oz/100 gal	12	Apply on 14-21 day intervals. Do not make more than 4 applications per crop cycle. Alternate application with a fungicide with a different Activity of action.
	<i>dimethomorph</i> Stature SC	40	ACTIVITY: Systemic 6.12-12.25 fl oz/100 gal	12	Begin spraying when plants are well established or at first sign of disease. Apply on 10-14 day interval. Thoroughly wet foliage until runoff.
	<i>dimethomorph + ametoctradin</i> Orvego	40 + 45	ACTIVITY: Systemic 11-14 fl oz/100 gal	12	Begin spraying when plants are well established or at first sign of disease using a full-coverage spray applied on a 10- to 14-day interval. Rotate with a fungicide with a different Activity of action (different FRAC#) to reduce fungicide resistance. Not labeled for landscape use.
	<i>fenamidone</i> FenStop	11	ACTIVITY: Locally Systemic 7-14 oz/100 gal (foliar spray)	12	Repeat as necessary at 28 day intervals. Has cross-resistance to strobilurin fungicides. Do not rotate with strobilurin fungicides.
	<i>fluopicolide</i> Adorn	43	ACTIVITY: Systemic Foliar Spray: 2-4 fl oz/100 gal Drench: 1-4 fl oz/100 gal	12	Apply before disease development. Use higher rate when treating plants with a high potential for disease development. Reapply after 14-28 days. Must be tank mixed with the labeled rate of another labeled fungicide product that has a different Activity. Do not apply more than two applications per cropping cycle.
	<i>fluoxastrobin</i> Disarm O	11	ACTIVITY: Systemic 1-4 oz/100 gal	12	Apply at 7-21 day intervals. Under light disease pressure, use lower rates (1-2 oz /100 gal) on a 7-14 day interval or the higher rates (3-4 oz /100 gal) on a 14-28 day interval. Under high disease pressure, use the higher rates on a 7-14 day interval.
	<i>fosetyl-AL</i> Aliette WDG	33	ACTIVITY : Systemic 2.5 lb/100 gal (rose) 2.5 lb/100 gal (bedding plants)	12	Do not make more than 1 application every 7 days (for rose) or 30 days (for bedding). Spray to wet using no more than 400 gal/acre.
<i>kresoxim-methyl</i> Cygnus	11	ACTIVITY : Systemic 3.2-6.4 oz/100 gal	12	Apply strictly as a protective spray and continue on a 7-10 day interval.	

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Downy Mildew (<i>Peronospora</i> , <i>Plasmopara</i> , <i>Pseudoperonospora</i> , etc.) (continued)	<i>mancozeb</i> Dithane 75DF Fore 80WSP Mancozeb DG Pentathlon DF Pentathlon LF Protect DF	M3	ACTIVITY : Contact 1-2 lb/100 gal 1.5 lb/100 gal 1.5 lb/100 gal 1-2 lb/100 gal 0.8-1.6 qt/A/100 gal 1-2 lb/100 gal	24	Addition of a spreader sticker will improve performance. Repeat application on 7-10 day intervals.
	<i>mancozeb + myclobutanil</i> Clevis	M3 + 3	ACTIVITY : Contact + Systemic 2 lb/100 gal (on viburnum)	24	Begin application at first sign of disease or when plants are well leafed out. Spray at 7-10 day intervals. Addition of spreader-binder or surfactant will improve performance.
	<i>mandipropamid</i> Micora	40	ACTIVITY : Systemic 4-8 fl oz/100 gal	4	Begin foliar applications prior to disease development and continue on 7-4-day interval. Make no more than 2 consecutive applications before switching to another effective non-Group 40 fungicide. Use shorter intervals and higher rates under high disease pressure.
	<i>mefenoxam</i> Subdue Maxx	4	ACTIVITY : Systemic 0.5-1 fl oz/100 gal (spray) 0.5-1 fl oz/100 gal (drench)	48 (spray) 0 (drench)	Apply as a tank mix for foliar spray with a non-Group 4 fungicide, such as with Adorn. Apply only one foliar application before rotating with another fungicide for resistance management. As a drench, apply at transplanting or in early spring or fall to reduce downy mildew disease development.
	<i>oxathiapiprolin</i> Segovis	U15	ACTIVITY: Contact 0.6-2.4 fl oz/100 gal (foliar spray) 0.65-3.2 fl oz/100 gal (drench)	4	Apply on 5-14 day intervals. Do not make more than 2 sequential applications before rotating to a fungicide with a different mode of action (different FRAC #).
	<i>phosphorous acid</i> Alude Fosphite + many others	33	ACTIVITY : Systemic 1.25-2.5 qt/100 gal 1-2 qt/100 gal See labels	4	Apply as spray to thoroughly wet foliage. Reapply as needed at 14-21 day intervals.
	<i>polyoxin D Zn salt</i> Affirm WDG	19	ACTIVITY : Systemic 0.25-0.5 lb/100 gal	4	Apply as full coverage foliar spray every 7-10 days. Apply prior to disease development and when conditions are conducive for disease.
	<i>pyraclostrobin + boscalid</i> Pageant	11 + 7	ACTIVITY : Systemic + Contact 12-18 oz/100 gal	12	Use preventively. Begin applications when conditions are favorable for disease, prior to disease symptom development. Reapply at 7-10 day intervals.
	<i>thiophanate methyl + mancozeb</i> Zyban WSB	1 + M3	ACTIVITY : Systemic/Contact 24 oz (4 bags)/100 gal	24	Apply at weekly intervals. Limit to 20 applications per year.
	<i>trifloxystrobin</i> Compass O 50WDG	11	ACTIVITY : Systemic 1-2 oz/100 gal (drip)	12	Apply at first sign of disease and continue at 7-14 day intervals. Rotate with fungicide in different chemical class (different FRAC #).
Entomosporium leaf spot	<i>azoxystrobin</i> Heritage	11	ACTIVITY : Systemic 1-4 oz/100 gal	4	Repeat every 7-28 days. Apply at the first sign of disease at bud break. Use low rate (1-2 oz) at 7-14 day intervals for low disease pressure; Use higher rate (3-4 oz) at 7-14 day intervals under high disease pressure. Rotate after 2-3 applications with non-strobilurin fungicide.
	<i>Bacillus subtilis</i> QST 713 strain Cease	44	ACTIVITY : Contact 2-8 qt/100-300 gal/A 4 qt/100-300 gal/A (typical)	4	Make applications on a 3-10 day schedule. Typical interval of 7-day. Shorten under severe disease pressure.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Entomosporium leaf spot (continued)	<i>chlorothalonil</i> Daconil Zn Daconil Ultrex Daconil Weather Stik + many other formulations	M5	ACTIVITY : Contact 2 pt/100 gal 1.4 lb/100 gal 1 3/8 pt/100 gal See labels for rates.	12	Re-apply at 7-14 day intervals. Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts.
	<i>chlorothalonil + thiophanate methyl</i> Spectro 90 WDG	M5 + 1	ACTIVITY : Contact/Systemic 1-2 lb/100 gal	12	Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Minimum 7 day re-treatment interval. Do not exceed 2.5 lb/A of product.
	<i>copper hydroxide + mancozeb</i> Junction	M1 + M3	ACTIVITY : Contact 1.5-3.5 lb/A	48	Do not apply in spray solutions having pH less than 6.5. Reapply at 7-14 day intervals.
	<i>copper salts of fatty and rosin acids</i> Camelot	M1	ACTIVITY : Contact 0.5-2 gal/100 gal/A	4	Discoloration of blooms may occur. Do not spray just before or during bloom periods. Apply at 7-14 day intervals.
	<i>mancozeb + myclobutanil</i> Clevis	M3 + 3	ACTIVITY : Contact + Systemic 2 lb/100 gal (on viburnum)	24	Begin application at first sign of disease or when plants are well leafed out. Spray at 7-10 day intervals. Addition of spreader-binder or surfactant will improve performance.
	<i>myclobutanil</i> Eagle 20EW	3	ACTIVITY : Systemic 6-12 oz /100 gal	24	Repeat application at 10-14 day intervals.
	<i>propiconazole</i> Banner Maxx II Propiconazole Strider	3	ACTIVITY : Systemic 5 -fl oz/100 gal 5-8 fl oz/100 gal 5-8 fl oz/100 gal	12-24 (check labels)	Apply every 14-21 days during period of infection. Spray to drip.
	<i>propiconazole + chlorothalonil</i> Concert II	3 + M5	ACTIVITY : Systemic + Contact 22-35 fl oz (1.4 -2.2 pt)/100 gal	12	For outdoor and landscape use only. Do not use in greenhouses. Limited host plant labeling; check label. Do not apply to African violets, begonias, Boston fern, geranium, pittosporum, schefflera. Reapply at 14-21 day intervals. Application to blooms or tender new growth may cause injury.
	<i>triadimefon</i> Bayleton 50	3	ACTIVITY : Systemic 5.5 oz/68.75-137.5 gal	12	Apply in early spring as growth starts. Repeat at 14-21 day intervals. Protect new growth that 25 develops in late summer and early fall as temperatures begin to drop. Bayleton not for use on plants grown for sale.
	<i>Triticonazole</i> Trinity	3	ACTIVITY: Systemic 12 fl oz/100 gal	12	Use preventively. Use highest labeled rate for <i>Entomosporium</i> .
Fire Blight (<i>Erwinia amylovora</i>)	<i>streptomycin sulfate</i> Agri-mycin 17	25	ACTIVITY : Contact 100 ppm (8 oz/100 gal)	12	For pear, apple, or pyracantha: Apply first spray at start of blossoming and continue every 3-4 days during bloom period. Apply additional sprays every 5-7 days after blooming when weather conditions favor disease spread.
	<i>copper hydroxide</i> Champ WG CuPRO 2005 T/N/O Nu-Cop 50 DF Nu-Cop HB Nu-Cop 3L	M1	ACTIVITY : Contact 1 lb/100 gal 0.75-2 lb/A 1 lb/100 gal 0.5 lb/100 gal 1 1/3 pt/100 gal	24-48 (check label)	Do not apply in spray solutions having pH less than 6.5. Do not tank mix with Aliette or other phosphante fungicides. Begin application at the first sign of disease and repeat at 7-14 day intervals.
	<i>copper hydroxide + mancozeb</i> Junction	M1 + M3	ACTIVITY : Contact 1.5-3.5 lb/100 gal (Suppression only)	48	Crabapple: Make 1 application between silver tip and green tip as a full cover- age spray. Injury may occur from late application. Pear: Apply at 5 day intervals during bloom period. Do not apply after bloom. Discontinue use when green tip reaches ½ an inch.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Fire Blight (<i>Erwinia amylovora</i>) (continued)	<i>copper salts of fatty & rosin acids</i> Camelot O	M1	ACTIVITY : Contact 0.5-2 gal/100 gal/A	4	Discoloration of blooms may occur. Do not spray just before or during bloom periods. Apply at 7-10 day intervals.
	<i>copper sulfate</i> Basicop	M1	ACTIVITY : Contact 2-4 lb/100 gal or 2-4 lb/A	24	Begin at 10% bloom and repeat at 5-7 day intervals until late bloom is over. Repeat applications after rains.
	<i>fosetyl-AL</i> Aliette WDG	33	ACTIVITY : Systemic 2.5 lb/100 gal	12	Begin spray at pre-bloom stage and continue at 7 day intervals until bloom period ends. Do not apply more than one application every 7 days.
Flower or Petal blights (<i>Ovulinia</i> , <i>Ciborinia</i> , <i>Sclerotinia</i>)	<i>captan</i> Captan 50WP	M4	ACTIVITY : Contact 2 lb/100 gal (Azalea) 1 lb/100 gal (Camellia)	48	Apply to soil around plants prior to bloom. Repeat at 7-14 day intervals through bloom.
	<i>chlorothalonil</i> Daconil Zn Daconil Ultrex Daconil Weather Stik many other formulations	M5	ACTIVITY : Contact 2 pt/100 gal 1.4 lb/100 gal 1 3/8 pt/100 gal See labels for rates.	12	Re-apply at 7-14 day intervals. Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Do not combine with pesticides, surfactants, or fertilizers in spray tank.
	<i>chlorothalonil + thiophanate methyl</i> Spectro 90WDG	M5 + 1	ACTIVITY : Contact/Systemic 1-2 lb/100 gal	12	Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Minimum 7-day re-treatment interval. Do not exceed 2.15 lbs/acre of product.
	<i>copper sulfate</i> Basicop	M1	ACTIVITY : Contact 2-4 lb/100 gal/A	24	Apply to entire plant before bud break in the spring. Repeat 2-3 weeks later. Remove and destroy any galls that may appear.
	<i>copper hydroxide + mancozeb</i> Junction	M1 + M3	ACTIVITY : Contact 1.5-3.5 lb/A	48	Do not apply in spray solutions having pH less than 6.5. Reapply at 7-14 day intervals.
	<i>mancozeb</i> Dithane 75DF Fore 80WP Mancozeb DG Pentathlon DF Pentathlon LF Protect DF	M3	ACTIVITY : Contact 1-2 lb/100 gal 1.5 lb/100 gal 1.5 lb/100 gal 1-2 lb/100 gal 0.8-1.6 qt/A/100 gal 1-2 lb/100 gal	24	Addition of a spreader sticker will improve performance. Apply in full cover spray, 2-3 times a week while flowers are opening. Direct spray into flowers and thoroughly spray ground under bushes.
	<i>mancozeb + myclobutanil</i> Clevis	M3 + 3	ACTIVITY : Contact + Systemic 2 lb/100 gal	24	Begin application at first sign of disease or when plants are well leafed out. Spray at 7-10 day intervals. Addition of spreader-binder or surfactant will improve performance.
	<i>PCNB</i> Terraclor 400	14	ACTIVITY : Contact Woody (drench): 6-12 oz /100 gal Magnolia: 3 pt/100 gal	12	Apply in sufficient water to assure good coverage. Apply to ground beneath bushes. Begin application prior to bud opening and repeat every 4-6 weeks during bloom period.
	<i>propiconazole</i> Banner Maxx II Propiconazole Pro Strider	3	ACTIVITY : Systemic 5-8 fl oz/100 gal 5-8 fl oz/100 gal 5-8 fl oz/100 gal	12-24 (check labels)	For outdoor use only. Apply every 14-21 days during period of infection and flower bloom. Spray to drip.
	<i>propiconazole + chlorothalonil</i> Concert II	3 + M5	ACTIVITY : Systemic + Contact 22-35 fl oz (1.4-2.2 pt)/100 gal	12	For outdoor and landscape use only. Do not use in greenhouses. Limited host plant labeling; check label. Do not apply to African violets, begonias, Boston fern, geranium, pittosporum, schefflera. Reapply at 14-21 day intervals. Application to blooms or tender new growth may cause injury.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Flower or Petal blights (<i>Ovulinia</i> , <i>Ciborinia</i> , <i>Sclerotinia</i>) (continued)	<i>tebuconazole</i> Torque	3	ACTIVITY : Systemic 4-10 fl oz/100 gal	12	Apply 2-3 times per week into the flowers as they open and develop color. Apply every 14 days.
	<i>thiophanate methyl</i> Allban Flo	1	ACTIVITY : Systemic 7.25-20 fl oz /100 gal (<i>Ovulinia</i>) 10.75-20 oz /100 gal	12	Apply as flowers open. Repeat application on 7-14 day intervals
	3336 F		12-16 fl oz /100 gal 8-16 oz /100 gal (<i>Ovulinia</i>)		
	3336 EG		12-16 oz /100 gal 8-16 oz /100 gal (<i>Ovulinia</i>)		
	SysTec 1998 WDG		10 fl oz/100 gal		
	OHP 6672 4.5F		10.75-20 fl oz/100 gal 7.25-20 oz /100 gal (<i>Ovulinia</i>)		
	OHP 6672 50WP		12-16 oz/100 gal 8-16 oz/100 gal (<i>Ovulinia</i>)		
	+many other formulations		See labels for rates		
	<i>thiophanate methyl + mancozeb</i> Zyban WSB	1 + M3	ACTIVITY : Systemic/Contact 12 oz (2 bags)/75 gal (azalea/ rhododendron) 24 oz (4 bags)/100 gal	24	While disease is prevalent, apply 4-6 day intervals. Azalea and rhododendron: <i>Ovulinia</i> : apply at weekly intervals.
	<i>triadimefon</i> Bayleton 50	3	ACTIVITY : Systemic 5.5 oz/68.75-137.5 gal	12	Application should begin at expanded bud stage (color showing). Repeat at 7-14 day intervals. Bayleton not for use on plants grown for sale. Landscape use only.
Fungal Leaf Spots** (<i>Phyllosticta</i> , <i>Phoma</i> , <i>Corynespora</i> , <i>Tubakia</i> , and others) **other than <i>Alternaria</i> , <i>Black spot</i> , <i>Cercospora</i> , <i>Septoria</i> , <i>Cristulariella</i> , <i>Entomosporium</i> , which are listed separately	<i>azoxystrobin</i> Heritage	11	ACTIVITY : Systemic 1-4 oz/100 gal 2-4 oz/100 gal	4	Repeat every 7-28 days. Apply at the first sign of disease at bud break. Use low rate (1-2 oz) at 7-14 day intervals for low disease pressure; Use higher rate (3-4 oz) at 14-28 day intervals under high disease pressure. Rotate after 2-3 applications with non-strobilurin fungicide.
	<i>Bacillus subtilis</i> QST 713 strain Cease	44	ACTIVITY : Contact 2-8 qt/100-300 gal/A 4 qt/100-300 gal/A (typical)	4	Make applications on a 3-10 day schedule. Typical interval of 7-days. Shorten under severe disease pressure.
	<i>benzovindiflupyr + azoxystrobin</i> Mural	7 + 11	ACTIVITY: Contact/Systemic 4-7 oz/100 gal	12	Do NOT apply to apple, crabapple, flowering cherry, privet, leatherleaf fern or other fern used for cut foliage. Apply at 7-14 day intervals.
	<i>chlorothalonil</i> Daconil Zn Daconil Ultrex Daconil Weather Stik + many other formulations	M5	ACTIVITY : Contact 2 pt/100 gal 1.4 lb/100 gal 1 3/8 pt/100 gal See labels for rates.	12	Re-apply at 7-14 day intervals. Apply to run-off to only dry foliage. Do not use with mist blowers of high pressure spray equipment in greenhouses. May discolor flowers/bracts. Do not combine with pesticides, surfactants, or fertilizers in spray tank.
	<i>chlorothalonil + thiophanate methyl</i> Spectro 90WDG	M5 + 1	ACTIVITY : Contact/Systemic 1-2 lb/100 gal	12	Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Minimum 7-day re-treatment interval. Do not exceed 2.15 lb/A of product.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Fungal Leaf Spots** (<i>Phyllosticta</i> , <i>Phoma</i> , <i>Corynespora</i> , <i>Tubakia</i> , and others) **other than <i>Alternaria</i> , <i>Black spot</i> , <i>Cercospora</i> , <i>Septoria</i> , <i>Cristulariella</i> , <i>Entomosporium</i> , which are listed separately (continued)	<i>copper hydroxide</i> Champ WG CuPRO 2005 T/N/O Nu-Cop 50 DF Nu-Cop HB Nu-Cop 3L	M1	ACTIVITY : Contact 0.5-1.0 lb/100 gal 0.75-2 lb A 1 lb/100 gal 0.5 lb/100 gal 1 1/3 pt/100 gal	24-48 (check label)	Do not apply in spray solutions having pH less than 6.5. Do not tank mix with Aliette or other phosphante fungicides. Begin application at the first sign of disease and repeat at 7-14 day intervals.
	<i>copper hydroxide + mancozeb</i> Junction	M1 + M5	ACTIVITY : Contact 1.5-3.5 lb/100 gal	48	Do not apply in spray solutions having pH less than 6.5. Reapply at 7-10 day intervals.
	<i>copper salts of fatty & rosin acids</i> Camelot O	M1	ACTIVITY : Contact 0.5-2 gal/100 gal/A	4	Discoloration of blooms may occur. Do not spray just before or during bloom periods. Apply at 7-10 day intervals.
	<i>copper sulfate</i> Basicop	M1	ACTIVITY :Contact 2-4 lb/100 gal or 2-4 lb/A	24	Phytotoxicity may occur on certain plant species/ cultivars. Limited ornamental plant labeling. Trees: Apply to swelling buds and rep eat 2 times at 10 day intervals as needed. Shrubs/Flowers: Apply preventively, and repeat at 7-10 day intervals and after rains.
	<i>fluxapyroxad + pyraclostrobin</i> Orkestra Intrinsic	7 + 11	ACTIVITY: Contact/Systemic 8-10 fl oz/100 gal	12	Do NOT apply to Ninebark or Wintercreeper. May cause flower discoloration of Petunia and Impatiens.
	<i>kresoxim-methyl</i> Cygnus	11	ACTIVITY : Systemic 1.6-3.2 oz/100 gal	12	Apply as protective spray and continue on a 7-14 day interval.
	<i>mancozeb</i> Dithane 75DF Fore 80WP Mancozeb DG Pentathlon DF Pentathlon LF Protect DF	M3	ACTIVITY : Contact 1-2 lb/100 gal 1.5 lb/100 gal 1.5 lb/100 gal 1-2 lb/100 gal 0.8-1.6 qt/A/100 gal 1-2 lb/100 gal	24	Addition of a spreader sticker will improve performance. Repeat application on 7-10 day intervals. Do not use Fore on Pachysandra.
	<i>mancozeb + myclobutanil</i> Clevis	M3 + 3	ACTIVITY : Contact + Systemic 2 lb/100 gal	24	Begin application at first sign of disease or when plants are well leafed out. Spray at 7-10 day intervals. Addition of spreader-binder or surfactant will improve performance.
	<i>propiconazole + chlorothalonil</i> Concert II	3 + M5	ACTIVITY : Systemic + Contact 22-35 fl oz (1.4-2.2 pt)/100 gal	12	For outdoor and landscape use only. Do not use in greenhouses. Limited ornamental plant labeling; check label. Do not apply to African violets, begonias, Boston fern, geranium, pittosporum, schefflera. Reapply at 14-21 day intervals. Application to blooms or tender new growth may cause injury.
	<i>potassium bicarbonate</i> MilStop		ACTIVITY : Contact 2.5-5 lb/100 gal	1	Apply by increasing 0.25 lb/application not exceeding 5 lb. Repeat applications at 1-2 week intervals. See label for precautions for use on poinsettia, impatiens, and pansy.
<i>pyraclostrobin + boscalid</i> Pageant	11 + 7	ACTIVITY : Systemic + contact 8-12 oz/100 gal	12	Use preventively. Begin applications when conditions are favorable for disease, prior to disease symptom development. Reapply at 7-14 day intervals.	
<i>tebuconazole</i> Torque	3	ACTIVITY : Systemic 4-10 fl oz/100 gal	12	Apply at least 3 times per year, 14-21 days apart beginning with spring bud break. Rotate with a fungicide in a different class (different FRAC #) to reduce fungicide resistance development. Do not use on African violet, begonia, Boston fern, or geranium.	

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Fungal Leaf Spots** <i>(Phyllosticta, Phoma, Corynespora, Tubakia, and others)</i> **other than <i>Alternaria, Black spot, Cercospora, Septoria, Cristulariella, Entomosporium, which are listed separately</i> (continued)	<i>thiophanate methyl</i> Allban Flo 3336 F 3336 EG SysTec 1998 WDG OHP 6672 4.5F OHP 6672 50WP + many more formulations	1	ACTIVITY : Systemic 10-14.5 fl oz/100 gal 12-16 fl oz /100 gal 12-16 oz/100 gal 20 fl oz/100 gal 10-14.5 fl oz/100 gal 12-16 oz/100 gal See product labels for rates.	12	Not recommended for use on Boston fern, Swedish Ivy or Easter Cactus. Apply at first sign of disease. Repeat application on 7-14 day intervals. Rotations or tank mix combinations of mancozeb or chlorothalonil can be utilized.
	<i>thiophanate methyl + mancozeb</i> Zyban WSB	1 + M3	ACTIVITY : Systemic/ Contact 24 oz/100 gal (4 Bags)	24	Apply at weekly intervals. Limit to 20 applications per year.
Fusarium stem and root rot	<i>azoxystrobin</i> Heritage	1	ACTIVITY : Systemic 1-4 oz/100 gal (directed spray) 0.2-0.9 oz/100 gal (drench)	4	Repeat every 7-21 days. Apply 1-2 pints solution per sq.ft. surface area, every 7-28 days.
	<i>Bacillus subtilis</i> QST 713 strain Cease	44	ACTIVITY : Contact 2-8 qt/100-300 gal/A 4 qt/100-300 gal/A (typical)	4	Drenches for use only in greenhouses and nurseries (open or enclosed). Apply 1 pt/3" soil depth to thoroughly soak the growing medium as a drench or directed spray. Optimal when used preventively and repeated every 21-28 days during growing cycle.
	<i>benzovindiflupyr + azoxystrobin</i> Mural	7 + 11	ACTIVITY: Contact/Systemic 5-7 oz/100 gal (directed soil spray) 2-3 oz/100 gal (drench)	12	Do NOT apply to apple, crabapple, flowering cherry, privet, leatherleaf fern or other fern used for cut foliage. Apply at 7-21 day intervals. Apply as a directed soil spray.
	<i>chlorothalonil + thiophanate methyl</i> Spectro 90 WDG	M5 + 1	ACTIVITY : Contact/Systemic 1-2 lb/100 gal	12	Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Minimum 7-day re-treatment interval. Do not exceed 2.15 lb/A of product.
	<i>cyprodinil + fludioxonil</i> Palladium	9 + 12	ACTIVITY : Systemic/Contact 2-4 oz/100 gal	12	Begin applications prior to the onset of disease, and repeat applications at 7-14 day intervals if conditions remain favorable for disease development. Ensure full spray coverage of all stems and inner areas of plants to the soil/media level.
	<i>etridiazole + thiophanate methyl</i> Banrot 8G Banrot 40WP	14 + 1	ACTIVITY : Contact/Systemic 12 oz/cu yd 4-8 oz/100 gal (bedding) 6-12 oz/100 gal (woody/foliage)	12	Use low rates for bedding plants and high rates for woody and foliage plants for Banrot 8G. Drench at seeding and transplanting. Reapply at 4-8 week intervals.
	<i>fludioxonil</i> Emblem Medallion WDG	12	ACTIVITY : Contact 2 pt/sq ft 2 pt/sq ft	12	Wet entire medium.
	<i>fludioxonil + mefenoxam</i> Hurricane (WP)	12 + 4	ACTIVITY : Contact 3/4 oz/100 gal (drench at seeding) 1 ½ oz/100 gal (2 packets) as drench of cuttings and transplants + Add 1 oz Medallion WDG fungicide/100 gal solution	48	Application to Impatiens, New Guinea Impatiens, Pothos, Geranium, and Easter Lily may cause stunting and/or chlorosis. Do not use on Leather leaf fern. Add Medallion fungicide at 1 oz/100 gal water as a tank mix. Make only one application to seedling crop prior to transplanting to larger containers. For cuttings or transplants, re-treat at 21-28 day intervals if needed. For use only in greenhouses, containers, and enclosed structures.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Fusarium stem and root rot (continued)	<i>fluoxastrobin</i> Disarm O	11	ACTIVITY : Systemic 2-4 oz/100 gal (Crown spray) 0.15-0.6/100 gal (Drench or surface spray)	12	Apply at 7-21 day intervals for crown spray and 14-28 day interval for drench or surface spray application.
	<i>pyraclostrobin</i> Empress	11	ACTIVITY : Systemic 1-3 fl oz/100 gal (unrooted cuttings, seedlings, plugs) 2-6 fl oz/100 gal (herbaceous/woody plants)	12	Use preventively when conditions are favorable for disease and prior to symptom development. Rotate to a non-group 11 fungicide for resistance management. Do not apply more than 4.4 fl oz/1000 sq ft/year. Repeat applications as needed 7-28 days after initial application.
	<i>pyraclostrobin + boscalid</i> Pageant	11 + 7	ACTIVITY : Systemic + contact 12-18 oz/100 gal	12	Use preventively. Begin applications when conditions are favorable for disease, prior to disease symptom development. The crown and base of the plant and the potting medium surrounding the crown must be thoroughly covered. Reapply at 7-14 day intervals.
	<i>thiophanate methyl</i> Allban Flo 3336 F 3336 EG SysTec 1998 WDG OHP 6672 4.5F OHP 6672 50WP + many more formulations	1	ACTIVITY : Systemic 10-14.5 fl oz /100 gal 8-16 fl oz /100 gal 12- 16 oz /100 gal (Spray) 16-24 oz /100 gal (Plant dip) 8-16 oz /100 gal (Drench) 20 fl oz /100 gal 10-14.5 fl oz/100 gal 12-16 oz /100 gal See label for rates.	12	Apply as a heavy spray or drench at rate of 0.5-2 pt/sq ft (100 gal/1,600-400 sq ft). Applications can be re-applied at 7-14 day intervals.
	<i>triflumizole</i> Terraguard SC	3	ACTIVITY : Contact 4-8 fl oz/100 gal	12	Apply soil drenches at weekly intervals. Use higher rate under heavy disease pressure.
	<i>triticonazole</i> Trinity TR Trinity	3	ACTIVITY : Systemic 2 cans/3,000 sq ft (greenhouse) 8-12 fl oz/100 gal	12	For Trinity TR: Elevate container above the plant canopy and clear a 6 ft area around can. Shut off exhaust and close vents. Repeat at 7 day intervals up to 3x per crop. For Trinity (flowable): The crown, base of plant, and rooting medium surrounding the crown must be thoroughly covered.
	Myrothecium leaf spot and blight	<i>azoxystrobin</i> Heritage	11	ACTIVITY : Systemic 2-4 oz/100 gal	4
<i>Bacillus subtilis</i> QST 713 strain Cease		44	ACTIVITY : Contact 2-8 qt/100 gal/A 4 qt/100 gal/A (typical)	4	Make applications on a 3-10 day schedule. Typical interval of 7-day. Shorten under severe disease pressure.
<i>chlorothalonil</i> Daconil Ultrex Daconil Zn Daconil Weather Stik		SA	ACTIVITY : Contact 1.4 lb/100 gal 2 pt/100 gal 1 3/8 pt/100 gal	12	Re-apply at 7-14 day intervals. Do not use with mist blowers of high pressure spray equipment in greenhouses. May discolor flowers/bracts. Do not combine with pesticides, surfactants, or fertilizers in spray tank.
<i>chlorothalonil + thiophanate methyl</i> Spectro 90WDG		M5 + 1	ACTIVITY : Contact/Systemic 1-2 lb/100 gal	12	Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Minimum 7 -day re-treatment interval. Do not exceed 2.15 lb/A of product.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Myrothecium leaf spot and blight (continued)	<i>copper salts of fatty & rosin acids</i> Camelot O	M1	ACTIVITY : Contact 0.5-2 gal/100 gal/A	4	Discoloration of blooms may occur. Do not spray just before or during bloom periods. Apply at 7-10 day intervals.
	<i>cyprodinil + fludioxonil</i> Palladium	9 + 12	ACTIVITY : Systemic/Contact 2-4 oz/100 gal	12	Begin applications prior to the onset of disease, and repeat applications at 7-14 day intervals if conditions remain favorable for disease development. Ensure full spray coverage of all stems and inner areas of plants to the soil/ media level.
	<i>fludioxonil</i> Emblem Medallion WDG	12	ACTIVITY : Contact 1-2 oz/100 gal 1-2 oz/100 gal	12	Re-apply at 7-14 day intervals. Drench may cause stunting and/or chlorosis to impatiens and New Guinea impatiens.
	<i>fluoxastrobin</i> Disarm O	11	ACTIVITY : Systemic 1-4 oz/100 gal	12	Under light disease pressure, use lower rates (1-2 oz/100 gal) on a 7-14 day interval or the higher rates (3-4 oz/100 gal) on a 14-28 day interval. Under high disease pressure, use the higher rates on a 7-14 day interval.
	<i>fluxapyroxad + pyraclostrobin</i> Orkestra Intrinsic	7 + 11	ACTIVITY: Contact/Systemic 8-10 fl oz/100 gal	12	May cause flower discoloration of Petunia and Impatiens.
	<i>metconazole</i> Tourney	3	ACTIVITY : Systemic 1-4 oz/100 gal	12	Apply to the point of drip at 14-28 day intervals.
	<i>pyraclostrobin + boscalid</i> Pageant	11 + 7	ACTIVITY : Systemic + contact 8-12 oz/100 gal	12	Use preventively. Begin applications when conditions are favorable for disease, prior to disease symptom development. Reapply at 7-14 day intervals. Do not expose petunia or impatiens in flower or wintercreeper or nine bark to spray or drift as injury may occur.
	<i>thiophanate methyl</i> Allban Flo 3336 F 3336 EG SysTec 1998 WDG OHP 6672 4.5 F OHP 6672 50WP +many more formulations	1	ACTIVITY : Systemic 10-14.5 fl oz/100 gal 12-16 fl oz/100 gal 12-16 oz/100 gal 20 fl oz/100 gal 10-14.5 fl oz/100 gal 12-16 oz/100 gal See product label for rates	12	Apply as a heavy spray or drench at rate of 0.5-2 pt/sq ft (100 gal/1,600-400 sq ft). Applications can be re-applied at 1-2 week intervals.
	<i>trifloxystrobin</i> Compass O 50WDG	11	ACTIVITY : Systemic 1-2 oz/100 gal	12	Apply at first sign of disease and continue at 7-14 day intervals. Rotate with fungicide in different chemical class.
	<i>triflumizole</i> Terraguard SC	3	ACTIVITY : Contact 4-8 oz/100 gal	12	Apply foliar sprays at 7-14 day intervals. Use high rate for initial application.
<i>triticonazole</i> Trinity TR Trintiy	3	ACTIVITY : Systemic 1 can/3,000 sq ft (greenhouse) 8-12 fl oz/100 gal	12	For Trintiy TR: Elevate container above the plant canopy and clear a 6 ft area around can. Shut off exhaust and close vents. Repeat at 7 day intervals up to 3x per crop (2x for pansies). For Trinity (flowable): Use preventively, repeat applications at 7-14 day intervals.	

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
<p>Needle Blight (<i>Passalora sequioae</i>, <i>syn. Cercosporidium</i>)</p> <p>*Spores are initially dispersed in mid-May to mid-June, with symptoms and spore release peaking in Aug- Sept. Begin preventive fungicide applications in mid- May to mid-June and continue through Sept. to Oct. Curative applications can reduce disease when applied Aug.- Oct. when symptoms are first seen.</p> <p>Note: Removal and disposal of infected plant parts can reduce spread. Air-blast applications are not as effective as pistol or direct application to interior of tree.</p>	<p><i>chlorothalonil</i> Daconil Zn Daconil Ultrex Daconil Weather Stik Thalonil 6L Thalonil 90DF + many more formulations</p>	M5	<p>ACTIVITY : Contact 2 pt/100 gal 1.4 lb/100 gal 1 3/8 pt/100 gal 1 3/8 pt/100 gal 1.3 lb/100 gal See product label for rates.</p>	12	Re-apply at 7 day intervals.
	<p><i>chlorothalonil + thiophanate methyl</i> Spectro 90WDG</p>	M5 + 1	<p>ACTIVITY : Contact/Systemic 1-2 lb/100 gal</p>	12	Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Minimum 7-day re-treatment interval. Do not exceed 2.15 lb/A of product.
	<p><i>copper hydroxide</i> Champ WG CuPRO 2005 T/N/O Nu-Cop 50 DF Nu-Cop HB Nu-Cop 3L Kocide 3000 Kocide 2000</p>	M1	<p>ACTIVITY : Contact 0.75-1.75 lb/100 gal 1.5-3 lb/A 1 lb/100 gal 0.5 lb/100 gal 1 1/3 pt/100 gal 0.75-1.75 lb/A 1.5-3 lb/A</p>	24-48 (check label)	Do not apply in spray solution having pH less than 6.5. Do not tank mix with Aliette fungicide. Reapply at 7-14 day intervals. Apply Kocide at 7-30 day intervals. **Kocide only labeled for Christmas trees
	<p><i>copper salts of fatty and rosin acids</i> Camelot</p>	M1	<p>ACTIVITY : Contact 0.5-2 gal/100 gal/A</p>	4	Apply first application when needles are just emerging. Make second application 3 weeks later.
	<p><i>mancozeb</i> Dithane 75DF Fore 80 WP Mancozeb DG Pentathlon DF Pentathlon LF Protect DF</p>	M3	<p>ACTIVITY : Contact 1-2 lb/100 gal 1.5 lb/100 gal 1.5 lb/100 gal 1-2 lb/100 gal 0.8-1.6 qt/A/100 gal 1-2 lb/100 gal</p>	24	Addition of a spreader sticker will improve performance. Apply at the first sign of disease. Repeat application on 7-10 day intervals.
	<p><i>mancozeb + myclobutanil</i> Clevis</p>	M3 + 3	<p>ACTIVITY : Contact 2 lb/100 gal</p>	24	Begin application at first sign of disease or when intervals. Addition of spreader-binder or surfactant will improve performance. Spray at 7-10 day intervals.
<p>Phoma basal and root rot (<i>Phoma exigua</i>)</p>	<p><i>cyprodinil + fludioxonil</i> Palladium</p>	9 +12	<p>ACTIVITY : Systemic/Contact 2-4 oz/100 gal</p>	12	Begin applications prior to the onset of disease, and repeat applications at 7-14 day intervals if conditions remain favorable for disease development. Ensure full spray coverage of all stems and inner areas of plants to the soil/ media level.
<p>Phomopsis tip blight</p>	<p><i>azoxystrobin</i> Heritage</p>	11	<p>ACTIVITY : Systemic 1-4 oz/100 gal</p>	4	Repeat every 7-28 days. Apply at the first sign of disease at bud break.
	<p><i>cyprodinil + fludioxonil</i> Palladium</p>	9 + 12	<p>ACTIVITY : Systemic/Contact 2-4 oz/100 gal</p>	12	Begin applications prior to the onset of disease, and repeat applications at 7-14 day intervals if conditions remain favorable for disease development. Ensure full spray coverage of all stems and inner areas of plants to the soil/ media level.
	<p><i>mancozeb</i> Dithane 75DF Fore 80WP Mancozeb DG Pentathlon DF Pentathlon LF Protect DF</p>	DC	<p>ACTIVITY : Contact 1-2 lb/100 gal 1.5 lb/100 gal 1.5 lb/100 gal 1-2 lb/100 gal 0.8-1.6 qt/A/100 gal 1-2 lb/100 gal</p>	24	Addition of a spreader sticker will improve performance. Repeat application on 7-10 day intervals.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Phomopsis tip blight (continued)	<i>mancozeb + myclobutanil</i> Clevis	M3 + 3	ACTIVITY : Contact + Systemic 2 lb/100 gal	24	Begin application at first sign of disease or when plants are well leafed out. Spray at 7-10 day intervals. Addition of spreader-binder or surfactant will improve performance.
	<i>metconazole</i> Tourney	3	ACTIVITY : Systemic 1-4 oz/100 gal	12	Apply to the point of drip at 14-28 day intervals.
	<i>potassium bicarbonate</i> MilStop		ACTIVITY : Contact 2.5-5 lb/100 gal	12	Repeat applications at 1-2 week intervals.
	<i>propiconazole</i> Banner Maxx II Propiconazole Strider	3	ACTIVITY : Systemic 5-8 fl oz/100 gal 5-8 fl oz/100 gal 5-8 fl oz/100 gal	12-24 (check labels)	Apply every 14-21 days beginning at bud break in spring and during periods of active plant growth. Spray to drip.
	<i>thiophanate methyl</i> Allban Flo 3336 F 3336 EG SysTec 1998 WDG OHP 6672 4.5F OHP 6672 50WP + many more formulations	1	ACTIVITY : Systemic 14.5-20 fl oz/100 gal 16-24 fl oz /100 gal 16-24 oz/100 gal 20 fl oz/100 gal 14.5-20 fl oz/100 gal 16-32 oz/100 gal See product label for rates.	12	Apply at bud break in the spring. Repeat application on 7-14 day intervals.
	<i>thiophanate methyl + mancozeb</i> Zyban WSB	1 + M3	ACTIVITY : Systemic/ Contact 36 oz (6 bags)/75 gal (juniper) 24 oz (4 bags)/100 gal	24	Apply every 7 days beginning as new growth breaks buds and expands (juniper). For other plants apply at weekly intervals.
Phytophthora diseases (Aerial blight, foliar blight, stem rot, root and crown rot)	<i>azoxystrobin</i> Heritage	11	ACTIVITY : Systemic 1-2 oz/100 gal (foliar spray)	4	Repeat every 7-28 days for foliar blight.
	<i>Bacillus subtilis</i> QST 713 strain Cease	44	ACTIVITY : Contact 2-8 qt/100-300 gal/A (foliar spray) 4-8 qt/100-300 gal/A (drench)	4	Drenches for use only in greenhouses. Apply 1 pt /3 in. soil depth to thoroughly soak the growing medium as a drench or directed spray. Optimal when used preventively and repeated every 3-10 days during growing cycle.
	<i>chlorothalonil</i> Daconil Ultrex Daconil Zn Daconil Weather Stik	M5	ACTIVITY : Contact 1.4 lb/100 gal 2 pt/100 gal 1 3/8 pt/100 gal	12	Reapply at 7-14 day intervals. Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Do not combine with pesticides, surfactants, or fertilizers in spray tank.
	<i>copper hydroxide</i> CuPRO 2005 T/N/O	M1	ACTIVITY : Contact 0.75-2 lb A	24	Do not apply in spray solutions having pH less than 6.5. Do not tank mix with Aliette or other phosphante fungicides. Begin application at the first sign of disease and repeat at 7-14 day intervals.
	<i>copper hydroxide + mancozeb</i> Junction	M1 + M3	ACTIVITY : Contact 1.5-3. lb/A	48	Do not apply in spray solutions having pH less than 6.5. Reapply at 7-14 day intervals.
	<i>copper salts of fatty and rosin acids</i> Camelot O	M1	ACTIVITY : Contact 0.5-2 gal/100 gal/A	4	Discoloration of blooms may occur. Do not spray just before or during bloom periods. Apply at 7-10 day intervals.
	<i>cyazofamid</i> Segway O	21	ACTIVITY : Limited Systemic 3-6 fl oz/100 gal	12	Apply on 14-28 day interval using another fungicide with a different FRAC code between applications. Do not make more than 2 applications per crop cycle for root disease control. May be applied through irrigation systems.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Phytophthora diseases (Aerial blight, foliar blight, stem rot, root and crown rot) (continued)	<i>dimethomorph</i> Stature SC	40	ACTIVITY : Systemic 12.25 fl oz /100 gal (aerial Phytophthora–foliar spray) 3.06-6.12 fl oz/50-100 gal (drench: greenhouse-grown, herbaceous, bedding plant) 6.12-12.25 fl oz/50-100 gal (drench: container- or field- grown, woody plants and herbaceous perennials)	12	Apply spray and drench when plant roots are well-established, or at first sign of disease, on a 10-14 day interval throughout the production cycle. For drench, use enough solution to wet root zone of the plant. Avoid watering plants for several hours before application to improve plant uptake of product. For foliar spray, thoroughly spray foliage until runoff.
	<i>dimethomorph + ametoctradin</i> Orvego	40 + 45	ACTIVITY : Systemic 14 fl oz/100 gal (aerial Phytophthora) 11-14 fl oz/100 gal (drench)	12	Begin spraying when plants are well established or at first sign of disease using a full-coverage spray applied on a 10-14 day interval. Rotate with a fungicide with a different Activity of action (different FRAC#) to reduce fungicide resistance.
	<i>fenamidone</i> FenStop	11	ACTIVITY : Systemic Spray: 7-14 oz/100 gal Drench: 14 oz/100 gal	12	Repeat as necessary at 28-day intervals. Has cross-resistance to strobilurin fungicides. Do not rotate with strobilurin fungicides.
	<i>fludioxonil + mefenoxam</i> Hurricane (WP)	12 + 4	ACTIVITY : Contact 3/4 oz/100 gal (drench at seeding) 1.5 oz/100 gal (2 packets) as drench of cuttings and transplants	48	Application to Impatiens, New Guinea Impatiens, Pothos, Geranium, and Easter Lily may cause stunting and/or chlorosis. Do not use on Leather leaf fern. Make only one application to seedling crop prior to transplanting to larger containers. For cuttings or transplants, re-treat at 21-28 day intervals if needed. For use only in greenhouses, containers, and enclosed structures.
	<i>fluopicolide</i> Adorn	43	ACTIVITY : Systemic Spray: 2-4 fl oz/100 gal Drench: 1-4 fl oz/100 gal	12	Apply before disease development. Use higher rate when treating plants with a high potential for disease development. Must be tank mixed with the labeled rate of another fungicide with a different Activity. If necessary, reapply after 14-28 days. Do not apply more than two (2) applications per cropping cycle. Do not apply sequentially, alternate with another fungicide.
	<i>fluoxastrobin</i> Disarm O	11	ACTIVITY : Systemic 1-4 oz/100 gal (Crown spray) 0.15-0.6/100 gal (Drench or surface spray)	12	Apply at 7-28 day intervals for crown spray and 14-28 day interval for drench or surface spray application.
	<i>fosetyl-Al</i> Aliette WDG	33	ACTIVITY : Systemic Spray: 2.5-5 lb/100 gal Bedding: 1.25-4 lb/100 gal Drench: 6.4-12.8 oz/100 gal Soil incorp: 8-12.8 oz/100 gal	12	Do not exceed 1 application every 30 days. Spray to wet using no more than 400 gal/A. Apply to 400 sq ft/100 gal (2 pt/sq ft) Use soil incorporation with well-rooted plants.
	<i>mandipropamid</i> Micora	40	ACTIVITY : Systemic 4-8 oz/100 gal	4	Apply as a foliar spray on a 7-14 day interval preventively or at the first sign of disease symptoms. Make no more than 2 consecutive applications before switching to another effective non-Group 40 fungicide.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Phytophthora diseases (Aerial blight, foliar blight, stem rot, root and crown rot) (continued)	<i>mefenoxam</i> Subdue GR	4	ACTIVITY : Systemic Foliage: 1.6-8 oz/cu yd 8-40 oz/1,000 sq ft bed area Bedding: 1.6-8 oz/cu yd 6-30 oz/1,000 sq ft bed area Flowers: 1.6-8 oz/cu yd 12-60 oz/1,000 sq ft bed area Woody: 1.6-12.5 oz/cu yd 26-125 oz/1,000 sq ft bed area Azalea: 1.6-10 oz/cu yd 14.8-75 oz/1,000 sq ft bed area	48 (0 - if soil incorp.)	Thoroughly mix per cu. yd. soil or potting medium. After 2-3 months, product may be reapplied as a soil surface application. Soil surface applications can be re-applied at 2-3 month intervals, if needed.
	Subdue MAXX		Foliage: 0.3-0.6 fl oz/100 gal Bedding: 0.13-0.25 fl oz/100 gal at seeding 0.5-1 fl oz/100 gal at transplanting Flowers: 0.5-1 fl oz/100 gal Woody: 1-2 fl oz/100 gal Azalea: 0.63-1.25 fl oz/100 gal	0 (drench)	Drench with 1 pt of solution/sq ft. For medium deeper than 4", apply 1.5-2 pt/sq ft. Use higher rate for soil surface spray; spray to wet root zone, irrigate after application with 0.5" of water.
	<i>oxathiapiprolin</i> Segovis	U15	ACTIVITY: Contact 0.6-2.4 fl oz/100 gal (foliar spray) 0.65-3.2 fl oz/100 gal (drench)	4	Apply on 5-14 day intervals. Do not make more than 2 sequential applications before rotating to a fungicide with a different Activity of action (different FRAC #).
	<i>phosphorous acid</i> Alude Fosphite	33	ACTIVITY : Systemic 1-2 qt/100 gal (foliar spray) 6.25-12.75 fl oz/100 gal (drench) 1-2 qt/100 gal (foliar spray) 12-24 fl oz/100 gal (drench)	4	Apply as spray to thoroughly wet foliage. Reapply as needed at 14-21 day intervals. As a drench, apply 1-2 pt of solution/sq ft at 2-4 week intervals. Thoroughly soak.
	<i>pyraclostrobin</i> Empress	11	ACTIVITY : Systemic 1-3 fl oz/100 gal (drench rooted cuttings, seedlings, plugs) 2-6 fl oz /100 gal (drench herbaceous /woody plants)	12	Use preventively when conditions are favorable for disease and prior to symptom development. Rotate to non-group 11 fungicide for resistance management. Do not apply more than 4.4 fl oz/1000 sq ft/year. Repeat applications as needed 7-28 days after initial application.
	<i>trifloxystrobin</i> Compass O 50WDG	11	ACTIVITY : Systemic 1-2 oz/100 gal (Aerial) 1-2 oz/100 gal (Drench)	12	Continue at 7-14 day intervals for aerial blight; 14-28 days as drench for root rot. Rotate with fungicide in different chemical class (different FRAC #).
	Pine needle cast (<i>Lophodermium</i>)	<i>chlorothalonil</i> Daconil Zn Daconil Ultrex Daconil Weather Stik	M5	ACTIVITY : Contact 4-8 pt/A 2.5-5 lb/100 gal or A 2.75-5.5 pt/A	12
<i>copper hydroxide</i> CuPRO 2005 T/N/O Kocide 3000 Kocide 2000		M1	ACTIVITY : Contact 1.5-3 lb/A 0.75-1.75 lb/A 1.5-3 lb/A	24-48 (check label)	Do not apply in spray solutions having pH less than 6.5. Do not tank mix with Aliette fungicide. Reapply at 14 day intervals.
<i>copper hydroxide + mancozeb</i> Junction		M1 + M3	ACTIVITY : Contact 1.5-3.5 lb/A	48	Do not apply in spray solutions having pH less than 6.5. Reapply at 7-14 day intervals.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Pine needle cast (<i>Lophodermium</i>) (continued)	<i>copper salts of fatty and rosin acids</i> Camelot O	M1	ACTIVITY : Contact 0.5-2 gal/100 gal/A	4	Apply first application when needles are emerging. Make second application 3 weeks later.
	<i>mancozeb</i> Dithane 75DF Fore 80WP Mancozeb DG Pentathlon DF Pentathlon LF Protect DF	M3	ACTIVITY : Contact 1-2 lb/100 gal 1.5 lb/100 gal 1.5 lb/100 gal 1-2 lb/100 gal 0.8-1.6 qt/A/100 gal 1-2 lb/100 gal	24	Addition of a spreader sticker will improve performance. Apply at 7-10 day intervals.
	<i>mancozeb + myclobutanil</i> Clevis	M3 + 3	ACTIVITY : Contact + Systemic 2 lb/100 gal	24	Begin application at first sign of disease or when plants are well leafed out. Spray at 7-10 day intervals. Addition of spreader-binder or surfactant will improve performance.
Powdery Mildew	<i>azoxystrobin</i> Heritage	11	ACTIVITY : Systemic 1-4 oz/100 gal	4	Preventative applications only. Repeat at 7-28 days. Do not make more than 2 sequential applications before rotating to another class of fungicide.
	<i>Bacillus subtilis</i> QST 713 strain Cease	44	ACTIVITY : Contact 2-4 qt/100 gal/A 4 qt/100-300 gal/A (typical)	4	Make applications on a 3-10 day schedule. Typical interval of 7-day. Shorten under severe disease pressure.
	<i>benzovindiflupyr + azoxystrobin</i> Mural	7 + 11	ACTIVITY: Contact/Systemic 4-7 oz/100 gal	12	Do NOT apply to apple, crabapple, flowering cherry, privet, leatherleaf fern or other fern used for cut foliage. Apply at 7-21 day intervals. Do not make more than 2 sequential applications before rotating with a product with a different Activity of action (different FRAC #).
	<i>chlorothalonil</i> Daconil Ultrex Daconil Zn Daconil Weather Stik	M5	ACTIVITY : Contact 1.4 lb/100 gal 2 pt/100 gal 1 3/8 pt/100 gal	12	Apply on 7-14 day intervals at first sign of disease or when conditions favor disease development. Do not combine with pesticides, surfactants, or fertilizers in spray tank.
	<i>chlorothalonil + thiophanate methyl</i> Spectro 90WDG	M5 + 1	ACTIVITY : Contact/Systemic 1-2 lb/100 gal	24	Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Minimum 7-day re-treatment interval. Do not exceed 2.15 lb/A of product.
	<i>copper hydroxide</i> CuPRO T/N/O Nu-Cop 50 DF Nu-Cop HB Nu-Cop 3L	M1	ACTIVITY : Contact 0.75-2 lb A 1 lb/100 gal 0.5 lb/100 gal 1 1/3 pt/100 gal	24-48 (check label)	Do not apply in spray solutions having pH less than 6.5. Do not tank mix with Alette or other phosphante fungicides. Begin application at the first sign of disease and repeat at 7-14 day intervals.
	<i>copper salts of fatty and rosin acids</i> Camelot	M1	ACTIVITY : Contact 0.5-2 gal/100 gal/A	4	Discoloration of blooms may occur. Do not spray just before or during bloom periods. Apply at 7-10 day intervals.
	<i>copper sulfate</i> Basicop	M1	ACTIVITY : Contact 2-4 lb/100 gal or 2-4 lb/A	24	Phytotoxicity may occur on certain plant species/cultivars. Limited host labeling. Apply preventively, and repeat at 7-10 day intervals and after rains.
	<i>copper sulphate pentahydrate</i> Phyton 27	M1	ACTIVITY : Contact 1½-2½ oz/100 gal	24	Apply preventively, and reapply on 3-5 day intervals. Poor curative activity.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Powdery Mildew (continued)	<i>cyprodinil + fludioxonil</i> Palladium	9 + 12	ACTIVITY : Systemic/Contact 4-6 oz/100 gal	12	Begin applications prior to the onset of disease, and repeat applications at 7-14- day intervals if conditions remain favorable for disease development. Ensure full spray coverage of all stems and inner areas of plants to the soil/media level.
	<i>fluoxastrobin</i> Disarm O	11	ACTIVITY : Systemic 1-4 oz/100 gal	12	Apply at 7-28 day intervals. Under light disease pressure, use lower rates (1-2 oz/100 gal) on a 7-14 day interval or the higher rates (3-4 oz/100 gal) on a 14-28 day interval. Under high disease pressure, use the higher rates on a 7-14 day interval.
	<i>fluxapyroxad + pyraclostrobin</i> Orkestra Intrinsic	7 + 11	ACTIVITY: Contact/Systemic 6-8 fl oz/100 gal	12	Do NOT apply to Ninebark or Wintercreeper.
	<i>kresoxim-methyl</i> Cygnus	11	ACTIVITY : Systemic 1.6-3.2 oz/100 gal	12	Apply as protective spray or at the first sign of disease. Continue on a 7-14 day interval. Rotate to non-strobilurin (SB) fungicide for two applications before re-use to reduce fungicide resistance development. Addition of up to 0.06% of a non-organosilicone spreader-sticker type adjuvant may improve control.
	<i>mancozeb + myclobutanil</i> Clevis	M3 + 3	ACTIVITY : Contact + Systemic 2 lb/100 gal	24	Begin application at first sign of disease or when plants are well leafed out. Spray at 7-10 day intervals. Addition of spreader-binder or surfactant will improve performance.
	<i>metconazole</i> Tourney	3	ACTIVITY : Systemic 1-4 oz/100 gal	12	Apply to the point of drip at 14-28 day intervals.
	<i>myclobutanil</i> Eagle 20EW	3	ACTIVITY : Systemic 6-12 oz/100 gal	24	Repeat application at 10-14 day intervals.
	piperalin Pipron	5	ACTIVITY : Contact 4-8 oz/100 gal	12	Flower/bract spotting may occur. See precautions on hydrangea, begonia, and poinsettia. Use with a surfactant on hard-to-wet leaves or under heavy disease pressure.
	<i>polyoxin D Zn salt</i> Affirm WDG	19	ACTIVITY : Systemic 0.25-0.5 lb/100 gal	4	Apply as full coverage foliar spray every 7-10 days. Apply prior to disease development and when conditions are conducive for disease.
	<i>propiconazole</i> Banner Maxx II Propiconazole Strider	3	ACTIVITY : Systemic 5-8 fl oz/100 gal 5-8 fl oz/100 gal 5-8 fl oz/100 gal	12	Do not apply to African violets, begonias, Boston fern or geranium. Do not use in greenhouses. Apply every 14-21 days during period of infection. Spray to drip.
	<i>propiconazole + chlorothalonil</i> Concert II	3 + M5	ACTIVITY : Systemic + Contact 22-35 fl oz (1.4-2.2 pt)/100 gal	12	For outdoor and landscape use only. Do not use in greenhouses. Limited host plant labeling; check label. Do not apply to African violets, begonias, Boston fern, geranium, pittosporum, schefflera. Reapply at 14-21 day intervals. Application to blooms or tender new growth may cause injury.
	<i>pyraclostrobin + boscalid</i> Pageant	11 + 7	ACTIVITY : Systemic + Contact 6-12 oz/100 gal	12	Use preventively. Begin applications when conditions are favorable for disease, prior to or at the first disease symptom development. Reapply at 7-10 day intervals.
<i>potassium bicarbonate</i> MilStop		ACTIVITY : Contact 2.5-5 lb/100 gal	1	Apply by increasing 0.25lb/application not exceeding 5.0lbs. Repeat applications at 1-2 week intervals. See label for precautions for use on poinsettia, impatiens, and pansy.	

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Powdery Mildew (continued)	<i>tebuconazole</i> Torque	3	ACTIVITY : Systemic 4-10 fl oz/100 gal	12	Apply at least 3 times per year, 14-21 days apart beginning with spring bed break.
	<i>thiophanate methyl</i> Allban Flo 3336 F 3336 EG SysTec 1998 WDG OHP 6672 4.5F OHP 6672 50WP + many more formulations	1	ACTIVITY : Systemic 10-20 fl oz/100 gal 12-24 fl oz /100 gal 12-24 oz/100 gal 10 fl oz/100 gal 10-20 fl oz/100 gal 8-16 oz/100 gal See product label for rates.	12	Not recommended for use on Boston fern, Swedish Ivy or Easter Cactus. Apply at first sign of disease. Repeat application on 7-14 day intervals.
	<i>thiophanate methyl + mancozeb</i> Zyban WSB	1 + M5	ACTIVITY : Systemic/Contact 24 oz (4 bags)/100 gal	24	Apply at weekly intervals. Limit to 20 application per year.
	<i>triadimefon</i> Bayleton 50	3	ACTIVITY : Systemic 5.5 oz/275-550 gal	12	Apply as full coverage foliage spray to the point of drip. Landscape use only.
	<i>trifloxystrobin</i> Compass O 50WDG	11	ACTIVITY : Systemic 1-2 oz/100 gal	12	Do not apply to Petunia, Violet, or New Guinea Impatiens or on Poinsettia after bract formation. Apply at first sign of disease and continue at 7-14 day intervals. Rotate with fungicide in different chemical class.
	<i>trifloxystrobin + triadimefon</i> Trigo	11 + 3	ACTIVITY : Systemic 1.2-2.4 oz/100 gal	12	Apply to the point of drip. Do not apply at intervals shorter than 30 days to avoid flower stalk length reduction. Do NOT use on Petunia, Violets, and New Guinea Impatiens.
	<i>triflumizole</i> Terraguard SC Terraguard SC/LS	3	ACTIVITY : Contact 4-16 oz/100 gal 4-8 oz/100 gal	12	Apply foliar sprays at weekly intervals. Use 16 oz rate for initial application to existing infections; use 4-8 oz rate preventively.
	<i>triticonazole</i> Trinity TR Trinity	3	ACTIVITY : Systemic 1 can/3,000 sq ft (greenhouse) 6-12 fl oz/100 gal	12	For Trinity TR: Elevate container above the plant canopy and clear a 6 ft area around can. Shut off exhaust and close vents. Repeat at 7 day intervals up to 3x per crop (2x for pansies). For Trinity (flowable): Use preventively. Use highest labeled rate for rose powdery mildew.
Pythium root and stem rot	<i>Bacillus subtilis</i> QST 713 strain Cease	44	ACTIVITY : Contact 2-8 qt/100-300 gal/A (foliar spray) 4-8 qt/100-300 gal/A (drench)	4	Drenches for use only in greenhouses. Apply 1 pt /3 in. soil depth to thoroughly soak the growing medium as a drench or directed spray. Optimal when used preventively and repeated every 3-10 days during growing cycle.
	<i>captan</i> Captan 50WP	M4	ACTIVITY : Contact 4 lb/100 gal (for 30 min; Begonia) 4 lb/100 gal (Azalea, Carnation, Chrysanthemum)	48	Dip cuttings in mixture before bedding.
	<i>cyazofamid</i> Segway O	21	ACTIVITY : Limited Systemic 1.5-3 fl oz/100 gal	12	Apply on 14-28 day interval using another fungicide with a different FRAC code between applications. Do not make more than 2 applications per crop cycle for root disease control. May be applied through irrigation systems.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Pythium root and stem rot (continued)	etridiazole Terrazole 35WP Truban 25EC Truban 30WP	14	ACTIVITY : Contact 3.5-10 oz/100 gal Woody/Foliage: 4-8 oz/100 gal Bedding: 4-6 oz/100 gal Woody: 3-10 oz/100 gal Foliage: 8-12 oz/100 gal Bedding: 4-6 oz/100 gal	12	Repeat at 4-8 week intervals for bedding plants and at 2-3 months for woody/foilage plants. Apply at 8-12 week intervals for foliage and at 4-8 week intervals for bedding plants.
	etridiazole + thiophanate methyl Banrot 8G Banrot 40WP	14 + 1	ACTIVITY : Contact/Systemic 12 oz/cu yd Bedding: 4-8 oz/100 gal Woody/Foliage: 6-12 oz/100 gal	12	Use low rate for bedding plants and high rate for woody and foliage plants for Banrot 8G. Drench at seeding and transplanting. Reapply at 4-8 week intervals.
	fenamidone FenStop	11	ACTIVITY : Systemic 7-14 oz/100 gal (foliar spray) 7-14 oz/50-100 gal (drench)	12	Repeat as necessary at 28-day intervals. Has cross-resistance to strobilurin fungicides. Do not rotate with strobilurin fungicides.
	fludioxonil + mefenoxam Hurricane (WP)	12 + 4	ACTIVITY : Contact 3/4 oz/100 gal (drench at seeding) 1.5 oz/100 gal (2 packets) as drench of cuttings and transplants	48	Application to Impatiens, New Guinea Impatiens, Pothos, Geranium, and Easter Lily may cause stunting and/or chlorosis. Do not use on Leather leaf fern. Make only one application to seedling crop prior to transplanting to larger containers. For cuttings or transplants, re-treat at 21-28 day intervals if needed. For use only in greenhouses, containers, and enclosed structures.
	fluopicolide Adorn	43	ACTIVITY : Systemic Foliar Spray: 2-4 fl oz/100 gal Drench: 1-4 fl oz/100 gal	12	Apply before disease development. Use higher rate when treating plants with a high potential for disease development. Must be tank mixed with the labeled rate of another fungicide with a different Activity. If necessary, reapply after 14-28 days. Do not apply more than two (2) applications per cropping cycle. Do not apply sequentially, alternate with another fungicide.
	mefenoxam Subdue GR	4	ACTIVITY : Systemic Foliage: 1.6-8 oz/cu yd 8-40 oz/1,000 sq ft bed area Bedding: 1.6-8 oz/cu yd 6-30 oz/1,000 sq ft bed area Flowers: 1.6-8 oz/cu yd 12-60 oz/1,000 sq ft bed area Woody: 1.6-12.5 oz/cu yd 26-125 oz/1,000 sq ft bed area Azalea: 1.6-10 oz/cu yd 14.8-75 oz/1,000 sq ft bed area	48 (0 – if soil incorp.)	Thoroughly mix per cu. yd. soil or potting medium. After 2-3 months, product may be reapplied as a soil surface application. Soil surface applications can be re-applied at 2-3 month intervals, if needed. Fungicide resistance known for <i>Pythium</i> species.
	Subdue MAXX		Foliage: 0.3-0.6 fl oz/100 gal Bedding: 0.13-0.25 fl oz /100 gal at seeding 0.5-1 fl oz/100 gal at transplanting Flowers: 0.5-1 fl oz/ 100 gal Woody: 1-2 fl oz/100 gal Azalea: 0.63-1.25 fl oz/100 gal	0 (drench)	Drench with 1 pt of solution/sq ft. For medium deeper than 4", apply 1.5-2 pt/sq ft. Use higher rate for soil surface spray; spray to wet root zone, irrigate after application with 0.5" of water. Fungicide resistance known for <i>Pythium</i> species.
propamocarb hydrochloride Banol	28	ACTIVITY : Systemic Herbaceous: 2-3 fl oz/ 10 gal Woody: 2.5 fl oz/10 gal	24	Apply 3 qt of solution per 10 sq ft before seeding or transplanting.	

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Pythium root and stem rot (continued)	<i>pyraclostrobin</i> Empress	11	ACTIVITY : Systemic 1-3 fl oz/100 gal (drench rooted cuttings, seedlings, plugs) 2-6 fl oz /100 gal (drench herbaceous/ woody plants)	12	Use preventively when conditions are favorable for disease and prior to symptom development. Rotate to non-group 11 fungicide for resistance management. Do not apply more than 4.4 fl oz/1000 sq ft/year. Repeat applications as needed 7-28 days after initial application.
Rhizoctonia root rot and web blight	<i>azoxystrobin</i> Heritage	11	ACTIVITY : Systemic 1-4 oz/100 gal (directed spray) 0.2-0.9 oz/100 gal (drench)	4	Repeat every 7-21 days for directed spray. Use 1-2 pt of solution/sq ft surface area, every 7-28 days for drench.
	<i>Bacillus subtilis</i> QST 713 strain Cease	44	ACTIVITY : Contact 4-8 qt/100 gal	4	Drenches for use only in greenhouses and nurseries (open or enclosed). Apply 1 pt/3" soil depth to thoroughly soak the growing medium as a drench or directed spray. Optimal when used preventively and repeated every 21-28 days during growing cycle.
	<i>benzovindiflupyr + azoxystrobin</i> Mural	7 + 11	ACTIVITY: Contact/Systemic 4-7 oz/100 gal (foliar spray) 5-7 oz/100 gal (directed soil spray) 2-3 oz/100 gal (drench)	12	Do NOT apply to apple, crabapple, flowering cherry, privet, leatherleaf fern or other fern used for cut foliage. Apply at 7-21 day intervals for directed soil spray; 7-28 days for drench; and 7-14 days for foliar spray..
	<i>chlorothalonil</i> Daconil Ultrex Daconil Weather Stik Daconil Zn + many other formulations	M5	ACTIVITY : Contact 1.4 lb/100 gal 1 3/8 pt/100 gal 2 pt/100 gal See product labels for rates.	12	Use for aerial/web blight as a foliar spray. Apply at 7-14 day intervals. Do not combine with pesticides, surfactants, or fertilizers in spray tank.
	<i>chlorothalonil + thiophanate methyl</i> Spectro 90WDG	M5 + 1	ACTIVITY : Contact/Systemic 1-2 lb/100 gal	12	For use on aerial/web blight only. Do not use with mist blowers or high pressure spray equipment in greenhouses. Minimum 7-day re-treatment interval. Do not exceed 2.15 lb/A of product.
	<i>copper salts of fatty & rosin acids</i> Camelot O	M1	ACTIVITY : Contact 0.5-2 gal/100 gal/A	4	Discoloration of blooms may occur. Do not spray just before or during bloom periods. Apply at 7-10 day intervals.
	<i>cyprodinil + fludioxonil</i> Palladium	9 + 12	ACTIVITY : Systemic/Contact 2-4 oz/100 gal	12	Begin applications prior to the onset of disease, and repeat applications at 7-14 day intervals if conditions remain favorable for disease development. Do not use on residential ornamentals
	<i>etridiazole + thiophanate methyl</i> Banrot 8G Banrot 40WP	14 + 1	ACTIVITY : Contact/Systemic 12 oz/cu yd Bedding: 4-8 oz/100 gal Woody/Foliage: 6-12 oz/100 gal	12	Use low rate for bedding plants and high rate for woody and foliage plants for Banrot 8G. Drench at seeding and transplanting. Reapply at 4-8 week intervals.
	<i>fludioxonil</i> Emblem Medallion WDG	12	ACTIVITY : Contact 1-2 oz/100 gal (foliar spray) 1 oz/100 gal (drench at seeding) 1-2 oz/100 gal (drench of cuttings and transplants)	12	May stunt Impatiens and New Guinea Impatiens. May stunt some Geranium cultivars. Do NOT use on Leather Leaf Fern. Re-apply spray at 7-14 day intervals. For drench, wet top-half of medium. Re-treat at 21-28 day intervals.
	<i>fludioxonil + mefenoxam</i> Hurricane (WP)	12 + 4	ACTIVITY : Contact 3/4 oz/100 gal (drench at seeding) 1.5 oz/100 gal (2 packets) as drench of cuttings and transplants	48	Application to Impatiens, New Guinea Impatiens, Pothos, Geranium, and Easter Lily may cause stunting and/or chlorosis. Do NOT use on leather leaf fern. Make only one application to seedling crop prior to transplanting to larger containers. For cuttings or transplants, re-treat at 21-28 day intervals if needed. For use only in greenhouses, containers, and enclosed structures.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Rhizoctonia root rot and web blight (continued)	<i>fluoxastrobin</i> Disarm O	11	ACTIVITY : Systemic 2-4 oz/100 gal (Crown spray) 0.15-0.6/100 gal (Drench or surface spray)	12	Apply at 7-21 day intervals for crown spray and 14-28 day interval for drench or surface spray application.
	<i>flutolanil</i> ProStar 70WP	7	ACTIVITY : Systemic 3-6 oz/100 gal (drench) 3-12 oz/100 gal (aerial blight)	12	Drench at 1-2 pt/sq ft. Re-apply 21-28 days after initial application, if needed. Foliar spray reapplied at 14-21 day intervals.
	<i>iprodione</i> Chipco 26019 N/G Iprodione Pro 2SE Chipco 26019 FLO	2	ACTIVITY : Contact Foliar spray: 1-2 lb/A Drench: 6.5 oz/100 gal Foliar spray: 1-2.5 qt/ 100 gal Drench: 13 fl oz/100 gal Foliar spray: 1-2.5 qt/ 100 gal Drench: 13 fl oz/100 gal	12	Do not use on <i>Spathiphyllum</i> or as a drench on Impatiens, New Guinea impatiens or Pothos. May cause stunting and chlorosis on some geranium cultivars. Re-apply foliar spray at 7-14 day intervals. Drench on 14-day interval with 1-2 pt of solution/sq ft.
	<i>iprodione + thiophanate methyl</i> 26/36	2 + 1	ACTIVITY : Contact + Systemic Foliar spray: 33-84 fl oz/100 gal Drench: 13.5 fl oz/100 gal	12	Drench at seeding or transplanting. Apply 1-2 pt/sq ft. Repeat at 14 day intervals. Do not make more than 6 applications per crop per year. Do not use on <i>Spathiphyllum</i> or New Guinea Impatiens. Do not drench Impatiens, Petunia or Pothos.
	<i>mancozeb</i> Dithane 75DF Fore 80WP Mancozeb DG Pentathlon DF Pentathlon LF Protect DF	M3	ACTIVITY : Contact 1-2 lb/100 gal 1.5 lb/100 gal 1.5 lb/100 gal 1-2 lb/100 gal 0.8-1.6 qt/100 gal 1-2 lb/100 gal	24	Addition of a spreader sticker will improve performance. Repeat application on 7-10 day intervals. Do not use Fore on Pachysandra.
	<i>metconazole</i> Tourney	3	ACTIVITY : Systemic 1-4 oz/100 gal	12	Apply to the point of drip at 14-28 day intervals.
	<i>polyoxin D Zn salt</i> Affirm WDG	19	ACTIVITY : Systemic 0.25-0.5 lb/100 gal	4	Apply as full coverage foliar spray every 7-10 days or as drench every 14-28 days. Apply prior to disease development and when conditions are conducive for disease.
	<i>PCNB</i> Turfcide 10G Terraclor 400	14	ACTIVITY: Contact Orna. beds: 15 lb/1000 sq ft Growing media: 1-1.5 lb/cu yd Bedding/Woody/Foliage drench: 6-12 oz/100 gal Pine seedlings: 2 pt/1000 sq ft	12	** Do not use on <i>Philodendron</i> or <i>Pilea</i>. Apply at seeding and/or transplant. Mix into top 2-3" of soil. Apply evenly over soil and incorporate into top 2" of soil in prepared seed bed. Repeat once 4-6 weeks later, if necessary.
	<i>pyraclostrobin</i> Empress	11	ACTIVITY : Systemic 1-3 fl oz/100 gal (drench rooted cuttings, seedlings, lugs) 2-6 fl oz /100 gal (drench herbaceous/ woody plants)	12	Use preventively when conditions are favorable for disease and prior to symptom development. Rotate to a non-group 11 fungicide for resistance management. Do not apply more than 4.4 fl oz/1000 sq ft/year. Repeat application as needed 7-28 days after initial application.
	<i>pyraclostrobin + boscalid</i> Pageant	11 + 7	ACTIVITY : Systemic + Contact 12-18 oz/100 gal	12	Use preventively. Begin applications when conditions are favorable for disease, prior to disease symptom development. Reapply at 7-14 interval; 7-21 days for drench. The crown and base of the plant and the soil or potting medium surrounding the crown must be thoroughly covered.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Rhizoctonia root rot and web blight (continued)	<i>thiophanate methyl</i> Allban Flo 3336 F 3336 EG SysTec 1998 WDG OHP 6672 4.5F OHP 6672 50WP + many more formulations	1	ACTIVITY : Systemic 10-14.5 fl oz/100 gal 8-16 fl oz/100 gal (drench) 16-24 oz/100 gal (Plant dip) 8-16 oz/100 gal 16-24 oz/100 gal (Plant dip) 20 fl. oz/100 gal 10-14.5 fl oz/100 gal 8-16 oz/100 gal See product labels for rates.	12	Not recommended for use on Boston fern, Swedish Ivy or Easter Cactus. Apply as a heavy spray or drench at rate of 0.5-2 pt/sq ft (100 gal/1,600-400 sq ft). Applications can be re-applied at 7-14 day intervals.
	<i>thiophanate methyl + mancozeb</i> Zyban WSB	M3 + 1	ACTIVITY : Systemic/Contact 24 oz (4 bags)/100 gal	24	Apply at weekly intervals. Limit to 20 applications per year.
	<i>trifloxystrobin</i> Compass O 50WDG	11	ACTIVITY : Systemic 0.5 oz/100 gal	12	Do not apply to Petunia, Violet, or New Guinea Impatiens or on Poinsettia after bract formation. Do not drench Pansy. Drench to wet upper half of medium. Repeat application in 21-28 day intervals.
	<i>triflumizole</i> Terraguard SC	3	ACTIVITY : Contact 4-8 oz/100 gal	12	Apply soil drenches at 2-4 week intervals. Apply foliar sprays at 7-14 day intervals.
Rust leaf spots (<i>Puccinia, Uromyces, Coleosporium, etc.</i>)	<i>azoxystrobin</i> Heritage	11	ACTIVITY : Systemic 1-4 oz/100 gal	4	Repeat every 7-28 days.
	<i>Bacillus subtilis</i> QST 713 strain Cease	4	ACTIVITY : Contact 2-8 qt/100 gal/A 4 qt/100 gal/A (typical)	4	Make applications on a 3-10 day schedule. Typical interval of 7-day. Shorten under severe disease pressure.
	<i>benzovindiflupyr + azoxystrobin</i> Mural	7 + 11	ACTIVITY: Contact/Systemic 4-7 oz/100 gal	12	Do NOT apply to apple, crabapple, flowering cherry, privet, leatherleaf fern or other fern used for cut foliage. Apply at 7-21 day intervals.
	<i>chlorothalonil</i> Daconil Zn Daconil Ultrex Daconil Weather Stik + many other formulations	M5	ACTIVITY : Contact 2 pt/100 gal 1.4 lb/100 gal 1 3/8 pt/100 gal See product label for rates.	12	Re-apply at 7-14 day intervals. Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Do not combine with pesticides, surfactants, or fertilizers in spray tank.
	<i>chlorothalonil + thiophanate methyl</i> Spectro 90WDG	M5 + 1	ACTIVITY : Contact/Systemic 1-2 lb/100 gal	12	Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Minimum 7-day re-treatment interval. Do not exceed 2.15 lb/A of product.
	<i>flutolanil</i> ProStar 70WP	7	ACTIVITY : Systemic 3-6 oz/100 gal	12	Spray 14-21 days. Make no more than 4 applications/year.
	<i>fluoxastrobin</i> Disarm O	11	1-4 oz/100 gal	12	Apply at 7-28 day intervals regularly. Under light disease pressure, use lower rates (1-2 oz /100 gal) on a 7-14 day interval or the higher rates (3-4 oz/100 gal) on a 14-28 day interval. Under high disease pressure, use the higher rates on a 7-14 day interval.
	<i>kresoxim-methyl</i> Cygnus	11	ACTIVITY : Systemic 3.2-6.4 oz/100 gal	12	Apply strictly as a protective spray and continue on a 7-10 day interval. Addition of up to 0.06% of a non-organosilicone spreader-sticker type adjuvant may improve control.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Rust leaf spots (<i>Puccinia</i> , <i>Uromyces</i> , <i>Coleosporium</i> , etc.) (continued)	<i>mancozeb</i> Dithane 75DF Fore 80WP Mancozeb DG Pentathlon DF Pentathlon LF Protect DF	M3	ACTIVITY : Contact 1-2 lb/100 gal 1.5 lb/100 gal 1.5 lb/100 gal 1-2 lb/100 gal 0.8-1.6 qt/A/100 gal 1-2 lb/100 gal	24	Addition of a spreader sticker will improve performance. Repeat application on 7-10 day intervals.
	<i>metconazole</i> Tourney	3	ACTIVITY : Systemic 1-4 oz/100 gal	12	Apply to the point of drip at 14-28 day intervals.
	<i>mancozeb</i> + <i>myclobutanil</i> Clevis	M3 + 3	ACTIVITY : Contact + Systemic 2 lb/100 gal	24	Begin application at first sign of disease or when plants are well leafed out. Spray at 7-10 day intervals. Addition of spreader-binder or surfactant will improve performance.
	<i>myclobutanil</i> Eagle 20EW	3	ACTIVITY : Systemic 6-12 oz/100 gal	24	Repeat application at 10-14 day intervals.
	<i>oxycarboxin</i> Plantvax 750WP	7	ACTIVITY : Contact 130g/100L	12	Do not mix with insecticides or miticides. For use only in enclosed structures. Re-apply at 14-day intervals.
	<i>propiconazole</i> Banner Maxx II Propiconazole Strider	3	ACTIVITY : Systemic 5-8 fl oz/100 gal 5-8 fl oz/100 gal 5-8 fl oz/100 gal	12	Do not use on geranium. Do not use in greenhouses. Apply every 14-21 days during period of infection. Spray to drip.
	<i>propiconazole</i> + <i>chlorothalonil</i> Concert II	3 + M5	ACTIVITY : Systemic + Contact 22-35 fl oz (1.4-2.2 pt)/100 gal	12	For outdoor and landscape use only. Do not use in greenhouses. Limited host plant labeling; check label. Do not apply to African violets, begonias, Boston fern, geranium, Pittosporum, Schefflera. Reapply at 14-21 day intervals. Application to blooms or tender new growth may cause injury.
	<i>pyraclostrobin</i> + <i>boscalid</i> Pageant	11 + 7	ACTIVITY : Systemic + Contact 6-12 oz/100 gal (<i>Puccinia</i> , <i>Uromyces</i>) 12-18 oz/100 gal (<i>Coleosporium</i>)	12	Use preventively. Begin applications when conditions are favorable for disease, prior to disease symptom development. Reapply at 7-14 day interval.
	<i>tebuconazole</i> Torque	3	ACTIVITY : Systemic 4-10 fl oz/100 gal	12	Apply at least 3 times per year, 14-21 days apart, and beginning with spring bud break. Rotate with a fungicide in a different class (different FRAC #) to reduce fungicide resistance development. Do not use on geranium.
	<i>thiophanate methyl</i> Allban Flo 3336 F 3336 EG SysTec 1998 WDG OHP 6672 4.5F OHP 6672 50WP + many more formulations	1	ACTIVITY : Systemic 10.75-20 fl oz/100 gal 12-16 fl oz /100 gal 12-16 oz/100 gal 20 fl oz/100 gal 10.75-20 fl oz/100 gal 12-16 oz/100 gal See product labels for rates.	12	Apply at first sign of disease. Repeat application on 7-14 day intervals.
	<i>thiophanate methyl</i> + <i>mancozeb</i> Zyban WSB	1 + M3	ACTIVITY : Systemic/ Contact 24 oz/100 gal (4 Bags)	24	Re-apply at weekly intervals. Limit to 20 applications per year.
	<i>triadimefon</i> Bayleton 50	3	ACTIVITY : Systemic 5.5 oz/275-550 gal	12	Apply as full coverage spray to the point of drip.
	<i>trifloxystrobin</i> Compass O 50WDG	11	ACTIVITY : Systemic 2-4 oz/100 gal	12	Apply at first sign of disease and continue at 7-14 day intervals. Rotate with fungicide in different chemical class.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Rust leaf spots (<i>Puccinia</i> , <i>Uromyces</i> , <i>Coleosporium</i> , etc.) (continued)	<i>trifloxystrobin + triadimefon</i> Trigo	11 + 3	ACTIVITY : Systemic 4.8-9 oz/100 gal (<i>Puccinia</i> , <i>Coleosporium</i>) 1.2-2.4 oz/100 gal (<i>Uromyces</i>)	12	Apply to the point of drip in early spring as growth starts at 14-21 days until new growth is fully expanded (<i>Puccinia</i>). Apply intervals no shorter than 30 days to avoid flower stalk length reduction. Do NOT use on Petunia, Violets, and New Guinea Impatiens.
	<i>triflumizole</i> Terraguard SC Terraguard SC/LS	3	ACTIVITY : Contact 2-8 oz/100 gal 4-8 fl oz/100 gal	12	Apply foliar sprays at 7-14 day intervals. Use high rates for initial application.
Rust: Cedar-Apple, and other <i>Gymnosporangium</i> spp.	<i>chlorothalonil</i> Daconil Ultrex Daconil Zn Daconil Weather Stik	M5	ACTIVITY : Contact 1.4 lb/100 gal 2 pt/100 gal 1 3/8 pt/100 gal	12	Apply every 7-14 days from July to August on cedar. Apply to crabapple at 7-14 day intervals. Do not combine with pesticides, surfactants, or fertilizers in spray tank.
	<i>kresoxim-methyl (11)</i> Cygnus	11	ACTIVITY : Systemic 3.2-6.4 oz/100 gal	12	Apply strictly as a protective spray and continue on a 7-10 day interval. The addition of up to 0.06% of a non-organosilicone spreader-sticker type adjuvant may improve rust control.
	<i>mancozeb + myclobutanil</i> Clevis	M3 + 3	ACTIVITY : Contact + Systemic 2 lb/100 gal (on crabapple)	24	Begin application at first sign of disease or when plants are well leafed out. Spray at 7-10 day intervals. Addition of spreader-binder or surfactant will improve performance.
	<i>myclobutanil</i> Eagle 20EW	3	ACTIVITY : Systemic 6-12 oz /100 gal	24	Apply to crabapple at leaf bud break. Repeat application at 10-14 day intervals.
	<i>propiconazole</i> Banner Maxx II Strider	3	ACTIVITY : Systemic 2-4 fl oz/100 gal 2-4 fl oz/100 gal	12	Apply every 14-21 days from July to August on cedar. Apply to crabapple at 14 -21 day intervals beginning at leaf bud break in spring.
	<i>propiconazole + chlorothalonil</i> Concert II	3 + M5	ACTIVITY : Systemic + Contact 9-17 fl oz (0.6-1.1 pt)/100 gal	12	For outdoor and landscape use only. Do not use in greenhouses. Reapply at 14-21 day intervals. Application to tender new growth may cause injury.
	<i>pyraclostrobin + boscalid</i> Pageant	11 + 7	ACTIVITY : Systemic + Contact 12-18 oz/100 gal	12	Use preventively. Begin applications when conditions are favorable for disease, prior to disease symptom development. Reapply at 7-14 day interval.
	<i>thiophanate methyl</i> Allban Flo 3336 F 3336 EG SysTec 1998 WDG OHP 6672 4.5F OHP 6672 50WP + many more formulations	1	ACTIVITY : Systemic 10.75-20 fl oz/100gal 12-16 fl oz /100 gal 12-16 oz/100 gal 20 fl oz/100 gal 10.75-20 fl oz/100 gal 12-16 oz/100 gal See product labels for rates.	12	Apply to crabapple at leaf bud break in the spring. Repeat application on 7-14 day intervals.
	<i>trifloxystrobin</i> Compass O 50WDG	3	ACTIVITY : Systemic 2-4 oz/10 gal	12	Apply at first sign of disease and continue at 7-14 day intervals. Rotate with fungicide with different Activity of action..
	<i>trifloxystrobin + triadimefon</i> Trigo	11 + 2	ACTIVITY : Systemic 1.2 -2.4 oz/100 gal	12	Apply to the point of drip when conditions favor disease. Do not apply at intervals shorter than 30 days to avoid growth reduction.
Scab (<i>Cladosporium</i>, <i>Venturia</i>, <i>Sphaceloma</i>)	<i>azoxystrobin</i> Heritage	11	ACTIVITY : Systemic 1-4 oz/100 gal	4	Apply every 10-28 days. Do not apply to apple trees. See label for tolerant crabapple cultivars as some are sensitive to fungicide. Do not make more than two sequential applications.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Scab (<i>Cladosporium</i> , <i>Venturia</i> , <i>Sphaceloma</i>) (continued)	<i>Bacillus subtilis</i> QST 713 strain Cease	44	ACTIVITY : Contact 2-8 qt/100-300 gal/A 4 qt/100-300 gal/A (typical)	4	Make applications on a 3-10 day schedule. Typical interval of 7 days. Shorten under severe disease pressure.
	<i>chlorothalonil</i> Daconil Zn Daconil Ultrex Daconil Weather Stik + many other formulations	M5	ACTIVITY : Contact 2 pt/100 gal 1.4 lb/100 gal 1 3/8 pt/100 gal See product label for rates.	12	Re-apply at 7-14 day intervals. Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts.
	<i>chlorothalonil</i> + <i>thiophanate methyl</i> Spectro 90WDG	M5 + 1	ACTIVITY : Contact/Systemic 1-2 lb/100 gal	12	Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Minimum 7-day re-treatment interval. Do not exceed 2.15 lb/A of product.
	<i>copper hydroxide</i> CuPRO 2005 T/N/O Nu-Cop 50 DF Nu-Cop HB Nu-Cop 3L	M1	ACTIVITY : Contact 0.75-2 lb A 1 lb/100 gal 0.5 lb/100 gal 1 1/3 pt/100 gal	24-48 (check label)	Do not apply in spray solutions having pH less than 6.5. Do not tank mix with Aliette or other phosphante fungicides. Begin application at the first sign of disease and repeat at 7-14 day intervals.
	<i>copper sulfate</i> Basicop	M1	ACTIVITY : Contact 2-4 lb/100 gal	24	For pyracantha only: Apply preventively, and repeat application every 7-10 days and after rains.
	<i>fluoxastrobin</i> Disarm O	11	ACTIVITY : Systemic 1-4 oz/100 gal	12	Apply at 7-28 day intervals regularly. Under light disease pressure, use lower rates (1-2 oz /100 gal) on a 7-14 day interval or the higher rates (3-4 oz /100 gal) on a 14-28 day interval. Under high disease pressure, use the higher rates on a 7-14 day interval.
	<i>kresoxim-methyl</i> Cygnus	11	ACTIVITY : Systemic 1-1.6 oz /100 gal	12	Begin applications at bud break or where environmental conditions are favorable for disease development and continue on a 10-14 day interval.
	<i>mancozeb</i> Dithane 75DF Fore 80WP Mancozeb DG Pentathlon DF Pentathlon LF Protect DF	M3	ACTIVITY : Contact 1-2 lb/100 gal 1.5 lb/100 gal 1.5 lb/100 gal 1-2 lb/100 gal 0.8-1.6 qt/A/100 gal 1-2 lb/100 gal	24	Addition of a spreader sticker will improve performance. Repeat application on 7-10 day intervals.
	<i>mancozeb</i> + <i>myclobutanil</i> Clevis	M3 + 3	ACTIVITY : Contact + Systemic 2 lb/100 gal	24	Begin application at first sign of disease or when plants are well leafed out. Spray at 7-10 day intervals. Addition of spreader-binder or surfactant will improve performance.
	<i>metconazole</i> Tourney	3	ACTIVITY : Systemic 1-4 oz/100 gal	12	Apply to the point of drip at 14-28 day intervals.
	<i>myclobutanil</i> Eagle 20EW	3	ACTIVITY : Systemic 6-12 oz/100 gal	24	Repeat application at 10-14 day intervals.
	<i>polyoxin D Zn salt</i> Affirm WDG	19	ACTIVITY : Systemic 0.5 lb/100 gal	12	Apply as full coverage foliar spray every 7-10 days. Apply prior to disease development and when conditions are conducive.
<i>propiconazole</i> Banner Maxx II Strider	3	ACTIVITY : Systemic 2-4 fl oz/100 gal (<i>Venturia</i>) 8-12 fl oz/100 gal (<i>Cladosporium</i>)	24	Apply every 14-21 days when conditions are favorable for disease development.	

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Scab (<i>Cladosporium</i>, <i>Venturia</i>, <i>Sphaceloma</i>) (continued)	<i>propiconazole + chlorothalonil</i> Concert II	3 + M5	ACTIVITY : Systemic + Contact 22-35 fl oz (1.4-2.2 pt)/100 gal	12	For outdoor and landscape use only. Do not use in greenhouses. Limited host plant labeling; check label. Do not apply to African violets, begonias, Boston fern, geranium, pittosporum, schefflera. Reapply at 14-21 day intervals. Application to blooms or tender new growth may cause injury.
	<i>potassium bicarbonate</i> MilStop		ACTIVITY : Contact 2.5-5 lb/100 gal	1	Apply by increasing 0.25 lb/application not exceeding 5 lb. Repeat applications at 1-2 week intervals. See label for precautions for use on poinsettia, impatiens, and pansy.
	<i>pyraclostrobin + boscalid</i> Pageant	11 + 7	ACTIVITY : Systemic + Contact 6-12 oz/100 gal	12	Use preventively. Begin applications when conditions are favorable for disease, prior to disease symptom development. Reapply at 7-10 day interval.
	<i>thiophanate methyl</i> Allban Flo 3336 F 3336 EG SysTec 1998 WDG OHP 6672 4.5F OHP 6672 50WP + many more formulations	1	ACTIVITY : Systemic 10.75-20 fl oz/100gal 12-16 fl oz/100 gal 12-16 oz/100 gal 20 fl oz /100 gal 10.75-20 fl oz/100 gal 12-16 oz/100 gal See product label for rates.	12	Apply as buds break in the spring. Repeat application on 7-14 day intervals during disease period. Rotations with chlorothalonil or propiconazole can be utilized.
	<i>thiophanate methyl +mancozeb</i> Zyban WSB	1 + M3	ACTIVITY : Systemic/Contact 24 oz/100 gal (4 Bags)	24	Re-apply at weekly intervals. Limit to 20 applications per year.
	<i>trifloxystrobin</i> Compass O 50WDG	11	ACTIVITY : Systemic 2-4 oz/100 gal	12	Do not apply to Poinsettia. Apply at first sign of disease and continue at 7-14 day intervals. Rotate with fungicide with different Activity of action.
	<i>triflumizole</i> Terraguard SC	3	ACTIVITY : Systemic 4-8 oz/100 gal	12	Apply foliar sprays at 7-14 day intervals. Use high rate for initial application.
Sclerotinia blight, stem rot, white mold (<i>Sclerotinia</i> spp.)	<i>azoxystrobin</i> Heritage	11	ACTIVITY : Systemic 1-4 oz/100 gal (directed spray) 0.2-0.9 oz/100 gal (drench)	4	Repeat every 7-21 days for directed spray. Use 1-2 pt of solution per sq.ft. surface area, every 7-28 days for drench.
	<i>chlorothalonil</i> Daconil Zn Daconil Ultrex Daconil Weather Stik + many other formulations	M5	ACTIVITY : Contact 2 pt/100 gal 1.4 lb/100 gal 1 3/8 pt/100 gal See product label for rates.	12	Re-apply at 7-14 day intervals. Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts.
	<i>chlorothalonil + thiophanate methyl</i> Spectro 90WDG	M5 + 1	ACTIVITY : Contact/Systemic 1-2 lb/100 gal	12	Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Minimum 7-day re-treatment interval. Do not exceed 2.15 lb/A of product.
	<i>cyprodinil + fludioxonil</i> Palladium	9 + 12	ACTIVITY : Systemic/Contact 2-4 oz/100 gal	12	Begin applications prior to the onset of disease, and repeat applications at 7-14-day intervals if conditions remain favorable for disease development. Ensure full spray coverage of all stems and inner areas of plants to the soil/ media level.
	<i>fluoastrobilin</i> Disarm O	11	ACTIVITY : Systemic 2-4 oz/100 gal	12	Apply at 7-28 day intervals regularly. Under light disease pressure, use lower rates (1-2 oz/100 gal) on a 7-14 day interval or the higher rates (3-4 oz/100 gal) on a 14-28 day interval. Under high disease pressure, use the higher rates on a 7-14 day interval.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Sclerotinia blight, stem rot, white mold (<i>Sclerotinia</i> spp.) (continued)	<i>iprodione + thiophanate methyl</i> 26/36	2 + 1	ACTIVITY : Systemic Drench: 13.5 fl oz/100 gal	12	Do not use as a drench on impatiens, petunia, or Pothos.
	<i>metconazole</i> Tourney	3	ACTIVITY : Systemic 1-4 oz/100 gal	12	Apply to the point of drip at 14-28 day intervals.
	PCNB Turfcide 10G	14	ACTIVITY : Contact 20 lb/100 sq ft	12	** Do not use on Philodendron or Pilea. Apply at seeding and/or transplant. Mix into top 2-3" of soil. Apply 1 week prior to planting. Apply evenly over soil and mix into soil at a depth of 4 in.
	<i>thiophanate methyl</i> Allban Flo 3336 F 3336 EG SysTec 1998 WDG OHP 6672 4.5F OHP 6672 50WP + many more formulations	1	ACTIVITY : Systemic 10.75-20 fl oz/100gal 8-16 fl oz/100 gal (Drench) 8-16 oz/100 gal 16-24 oz/100 gal (Plant dip) 0.3-0.8 lb/100 gal 10.75-20 fl oz/100 gal 12-16 oz/100 gal See product label for rates.	12	Apply as a heavy spray or drench at the rate of 0.5-2 pt/sq ft (100 gal/1,600-400 sq ft). Repeat applications may be made at 7-14 day intervals. Do not apply to plug trays or seeding flats at the time of seeding.
	<i>triticonazole</i> Trinity	3	ACTIVITY: Systemic 8-12 fl oz/100 gal	12	Stem areas of the plants must be thoroughly covered until run-off.
Septoria leaf spot see Cercospora leaf spot as fungicides are the same.					
Shot Hole leaf spot (fungal and bacterial)	<i>copper sulfate</i> Basicop	M1	ACTIVITY : Contact 2-4 lb/100 gal/A	24	Apply preventively, and repeat application every 7-10 days and after rains.
	<i>copper hydroxide</i> CuPRO 2005 T/N/O Nu-Cop 50 DF Nu-Cop HB Nu-Cop 3L	M1	ACTIVITY : Contact 0.75-2 lb/A 1.0 lb/100 gal 0.5 lb/100 gal 1 1/3 pt/100 gal	24-48 (check label)	Do not apply in spray solutions having pH less than 6.5. Do not tank mix with Aliette or other phosphante fungicides. Begin application at the first sign of disease and repeat at 7-14 day intervals.
	<i>copper hydroxide + mancozeb</i> Junction	M1 + M3	ACTIVITY : Contact 1.5-3 lb/A	48	Do not apply in spray solutions having pH less than 6.5. Reapply at 7-14 day intervals.
	<i>mancozeb</i> Dithane 75DF Fore 80WP Mancozeb DG Pentathlon DF Pentathlon LF Protect DF	M3	ACTIVITY : Contact 1-2 lb/100 gal 1.5 lb/100 gal 1.5 lb/100 gal 1-2 lb/100 gal 0.8-1.6 qt/A/100 gal 1-2 lb/100 gal	24	Addition of a spreader sticker will improve performance. Repeat application on 7-10 day intervals. Do not use Fore on Pachysandra.
	<i>metconazole</i> Tourney	3	ACTIVITY : Systemic 1-4 oz/100 gal	12	Apply to the point of drip at 14-28 day intervals.
	Southern Blight (<i>Sclerotium rolfsii</i>)	<i>azoxystrobin</i> Heritage	11	ACTIVITY : Systemic 1-4 oz/100 gal (directed spray) 0.2-0.9 oz/100 gal (drench)	4
<i>benzovindiflupyr + azoxystrobin</i> Mural		7 + 11	ACTIVITY: Contact/Systemic 5-7 oz/100 gal (directed soil spray) 2-3 oz/100 gal (drench)	12	Do NOT apply to apple, crabapple, flowering cherry, privet, leatherleaf fern or other fern used for cut foliage. Apply at 7-21 day intervals for directed soil spray or 7-28 days for a drench application.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Disease	Fungicide	MOA (FRAC)	General Rate	REI (hours)	Remarks
Southern Blight (<i>Sclerotium rolfsii</i>) (continued)	<i>cyprodinil + fludioxonil</i> Palladium	9 + 12	ACTIVITY : Systemic/Contact 2-4 oz/100 gal	12	Begin applications prior to the onset of disease, and repeat applications at 7-14-day intervals if conditions remain favorable for disease development. Ensure full spray coverage of all stems and inner areas of plants to the soil/ media level.
	<i>flutolanil</i> ProStar 70WP	7	ACTIVITY : Systemic 3-6 oz/100 gal	12	Drench at 1-2 pt/sq ft. Re-apply 21-28 days after initial application, if needed.
	<i>fludioxonil</i> Emblem Medallion WDG	12	ACTIVITY : Contact 2 pt/sq ft 2 pt/sq ft	12	Wet entire medium.
	<i>fludioxonil + mefenoxam</i> Hurricane WP	12 + 4	ACTIVITY : Contact 0.75 oz/100 gal (drench at seeding) 1.5 oz/100 gal (2 packets) as drench of cuttings and transplants + Add 1 oz Medallion WDG fungicide/100 gal solution	48	Application to Impatiens, New Guinea Impatiens, Pothos, Geranium, and Easter Lily may cause stunting and/or chlorosis. Do not use on leather leaf fern. Add Medallion fungicide at 1 oz/100 gal water as a tank mix. Make only one application to seedling crop prior to transplanting to larger containers. For cuttings or transplants, re-treat at 21-28 day intervals if needed. For use only in greenhouses, containers, and enclosed structures.
	<i>fluoxastrobin</i> Disarm O	11	ACTIVITY : Systemic 2-4 oz/100 gal (Crown spray) 0.15-0.6 oz/100 gal (Drench or surface spray)	12	Apply at 7-21 day intervals for crown spray and 14-28 day interval for drench or surface spray application.
	<i>PCNB</i> Terraclor 400	14	ACTIVITY : Contact Drench: 3 pt/100 gal Lilies: 6-9 pt/100 gal	12	** Do not use on Philodendron or Pilea. Broadcast evenly on soil and incorporate into top 2-3" by rototilling or discing. Repeat once 4-6 weeks later, if necessary.
	<i>tebuconazole</i> Torque	3	ACTIVITY : Systemic 4-10 fl oz/100 gal	12	Apply at least 3 times per year, 14-21 days apart beginning with spring bud break. Rotate with a fungicide in a different class (different FRAC #) to reduce fungicide resistance development. Do not use on African violet, begonia, Boston fern, or geranium.
	<i>thiophanate methyl</i> 3336 F 3336 EG SysTec 1998 WDG OHP 6672 4.5 F OHP 6672 50WP + many more formulations	1	ACTIVITY : Systemic 16-24 fl oz/100 gal 16-24 oz/100 gal 0.8 lb/100 gal 10.75-20 fl oz/100gal 12-16 oz/100 gal See product label for rates.	12	Not recommended for use on Boston fern, Swedish Ivy or Easter Cactus. Apply as a heavy spray or drench at rate of 0.5-2 pt/sq ft (100 gal/1,600-400 sq ft). Applications can be re-applied at 7-14 day intervals.
Volutella blight (<i>Volutella buxi, V. pachysandrae</i>)	<i>chlorothalonil</i> Daconil Zn Daconil Ultrex Daconil Weather Stik + many other formulations	M5	ACTIVITY : Contact 2 pt/100 gal 1.4 lb/100 gal 1 3/8 pt/100 gal See product label for rates.	12	Re-apply at 7-14 day intervals. Do not use with mist blowers or high pressure spray equipment in greenhouses.
	<i>chlorothalonil + thiophanate methyl</i> Spectro 90WDG	M5 + 1	ACTIVITY : Contact/Systemic 1-2 lb/100 gal	24	Do not use with mist blowers or high pressure spray equipment in greenhouses. May discolor flowers/bracts. Minimum 7-day re-treatment interval. Do not exceed 2.15 lb/A of product.
	<i>copper hydroxide</i> CuPRO 2005 T/N/O Nu-Cop 50 DF Nu-Cop HB Nu-Cop 3L	M1	ACTIVITY : Contact 0.75-2 lb/A 1 lb/100 gal 0.5 lb/100 gal 1 1/3 pt/100 gal	24-48 (check label)	Do not apply in spray solutions having pH less than 6.5. Do not tank mix with Aliette or other phosphante fungicides. Begin application at the first sign of disease and repeat at 7-14 day intervals.

Table 5-1. Disease Control for Ornamental Plants and Trees in Commercial Greenhouses, Nurseries, and Landscapes (continued)

Volutella blight (<i>Volutella buxi</i> , <i>V. pachysandrae</i>)	<i>copper sulphate</i> pentahydrate Phyton 27	M1	ACTIVITY : Contact 1.5-2.5 oz/100 gal	24	Reapply at 3-5 day intervals.
	<i>mancozeb</i> Dithane 75DF Fore 80WP Mancozeb DG Pentathlon DF Pentathlon LF Protect DF	M3	ACTIVITY : Contact 1-2 lb/100 gal 1.5 lb/100 gal 1.5 lb/100 gal 1-2 lb/100 gal 0.8-1.6 qt/A/100 gal 1-2 lb/100 gal	24	Addition of a spreader sticker will improve performance. Repeat application on 7-10 day intervals. Do not use Fore on Pachysandra.
	<i>mancozeb + myclobutanil</i> Clevis	M3 + 3	ACTIVITY : Contact + Systemic 2 lb/100 gal	24	Begin application at first sign of disease or when plants are well leafed out. Spray at 7-10 day intervals. Addition of spreader-binder or surfactant will improve performance.
	<i>thiophanate methyl + mancozeb</i> Zyban WSB	1 + M3	ACTIVITY : Systemic/Contact 24 oz /100 gal (4 Bags)	24	Re-apply at weekly intervals. Limit to 20 applications/year.

Table 5-2. Relative Effectiveness of Various Chemicals for Disease Control on Ornamental Plants

Extension Plant Pathologists

Jean Williams-Woodward

University of Georgia

Nicole Ward Gaultier

University of Kentucky

Alan Windham

University of Tennessee

Footnotes

¹ Key to Fungicide Groups: 1: methyl benzimidazole carbamates; 2: dicarboxamides; 3: demethylation inhibitors; 4: phenylamides; 5: amines; 7: carboxamides; 9: anilino-pyrimidines; 11: quinone outside inhibitors; 12: phenylpyrroles; 14: aromatic hydrocarbons and heteroaromatics; 17: hydroxyanilides; 19: polyoxins; 21: quinone inside inhibitors; 33: phosphonates; 40: carboxylic acid amines; 43: benzimidazoles; 44: microbial; 45: quinone x-inhibitors.

M: multi-site activity; NC: not classified; P: plant extract; U: unknown

² Restricted Entry Interval (REI) for product

³ Product labeled for use in G = greenhouse; N = nursery; L = landscape.

^{Dr} = Product should be applied as a drench

^S = Product should be applied as a foliar spray

^R = Resistance to this pesticide has been detected in the pathogen population

^V = Product is applied as a vapor from canisters

ⁱ = Incompatible with Rootshield

^a = Do not apply to landscapes associated with apartment buildings, daycare centers, playgrounds, schools, athletic fields, etc...

^b = Only Truban 5G can be used in outdoor beds; Terrazole is for commercial use ONLY; label restricts the use of Terrazole in residential greenhouses or indoor plant sites.

^c = Banol is NOT labeled for field-grown ornamentals

^d = Kocide is only labeled for use on conifers in Christmas tree plantings and silviculture nurseries.

^e = Do NOT apply with mist blowers or high pressure spray equipment in greenhouses.

Note: Recommendations for the use of agricultural chemicals are included here as a convenience to the reader. The use of brand names and mention or listing of commercial products does not imply endorsement nor discrimination against similar products or services not mentioned. Individuals who use agricultural chemicals are responsible for ensuring that the intended use complies with current STATE regulations and conforms to the product label. Examine a current product label before applying any chemical. For assistance, contact your county Cooperative Extension agent.

Table 5-2. Relative Effectiveness of Various Chemicals for Disease Control on Ornamental Plants

Relative control rating: G= good (100-80%); F= fair (79-50%); P= poor (49-0%)

FRAC ¹	Trade name	Active ingredient(s)	REI ²	Sites ³	Bacterial leaf spots/blights	Black root rot (<i>Thielaviopsis</i>)	Botrytis	Cedar rusts	Conifer Tip Blights	Downy mildew	Fire blight	Fungal stem cankers	Fungal leaf spots	Fusarium stem rot	Leaf rusts	Passalora needle blight	Phytophthora root rot	Pythium root rot	Powdery mildew	Rhizoctonia blight/root rot	Notes
1	3336, OHP 6672, Allban, Fungo Flo, Transom, T-Bird, T-Methyl	Thiophanate methyl	12	G, N, L		G ^{Dr}	P-G ^{S,R}		F-G ^S			P-F ^S	F ^S	F-G ^{Dr}		F ^S			F ^S	G ^{Dr}	Do not mix with copper-containing materials or with highly alkaline pesticides such as lime or sulfur.
1 + 2	26/36 Fungicide	Thiophanate methyl + Iprodione	12	G, N, L		G ^{Dr}	P-G ^{S,R}						G ^S	F-G ^{Dr}							Do not apply to Spathiphyllum or New Guinea impatiens. Not effective on <i>Cylindrocladium spathiphylli</i> .
1 + 14	Banrot	Thiophanate methyl + Etridiazole	12	G, N, L		F ^{Dr}								P-F ^{Dr}		P ^{Dr}	G ^{Dr}			F-G ^{Dr}	
1 + M3	Zyban	Thiophanate methyl + Mancozeb	24	G, N, L																	
1 + M5	Spectro 90	Thiophanate methyl + Chlorothalonil	12	G, N, L		F-G ^{Dr}			F-G ^S				G ^S	G ^{Dr}		G ^S			F-G ^S	G ^{Dr}	Do not apply to green or variegated pittosporium or schefflera more than once.
2	Chipco 26019, Iprodione	Iprodione	12	G, N, L			P-G ^{S,R}						F-G ^S	F-G ^{Dr}						F ^{Dr}	Do not apply as a soil drench on Impatiens and Pathos. Do not apply on Spathiphyllum.
3	Banner Maxx, Strider, Fathom ⁱ	Propiconazole	12-24	N, L				F ^S	F ^S				G ^S						G ^S	G ^{Dr}	May cause some growth regulator effects or phytotoxicity, in particular on rose.
3	Bayleton 50	Triadimefon	12	L																	
3	Eagle 20EW	Myclobutanil	24	G, N, L				F ^S					G ^S			F ^S			G ^S		Special use instructions for chrysanthemums. May prevent rooting on some Prunus spp. (e.g., sand cherry)
3	Fungaflor TR ^l	Imazalil	24	G			F-G ^V												G ^V		
3	Terraguard ⁱ	Triflumizole	12	G, N, L		G ^{Dr}													G ^S		Do not apply on impatiens plugs; phytotoxic to some cultivars of impatiens.
3	Torque	Tebuconazole	12	N, L				F ^S					G ^S	F-G ^{Dr}					G ^S	G ^{Dr}	Not for homeowner use. Do not apply to bearing fruit trees or vegetables.
3	Tourney	Metconazole	12	N, L									G ^S						G ^S		May cause growth regulation on some ornamentals.
3	Trinity, Trintiy TR	Triticonazole	12	G									F-G ^S						G ^S		Total Release product in cannisters. For use on floricultural crops.

Table 5-2. Relative Effectiveness of Various Chemicals for Disease Control on Ornamental Plants (continued)

Relative control rating: G= good (100-80%); F= fair (79-50%); P= poor (49-0%)

FRAC ¹	Trade name	Active ingredient(s)	REI ²	Sites ³	Bacterial leaf spots/blights	Black root rot (<i>Thielaviopsis</i>)	Botrytis	Cedar rusts	Conifer Tip Blights	Downy mildew	Fire blight	Fungal stem cankers	Fungal leaf spots	Fusarium stem rot	Leaf rusts	Passalora needle blight	Phytophthora root rot	Pythium root rot	Powdery mildew	Rhizoctonia blight/root rot	Notes
3 + 11	Trigo	Triadimefon + Trifloxystrobin	12	G, N				F ^S					G ^S							G ^S	Do not apply on petunia, violets, or New Guinea impatiens. Do not apply on bearing fruit trees.
3 + M3	Clevis	Myclobutanil + Mancozeb	24	G, N, L				F ^S					G ^S							G ^S	
3 + M5	Concert II ⁱ	Propiconazole + Chlorothalonil	12	N, L ^a				F ^S	F ^S				G ^S							G ^S	Do not apply on African violet, begonia, Boston fern, geranium, variegated and green pittosporium, and schefflera; may cause injury to buds, blooms, or tender new growth.
4	Subdue Maxx	Mefenoxam	0-48	G, N, L							G ^{Dr}						G ^{Dr}	P- G ^{Dr}			Some species of <i>Pythium</i> and <i>Phytophthora</i> are insensitive to this product. A granular formulation of Subdue can also be mixed into the substrate.
4 + 12	Hurricane WDG	Mefenoxam + Fludioxonil	48	G, N													G ^{Dr}	P- G ^{Dr}		G ^{Dr}	
5	Pipron	Piperalin	12	G																G ^S	For use only in greenhouses and similar enclosed structures. May be phytotoxic on flower buds of some plants, check label.
7	Prostar	Flutolanil	12	G, N											F-G ^S					G ^S , ^{Dr}	
7 + 11	Pageant Intrinsic	Boscalid + Pyraclostrobin	12	G, N, L				F-G ^S	F ^S	F ^S			G ^S	F-G ^{Dr}		G ^S	F ^{Dr}	F ^{Dr}	G ^S	G ^{Dr}	Do not mix with organosilicone adjuvants. Impatiens and petunia flowers may become discolored after application. Do not apply on Ninebark or wintercreeper.
7 + 11	Okestra Intrinsic	Fluxapyroxad + Pyraclostrobin	12	G, N, L									G ^V	F-G ^{Dr}		G ^S				G ^S	Do not apply to Ninebark or wintercreeper. May cause flower discoloration on Impatiens and Petunia. Drenching may cause stunting of Carnation/Dianthus, Impatiens, Viola/Pansy.
7 + 11	Mural	Benzovindiflupyr + Azoxystrobin	12	G, N, L				F - G ^S					G ^S								Do not apply to apple, crabapple, flowering cherry (Yoshinala), privet, or leatherleaf fern and other ferns for cut foliage.

Table 5-2. Relative Effectiveness of Various Chemicals for Disease Control on Ornamental Plants (continued)

Relative control rating: G= good (100-80%); F= fair (79-50%); P= poor (49-0%)

FRAC ¹	Trade name	Active ingredient(s)	REI ²	Sites ³	Bacterial leaf spots/blights	Black root rot (<i>Thielaviopsis</i>)	Botrytis	Cedar rusts	Conifer Tip Blights	Downy mildew	Fire blight	Fungal stem cankers	Fungal leaf spots	Fusarium stem rot	Leaf rusts	Passalora needle blight	Phytophthora root rot	Pythium root rot	Powdery mildew	Rhizoctonia blight/root rot	Notes
11	Compass O	Trifloxystrobin	12	G, N, L				F ^S					G ^S				F ^{Dr}		G ^S	F-G ^{Dr}	Do not mix with organosilicone adjuvants. May cause phytotoxicity on pansy.
11	Cygnus	Kresoxim methyl	12	G, N, L									G ^S						G ^S		Do not mix with organosilicone adjuvants; May be phytotoxic to some Prunus spp.
11	Disarm O	Fluoxastrobin	12	G, N						F ^S			F ^S	F ^S			F ^{Dr}		F ^S	F ^{Dr}	Limited host plant list; mostly herbaceous plants and rose.
11	FenStop	Fenamidone	12	G						F ^S			G ^S				F ^{Dr}	F ^{Dr}	G ^S		Do not apply to Oxalis.
11	Heritage	Azoxystrobin	4	G, N, L			F ^S	F ^S		F ^S			G ^S	F-G ^{Dr}		G ^S	P ^{Dr}	P ^{Dr}	G ^S	G ^{Dr}	Do not mix with organosilicone adjuvants.
11	Empress Intrinsic	Pyraclostrobin	12	G, N										F-G ^{Dr}			P ^{Dr}	P-F ^{Dr}		G ^{Dr}	Do not mix with organosilicone adjuvants; Do not apply on Ninebark or Wintercreeper.
9 + 12	Palladium	Cyprodinil + Fludioxonil	12	G, N, L									F ^S						G ^S		Do not apply to leather leaf fern or field-grown fern harvested for floral arrangements; may leave residue on poinsettia with bracts.
12	Medallion, Emblem	Fludioxonil	12	G, N, L		F ^{Dr}	F-G ^S						F ^S	G ^{Dr}						G ^{Dr}	Do not apply on leather leaf fern; may cause stunting or chlorosis on impatiens and some varieties of geranium.
12	Mozart TR	Fludioxonil	24	G			G ^S						F ^S								
14	Terraclor 400	PCNB	12	G, N, L																	
14	Terrazole, Truban	Etridiazole	12	G, N, L ^b						G ^{Dr}							G ^{Dr}	G ^{Dr}			
17	Decree	Fenhexamid	12	G, N			G ^S														Only labeled for Botrytis.
19	Affirm	Polyoxin D zinc salt	4	G, N, L		G ^{Dr}	G ^S			P-F ^S			F-G ^S	F ^S					F-G ^S	F-G ^{Dr}	
21	Segway O	Cyazofamid	12	G, N, L						G ^{S, Dr}							G ^{Dr}	F-G ^{Dr}			
25	Agri-Mycin 17	Streptomycin	12	N, L							F ^{S, R}										Apply in foliar and bud sprays; Do not apply after fruit is visible.
28	Banol		24	G, N ^c													P-F ^{Dr}	P-F ^{Dr}			Phytotoxicity seen in some crops.

Table 5-2. Relative Effectiveness of Various Chemicals for Disease Control on Ornamental Plants (continued)

Relative control rating: G= good (100-80%); F= fair (79-50%); P= poor (49-0%)

FRAC ¹	Trade name	Active ingredient(s)	REI ²	Sites ³	Bacterial leaf spots/blights	Black root rot (<i>Thielaviopsis</i>)	Botrytis	Cedar rusts	Conifer Tip Blights	Downy mildew	Fire blight	Fungal stem cankers	Fungal leaf spots	Fusarium stem rot	Leaf rusts	Passalora needle blight	Phytophthora root rot	Pythium root rot	Powdery mildew	Rhizoctonia blight/root rot	Notes
33	Aliette WDG, Areca	Fosetyl-AI [Aluminum tris (O-ethyl phosphonate)]	12	G, N, L	P - F ^S					G ^S							G ^{S,Dr}	G ^{Dr}	P ^S		Not compatible with flowable formulations of chlorothalonil, mancozeb, triadimefon, fenamirrol, formulations containing thiophanate-methyl and chlorothalonil, or copper fungicides as tank mixtures.
33	Alude, Fosphite, K-Phite, Magellan, Resyst	Mono- and di-potassium salts of phosphorous acid	4	G, N, L	P - F ^S					G ^S							G ^{S,Dr}		F ^S		Do not apply to plants under severe water stress or during very HIGH or very LOW temperatures.
33	Vital	Potassium phosphite	4	G, N, L						G ^S							G ^{S,Dr}		F ^S		Do not apply to plants under severe water stress or during very HIGH or very LOW temperatures.
40	Micora	Mandipropamid	4	G, N						G ^{S,Dr}							F ^{Dr}				This product can also be used on vegetables sold to the retail market in GH with permanent flooring
40	Stature SC	Dimethomorph	12	G, N						G ^{S,Dr}							F ^{Dr}	F ^{Dr}			Active may settle out of solution; requires agitation if left to sit.
40 + 45	Orvego	Dimethomorph + Ametoctradin	12	G, N						G ^{S,Dr}							G ^{Dr}				
43	Adorn	Fluopicolide	12	G, N, L						G ^{S,Dr}							G ^{Dr}	P ^{Dr}			Adorn MUST be tank mixed for resistance management with another product that is registered for use against the target disease. Do not make more than one application of Adorn per crop on poinsettia-phytotoxicity has been observed with repeat applications.
44	Cease	<i>Bacillus subtilis</i> QST 713 strain	4	G, N, L	P-F ^S						P ^S								F ^S		
M1	Camelot O	Copper octanoate	4	G, N, L	F ^S		F ^S				P ^{S,R}		F ^S						G ^S		Do not tank mix with Aliette. Avoid contact with metal surfaces. Discoloration of blooms may occur on certain plant varieties: check label. Do not apply to hibiscus plants in flower.
M1	Cuproxat	Tribasic copper sulfate	48	G, N	F ^S				F-G ^S	F ^S			F ^S			F-G ^S			F-G ^S		

Table 5-2. Relative Effectiveness of Various Chemicals for Disease Control on Ornamental Plants (continued)

Relative control rating: G= good (100-80%); F= fair (79-50%); P= poor (49-0%)

FRAC ¹	Trade name	Active ingredient(s)	REI ²	Sites ³	Bacterial leaf spots/blights	Black root rot (<i>Thielaviopsis</i>)	Botrytis	Cedar rusts	Conifer Tip Blights	Downy mildew	Fire blight	Fungal stem cankers	Fungal leaf spots	Fusarium stem rot	Leaf rusts	Passalora needle blight	Phytophthora root rot	Pythium root rot	Powdery mildew	Rhizoctonia blight/root rot	Notes
M1	CuPRO, Nu-COP, Champ	Copper hydroxide	24-48	G, N, L	F ^S						P ^{S,R}		F ^S			G ^S			G ^S		Do not tank mix with Aliette. Avoid contact with metal surfaces.
M1	Kocide ^d	Copper hydroxide	24	N												G ^S					Do not tank mix with Aliette. Avoid contact with metal surfaces.
M1	Phyton 27	Copper sulphate pentahydrate	24	G, N, L	F ^S		F ^S				P ^{S,R}		F ^S						G ^S		May damage tender open blooms. Do not tank mix with B-NINE or use within 7 days of a B-NINE application.
M1	Phyton 35	Copper sulphate pentahydrate	48	G, N, L	F ^S		F ^S			P ^{S,R}	P ^{S,R}		F ^S						G ^S		Do not apply within 7 days of B-NINE or within 14 days of acidic compounds or Aliette/phosphite applications.
M1 + M3	Junction	Copper hydroxide + Mancozeb	48	G, N, L	F ^S						F ^{S,R}		G ^S						G ^S		Injury may occur from late season application; no post-bloom applications on some plants, check label.
M3	Protect T/O, Fore, Dithane, Pentathlon	Mancozeb	24	G, N, L	F-G ^S	P-F ^{Dr}	F ^S	F ^S		F ^S		F-G ^S	G ^S			G ^S			P ^S	P-F ^{Dr}	Not for use on marigold.
M5	Daconil Ultrex / Weatherstik / Zn, Mainsail	Chlorothalonil	12	G ^e , N, L ^a			G ^S	F ^S					G ^S			G ^S			G ^S		Do not combine in the spray tank with other pesticides or fertilizers unless tested first. Avoid applications during bloom period on some plants: check label. Do not apply on poinsettia during or after bract formation.
M5	Exotherm Termil	Chlorothalonil	12	G			G ^V														Do NOT apply when greenhouse temperature is above 75°F.
NC	Milstop	Potassium bicarbonate	1	G, N, L									P-F ^S						F-G ^S		Do not mix with other pesticides or fertilizers not compatible with mild alkaline solutions. Do NOT apply with Dipel, Latron B-1956, Latron AG-98, or horticultural oil. Does not require the addition of a surfactant. Do not apply within 25-ft of body of water. Do not use on young pansies.
P	Regalia	Extract of Giant Knotweed (<i>Reynoutria sachalinensis</i>)	4	G, N, L						F-P ^S											Concentrations at 1% or higher applied on young tissue may cause phytotoxicity.
U15	Segovis	Oxathiapiprolin	4	G, N, L						G ^{S,Dr}							G ^{S,Dr}				

Table 5-3. Disinfection of Containers, Benches, and Surfaces in Greenhouses and Commercial Nurseries**Jean L. Williams-Woodward**

Extension Plant Pathologist, University of Georgia

For containers, pots, flats, benches and other surfaces

Material and Brand Name	Rate of Use	Application	Use/Remark
<i>alcohol</i> grain rubbing, wood, Lysol Disinfectant Spray (70% to 100%)	Full strength. (Lysol is RTU – read label)	Dip, swab or spray; do not rinse. 10 min for pots, flats, surfaces. Tools can be dipped for 10 sec.	Items that are being treated should be clean of dirt and debris. Temperature should be above 60°F.
<i>chlorine dioxide</i> Selectocide	100 ppm/10 min. or 50 ppm/20 min. for non-porous surfaces. See label for disease control.	Apply by mop, sponge, or sprayer to wet for allotted time. May be applied through irrigation lines.	See Technical Bulletin for product as contact times and concentrations are application-specific.
<i>hydrogen dioxide (hydrogen peroxide), peroxyacetic acid</i> ZeroTol 2.0, SaniDate 5.0, Oxidate 2.0 ZeroTol, SaniDate	0.5 fl. oz to 2.5 fl. oz/gal water for clean non-porous surfaces & tools. Read labels as rates and directions products vary.	Dip, swab, or spray; do not rinse. Contact time of 1-10 min needed.	Sweep and remove all plant and soil debris prior to use. Must be used in neutral pH (~7.0) water. Very corrosive; eye/skin irritant. Must be stored in cool location.
<i>phenolics</i> Lysol Concentrate Disinfectant, Pheno-Cen Spray Disinfectant	1.25 fl. oz (2.5 Tbsp)/gal water. Mix well. Pheno-Cen Spray is RTU.	Dip tools for 10 sec and allow to dry. Do not rinse. 10 min for pots, equipment, surfaces.	Lots of Lysol formulations; they are NOT the same. Make sure product contains 5.5% O-benzyl-p-chlorophenol. Wear gloves; Concentrate harmful to eyes/skin.
<i>quaternary ammonium</i> Triathlon, Physan 20, GreenShield KleenGrow	1 tsp. to 1 Tbsp /gal. See label; varies with surface.	Dip or swab to keep wet for at least 10 minutes. Do not rinse. Allow to air dry.	Not effective on wood or porous surfaces. Effective on non-porous surfaces (floors, walls, metal benches, pots, tools)
<i>sodium carbonate peroxyhydrate</i> TerraCyte, Green Clean	15 lb. over 1000 sq. ft. bed or bench weekly; 1/3-½ tsp /8- or 10-in. pot bi-weekly curative rate.	Evenly distribute over bed, bench or surface of pot. Apply to wet surfaces and rinse granules off foliage to prevent burn.	Apply to wet surfaces. Activated by moisture. Rinse from foliage. Undiluted granules will cause burn on non-target plants.
<i>sodium hypochlorite</i> 8.25% Clorox, Commercial bleach	10% concentration	Dip 1 to 10 seconds, brush, spray, let drain, do not rinse. Best to soak object 10 min.	Change solution at least every hour. Alkaline water (pH>6.8) reduces effectiveness. Chlorine is toxic to some plants.
solarization	140°F, 4 to 8 hr /day for 7 days	Place cleaned items on sunny driveway, cover tightly with clear plastic.	Remove debris from containers and surfaces. Keep surfaces moist.
steam and aerated steam	Heat object to 180°F for 30 min; 140°F for at least 30 min	Loosely stack objects and cover with tarp to seal.	Plastic containers can become brittle after repeated treatment.

Table 5-4. Sterilization and Pasteurization of Soil and Potting Mixes for Greenhouses and Commercial Nurseries**Jean L. Williams-Woodward**

Extension Plant Pathologist, University of Georgia

For soils, soil in plant beds and/or potting mixes

Material	Rate of Use	Application	Relative Effectiveness					Use/Remark
			Weeds*	Nematode	Insects	Bacteria	Fungi	
aerated steam	145-160°F for 30 min.	Same as steam.	good	good	good	good	good	All crops. All pests.
steam	Heat soil to 180° to 200°F (30 min) 6 inches deep	Perforated pipes on or in soil, cover with tarp.	good	good	good	good	good	All crops. All pests.
dry heat	180°F for 30 min.	Place small quantities in oven.	fair	good	good	good	good	
solarization	140°F, 4 to 8 hr. per day for 7 days	Cover pots, benches, tools, shallow soil with plastic tarp or close greenhouse during hot, sunny days in summer for at least 1 week.	fair to poor	fair	good	fair	good	Greenhouse must reach 140°F or higher each day. Remove debris and heat-sensitive materials. Keep greenhouse and contents moist.
<i>dazomet</i> Basamid G (*Restricted Use)	Rates vary. See label. For soilborne pathogens: 10-13 oz/100 ft ²	See label and follow application restrictions.	good	good	fair	good	good	Restricted Use pesticide. Restricted entry for 5 days. Application with handheld equipment is prohibited.
<i>metam sodium</i> Vapam HL (*Restricted Use)	Read Label	Read and follow label directions and use precautions.	good	good	fair	fair	good	NOT for use in greenhouses or other enclosed structures. Applicators must have certified applicator training. All crops, all pests. Long waiting period after fumigating in cold soil (under 60°F).

*Weed control rankings by Joseph C. Neal, North Carolina State University

6. Weed Management

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Weeds reduce the aesthetic qualities of landscape plantings and compete with nursery crops for nutrients, water, and light. Root systems compete for nitrogen and water. Even seemingly non-competitive weeds like bittercress (*Cardamine* spp.) have been shown to reduce growth of container-grown plants. Tall weeds and vines shade crops, reducing photosynthesis and growth. Vining weeds such as morningglory (*Ipomoea* spp.) are particularly damaging because they disfigure stems and new growth. In landscape plantings, weeds must be controlled or removed to maintain quality aesthetics. Weeds may also need to be removed for health and safety reasons. For example, poison ivy (*Toxicodendron radicans*) contains a toxin that causes skin rashes in most people. Weeds with thorns, such as horsenettle (*Solanum carolinense*) and wild blackberry (*Rubus* spp.) are a nuisance to workers and customers. Flowering weeds such as white clover may attract bees, which is a concern if insecticides are being applied or if site users are allergic to bee stings. Additionally, weeds harbor insect pests, disease pathogens, and rodents that can damage nursery crops. For these reasons and more, weed management is a crucial component of crop production and landscape maintenance.

Integrated weed management programs should include assessments of the weed populations (and the necessity of control), cultural practices that can reduce weed populations, and the judicious use of preemergence and/or postemergence herbicides.

Weed Scouting

The first step in any pest management program is to identify the pest(s). Scouting fields for weeds will enable the grower to determine which weeds are present and to plan appropriate management strategies. Weed scouting differs from traditional insect pest scouting programs because most weed control practices are preventative. Thus, weed management decisions are based on field histories rather than on current population densities. Field nurseries and landscape plantings should be scouted at least twice a year, in late summer or early fall, and again in late spring or early summer. In late summer, most summer annual, perennial, and biennial weeds are in bloom and thus easier to identify. In late spring/early summer, winter annuals are in bloom, while perennials and summer annuals that escaped control procedures can be identified. In container nurseries, weed scouting is a continuous process and should be integrated with other production practices. Weed scouting involves assembling an inventory of the weeds in each block. This is done by simply walking each field and recording the species encountered. Then, highlight the most important species – those that are new to the field, most prevalent, or those requiring specialized control programs. Infestations of perennial weeds should be mapped so maintenance staff can return to these locations when weed control treatments are needed. With this information, the grower or landscape professional can better plan a weed management program that matches the needs of each crop and field.

Cultural Practices that Reduce Weed Populations

Sanitation practices that exclude weed introductions and prevent spread are cornerstones of an integrated weed management plan. Sanitation, in particular, is an under-recognized and under-utilized component of nursery and landscape weed management plans and programs. This includes a commitment to weed prevention and management throughout the site and throughout the crop production cycles. In container nurseries, this begins with weed-free substrates. Store pots and flats where they will not be contaminated with weed seeds, keep liners and liner production areas as weed free as possible, and prevent the introduction and spread of weeds into production systems. In field nurseries and landscapes, be sure to control perennial and other hard-to-kill weeds before planting. After planting, monitor fields regularly for introduced weeds or hard-to-control species. Control these species before they can spread. It's much easier to prevent weeds from getting out of hand than it is to clean up a weedy site.

In landscape plantings, mulches can suppress most small-seeded annual weeds. Many types of mulches are available, including barks, pine straw, municipal composts, crushed rocks, and others. All such mulches suppress annual weeds by excluding light and by being a physical barrier.

When mulches are too fine, too thick, or begin to decompose, they stay wet between rain events, allowing weeds to germinate and grow directly in the mulch. Therefore, for weed control, a fairly coarse-textured mulch with a low water-holding capacity would be preferable. To effectively suppress weeds, the depth of organic mulches should be about 3 to 4 inches. Plan for periodic replenishment. When used alone, mulches rarely provide 100% weed control. Supplemental hand weeding or herbicide applications will generally be necessary.

Preemergence and Postemergence Herbicides

Herbicides are relatively inexpensive and effective means of controlling weeds. Yet, these tools must be used with care and understanding to control weeds without risking damage to your crops, nearby plantings, or the environment.

Preemergence herbicides are important components of most nursery and landscape weed management plans. They work by forming a residual barrier in the soil surface that prevents weed seedling emergence. Thus, application timing is critical to ensure the herbicide barrier is present before weeds germinate, and herbicides must be re-applied to maintain control throughout the growing season. In container nurseries, three to six applications are required per year. In field nurseries or landscapes, two to three applications are required. The reapplication timings will depend on the herbicide used, the application rate, the watering frequency/daily amount, and local environmental conditions. Perhaps more importantly, the need for reapplication will depend on weed populations. Sites with a history of heavy weed infestations will need more frequent herbicide applications than will sites with a history of few weeds.

When weeds escape the preemergence herbicide application, postemergence herbicides are often used. Postemergence herbicides control weeds after they have emerged. They may be selective or non-selective, contact action or systemic. Diquat, glufosinate, and glyphosate are examples of non-selective postemergence herbicides, injuring any vegetation contacted. Clethodim, fluazifop-p, and sethoxydim are examples of selective postemergence herbicides that control grass weeds but not broadleaf weeds. Selective herbicides may sometimes be used as broadcast treatments over the top of some ornamental crops, but one cannot assume these products can be safely applied to all ornamental plants. Non-selective herbicides may be used in many production and landscape settings as "directed sprays," avoiding contact with desirable plants. Postemergence herbicides may also be categorized as contact or systemic. For example, glyphosate is systemic, translocating to the roots, thereby killing the entire plant. It is effective on annual and perennial weeds. Diquat and paraquat are contact-type herbicides, controlling small annual weeds but only "burning-back" perennial or large annual weeds since these herbicides do not directly affect underground plant parts.

Resistance Management

Herbicide-resistant weeds are common in most agronomic crops in the United States. While not currently widespread in nursery crops, herbicide-resistant weeds are becoming an increasing threat to nursery crops. Rotating herbicide modes of action and using multiple control tactics will delay or prevent the development and spread of herbicide-resistant weeds. The Weed Science Society of America (www.wssa.net) has grouped herbicides into MOA categories, which are listed in this guide to aid in the development of resistance management programs.

Alternatives to Herbicides

Alternatives to herbicides do exist. Weeds can be controlled by thermal devices – flame, steam, or hot foam weeders. These devices function similarly to non-selective, contact herbicides, controlling the above-ground vegetation contacted by the treatment. Effective control of seedling annual weeds may be obtained, but larger annual weeds and perennials will grow back rapidly, necessitating multiple treatments.

Mechanical control, using hand-held or tractor-mounted cultivators, may also be used to control weeds. Mechanical cultivation works best when weeds are very small. Soil cultivation can be effective, but it will also increase soil erosion and may damage shallow-rooted crops. Thus, reliance on cultivation for annual weed control in field nurseries is discouraged. Hand removal will always be a part of weed management plans for landscape plantings and container nurseries. When hand weeding, remove weeds when they are young, before they have a chance to establish an extensive root system and before they flower. String trimmers may be used to cut weeds off at the ground. If this trimming is done at the right time, it can prevent reproduction by seed. Mowing will reduce the height of weeds, improving site aesthetics, but mowed weeds are nearly as competitive as unmowed weeds in field nurseries.

In landscape plantings, alternative "natural" chemical treatments are sometimes preferred over synthetic herbicides. Several such products are available in retail markets and some are certified organic by the Organic Materials Review Institute (OMRI). These products generally include vinegar (acetic acid) along with one or more natural oils (such as clove oil, oregano oil, citrus oil, and others). All of these products provide non-selective, contact-type weed control. Seedling annual broadleaf weeds may be well controlled but grasses, large broadleaf weeds, and perennial weeds will exhibit foliar injury then plants will re-grow, necessitating repeated treatments. Additionally, users should be aware that "natural" is not synonymous with "safe." Many of these "natural" products have higher acute toxicities to the user than synthetic herbicides.

Field Nursery Weed Control Calendar

There is no single weed control plan that fits all fields, but the generic calendar below can provide a starting point to develop your weed management plan.

Table 6-1. Generic Weed Control Calendar

Task	Late Winter	Early Spring	Late Spring	Early Summer	Mid-Summer	Late Summer	Early Fall
Weed scouting			X	X			X
Preemergence herbicides	X		X			X	
Postemergence herbicide applications			spot treat	spot treat	spot treat	spot treat	treat perennial weeds
Sprayer maintenance	X						
Nutsedge control	PRE	PRE	PRE	POST	POST	POST	

Many herbicides are available for each of the timings listed above. Product selection is based on safety to crop species and the target weeds, and some weed species will “drive” your choices. A few examples include the following:

- If yellow nutsedge is present in the field, the late-winter, early-spring or late-spring preemergence herbicide application should include a residual herbicide such as dimethenamid-p or s-metolachlor that specifically targets yellow nutsedge. These products would typically be combined with simazine, flumioxazin, or isoxaben for improved broadleaf weed control, depending on the crop species. A second preemergence application of a yellow nutsedge control product will be needed about 2 months later for longer-term suppression. You may also need a postemergence yellow nutsedge herbicide at that time.
- Morningglory is particularly difficult to control in field nurseries. When present, the late winter preemergence herbicide application is often supplemented with a late spring or early summer application of flumioxazin or simazine.
- If eclipta is present in the field, you might select indaziflam or simazine for the late spring application.

Emerged weeds should be removed when they are small, before they can compete with the crop and before they can spread. Creeping perennial weeds like bindweed and horsenettle should be aggressively managed to locally eradicate them. Sometimes, this may require leaving fields fallow for a season.

Suggested Preemergence Herbicide Rotational Regimens for Container-Grown Woody Plants

Weed control in container nursery crops requires a 12-month plan, and it relies upon multiple applications of preemergence herbicides, supplemented with hand weeding and other sanitation practices. Our research evaluating the longevity of residual weed control in southeastern container nurseries has demonstrated that preemergence herbicides typically provide less than 8 weeks of residual weed control. Additionally, year-round weed control is required for woody perennial crops. Thus, three to six applications of preemergence herbicides are necessary to maintain residual weed control in container nurseries. The most cost-effective weed control program will optimize preemergence herbicide selection based on the crops being grown and weeds present (or expected). For example, bittercress is dominant in late fall, winter, and spring. Therefore, you should make sure that the preemergence herbicide selected at those times of year will provide control of bittercress. Likewise, in the summer months when spotted spurge is the dominant broadleaf weed, herbicides chosen for use in the summer should be effective on this species and other target summer annual weeds of importance at your site.

An example: Granular herbicides for shrub roses, spring potted for fall sales.

While no single herbicide program will fit all nursery sites, the following are some suggested starting points for granular herbicide rotations. Common groundsel and bittercress are dominant weeds in spring and fall, while spotted spurge, eclipta, sedges, and doveweed are dominant weeds in the summer. At the time of the second application, there will be mixtures of summer and winter annuals present, such as bittercress

Table 6-2. Suggestions for Granular Herbicide Rotations

Timing	Primary weeds of concern			
	Bittercress and Spotted spurge	Eclipta, Common groundsel	Bittercress, Annual sedges, Doveweed	Flexuous bittercress, Annual grasses
Appl. 1. At spring potting	Oxyfluorfen combination granule (Biathlon, HGH, OH2, Rout, or Regal OO)	Oxyfluorfen combination granule	Oxyfluorfen combination granule	Ronstar G
Appl. 2. 8-10 weeks, late spring	Freehand	Marengo	FreeHand	Oxyfluorfen combination granule
Appl. 3 ~16 weeks, mid-summer	Snapshot	BroadStar	BroadStar	Marengo
Appl 4. ~24 weeks, late summer	Marengo	Oxyfluorfen combination granule	Marengo	Snapshot

and spotted spurge. As you can see, the options can be diverse. Select from herbicides with which you have had experience and success. Re-treatments should be on a regular schedule. We recommend every 8 to 10 weeks.

These are only four possibilities — many other rotational programs are possible and necessary. Modify these options into a strategy that addresses your particular situation. Longer-term crops will require additional treatments. Here are a few important points to consider.

- Some herbicides should not be applied immediately after potting. In this example, we avoid applications of Broadstar, Freehand, or Marengo on newly potted rooted cuttings of several crop species to ensure the new plants are off to a good start.
- Some herbicides should not be applied sequentially. We have found that “back to back” applications of some herbicides will stunt crops. It is better to rotate to different modes of action.
- Optimize herbicide selections based on the field history of weed species. If you had long-stalked phyllanthus in the field last year, it will likely be back again this year. So, you should select your herbicide for the summer months with this in mind. In this case, summer treatments should include products that are effective on both spotted spurge and long-stalked phyllanthus. Other species, such as eclipta or doveweed, may necessitate different herbicide selections.
- The last application in the fall should be made 2 to 3 weeks before winter covers are in place, and it should include an herbicide for bittercress control. Other winter weeds that may affect your product choices include groundsel, marsh parsley, willowherb, pearlwort, or sowthistle.
- Avoid treatments during and shortly after bud break for both spray and granular herbicides. The potential for injury is greatest at this time and least when plants are dormant.
- Apply herbicides uniformly and accurately.
- Hand weed frequently to prevent “escaped” weeds from reproducing and spreading.

Selecting the Right Herbicides

If you decide to use an herbicide, consider the following selection criteria:

1. Herbicide selection starts with determining which are safe on the ornamental species. Use the charts contained herein to guide these selections.
2. From that list of products, select one that controls most of the weeds present (no herbicide will control all weeds). Combination treatments are sometimes needed to control a diversity of weeds.
3. Consider the proximity of susceptible species and the likelihood of exposure, including potential residual effects on subsequent plantings (such as an annual flower bed).
4. Apply the herbicide(s) accurately and uniformly.

More detailed guidelines on nursery and landscape weed management are available from your local Cooperative Extension Service and in the Southern Nursery IPM manuals listed below.

IPM for Select Deciduous Trees in Southeastern US Nursery Production

https://wiki.bugwood.org/IPM_book

IPM for Shrubs in Southeastern US Nursery Production: Vol. I

https://wiki.bugwood.org/IPM_Shrub_Book

IPM for Shrubs in Southeastern US Nursery Production: Vol. II (coming soon)

<https://wiki.bugwood.org/SNIPM>

Additional resources:

Weed Management in Nurseries, Landscapes and Christmas trees. <https://weeds.ces.ncsu.edu/>

Table 6-3. Chemical Weed Control in Ornamentals

More detailed information about herbicides labeled for use in nursery crops and landscape plantings is available at the NCSU Extension Portal: "Weed Management in Nurseries, Landscapes and Christmas Trees," <https://weeds.ces.ncsu.edu/>

Weed	Herbicide and Formulation	Mode of Action	Amount Formulation Per Acre	Pounds Active Ingredient Per Acre	Precautions and Remarks
Preplant to all Ornamentals					
Most annuals and perennials	dazomet MOA 27 (Basamid granular)	27	218 to 525 lb	216 to 520	Preplant soil fumigant. Dazomet is a restricted-use pesticide. Follow label directions and restrictions. Incorporate to 8 inches deep. Drench with water or cover with plastic for best results. Planting must be delayed until fumigant has dissipated from the soil. This may take a month or more.
	diquat dibromide MOA 22 (Reward) 2 L	22	1 to 2 qt	0.5 to 1	Non-selective, contact-type, postemergence control of seedling weeds. A nonionic surfactant should be added to the spray solution. Apply for full coverage and thorough weed contact. Retreatment will be necessary for established weeds. May be used in landscapes, nurseries, and greenhouses.
	glufosinate MOA 10 (Finale) 1 L	10	3 to 6 qt	0.75 to 1.5	Non-selective postemergence control of weeds. Thorough coverage is essential. Apply in a minimum of 20 gallons of water per acre. No residual control. Repeat applications may be necessary for control of perennial weeds.
	glyphosate MOA 9 (Roundup Pro, Touchdown Pro, and many others)	9	1 to 5 qt	1 to 5	Non-selective, systemic herbicide. Apply to emerged weeds prior to planting ornamentals.
	paraquat MOA 22 (Gramoxone Extra) 2.5 L	22	2 to 3 pt	0.6 to 0.9	Non-selective, contact herbicide. Apply when grass and weeds are 1 to 6 inches high and succulent for best results. Direct spray with low pressure to avoid contact with foliage or bark of crop less than 1 year old. Add nonionic surfactant, 0.25% by volume (2 pints per 100 gallons of water). Not for use in landscapes or greenhouses.
Post-plant Preemergence Weed Control					
Annual grasses and broadleaf weeds (preemergence) See label for susceptible species	benefin + oryzalin MOA 3 (XL) 1 + 1 G	3	200 to 300 lb	2 to 3 + 2 to 3	Apply preemergence to weeds. May be applied in spring and fall to ornamental plants.
	dichlobenil MOA 20 (Casoron) 4 G	20	100 to 150 lb	4 to 6	Do not use on fir, hemlock, <i>Ilex crenata</i> , <i>I. rotunda</i> , or <i>I. vomitoria</i> . Do not use more than 6 pounds per acre on azalea, rhododendron, boxwood, holly, euonymus, forsythia, leucothoe, ivy, lilac, heather, or any plantings less than 1 year old. Do not use in seedbeds, cutting, or transplant beds. Do not apply until 4 weeks after transplanting any plants. Apply in winter. http://content.ces.ncsu.edu/casoron-dichlobenil
	dithiopyr MOA 4 (Dimension) 2 EW 40 WP	4	2 pt 20 oz	0.5	Preemergence control of annual grasses and some small seeded broadleaf weeds in turf, landscape plantings, and nurseries. Use as a directed application around ornamental plants unless specified otherwise on the product label. See label for tolerant species and restrictions. http://content.ces.ncsu.edu/dimension-dithiopyr
	dimethenamid-p MOA 15 (Tower) 6 EC	15	21 to 36 oz	1 to 1.5	Preemergence control of annual sedges, annual grasses, and many annual broadleaf weeds in woody landscape plantings and field and container nurseries. Suppression of yellow nutsege. Avoid foliar treatments over the top of early spring growth flushes as injury to ornamental plants can occur. http://content.ces.ncsu.edu/tower-dimethenamid-p
	dimethenamid-p + pendimethalin MOA 15 + 3 (Freehand) 1.75 (0.75 + 1) G	15 + 3	100 to 200 lb	1.75 to 3.5	Preemergence control of annual grasses and many broadleaf weeds from seed as well as suppression of yellow nutsedge in container and field nurseries and woody landscape plantings. http://content.ces.ncsu.edu/freehand-dimethenamid-p-pendimethalin
	flumioxazin MOA 14 (Broadstar) G	14	150	0.375	Preemergence control of most annual broadleaf and annual grasses in container and field-grown woody nursery crops. Not for use in landscape plantings. See label for species and precautions. Do not apply to wet foliage or newly potted liners. http://content.ces.ncsu.edu/broadstar-flumioxazin
	flumioxazin MOA 14 (Sureguard) DG	14	0.75 lb	0.375	Preemergence control of most annual broadleaf and annual grasses, and early postemergence control of seedling broadleaf weeds in field and container-grown woody nursery crops and certain landscape plantings. See label for species and precautions. https://content.ces.ncsu.edu/sureguard-flumioxazin
	imazaquin MOA 2 (Image) 1.5 LC	2	1 to 1.3 qt	0.4 to 0.5	Apply as a directed spray away from rooting zone. Labeled for over-the-top sprays on a few species.

Table 6-3. Chemical Weed Control in Ornamentals (continued)

Weed	Herbicide and Formulation	Mode of Action	Amount Formulation Per Acre	Pounds Active Ingredient Per Acre	Precautions and Remarks
Post-plant Preemergence Weed Control (continued)					
Annual grasses and broadleaf weeds (preemergence) See label for susceptible species (continued)	Indaziflam MOA 21 (Marengo) 0.0224% G	29	100 to 200 lb	0.022 to 0.044	Preemergence control of many annual weeds in container or field grown nursery crops. Not labeled for use in landscape plantings. See label for specific species. http://content.ces.ncsu.edu/marengo-indaziflam
	(Marengo) 0.622 SC		7.5 to 15.5 fl oz	0.036 to 0.075	Preemergence weed control in field grown nursery crops Use as a directed spray. Also for use as a ground treatment in container nurseries and greenhouses (and similar covered structures). When treating inside covered houses, structures should have no crop present at the time of treatment. See label for full details.
	Indaziflam MOA 21 (Specticle) 0.0224% G	29	100 to 200 lb	0.022 to 0.044	Preemergence control of many annual weeds in established woody landscape plantings. Do not use in areas planted to or to be planted to bedding plants. Labeled for use on a limited number of herbaceous perennials. The GR formulation is less injurious to ornamental plants than the SC formulation. The SC formulation should be applied as a directed spray, avoiding contact with the foliage of ornamental plants. Check labels for details.
	(Specticle) 0.622 SC		6 to 12 fl oz	0.029 to 0.058	
	isoxaben MOA 21 (Gallery) 75 DF	21	0.66 to 1.33 lb	0.5 to 1	Use as preemergence control of broadleaf weeds in many field and container grown ornamentals, turf, and landscape plantings. Generally used in combination with another herbicide for broader spectrum weed control. http://content.ces.ncsu.edu/gallery-isoxaben
	(Gallery) 4.16 SC		16 to 31 fl oz		
	isoxaben + prodiamine MOA 21 + 3 (Gemini) 3.7 SC (1.5 + 2.2)	21 + 3	43.5 to 87 fl oz	1.25 (0.5 + 0.75) to 2.5 (1 + 1.5)	Preemergence control of weeds in field- and container-grown ornamentals and landscape plantings. See label for specific species.
	isoxaben + trifluralin MOA 21 + 3 (Snapshot TG) 2.5 G	21 + 3	100 to 200 lb	2.5 to 5	Preemergence control of weeds in field- and container-grown ornamentals and landscape plantings. See label for specific species. https://content.ces.ncsu.edu/snapshot-tg-isoxaben-trifluralin
	S-metolachlor MOA 15 (Pennant Magnum) 7.62 EC	15	1.3 to 2.6 pt	1.2 to 2.5	Preemergence control of annual grasses, annual sedges, and some annual broadleaf weeds including doveweed, as well as suppression of yellow nutsedge. Apply to soil surface immediately after planting. Avoid foliar treatments over the top of early spring growth flushes as injury to ornamental plants can occur. https://content.ces.ncsu.edu/pennant-magnum-s-metolachlor
	napropamide MOA 15 (Devrinol) 50 DF	15	8 to 12 lb	4 to 6	Apply preemergence to weeds and as a directed spray in ornamentals. Can be used in field or container nurseries or landscape plantings. If broadcast over top of ornamentals, irrigate soon after application to reduce risk of foliar injury. https://content.ces.ncsu.edu/devrinol-napropamide
	oryzalin MOA 3(Surflan) 4 AS	3	2 to 4 qt	2 to 4	Preemergence to weeds in field or container nurseries or landscape plantings. Apply only to established plantings. Do not use in seedbeds or transplant beds. Not recommended for use on soils containing more than 3% organic matter. Use higher rate for longer term control. Do not apply on hemlock. http://content.ces.ncsu.edu/surflan-oryzalin
	oxadiazon MOA 14 (Ronstar) 2 G	14	100 to 200 lb	2 to 4	Apply preemergence to weeds. Can be used on container- and field-grown ornamentals. Repeat applications are labeled for some species. Injury has been observed on ajuga, liriopse, mondo, and fig. Granules may burn tender foliage of several species if irrigation is not used to wash them off. Caution: Plants that trap granules in leaf axil can be injured.
	oxyfluorfen MOA 14 (Goal) 2 XL	14	5 to 10 pt	1 to 2	Preemergence and postemergence control of many broadleaf and grass weeds in conifers and dormant deciduous trees. Do not apply when conifers have young tender growth. Lower rates are used in conifer seedbeds and for postemergence treatments. https://content.ces.ncsu.edu/goal-goaltender-oxyfluorfen
(Galigan) 2E					
oxyfluorfen + oryzalin MOA 14 + 3 (Rout) 3 (2+1) G	14 + 3	100 lb	3 (2 + 1)	Apply preemergence to weeds. Can be used on container and field-grown ornamentals. Repeat applications are labeled. Injury is to be expected to herbaceous plants or to plants with leaf orientation that might trap granules. Check label for genera of plants on which it can be used.	
oxyfluorfen + oxadiazon MOA 14 (Regal OO) 3 (2 + 1) G	14 + 14	100 lb	3 (2 + 1)	Apply preemergence to weeds. May be used on container- or field-grown woody ornamentals, including liner production. Injury is to be expected to herbaceous plants or to plants with leaf orientation that might trap granules. Check label for genera of plants on which it can be used. https://content.ces.ncsu.edu/regal-o-o-oxyfluorfen-oxadiazon	
oxyfluorfen + pendimethalin MOA 14 + 3 (Ornamental Herbicide 2) 3 (2+1) G	14 + 3	100 lb	3 (2 + 1)	Apply preemergence to weeds. Can be used on container- and field-grown ornamentals. Repeat applications are labeled. Injury is to be expected to herbaceous plants or to plants with leaf orientation that might trap granules. Check label for genera of plants on which it can be used. https://content.ces.ncsu.edu/regal-o-o-oxyfluorfen-oxadiazon	

Table 6-3. Chemical Weed Control in Ornamentals (continued)

Weed	Herbicide and Formulation	Mode of Action	Amount Formulation Per Acre	Pounds Active Ingredient Per Acre	Precautions and Remarks
Post-plant Preemergence Weed Control (continued)					
Annual grasses and broadleaf weeds (preemergence)	oxyfluorfen + prodiamine MOA 14 + 3 (Biathlon) 2.75 G	14 + 3	100 lb	2.75 (2 + 0.75)	Apply preemergence to weeds. Can be used on container- and field-grown ornamentals. Repeat applications are labeled. Injury is to be expected to herbaceous plants or to plants with leaf orientation that might trap granules. Check label for genera of plants on which it can be used. https://content.ces.ncsu.edu/biathlon-oxyfluorfen-prodiamine
See label for susceptible species (continued)	oxyfluorfen + trifluralin MOA 14 + 3 (HGH 75) 5 (2 + 3) G	14 + 3	100 lb	5 (2 + 3)	Preemergence control of annual grasses and broadleaf weeds in container- and field-grown woody ornamentals and landscape beds. Injury is to be expected to herbaceous ornamentals or plants with leaf orientation that might trap granules. https://content.ces.ncsu.edu/hgh-75-oxyfluorfen-trifluralin
	pendimethalin MOA 3 (Corral, Pendulum) several formulations	3	See label	2 to 4	Preemergence control of annual grasses and some broadleaf weeds in turf, landscape plantings, container and field-grown nursery crops, and Christmas trees. Pendulum Aqua Cap is labeled only for turf and landscape uses. See labels for details. https://content.ces.ncsu.edu/pendulum-aquacap-coral-pendimethalin
	prodiamine MOA 3 (Barricade) 65 WG, 4 FL (Regalkade) 0.5 G	3	1 to 1.15 lb 21 to 48 oz 150 lb	0.65 to 0.75	Apply preemergence to weeds. Labeled for use in turf, landscape plantings, and nurseries. See label for tolerant species and restrictions. https://content.ces.ncsu.edu/barricade-prodiamine-regalkade-g-prodiamine
	pronamide MOA 3 (Kerb) 50 WP	3	2 to 4 lb	1 to 2	Pre- and postemergence control of cool-season grasses and some annual broadleaf weeds from seed. Apply in late winter just before rain or snowfall. Not recommended for soils that are high in muck or peat. Check label for use restrictions.
	simazine MOA 5 (Princep) 4 L	5	2 to 3 qt	2 to 3	Apply preemergence to weeds in field nurseries and Christmas trees. Injury has occurred on azaleas, Japanese holly, euonymus, lilac, privet, pittosporum, mock orange, hemlock, boxwood, and several other broadleaf species. High rates will injure Fraser fir. https://content.ces.ncsu.edu/princep-simazine-simazine
	trifluralin MOA 3 (Preen) 1.47G (Treflan) 5 G	3	136 to 272 lb 80 lb	2 to 4 4	Preemergence to weeds. Irrigate after application. May injure some azalea cultivars.
Post-Plant, Postemergence Selective Grass Control					
Annual and perennial grasses (postemergence) See label for tolerant species	clethodim MOA 1 (Envoy and others)	1	8 to 34 fl oz	0.06 to 0.25	Postemergent grass control. Annuals 2 to 6 inches tall, perennials at 4 to 12 inches new growth. Add nonionic surfactant at 0.25% v/v (2 pints per 100 gallons) to final spray. https://content.ces.ncsu.edu/envoy-plus-clethodim
	fenoxaprop-P MOA 1 (Acclaim Extra) .57EC	1	13 to 39 oz	0.06 to 0.17	Apply to emerged grass using at least 40 gpa. Can be used overtop of many flowers and woody ornamentals. Check label. Injury has been observed on Bar Harbor juniper, philodendron, Salvia, Podocarpus, and Pittosporum when sprayed with this product.
	fluazifop-P MOA 1 (Fusilade II) 2 EC	1	2 to 3 pt	0.25 to 0.4	Postemergence grass control. Annuals not over 2 to 8 inches tall, perennials at 4 to 12 inches new growth. Consult label for tolerant species. Use nonionic surfactant and no oil. https://content.ces.ncsu.edu/fusilade-ii-fluazifop-p-butyl
	sethoxydim MOA 1 (Segment, Sethoxydim) 1 EC	1	36 to 60 oz	0.3 to 0.5	Postemergence grass control. Annuals up to 12 inches tall and 6 to 10 inches new growth on perennials. https://content.ces.ncsu.edu/segment-sethoxydim
Post-Plant, Postemergence Weed Control					
Annual grasses and broadleaf weeds (postemergence)	asulam MOA 18 (Asulox) 3.34 L	18	77 to 128 oz	2 to 7	Apply postemergence to weeds in many conifers.
	bentazon MOA 6 (Basagran TO) 4 L	6	1.5 to 2 pt	0.75 to 1	Postemergent directed to many established ornamentals for yellow nutsedge and seedling broadleaf weed control.
	clopyralid MOA 4 (Lontrel) 3 L	4	4 to 11 oz	0.09 to 0.25	Postemergence control of legume and many aster weeds. Can be used as a directed spray around on several field-grown woody ornamentals. Can be applied overtop of actively growing conifers transplanted 1 year or more. Apply when weeds are young and actively growing. https://content.ces.ncsu.edu/lontrel-clopyralid
	dichlobenil MOA 20 (Casoron) 4 G	20	100 to 150 lb	4 to 6	Pre- and postemergence control of many annual and perennial weeds. Do not use on fir, hemlock, Ilex crenata, I. rotunda, or I. vomitoria. Do not use more than 6 pounds per acre on azalea, rhododendron, boxwood, holly, euonymus, forsythia, leucothoe, ivy, lilac, heather, or any plantings less than 1 year old. Do not use in seedbeds, cutting, or transplant beds. Do not apply until 4 weeks after transplanting any plants. Winter applications are best. https://content.ces.ncsu.edu/casoron-dichlobenil

Table 6-3. Chemical Weed Control in Ornamentals (continued)

Weed	Herbicide and Formulation	Mode of Action	Amount Formulation Per Acre	Pounds Active Ingredient Per Acre	Precautions and Remarks
Post-Plant, Postemergence Weed Control (continued)					
Annual grasses and broadleaf weeds (postemergence) (continued)	diquat dibromide (Reward) 2 L	22	1 to 2 qt	0.5 to 1	Non-selective, contact-type, postemergence control of seedling weeds. A nonionic surfactant should be added to the spray solution. Apply for full coverage and thorough weed contact. Retreatment will be necessary for established weeds. May be used in landscapes, nurseries, and greenhouses.
	flumioxazin (Sureguard) DG	14	0.75 lb	0.375	Early-postemergence and residual control of many seedling annual broadleaf weeds in field and container-grown woody nursery crops and certain landscape plantings. See label for species and precautions. https://content.ces.ncsu.edu/sureguard-flumioxazin
	glufosinate (Finale) 1 L	10	3 to 6 qt	0.75 to 1.5	Non-selective postemergence control of weeds. Thorough coverage is essential. Apply in a minimum of 20 gallons of water per acre. No residual control. Repeat applications may be necessary for control of perennial weeds.
	glyphosate (Many formulations are available including Roundup-Pro Max, Touchdown Pro, and others)	9	1 to 5 qt	1 to 5	Non-selective postemergence, systemic control of weeds. DO NOT SPRAY GREEN BARK OR FOLIAGE of crop. Exercise extreme caution in applications near small plants. Use of a shielded sprayer can increase crop safety. Apply in 20 to 30 gallons of water per acre as a directed spray under shrubs or trees. No residual control. Repeat applications may be necessary for control of perennial weeds. https://content.ces.ncsu.edu/glyphosate-1
	imazaquin (Image) 1.5 LC	2	1 to 1.3 qt	0.4 to 0.5	Apply as a directed spray away from rooting zone. May injure landscape plants through foliar or root absorption. Read the label carefully before use.
	oxyfluorfen (Goal) 2 EC	14	1 to 2 pt	0.25 to 0.5	Pre- and postemergence control. Apply 1 to 2 pints of Goal 2 EC per acre as a postemergence application on some conifers. Add 0.25% (v/v) nonionic surfactant.
	paraquat (Gramoxone Extra) 2.8 L	20	2 to 3 pt	0.6 to 0.9	Non-selective postemergence control of weeds. Apply when grass and weeds are 1 to 6 inches high and succulent for best results. Direct spray with low pressure to avoid contact with foliage or bark of crop less than 1 year old. Add wetting agent to make 0.25% (2 pints per 100 gallons) by volume of spray for best results. Not for use in landscapes.
	pelargonic acid (Scythe)	27	3 to 10% by volume	na	Non-selective, contact-type control of seedling broadleaf and grass weeds. Use as a directed spray avoiding contact with foliage and stems of desirable plants. Thorough spray coverage is required. Use the lower concentration for small, succulent seedling weeds. Higher concentrations are needed for larger weeds. Repeated applications are generally required. May be used in landscapes, nurseries, and greenhouses.
Sedges (postemergence)	bentazon (Basagran T/O) 4 L	6	1.5 to 2 pt	0.75 to 1	Postemergent directed spray. For best results add 1 quart per acre crop oil concentrate. For yellow nutsedge and annual sedges; does not control purple nutsedge. May be used in nurseries or landscape plantings.
	halosulfuron (Sledgehammer) 75 DF	2	0.67 to 1.33 oz	0.031 to 0.062	Early postemergence control of yellow and purple nutsedge. Use only as a directed spray around established woody plants. Add 0.25% nonionic surfactant. For use in landscape plantings only. Not labeled for use in nurseries. https://content.ces.ncsu.edu/sledgehammer-halosulfuron
	imazaquin (Image) 1.5 LC	2	1 to 1.3 pt	0.4 to 0.5	Pre- or early postemergence control of purple nutsedge. Use as a directed spray. Labeled as an over the top spray on a few species. Add a nonionic surfactant. For use in landscape plantings only. Read label carefully before use.
	sulfentrazone (Dismiss) 4L	14	6 oz	0.188	Postemergence suppression of yellow and purple nutsedge, as well as several broadleaf weeds. Apply as a directed spray avoiding contact with foliage of desirable plants. Reapply when regrowth of treated weeds is observed. Do not exceed 12 ounces per acre per year. May be used in landscape plantings, as well as field and container nurseries.

Table 6-4. Weed Susceptibilities to Preemergence Herbicides

Based on label: G = good control (80-100%); F = fair control (50-80%); P = poor control (0-50%); Based on research: g = good control (80-100%); f = fair control (50-80%); p = poor control (0-50%)

Weed Species	Genus	Barricade/Regalkade	Biathlon	Broadstar/Sureguard	Casoron	Dacthal	Devrinol	Dimension	Freehand	Eptam	Gallery	Gemini	Goal	HGH 75	Marengo / Specticle	OH2	Pendulum	Pennant Magnum	Princep	Regal 00	Ronstar G	Rout	Snapshot TG	Surflan	Tower	Trifluralin	XL	
Broadleaf weeds																												
Ageratum, tropic	Ageratum														G													
Allysum, hoary	Berteroa	p	f	g	g	p	p		p	p	g	g	f	f	g	f	p	p	p	g	g	f	g	p	p	p	p	p
Artilleryweed	Pilea	g	g	g					g		f	g			g	g	g	p-f		g	g	g	f		g	p		
Aster	Aster				G						G	G											G					
Bedstraw	Galium												G	G					g									
Beggarweed, Florida	Desmodium																								F			
Bindweed, field (from roots)	Convolvulus	p	p	p	f	p	p	p	p	p	P		p	p	p	p	p	p	p	p	p	p	P	p	p	p	p	p
Bindweed, hedge (from roots)	Calystegia	p	p	p	f	p	p	p	p	p	p		p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p
Bittercress	Cardamine	f	G	G	g	p		G	G		G	G	g	G	G	G	f	P	f	G	G	G	G	G	G	p	f	
Bristly oxtongue	Picris											G																
Buckwheat, wild	Polygonum												G	G	G				g									
Burclover	Medicago			G							F	G	G	G	G								F					
Burnweed, American	Erechtites	p	g	G					g		p		g	g	G	g	p					g	p		g	p		
Bursage, Annual	Ambrosia											G																
Burweed, lawn	Soliva								F		G		G	G														
Buttercup	Ranunculus																											
Camphorweed	Heterotheca				G														g									
Carpetweed	Mollugo	G	g	G	G		G	G	G		F	G	G	G		g	G	F	G		G	g	F	G	G	G	G	
Carrot, wild	Daucus				G		p				G	G							p				G	p			F	
Catsear dandelion	Hypochoeris														G													
Chamberbitter	Phyllanthus	p	f	G	p			p	f		p	G	f-g	f	f	f	p	p		g	g	f	p-f	f	f-g	p		
Chamomile, false	Matricaria														F													
Chamomile, mayweed	Anthemis								G			G																
Chickweed, common	Stellaria	G	G	G	G		G	G	G	G	G	G	f	G	G	G	G	f	G	f	p	G	G	G	G	G	G	
Chickweed, mouseear	Cerastium	g	g	G	G		p	G	G		G	G		g	G	g	G		p	f	p	g	G	p	G	g	g	
Clover, hop	Trifolium								F																			
Clover, white (from seed)	Trifolium				g		p				G	G	G	G	G		p		f			G	G	p				

Table 6-4. Weed Susceptibilities to Preemergence Herbicides (continued)

Based on label: G = good control (80-100%); F = fair control (50-80%); P = poor control (0-50%); Based on research: g = good control (80-100%); f = fair control (50-80%); p = poor control (0-50%)

Weed Species	Genus	Barricade/Regalkade	Biathlon	Broadstar/Sureguard	Casoron	Dacthal	Devrinol	Dimension	Freehand	Eptam	Gallery	Gemini	Goal	HGH 75	Marengo / Specticle	OH2	Pendulum	Pennant Magnum	Princep	Regal 00	Ronstar G	Rout	Snapshot TG	Surflan	Tower	Trifluralin	XL		
Broadleaf weeds (continued)																													
Cocklebur, common	Xanthium				p		p						G	G			p	p	f								p		
Coffeeweed	Senna			G	G																								
Copperleaf	Acalypha																												
Cudweed	Gnaphalium		G		G		G		G		G	G		G	G	G	G	p	g	G			G	p					
Dandelion (seedling)	Taraxacum		G	G	G		p				G	G		G	G	G	p	p	f	G		G	G	g			f		
Dandelion, false	Pyrrhopappus				G																								
Deadnettle, purple	Lamium				G					G									G	g									
Dock, curly or broadleaf	Rumex				G						P	f/c			G									P					
Dodder	Cuscuta						p																	p	p				
Dogfennel	Eupatorium	p	g	G	G		p-f	f		F	G		g	g	g	p		g		F	G	G	g	p	f				
Evening primrose	Oenothera	p	g		G		p		G		f	P	G		G	g	G	f	g		F	G	G	g					
Eclipta	Eclipta	p	p	f	p		p	F		p	P	p	p	G	p	p	p		p	p	p	f	p	p-f	F	p			
Fiddleneck	Amsinckia								F			G																	
Filaree, redstem	Erodium			G	g		G		F		G	G	G	G	G		G		G				g	G	G				
Filaree, whitestem	Erodium											G																	
Fleabane	Erigeron		G		g						G	G			G	G			g				G	g					
Flixweed	Descurainia												G	G					g										
Florida Betony	Stachys	p	p	p	G	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p
Galinsoga, hairy	Galinsoga	f		G	p		g		g	p	G	G	g	g			p	G	g		F		G	f	F	p			
Galinsoga, smallflower	Galinsoga																								F				
Geranium, Carolina	Geranium			G	g		g	G			G	G	G						f				G	g					
Goosefoot	Chenopodium										F	G		G									G						
Groundcherry	Physalis										G	G	G	G									G						
Groundsel, common	Sencio	p-f	G	G	G		G	p	f		f	f	G	G	G	G	p	p	G	G	p-f	G	F-G	F	F	p	F		
Henbit	Lamium	G		G	G		g	G	G	G	G	F	G	G	G		f		G				G	G	f	g	G		
Horseweed (marestail)	Conyza	f	G	G	G		f	F	g		G	G	F	g	G	G	p	f	g	G	f	G	G	F					
Jimsonweed	Datura		p	G	p		p				F	G	G	G		p	p	p	g			p	G	p		p			

Table 6-4. Weed Susceptibilities to Preemergence Herbicides (continued)

Based on label: G = good control (80-100%); F = fair control (50-80%); P = poor control (0-50%); Based on research: g = good control (80-100%); f = fair control (50-80%); p = poor control (0-50%)

Weed Species	Genus	Barricade/Regalkade	Biathlon	Broadstar/Sureguard	Casoron	Dacthal	Devrinol	Dimension	Freehand	Eptam	Gallery	Gemini	Goal	HGH 75	Marengo / Specticle	OH2	Pendulum	Pennant Magnum	Princep	Regal 00	Ronstar G	Rout	Snapshot TG	Surflan	Tower	Trifluralin	XL	
Broadleaf weeds (continued)																												
Knapweed, Russian or spotted	Centaurea				G																							
Knawel	Scleranthus																											
Knotweed, prostrate	Polygonum	f			G		G	p	G		F	F	G	G	G		G	g	f		g	g	G	G		G	G	
Kochia	Kochia			G					F		F		G	G														
Ladysthumb	Polygonum			G							f	F	G	G					g				G					
Lambsquarters	Chenopodium	G		G	G		G	f	f	G	F	G	G	G	G		G	f	G		G	G	G	G	F	G		
Lettuce, prickly	Lactuca		g		g		G				G	G	G	G		g			G				G	F				
Liverwort (from spores)	Marchantia			G	p		p		F		p		p						p		P				G			
London rocket	Sysimbrium											G		G	F													
Mallow	Malva			G	p		F				F	P	G	G	G				p				F	F		p		
Marsh parsley	Cyclospermum	p	p	f					g		p	p	p	p	p	p	p	p		p	p	p	p	p	g	p	p	
Maypops	Passiflora				G								G															
Mayweed (chamomile)	Anthemis			G							G			G					g				G		G			
Medic, black	Medicago							G			F	F			F							G	F					
Milkweed	Asclepias										P												P					
Morningglory, annual	Ipomoea			G	f		p		p		p	p	G	f			f	p	G		f		F	F		f		
Mugwort (from rhizome)	Artemesia	p	p	p	G	p	p	p	p	f	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p
Mulberryweed	Fatoua	f-g	g	G			p		g		g	g	g	g		g	f	p-f		g	f	g	f-g	g	f	p		
Mullein, common	Verbascum																						F					
Mustard, black	Brassica											G			F													
Mustard, wild	Brassica, others			G	G		f	G			G	G	G	G	G			p	G		g	g	G	F				
Nettle, stinging	Urtica										F	G	G	G									F			G		
Nightshade, black	Solanum			G	g		p		G	G	G	G	G	G	G		p	G	G				G	F	G	f		
Nightshade, hairy	Solanum								G						G										G			
Parsley-piert	Aphanes			G																								
Parthenium	Parthenium	p-f	g	g					f		f-g	f-g	g		G	g	p	p-f		g		g	f-g		g			
Pearlwort	Sagina	g	G	f	p		p		G		g			G		G	g	g	p	G		G			p			

Table 6-4. Weed Susceptibilities to Preemergence Herbicides (continued)

Based on label: G = good control (80-100%); F = fair control (50-80%); P = poor control (0-50%); Based on research: g = good control (80-100%); f = fair control (50-80%); p = poor control (0-50%)

Weed Species	Genus	Barricade/Regalkade	Biathlon	Broadstar/Sureguard	Casoron	Dacthal	Devrinol	Dimension	Freehand	Eptam	Gallery	Gemini	Goal	HGH 75	Marengo / Specticle	OH2	Pendulum	Pennant Magnum	Princep	Regal 00	Ronstar G	Rout	Snapshot TG	Surflan	Tower	Trifluralin	XL			
Broadleaf weeds (continued)																														
Pennywort (from seed)	Hydrocotyle										G	G											G							
Pepperweed	Lepidium		G		g		g		F		G	G	G	G	f	G	g		G	G	f		G	g				g		
Phyllanthus, long stalked	Phyllanthus	p	g	G				p-f	f		p	p-f	f-g	f-g	G	g	p	p		g	f-g	g	p-f	f	p-f	p				
Pigweed spp.	Amaranthus	G	G	G	G		G	p	f-g	f	p-f	G	G	G	f	G	G	f	G	G	G	G	G	G	G	G	G			
Pimpernel, scarlet	Anagallis										F	G	G	G								G		F						
Pineappleweed	Matricaria			G	G		G	F			G	G					p	f	G		g		G	g						
Plantain	Plantago			G	G		p	p			G	G			G			g	p				G	g						
Poinsettia, wild	Euphorbia			G																										
Pokeweed, common	Phytolacca	g									G	G	g				g	p	f		p	g		g						
Puncturevine	Tribulus			G					F						G		G									G	G			
Purslane, common	Portulaca	G	g	G	G		G	F	G	G	G	G	G	G	G	g	G	f	G		G	G	G	G	G	G	G	G		
Pusley, Florida	Richardia	G		G	G		p		G	G	F	G	G	G	G		G	G	G				F	G	G	G				
Radish, wild	Raphanus			g	G						G	G																		
Ragweed, common	Ambrosia	f		G	G		F	p	F		f		f		F		p	p	G		g		G	F	F	p				
Redmaids	Calandrinia			G								G		G	G															
Redweed	Melochia			G																										
Rocket, London	Sysimbrium								F						G															
Sesbania, hemp	Sesbania			G											F															
Shepherdspurse	Capsella	G	G	G	G		g	G	G		G	G	G	G	G	G	G		G	G	G	G	G	G	G	G	G	G		
Sida, prickly	Sida	p		G			p				G	G	G	G	G		g	p	g		g		G	F						
Smartweed	Polygonum			G	G		g		F		f	F	G	G			f	f	G		G		G	F		f				
Sorrel, red	Rumex				g		p				G	G	F	G					p				G							
Southern waterbuttons	Cotula											G			F															
Sowthistle, annual	Sonchus	p	G	G	g		G		f		G	G	G	G	G	G	g		f		G	G	f-g	F	f					
Spanishneedles	Bidens				G							F							g											
Speedwell spp.	Veronica			G	g		p	F	G		G	G	G		G				G		G		G							
Spurge, garden	Chamaesyce	g	f	g				f-g	g		f	g	f	f	g	f	f-g	f		f-g	f	f	f-g	g	g	f	g			

Table 6-4. Weed Susceptibilities to Preemergence Herbicides (continued)

Based on label: G = good control (80-100%); F = fair control (50-80%); P = poor control (0-50%); Based on research: g = good control (80-100%); f = fair control (50-80%); p = poor control (0-50%)

Weed Species	Genus	Barricade/Regalkade	Biathlon	Broadstar/Sureguard	Casoron	Dacthal	Devrinol	Dimension	Freehand	Eptam	Gallery	Gemini	Goal	HGH 75	Marengo / Specticle	OH2	Pendulum	Pennant Magnum	Princep	Regal 00	Ronstar G	Rout	Snapshot TG	Surflan	Tower	Trifluralin	XL
Broadleaf weeds (continued)																											
Spurge, hyssop	Chamaesyce	g	f	g				f	G		f	F	f	f	g	f	f	p-f		f	p-f	f-g	f	g	g		
Spurge, petty	Euphorbia	p	g	G					f		f	F			p-f	g	p	p			p-f	g	p	p-f	f	p	
Spurge, spotted	Chamaesyce	g	f-g	G	G	f	p	G	G		f	G	f	f	G	f-g	f	p	f	f	p-f	f-g	f	g	G	p	f
Spurry, corn	Spergula				p		p			G			G	G					p								
Spurry, sand	Spurgularia	g									g		G						g				g				
Sweetclover, yellow	Melilotus											G															
Sunflower	Helianthus											G			F												
Swinecress	Corronopus										F	G			G								F				
Tansymustard, green	Descurainia											G															
Tassleflower	Emilia	p	f	G					G		p	p		f	G	f	p	p				f	p		f		
Telegraphplant	Heterotheca											G															
Thickhead	Crassocephalum		g	G					f-g					g	g	g	p	p		f	f	g	p				
Thistle, Bull	Cirsium				G						G		G	G													
Thistle, Canada (from seed)	Cirsium			G	G		p								G				p							G	
Thistle, Musk	Carduus										F	G											G				
Thistle, Russian	Salsola			G	G						G	G	G	G					G				G			G	
Turkey mullein	Croton											G															
Velvetleaf	Abutilon	f		G	p		p	p	F		F		G	G	F		G	g	f		g		G	F		p	p
Venice mallow	Hibiscus											P															
Vetch	Vicia											f			F												
Virginia winged rockcress	Sibara											G															
Yellow cress, annual	Rorippa			g					g		g	g			g		g	p					g			p	
Yellow Rocket	Barabea			G	G																						
Waterhemp, common	Amaranthus																								G		
Waterhemp, tall	Amaranthus																								G		
Willowherb	Epilobium	p	f	G					g		p	p	f	f	G	f	p	p		g	g	f	p	g	f	p	f
Woodsorrel (Oxalis)	Oxalis	G	G	G	G		p	g	G		G	F	G	G	F	G	G	p	p	G	G	G	G	G	g	f	F

Table 6-4. Weed Susceptibilities to Preemergence Herbicides (continued)

Based on label: G = good control (80-100%); F = fair control (50-80%); P = poor control (0-50%); Based on research: g = good control (80-100%); f = fair control (50-80%); p = poor control (0-50%)

Weed Species	Genus	Barricade/Regalkade	Biathlon	Broadstar/Sureguard	Casoron	Dacthal	Devrinol	Dimension	Freehand	Eptam	Gallery	Gemini	Goal	HGH 75	Marengo / Specticle	OH2	Pendulum	Pennant Magnum	Princep	Regal 00	Ronstar G	Rout	Snapshot TG	Surflan	Tower	Trifluralin	XL	
Grasses																												
Barley, mouse	Hordeum														G													
Barnyardgrass	Echinochloa	G	G	f			G	G	G	G	p	G	F	G	G	G	G	f	G	G	G	G	G	G	G	G	G	G
Bermudagrass (from rhizomes)	Cynodon	p	p	p	f	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p
Bluegrass, annual	Poa	G	G	f	G		G	G	G	G	p	G	F	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G
Bluegrass, roughstalk	Poa								G																G			
Brome, California	Bromus								G																G			
Brome, downy	Bromus						G	G	G	G	p			G					G				G	g	G	G		
Brome, foxtail	Bromus														G													
Cheat	Bromus														G													
Crabgrass, large	Digitaria	G	G	F	G	f	G	G	G	G	p	G	F	G	G	G	G	G	p-f	G	G	G	G	G	G	G	G	G
Crabgrass, smooth	Digitaria	G	g	F	G	f	G	G	G	G	p	G	f	G	G	g	G	G	p-f	G	G	g	G	G	G	G	G	G
Crowfootgrass	Dactyloctenium							G	F		p	G					G	G	p					G			G	
Cupgrass, Southwestern	Eriochloa								G																G			
Cupgrass, wooly	Eriochloa								F			G													G			
Fescue, ratttail	Vulpia											G													G			
Fescue, tall (from seed)	Festuca (=Schedonorus)	g			G		f	g			p								f		g		g	g		f		
Foxtail (yellow, green)	Setaria	G	g	F	G		G	G	G	G	p	G		G	G	g	G	G	f		G	G	F	G	G	G	G	G
Foxtail, giant	Setaria	G	g	F	G		G	G	G	G	p	G	F	G	G	g	G	G	f			g	G	G	G	G	G	G
Goosegrass	Eleusine	G	g	F	p	p	G	G	G	G	p	G	F	G	G	g	G	G	G	G	G	G	G	G	G	G	G	G
Guineagrass	Panicum														G													
Itchgrass	Rottboellia								F		p	G					G		p									
Johnsongrass (rhizome)	Sorghum	p	p	p	f	p	p	p	p	p	p		p	p		p	p	p	p	p	p	p	p	p	p	p	p	p
Johnsongrass (seedling)	Sorghum	G	g				F		G	F	p	G	f	G		g	G	f	p		f	g	F	G	F	f	G	
Junglerice	Echinochloa								F			F																

Table 6-4. Weed Susceptibilities to Preemergence Herbicides (continued)

Based on label: G = good control (80-100%); F = fair control (50-80%); P = poor control (0-50%); Based on research: g = good control (80-100%); f = fair control (50-80%); p = poor control (0-50%)

Weed Species	Genus	Barricade/Regalkade	Biathlon	Broadstar/Sureguard	Casoron	Dacthal	Devrinol	Dimension	Freehand	Eptam	Gallery	Gemini	Goal	HGH 75	Marengo / Specticle	OH2	Pendulum	Pennant Magnum	Princep	Regal 00	Ronstar G	Rout	Snapshot TG	Surflan	Tower	Trifluralin	XL	
Lovegrass	Eragrostis			F					F			G		G	G													
Grasses (continued)																												
Millet, wild	Panicum																								F			
Orchardgrass	Dactylis				G						p							p	f					g				
Panicum, browntop	Panicum								F			G																
Panicum, fall	Panicum			F			G		F	g	p	G		G			G	G	G		G	G	G	G	G	G		
Panicum, Texas	Panicum	G		F			G		F		p	G		G			G					F	F	G	F	G		
Quackgrass (from rhizome)	Elymus	p	p	p	G	p	p	p	p	G	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
Quackgrass (from seed)	Elymus				g						p																	
Red rice	Oryza								G																G			
Rescuegrass	Bromus											G																
Ryegrass, annual	Lolium	g	g		g		G	G	G	G	p		f		G	g		g	G		g	g	G	G	G			
Ryegrass, perennial	Lolium														G													
Sandbur	Cenchrus						G		G	G	p			G	G		G	f	p			g	G		G	G	G	
Shattercane	Sorghum									G	p								p				p		F	G		
Signalgrass, broadleaf	Brachiaria	G							G		p	G		G			G	G	G					G	F			
Smutgrass	Sporobolus							G			p								p									
Sprangletop	Leptochloa						G		F		p	G					G		p				G				G	
Stiltgrass, Japanese	Microstegium	g					f	g	p		p				f-g		g	p			f		f	g	p-f	f		
Witchgrass	Panicum						G		G		p	G	F	G			G	G	G				G	G	G			
Sedges and other monocots																												
Kyllinga (from seed)	Kyllinga			G					F						G										g			
Nutsedge, purple	Cyperus	p	p	p	f	p	p	p	p	F	p		p	p	p	p	p	p	p	p	p	p	p	p	p	f	p	p
Nutsedge, yellow	Cyperus	p	p	p	G	p	p-f	p	F	f	p		p	p	p	p	p	F	p	p	p	p	p	p	F	p	p	
Sedge, annual	Cyperus		f						g		p				F	f	f	g				f	p		G			
Sedge, rice flat-	Cyperus	p	f	p				f	G		p	f-p			F	f-g	f	g				f-g	p-f		G	p		
Doveweed	Murdannia		f-p	g					G			p		f-p	G	f-p		f-g				f-p			G			

Table 6-4. Weed Susceptibilities to Preemergence Herbicides (continued)

Based on label: G = good control (80-100%); F = fair control (50-80%); P = poor control (0-50%); Based on research: g = good control (80-100%); f = fair control (50-80%); p = poor control (0-50%)

Weed Species	Genus	Barricade/Regal kade	Biathlon	Broadstar/Sureguard	Casoron	Dacthal	Devrinol	Dimension	Freehand	Eptam	Gallery	Gemini	Goal	HGH 75	Marengo / Specticle	OH2	Pendulum	Pennant Magnum	Princep	Regal 00	Ronstar G	Rout	Snapshot TG	Surflan	Tower	Trifluralin	XL	
Onion or garlic, wild	Allium	p	p	p		p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	
Non-flowering plants																												
Bracken Fern	Pteridium				G															p								
Horsetail (Equisetum) (from rhizomes)	Equisetum	p	p	p	G	p	p	p	p		p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	p	

Table 6-5. Weed Susceptibilities to Postemergence Herbicides

Based on label: G = good control (80-100%); F = fair control (50-80%); P = poor control (0-50%); Based on other research: g = good control (80-100%); f = fair control (50-80%); p = poor control (0-50%)

Weed Species	Acclaim Extra	Envoy	Fusilade II	Segment	Asulox	Basagran TO	Casoron	Dismiss	Garlon	Goal	Image	Kerb	Lontrel	Sedgehammer	Sureguard	Gramoxone	Finale	Reward	Glyphosate	Scythe
Broadleaf weeds																				
American Burnweed	P	P	P	P										p	f	f	f	f	g	f
Artichoke	P	P	P	P									G							F
Aster	P	P	P	P			G										G		g	F
Bedstraw	P	P	P	P				f		F									f	F
Betony, Florida	P	P	P	P			G		p				p							F
Bindweed, field	P	P	P	P					G								G		f	P
Bindweed, hedge	P	P	P	P					G								G		f	P
Bittercress	P	P	P	P				f			G					g		g	G	F
Blackberry	P	P	P	P					G							f	F	f	G	P
Buckwheat, wild	P	P	P	P						F									g	F
Burclover	P	P	P	P						G							g	f	f	F
Buttercup	P	P	P	P				f			G						f	f	G	F
Camphorweed	P	P	P	P			G										f	f	g	F
Carpetweed	P	P	P	P			G	f		G						g	g	g	g	G
Carrot, wild	P	P	P	P			G									g	f	f	g	F
Chamberbitter	P	P	P	P													g	g	g	
Chickweed, common	P	P	P	P		f	G	f		f	G	G		p		g	G	g	G	G
Chickweed, mousear	P	P	P	P			G	f			G	G				g	G	g	G	F
Clematis	P	P	P	P												f		f	f	P
Clover, white	P	P	P	P		p		f		F	G					f	G	f	G	P
Cocklebur, common	P	P	P	P						G			G			g	G	g	G	F
Coffeeweed	P	P	P	P			G						G							F
Copperleaf	P	P	P	P				f					p	p	f	G	g	f	g	f
Cudweed	P	P	P	P			G	f			F					g	g	g	g	F
Dandelion	P	P	P	P			G	F	G	f	F		G			g	G	g	G	F
Deadnettle, purple	P	P	P	P			G				G						g	f	g	G
Dock, curly or broadleaf	P	P	P	P			G	F	G				G				G	p	g	P
Dodder	P	P	P	P												g		g		G
Dogfennel	P	P	P	P			G									f	f	f	g	P
Dollarweed (Hydrocotyle)	P	P	P	P		p	p	f	p	p	G		p	p	p	p	f	p	f	p
Eclipta	P	P	P	P		f		f					g	f			f	f	G	F
Evening primrose	P	P	P	P			G	f		f	G					g	g	g	f	F
Falsedandelion	P	P	P	P			G										f	p	G	F
Filaree, redstem	P	P	P	P				f		F						g	f	g	G	F
Fleabane	P	P	P	P									g			g	G	g	G	F
Flixweed	P	P	P	P						F										G
Galinsoga, hairy	P	P	P	P				f		f			g			g	g	g	g	F
Geranium, Carolina	P	P	P	P				f			G					g	f	g	g	F
Goosefoot	p	p	p	p			G						p				g		g	
Groundsel, common	P	P	P	P		p	G			F			G	g		g	g	g	G	F
Ground ivy	P	P	P	P		p	g	f	f	p			p	p			f	f	g	f
Henbit	P	P	P	P		p	G			G	G					g	g	g	G	G
Honeysuckle	P	P	P	P												f	p	p	G	P

Table 6-5. Weed Susceptibilities to Postemergence Herbicides (continued)

Based on label: G = good control (80-100%); F = fair control (50-80%); P = poor control (0-50%); Based on other research: g = good control (80-100%); f = fair control (50-80%); p = poor control (0-50%)

Weed Species	Acclaim Extra	Envoy	Fusilade II	Segment	Asulox	Basagran TO	Casoron	Dismiss	Garlon	Goal	Image	Kerb	Lontrel	Sedghammer	Sureguard	Gramoxone	Finale	Reward	Glyphosate	Scythe
Broadleaf weeds (continued)																				
Horseweed (marestail)	P	P	P	P	g								G	f		f	G	f	G	F
Jimsonweed	P	P	P	P						F			G			g	G	g	g	F
Knapweed, Russian	P	P	P	P			G						G							F
Knawel	P	P	P	P				f			G						g	g	g	G
Knotweed, prostrate	P	P	P	P			G	f		F						g		g	G	F
Ladysthumb	P	P	P	P		F				F			G				g	f	g	F
Lambsquarters	P	P	P	P		G	G		G	G				f		f	G	f	G	P
Lespedeza	P	P	P	P				f								f		f	G	F
Lettuce, prickly	P	P	P	P					G	F			G			g	G	g	G	G
Liverwort	P	P	P	P						p						g		f	P	F
Locust	P	P	P	P					G							f	p	p	G	P
Loosestrife	P	P	P	P			G												g	F
Mallow	P	P	P	P				f		F						g	G	g	g	F
Maypops	P	P	P	P			G										p	p	f	P
Mayweed (chamomile)	P	P	P	P						G			G						G	F
Medic, black	P	P	P	P							G								g	F
Morningglory, annual	P	P	P	P				g		F						g	f	f	f	F
Mugwort	P	P	P	P			G		f				f			f	f	p	f	p
Mulberryweed	p	p	p	p		p			f	p			p			g	g	f	g	f
Mustard, wild	P	P	P	P		G				G						g	G	g	G	F
Nettle, stinging	P	P	P	P						F							G			F
Nightshade, black	P	P	P	P						F			G			g	G	g	G	F
Parsley-piert	P	P	P	P				f			G									F
Pearlwort	P	P	P	P		p								p		g		g	g	G
Pennywort (=dollarweed)	P	P	P	P		p	p	f	p	p	G		p	p	p	p	f	p	f	p
Pepperweed	P	P	P	P			G			F						g	g	g	g	F
Pigweed spp.	P	P	P	P		p	G	F		F						g	G	g	G	G
Pimpernel, scarlet	P	P	P	P						F									g	G
Pineappleweed	P	P	P	P			G	f					G			f		f	g	F
Plantain	P	P	P	P			G	F	G				p			g	f	p	g	F
Poison ivy (oak)	P	P	P	P					G							f	G	f	G	P
Broadleaf weeds, cont.																				
Pokeweed, common	P	P	P	P													f	f	f	F
Puncturevine	P	P	P	P				f								f	f	f	g	f
Purslane, common	P	P	P	P			G	f		G				g		g	G	g	g	G
Pusley, Florida	P	P	P	P			G	f								g		f	G	G
Radish, wild	P	P	P	P			G												g	G
Ragweed, common	P	P	P	P		F	G		G	f			G			g	G	g	G	G
Sandspurry	P	P	P	P						G									g	G
Shepherdspurse	P	P	P	P			G	f		F						g	G	g	G	G
Sida, prickly	P	P	P	P						F						f		f	g	F
Smartweed	P	P	P	P			G	f	G	F			G			f	G	f	G	F
Sorrel, red	P	P	P	P			G	F		F	G		G			f		f	g	F
Spanishneedles	P	P	P	P			G												G	G

Table 6-5. Weed Susceptibilities to Postemergence Herbicides (continued)

Based on label: G = good control (80-100%); F = fair control (50-80%); P = poor control (0-50%); Based on other research: g = good control (80-100%); f = fair control (50-80%); p = poor control (0-50%)

Weed Species	Acclaim Extra	Envoy	Fusilade II	Segment	Asulox	Basagran TO	Casoron	Dismiss	Garlon	Goal	Image	Kerb	Lontrel	Sedgehammer	Sureguard	Gramoxone	Finale	Reward	Glyphosate	Scythe
Broadleaf weeds (continued)																				
Speedwell spp.	P	P	P	P			G	G	f	F			p			g		g	G	G
Spurge, prostrate	P	P	P	P			G				p			f		g		g	G	F
Spurge, spotted	P	P	P	P		p	G	f						f		g		g	G	F
Spurry, corn	P	P	P	P						F						g		g	g	G
Thistle, bull	P	P	P	P		g							f			p	f	p	f	F
Thistle, Canada	P	P	P	P			G		G				G			f	G	f	G	p
Thistle, musk	p	p	p	P									G				F	p	g	p
Thistle, Russian	p	p	P	P			G			F							G	p	g	p
Trumpetcreeper	P	P	P	P												f	p	p	F	P
Vetch	P	P	P	P		p			G							f	f	f	p	F
Virginia creeper	P	P	P	P					g							f	f	p	g	P
Violet, annual	P	P	P	P			F	f	F				p	p	f	g	f	f	f	f
Willowherb	P	P	P	P													g	g	g	f
Woodsorrel, yellow	P	P	P	P		p	G	f					p	f		g	G	g	g	F
Yellow, Rocket	P	P	P	P			G										G	f	G	F
Grasses																				
Barnyardgrass	G	G	G	G		p			P	F			p			g	G	f	G	P
Bermudagrass	F	G	G	G		p		p	P				p	p		f	G	p	G	P
Bluegrass, annual	P	G				p		p	P	F	F	G	p	p		g	G	p	G	f
Brome, downy			G			p			P			G	p				G	f	G	
Crabgrass, large	G	G	G	G		p			P	G			p	p		g	G	f	G	f
Crabgrass, smooth	G	G	G	G		p			P				p			g	G	f	G	f
Crowfootgrass		G				p							p							
Fescue, tall	P	F	f	F		p	G	p	P		F	G	p	p		g	f	p	G	P
Foxtail (yellow, green)	G	G	G	G		p	G		P				p			g	G	f	G	f
Foxtail, giant	G	G	G	G		p	G		P	F			p			g	G	f	G	f
Goosegrass	G	G	G	G		F	p		F	P	F		p			g	G	f	G	f
Johnsongrass (mature)	F	F	G	G		p		p	P				p	p		f	p	p	G	P
Orchardgrass	p	F	f	F		p	G	p	P			G	p	p		p	p	p	G	P
Panicum, fall	G	G	G	G		p			P	f			p			p	G	f	G	f
Panicum, Texas		G	G	f		p	G						p				f	f	G	
Quackgrass	p	G	G	G		p	G		P			G	p	p		p	f	p	G	P
Ryegrass, annual	P	G	G	G		p		p	P			G	p	p		f	f	p	G	p
Sandbur	G	G	G	G					P		G		p			f	G	f	G	
Shattercane		G	G	G									p				G		G	
Signalgrass, broadleaf		G	G	G					P				p			f	G	f	G	
Sprangletop	G	G		G									p						G	
Stiltgrass, Japanese	G	g	g	g												f	g	f	g	
Witchgrass		G					G			F			p						G	
Other grass-like monocots																				
Dayflower	P	P	P	P			f										f		f	F
Doveweed	P	P	P	P				p		p			p	p	p-f	p	p	p	p	p
Nutsedge, purple	p	p	p	p		p	p	f	F	p	p	G	p	G		f	g	f	g	p
Nutsedge, yellow	p	p	p	p		p	f	G	G		G		p	G		f	G	f	g	P

Table 6-5. Weed Susceptibilities to Postemergence Herbicides (continued)

Based on label: G = good control (80-100%); F = fair control (50-80%); P = poor control (0-50%); Based on other research: g = good control (80-100%); f = fair control (50-80%); p = poor control (0-50%)

Weed Species	Acciaim Extra	Envoy	Fusilade II	Segment	Asulox	Basagran TO	Casoron	Dismiss	Garlon	Goal	Image	Kerb	Lontrel	Sedghammer	Sureguard	Gramoxone	Finale	Reward	Glyphosate	Scythe
Other grass-like monocots (continued)																				
Onion or garlic, wild	P	P	P	P				f			G						G		f	P
Sedge, annual	p	p	p	p	p	G	p	G	p	p	g	p	p	g	p	f	g	f	g	f
Non-flowering plants																				
Bracken fern	P	P	P	P			G												p	P
Horsetail (Equisetum)	p	p	p	p	F	p	G						p	f		p		p	f	P
Moss	P	P	P	P												f		f	P	F

Table 6-6. Preemergence Herbicides Registered for Use on Woody Ornamentals

F = registered for use in the field (or landscape)
 C = registered for use in containers
 f/c = registered for both field and container use
 d = registered for directed applications only
 Ø = label prohibits use on this species
 F*, C*, or f/c* = registered for some species or cultivars; consult label for details
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Genus and species (Index of common names, by genus, is available in Table 6-9.)	Barricade	Biathlon	Broadstar	Casoron	Dacthal	Devrinol	Dimension	Freehand	Gallery	Gemini	Goal	HGH 75	Image	Kerb	Marengo/Specticle G	Marengo/Specticle SC	OH2	Pendulum (EC)	Pendulum (granule)	Pennant Magnum	Princep	Regalkade	Regal 00	Ronstar G	Rout	Snapshot TG	Surflan	Sureguard	Tower	Treflan	XL	
Abelia spp.					F	f/c							Ø							F			f/c							f/c		
<i>Abelia x grandiflora</i>	f/c*	f/c*	f/c		F	f/c	F*	f/c	f/c*	f/c*		f/c*	Ø			d	f/c	f/c	f/c	f/c		f/c*	f/c		f/c	f/c	F			f/c*	F	
<i>Abeliophyllum distichum</i>			f/c											F																		
Abies spp.	F				F	f/c								F						F		F								f/c*		
<i>Abies balsamea</i>	F		f/c		F	f/c			f/c	f/c		f/c		F				f/c	f/c	F	F	F				f/c	F			f/c	F	
<i>Abies bommuelleriana</i>	F				F	f/c						f/c		F						F		F						f/c		f/c		
<i>Abies concolor</i>	F				F	f/c			F	f/c				F				f/c	f/c	F	F	F				F	F	f/c				F
<i>Abies fraseri</i>	F		f/c		F	f/c	F	f/c			F			F		d		f/c	f/c	F	F	F					F	f/c	f/c			F
<i>Abies grandis</i>	F		f/c		F	f/c					F			F						F		F					F	f/c				F
<i>Abies koreana</i>	F		f/c		F	f/c								F						F		F										
<i>Abies lasiocarpa</i>	F				F	f/c								F						F		F					F	f/c				F
<i>Abies procera</i>	F		f/c		F	f/c					F			F						F		F							f/c			
<i>Abies veitchi</i>	F				F	f/c								F						F		F					F					F
Acacia spp			f/c						f/c*	f/c*		f/c*					f/c*		f/c*				f/c	f/c		f/c*	F			f/c*	F*	
Acer spp.				F	F	F		f/c*						F						F			f/c	f/c			F	f/c				F
<i>Acer ginnala</i>			f/c	F	F	F	f/c*		f/c			f/c		F						F			f/c	f/c		f/c	F	f/c		f/c		F
<i>Acer griseum</i>				F	F	F								F					f/c	F			f/c	f/c			F	f/c				F
<i>Acer negundo</i>				F	F	F		f/c						F						F	F		f/c	f/c			F	f/c	f/c			F
<i>Acer nigrum</i>				F	F	F					F			F						F			f/c	f/c			F	f/c				F
<i>Acer palmatum</i>	f/c		f/c	F	F	F	F	f/c	f/c			f/c*		F	f/c	d	f/c*	f/c	f/c	F		f/c	f/c	f/c	f/c*	f/c*	F	f/c	f/c	f/c	f/c*	F
<i>Acer pensylvanicum</i>			f/c	F	F	F								F						F			f/c	f/c			F	f/c				F
<i>Acer platanoides</i>	f/c			F	F	F	F					f/c		F				f/c	f/c	F		f/c	f/c	f/c			F	f/c		f/c		F
<i>Acer rubrum</i>			f/c	F	F	F	f/c*	f/c	F*		F	f/c*		F	f/c	d		f/c	f/c	f/c			f/c	f/c		F	F	f/c	f/c	f/c*	F	
<i>Acer saccharinum</i>				F	F	F	F		f/c			f/c		F						F			f/c	f/c		f/c	F	f/c		f/c		F

Table 6-6. Preemergence Herbicides Registered for Use on Woody Ornamentals (continued)

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<i>Acer saccharum</i>				F	F	F	F	f/c			F	f/c		F		d		f/c	f/c	F			f/c	f/c			F	f/c	f/c	f/c	F
<i>Actinidia spp.</i>									F	f/c																F	F			f/c	F
<i>Actinidia arguta</i>															f/c																
<i>Actinidia chinensis</i>	f/c																					f/c								f/c	F
<i>Aesculus spp.</i>																												f/c			
<i>Aesculus glabra</i>														F		d												f/c			
<i>Aesculus pavia</i>																		f/c	f/c									f/c			
<i>Agave americana</i>									F			f/c													F	F		f/c	f/c	F	
<i>Akebia quinata</i>	f/c									f/c																					
<i>Albizia julibrissin</i>									f/c	f/c																					
<i>Alnus glutinosa</i>						F												f/c	f/c												
<i>Amelanchier spp.</i>						F		f/c																							
<i>Amelanchier alnifolia</i>									f/c	f/c														f/c							
<i>Amelanchier canadensis</i>															f/c																
<i>Amelanchier laevis</i>																		f/c	f/c												
<i>Andromeda polifolia</i>							F*		f/c	f/c															f/c						
<i>Anisodonte hypomandarum</i>										f/c																					
<i>Arbutus spp.</i>																		f/c	f/c												
<i>Arctostaphylos spp.</i>										f/c																	F*				F*
<i>Arctostaphylos densiflora</i>										f/c																					

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<i>Arctostaphylos uva-ursi</i>				F			F		f/c										f/c					f/c	f/c						
<i>Arctostaphylos stanfordiana</i>																															F
Ardisia japonica									f/c	f/c																f/c					
Aronia spp.																d															
Aucuba spp.					F	F														F											
<i>Aucuba japonica</i>	f/c				F	F			f/c*	f/c*					f/c	d		f/c	f/c	f/c*			f/c								
Baccharis pilularis										f/c																					
Bauhinia galpinii										f/c																					
Berberis spp.				F	F		f/c							F	d					F	F		f/c	f/c					f/c		
<i>Berberis julianae</i>	f/c			F	F									F						F	F	f/c	f/c	f/c							
<i>Berberis thunbergii</i>	f/c	f/c	f/c	F	F		F*		f/c*	f/c*		f/c*		F			f/c*	f/c	f/c	F	F	f/c	f/c	f/c	f/c*	f/c*	f/c*		f/c	f/c*	f/c*
<i>Berberis verruculosa</i>	f/c			F	F									F						F	F	f/c	f/c	f/c							
<i>Berberis x gladwynensis</i>	f/c		f/c	F	F				f/c			f/c		F				f/c	f/c	F	F	f/c	f/c	f/c		f/c				f/c	
<i>Berberis x mentorensis</i>	f/c			F	F				f/c			f/c		F						F	F	f/c	f/c	f/c		f/c					f/c
Betula spp.			f/c	F	F		f/c							F	d					F			f/c					f/c	f/c		
<i>Betula nigra</i>			f/c	F	F		F		f/c	f/c	F	f/c		F	d			f/c	f/c	f/c			f/c			f/c	F	f/c		f/c	F
<i>Betula papyrifera</i>			f/c	F	F				F	f/c		f/c		F			f/c			F			f/c	f/c		F	F	f/c		f/c	F
<i>Betula pendula</i>			f/c	F	F	F			f/c	f/c		f/c		F				f/c	f/c	F			f/c				F	f/c		f/c	F
Bougainvillea spp.	f/c					f/c	f/c*		f/c*			f/c			f/c					F		f/c		f/c*	f/c*	f/c*	F*			f/c*	F*
Brachychiton populneus									f/c	f/c		f/c																		f/c	

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<i>Bucida buceras</i>										f/c																							
<i>Buddleia davidii</i>	f/c*	f/c	Ø					f/c		f/c*					f/c	d			f/c			f/c*		f/c			f/c		f/c				
<i>Butia spp.</i>																		f/c	f/c														
<i>Buxus spp.</i>				F	F	f/c		f/c						F						f/c			f/c						f/c*				
<i>Buxus harlandii</i>				F	F	f/c								F						f/c			f/c										
<i>Buxus microphylla</i>	f/c	f/c*	f/c	F	F	f/c	f/c*	f/c*	f/c*	f/c*		f/c		F	f/c	d	f/c*	f/c	f/c	f/c		f/c	f/c	f/c	f/c*	f/c*	f/c*		f/c*	f/c*			
<i>Buxus sempervirens</i>				F	F	f/c	f/c*	f/c	f/c	f/c		f/c		F			f/c*	f/c	f/c	f/c			f/c	f/c	f/c*	f/c	f/c		f/c	f/c	f/c		
<i>Buxus sinica</i>		f/c*																															
<i>Callicarpa spp.</i>																																	
<i>Callistemon spp.</i>	f/c		f/c			f/c															F		f/c						f/c				
<i>Callistemon citrinus</i>	f/c		f/c			f/c	f/c*	f/c	f/c*			f/c			f/c		f/c	f/c	f/c		F	f/c	f/c			F	f/c			f/c	f/c		
<i>Callistemon lanceolatus</i>	f/c		f/c			f/c															F		f/c										
<i>Callistemon viminalis</i>	f/c		f/c			f/c			f/c			f/c									F	f/c	f/c			f/c					f/c		
<i>Calluna spp.</i>						f/c											Ø*																
<i>Calluna vulgaris</i>	f/c			F		f/c			f/c	f/c*		f/c						f/c	f/c			f/c		f/c		f/c					f/c		
<i>Camellia spp.</i>				F	F	f/c		f/c												F			f/c						f/c				
<i>Camellia japonica</i>			f/c	F	F	f/c	f/c*		f/c	f/c		f/c			f/c	d	f/c*	f/c	f/c	F			f/c	f/c	f/c*	f/c					f/c		
<i>Camellia sasanqua</i>				F	F	f/c	f/c*					f/c			f/c	d	f/c			F			f/c	f/c							f/c		
<i>Campsis x tagliabuana</i>										f/c*																							
<i>Caragana arborescens</i>																					F												
<i>Carissa spp.</i>						F*																		f/c*									
<i>Carissa grandiflora</i>																		f/c	f/c						f/c*								

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<i>Carya illinoensis</i>			f/c	F		F			F		F							f/c	f/c							F	f/c	f/c		f/c	f/c		
<i>Caryopteris spp.</i>																d													f/c				
<i>Caryopteris x clandonensis</i>								f/c	f/c*						f/c											f/c*							
<i>Castanea spp.</i>			f/c								F																	f/c					
<i>Castanea mollissima</i>			f/c								F	f/c																f/c		f/c			
<i>Catalpa bignoniaceae</i>																d																	
<i>Ceanothus spp.</i>				F				f/c	F			f/c			Ø*		f/c	f/c	f/c			f/c*				F	f/c		f/c	f/c	f/c		
<i>Ceanothus americanus</i>				F					F			f/c					f/c	f/c	f/c					f/c		F	f/c			f/c	f/c		
<i>Ceanothus prostratus</i>				F					F			f/c					f/c	f/c	f/c							F	f/c			f/c	f/c		
<i>Cedrus spp.</i>						f/c								F																			
<i>Cedrus atlantica</i>						f/c								F										f/c			f/c						
<i>Cedrus deodara</i>			f/c			f/c								F														f/c					
<i>Celtis occidentalis</i>				F																				f/c									
<i>Cephalanthus occidentalis</i>																			f/c														
<i>Cephalotaxus spp.</i>																														f/c			
<i>Cephalotaxus harringtonia</i>									f/c*	f/c					f/c											f/c*				f/c			
<i>Ceratonia siliqua</i>									F	f/c											F					F	F			f/c	F		
<i>Cercidiphyllum</i>																																	
<i>Cercis canadensis</i>		f/c*	f/c		F			f/c	f/c	f/c	F	f/c		F		d	f/c						f/c		f/c	f/c	f/c	f/c		f/c	f/c		

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Chaenomeles spp.				F				f/c*						F																			
<i>Chaenomeles japonica</i>				F			F		f/c	f/c				F				f/c	f/c								f/c			f/c			
<i>Chaenomeles speciosa</i>				F				f/c						F										f/c						f/c			
Chamaecyparis spp.								f/c		f/c*						d							f/c										
<i>Chamaecyparis lawsoniana</i>																f/c*							f/c				F					F	
<i>Chamaecyparis obtusa</i>							F*		f/c*	f/c*		f/c*					f/c						f/c	f/c	f/c*	f/c*	F*			f/c*	F*		
<i>Chamaecyparis pisifera</i>	f/c								f/c*	f/c*		f/c*					f/c*	f/c	f/c			f/c	f/c	f/c	f/c*	f/c*	F*			f/c*	F*		
<i>Chamaecyparis thyoides</i>															f/c	d																	
<i>Chamaedorea cataractarum</i>									f/c	f/c		f/c			f/c	d							f/c			f/c	F			f/c	F		
<i>Chamaedorea costaricana</i>										f/c																							
<i>Chamaedorea elegans</i>									f/c	f/c		f/c					f/c				F		f/c			f/c	F			f/c	F		
<i>Chamaedorea humilis</i>										f/c																							
Cheirodendron spp.																																	
Chionanthus																																	
Choisya ternata																								f/c									
Cistus spp.				F																				f/c*									
Citrus spp.	f/c		f/c			F			F									f/c	f/c	F				f/c*		F*	f/c*	f/c		f/c	f/c*		
Cladrastis spp.								f/c										f/c*	f/c*														
Clethra spp.								Ø							Ø*	Ø*											f/c			f/c			

Table 6-6. Preemergence Herbicides Registered for Use on Woody Ornamentals (continued)

F = registered for use in the field (or landscape)

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<i>Clethra alnifolia</i>		f/c*	Ø*					Ø	f/c		f/c				Ø*	Ø*									f/c	f/c			f/c		
<i>Cleyera japonica</i> (See <i>Ternstroemia</i> spp.)									f/c	f/c	f/c				f/c	d						f/c		f/c	f/c	f/c	f/c		f/c	f/c	
<i>Colonema pulchrum</i>									f/c	f/c															f/c	f/c					
<i>Convolvulus cneorum</i>									f/c*																						
<i>Cornus</i> spp.				F	F	f/c		f/c*						F						f/c	F		f/c				f/c	f/c*			
<i>Cornus alba</i>				F	F	f/c		f/c				f/c		F				f/c	f/c	f/c	F		f/c			f/c	F	f/c	f/c	f/c	F
<i>Cornus amomum</i>				F	F	f/c								F				f/c	f/c	f/c	F		f/c				f/c				
<i>Cornus florida</i>	f/c		f/c	F	F	f/c	F	f/c	f/c*	f/c*	F	f/c*		F			f/c	f/c	f/c	f/c	F	f/c	f/c	f/c	f/c	f/c	F	f/c	f/c	f/c*	F
<i>Cornus kousa</i>				F	F	f/c			f/c	f/c				F		d		f/c	f/c	f/c	F		f/c	f/c			f/c	f/c		f/c	f/c
<i>Cornus sericea</i> (= <i>stolonifera</i> or <i>baileyi</i>)	f/c	f/c*			F	f/c	F*		F*			f/c		F				f/c	f/c	f/c	F	f/c	f/c	f/c	f/c	F*	F	f/c		f/c	F*
<i>Correa</i> spp.																		f/c	f/c												
<i>Corylus</i> spp. (Filbert)				F		F			F		F																		f/c	F	
<i>Corylus americana</i>									f/c*																						
<i>Corylus maxima</i>			f/c																												
<i>Cotinus</i> spp.																															
<i>Cotinus coggygria</i>							F*		f/c	f/c*		f/c			f/c											f/c*				f/c*	
<i>Cotinus dammeri</i>									f/c*			f/c*														f/c*					
<i>Cotoneaster</i> spp.				F	F	f/c								F						f/c	F		f/c	f/c*				f/c	f/c*		
<i>Cotoneaster adpressus</i>				F	F	f/c		f/c	f/c	f/c		f/c		F						f/c	F		f/c	f/c*		f/c	F		f/c*	F	
<i>Cotoneaster apiculatus</i>	f/c			F	F	f/c	F		f/c	f/c		f/c		F			f/c	f/c	f/c	f/c	F	f/c	f/c	f/c*		f/c	f/c		f/c	f/c	f/c

Table 6-6. Preemergence Herbicides Registered for Use on Woody Ornamentals (continued)

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<i>Cotoneaster buxifolius</i>	f/c			F	F	f/c								F						f/c	F	f/c	f/c	f/c*			F			f/c	F
<i>Cotoneaster congestus</i>				F	F	f/c			f/c	f/c				F						f/c	F		f/c	f/c*		f/c	F			f/c	F
<i>Cotoneaster dammeri</i>	f/c	f/c	f/c	F	F	f/c			f/c	f/c		f/c		F	f/c	d	f/c*	f/c	f/c	f/c	F	f/c	f/c	f/c*	f/c*	f/c	f/c			f/c	f/c
<i>Cotoneaster himalayan</i>				F	F	f/c			f/c	f/c		f/c		F						f/c	F		f/c	f/c*		f/c	F			f/c	F
<i>Cotoneaster horizontalis</i>				F	F	f/c			f/c	f/c		f/c		F				f/c	f/c	f/c	F		f/c	f/c*		f/c	f/c			f/c	f/c
<i>Cotoneaster lacteus</i>				F	F	f/c								F							F		f/c	f/c*						f/c	f/c
<i>Cotoneaster microphyllus</i>	f/c			F	F	f/c				f/c				F						f/c	F	f/c	f/c	f/c*			F			f/c	F
<i>Cotoneaster salicifolius</i>				F	F	f/c								F						f/c	F		f/c	f/c*	f/c*		f/c			f/c	
<i>Crataegus aaspp.</i>	f/c				F	F	F*	f/c	F*	f/c*		f/c*		F		d	f/c	f/c	f/c			f/c					F*		f/c		f/c*
<i>Crataegus douglasii</i>															f/c																
<i>Cryptomeria japonica</i>		f/c*						f/c	f/c	f/c					f/c	d		f/c	f/c							f/c	f/c		f/c		f/c
<i>Cupaniopsis anacardioides</i>									F	f/c		f/c														F	F			f/c	F
<i>Cupressus spp.</i>					F	f/c																	f/c	f/c							
<i>Cupressus arizonica</i> var. <i>glabra</i>					F				f/c*	f/c*													f/c	f/c		f/c*	f/c			f/c	f/c
<i>Cupressus sempervirens</i>	f/c		f/c		F	f/c	F*		f/c	f/c*					f/c	d	f/c	f/c	f/c			f/c	f/c	f/c	f/c*	f/c	f/c				f/c

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<i>xCupressocyparis leylandii</i> (= <i>Cupresses leylandii</i>)							F	f/c	f/c*	f/c*					f/c	d		f/c	f/c				f/c	f/c		f/c*	f/c					
<i>Cycas revoluta</i>							F		f/c	f/c		f/c														f/c					f/c	
<i>Cytisus spp.</i>									f/c*											F*			f/c			F						
<i>Cytisus praecox</i>									f/c	f/c		f/c											f/c			f/c	F			f/c*	F	
<i>Cytisus scoparius</i>							F*		f/c	f/c		f/c			f/c		f/c*						f/c	f/c		f/c	F			f/c*	F	
<i>Daphne spp.</i>																d																
<i>Daphne caucasica</i>															f/c																	
<i>Daphne cneorum</i>									f/c	f/c																						
<i>Daphne odora</i>									f/c	f/c		f/c												f/c		f/c				f/c		
<i>Dasyliion wheeleri</i>																											F					F
<i>Deutzia aaspp.</i>			Ø*	F	F							f/c					f/c*								f/c*					f/c	F*	
<i>Deutzia crenata</i>				F	F				f/c			f/c														f/c	F			f/c	F*	
<i>Deutzia gracillis</i>		f/c*		F	F			f/c	f/c			f/c			f/c			f/c	f/c					f/c		f/c	Ø		f/c	f/c		
<i>Diervilla spp.</i>																		f/c*	f/c*													
<i>Diospyros spp.</i>																																
<i>Dodonaea viscosa</i>	f/c								F	f/c		f/c							f/c			f/c				F	F			f/c	F	
<i>Dypsis lutescens</i>										f/c						d																
<i>Elaeagnus spp.</i>			f/c		F															F												
<i>Elaeagnus angustifolia</i>			f/c	F	F				f/c		F	f/c			f/c					F	F			f/c		f/c	f/c			f/c	f/c	
<i>Elaeagnus pungens</i>	f/c		f/c		F				f/c	f/c		f/c								F		f/c			f/c*	f/c						
<i>Elaeagnus x ebbengei</i>			f/c		F				f/c	f/c								f/c	f/c	F						f/c*						

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<i>Encelia farinosa</i>																			f/c														
<i>Enkianthus campanulatus</i>									f/c*	f/c																							
<i>Epimedium x rubrum</i>		f/c*																															
<i>Erica spp.</i>		Ø*		F	F*																			f/c*									
<i>Erica cinerea</i>			f/c	F			F*			f/c		f/c														f/c				f/c*			
<i>Erica vagans</i>				F					f/c	f/c		f/c														f/c				f/c			
<i>Erica x darleyensis</i>				F					f/c	f/c							Ø									f/c				f/c			
<i>Eriobotrya japonica</i>																								f/c	f/c								
<i>Escallonia spp.</i>									f/c	f/c							f/c*	f/c*	f/c*	F*			f/c	f/c	f/c*		f/c*				f/c*		
<i>Eucalyptus spp.</i>					F	f/c	F*														F			f/c				f/c					
<i>Eucalyptus camaldulensis</i>					F	f/c				f/c	F																						
<i>Eucalyptus cinerea</i>			f/c		F	f/c			F*	f/c		f/c										F		f/c		F	F	f/c		f/c	F*		
<i>Eucalyptus microtheca</i>					F	f/c			f/c	f/c		f/c										F		f/c		f/c		f/c					
<i>Eucalyptus nicholii</i>					F	f/c																F		f/c			F	f/c				F	
<i>Eucalyptus pulverulenta</i>					F	f/c					F																						
<i>Eucalyptus polyanthemus</i>																d																	
<i>Eucalyptus sideroxylon</i>					F	f/c			F	f/c		f/c						f/c*	f/c*		F			f/c		F	F	f/c		f/c	F		
<i>Eucalyptus viminalis</i>					F	f/c					F											F		f/c				f/c					
<i>Eugenia myrtifolia</i>									f/c	f/c*												F				f/c							
<i>Euonymus spp.</i>				F	F	f/c		f/c						F		d					F			f/c*							f/c		

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<i>Euonymus alatus</i>		Ø*	f/c*	F	F	f/c		f/c	Ø*	Ø*				F			Ø*	f/c	f/c	F			f/c*		f/c*	Ø*	F		f/c	f/c	F	
<i>Euonymus fortunei</i>	f/c	f/c*		F	F	f/c	f/c*	f/c	f/c*	f/c*		f/c*		F			f/c*	f/c	f/c	f/c		f/c	f/c*	f/c	f/c*	f/c*	f/c*			f/c	f/c*	
<i>Euonymus japonicus</i>	f/c	f/c*		F	F	f/c	F*	f/c	f/c*	f/c*		f/c*		F	Ø*	Ø*	f/c*	f/c	f/c			f/c	f/c*		Ø*	f/c*	f/c*			f/c	f/c*	
<i>Euonymus vegetus</i>				F	F	f/c		f/c	f/c					F									f/c*			f/c	f/c					
<i>Euonymus x kiautschovica</i>	f/c			F	F	f/c		f/c	f/c			f/c		F			f/c*					f/c	f/c*	f/c	f/c*	f/c	F			f/c	F	
Fagus spp.														F																		
<i>Fagus sylvatica</i>									f/c	f/c				F										f/c								
Fatsyhedera lizei										f/c																f/c	f/c				f/c	
Fatsia japonica	f/c								f/c	f/c												f/c				f/c	f/c					F
Ficus benjamina										f/c																						
<i>Ficus carica</i>									F									f/c			F										f/c	
<i>Ficus pumilla</i>																					F				Ø						f/c	
Forsythia spp.				F	F	f/c						f/c		F							f/c		f/c						f/c			
<i>Forsythia suspensa</i>	f/c		f/c	F	F	f/c	F*			f/c		f/c		F							f/c		f/c	f/c								
<i>Forsythia viridissima</i>	f/c			F	F	f/c	F*			f/c		f/c		F							f/c		f/c	f/c								
<i>Forsythia x intermedia</i>	f/c		f/c	F	F	f/c	f/c*	f/c	f/c	f/c*		f/c		F	f/c	d	f/c*	f/c	f/c	f/c		f/c	f/c	f/c	f/c*	f/c	f/c	F			f/c	F
Fothergilla spp.								f/c																								
<i>Fothergilla gardenii</i>															f/c		f/c*								f/c*							
Franklinia spp.																		f/c	f/c													
Fraxinus spp.				F	F	F		f/c		f/c*				F							F					f/c*	F	f/c	f/c	f/c*	F	
<i>Fraxinus americana</i>			f/c	F	F	F	F*				F	f/c		F				f/c	f/c	F							F	f/c		f/c	F	
<i>Fraxinus pennsylvanica</i>			f/c	F	F	F	F				F			F		d		f/c	f/c	F				f/c			F	f/c			F	

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Gardenia spp.				F		f/c																	f/c									
<i>Gardenia jasminoides</i>	f/c	f/c*	f/c	F		f/c	f/c*	f/c	f/c*	f/c*		f/c*	F		f/c	d	f/c*	f/c	f/c	f/c		f/c	f/c	f/c	f/c*	f/c*	f/c			f/c*	f/c	
<i>Gardenia radicans</i>																d																
<i>Gelsemium sempervirens</i>							F		f/c	f/c		f/c							f/c	F				f/c	f/c					f/c		
Genista spp.																														f/c		
<i>Genista pilosa</i>							F*		f/c	f/c		f/c													f/c	F			f/c	F		
<i>Genista tinctoria</i>																							f/c							f/c		
Ginkgo biloba			f/c						F	f/c		f/c		F				f/c	f/c	F				f/c	F	f/c	f/c		f/c	f/c		
Gleditsia triacanthos						F		f/c	F*	f/c		f/c		F		d		f/c	f/c	F	F				F	F	f/c	f/c	f/c	F		
Hamamelis virginiana									f/c	f/c														f/c						?		
Hardenbergia violacea										f/c																						
Hebe buxifolia									f/c	f/c																						
Hedera spp.						f/c														F												
<i>Hedera canariensis</i>						f/c			F	f/c										F				f/c	F	F			f/c	F		
<i>Hedera helix</i>	f/c		f/c	F	F	f/c	F*		f/c	f/c								f/c	f/c	f/c		f/c		f/c	f/c	F			f/c	F		
Hemigraphis alternata																																
Hesperaloe parviflora										f/c*																						
Heteromeles arbutifolia									F			f/c														F	F			f/c	F	
Hibiscus spp.						f/c	F*	f/c*		f/c*										F				f/c*						f/c		
<i>Hibiscus rosa-sinensis</i>	F*					f/c	F*		f/c*			f/c			f/c	d				F		f/c		f/c	f/c*	f/c*	F		f/c	f/c	F*	

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Genus and species (Index of common names, by genus, is available in Table 6-9.)	Barricade	Biathlon	Broadstar	Casoron	Dacthal	Devrinol	Dimension	Freehand	Gallery	Gemini	Goal	HGH 75	Image	Kerb	Marengo/Specticle G	Marengo/Specticle SC	OH2	Pendulum (EC)	Pendulum (granule)	Pennant Magnum	Princep	Regalkade	Regal 00	Ronstar G	Rout	Snapshot TG	Surflan	Sureguard	Tower	Treflan	XL		
<i>Hibiscus syriacus</i>	F*	f/c*				f/c	F*	f/c	f/c*	f/c*		f/c*			f/c	d		f/c	f/c	F		F		f/c*		f/c*	F*		f/c	f/c	F*		
Hydrangea spp.		Ø*	Ø		F				Ø	Ø										F			f/c			Ø			f/c				
<i>Hydrangea arborescens</i>			Ø		F				Ø								Ø*			F			f/c		Ø*	Ø							
<i>Hydrangea macrophylla</i>	f/c		Ø		F			f/c	Ø						Ø*	Ø*	f/c*		f/c	F		f/c	f/c			Ø	f/c						
<i>Hydrangea paniculata</i>			Ø		F				Ø											F			f/c		Ø*	Ø							
<i>Hydrangea quercifolia</i>			Ø		F				Ø											F			f/c			Ø	f/c						
Hypericum spp.						F			f/c														f/c		f/c	f/c	f/c			f/c	F		
<i>Hypericum frondosum</i>																								f/c	f/c		f/c			f/c	F		
<i>Hypericum patulum</i>						F			f/c								f/c*				F			f/c	f/c	f/c	f/c	f/c			f/c	F	
Ilex spp.				F*	F	f/c		f/c*				f/c		F						F	F		f/c*	f/c					f/c*	f/c			
<i>Ilex aquifolium</i>				F	F	f/c		f/c	F*	f/c*		f/c		F						F	F		f/c	f/c			F*	F*		f/c	F*		
<i>Ilex cassine</i>				F	F	f/c	f/c	f/c	f/c	f/c		f/c		F						F	F		f/c	f/c						f/c			
<i>Ilex cornuta</i>	F	f/c*	f/c	F*	F	f/c	F*	f/c	f/c*	f/c*		f/c	F*	F	f/c	d	f/c*	f/c	f/c	f/c	F	f/c	f/c	f/c	f/c*	f/c*	f/c*		f/c	f/c	f/c*		
<i>Ilex crenata</i>	f/c		f/c	Ø	F	f/c	f/c*	f/c	f/c*	f/c*		f/c	F*	F	f/c	d	f/c*	f/c	f/c	f/c	F	f/c	f/c	f/c	f/c*	f/c*	f/c*		f/c	f/c	f/c*		
<i>Ilex glabra</i>			f/c	F	F	f/c		f/c	f/c*	f/c*		f/c		F	f/c	d				F	F		f/c	f/c		f/c*	F			f/c	F		
<i>Ilex latifolia</i>				F	F	f/c		f/c				f/c		F						F	F		f/c	f/c						f/c			
<i>Ilex opaca</i>	f/c			F	F	f/c		f/c	f/c			f/c		F		d	f/c	f/c	f/c	F	F	f/c	f/c	f/c	f/c				f/c	f/c			
<i>Ilex pernyi</i>	f/c			F	F	f/c		f/c		f/c		f/c		F						F	F	f/c	f/c	f/c						f/c			
<i>Ilex verticillata</i>			Ø	F	F	f/c		f/c				f/c		F		d				F	F		f/c	f/c						F	f/c		
<i>Ilex vomitoria</i>	f/c			Ø	F	f/c	F*	f/c	f/c*	f/c*		f/c	F*	F			f/c*	f/c	f/c	F	F	f/c	f/c	f/c	f/c*	f/c	f/c			f/c	f/c		
<i>Ilex x aquipernyi</i>				F	F	f/c		f/c	f/c	f/c		f/c		F		d				F	F		f/c	f/c	f/c*	f/c	f/c			F*	f/c	f/c	
<i>Ilex x attenuata</i>		f/c*		F	F	f/c	f/c*	f/c	f/c	f/c*		f/c		F		d		f/c*	f/c*	f/c	F		f/c	f/c		f/c*					f/c		

Table 6-6. Preemergence Herbicides Registered for Use on Woody Ornamentals (continued)

F = registered for use in the field (or landscape)

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<i>Ilex x meserveae</i>		f/c*	f/c	F	F	f/c	F*	f/c	f/c*	f/c*		f/c		F	f/c	d	f/c*			F	F		f/c	f/c	f/c*	f/c*	F*			f/c	F*	
<i>Ilex x Nellie R. Stevens</i>			f/c	F	F	f/c	f/c	f/c	f/c	f/c		f/c		F		d	f/c			F	F		f/c	f/c						f/c		
Illicium spp.																				F												
<i>Illicium annisatum</i>									f/c	f/c		f/c								F						f/c						
<i>Illicium floridanum</i>			f/c						f/c			f/c			f/c					F						f/c				f/c		
<i>Illicium parviflorum</i>		f/c*															f/c	f/c	F													
Itea spp.																																
<i>Itea ilicifolia</i>												f/c														f/c*				f/c*		
<i>Itea virginica</i>			f/c					f/c	f/c*	f/c*					f/c																	
Ixora coccinea										f/c						Ø																
Jasminum spp.	f/c*									f/c										F			f/c			f/c*						
<i>Jasminum flordium</i>																								f/c								
<i>Jasminum nudiflorum</i>										f/c					f/c					F		f/c	f/c									
Juglans spp.	f/c		f/c											F								f/c										
<i>Juglans nigra</i>			f/c			F		f/c	F		F			F				f/c	f/c			f/c				F	F	f/c	f/c	f/c	F	
<i>Juglans regia</i>			f/c	F		F			F					F				f/c	f/c			f/c				F	F			f/c	F	
Juniperus spp.				F	F	f/c		f/c				f/c		F				f/c	f/c*	F	F		f/c	f/c			f/c		f/c	f/c	f/c	
<i>Juniperus chinensis</i>	f/c	f/c*		F	F	f/c	f/c*	f/c	f/c*	f/c*	f/c	f/c	F*	F	f/c	d	f/c*	f/c	f/c*	f/c	F	F	f/c	f/c	f/c*	f/c*	f/c*	f/c*	f/c	f/c	f/c	f/c
<i>Juniperus conferta</i>	f/c	f/c*	f/c	F	F	f/c	f/c*	f/c	f/c*			f/c	F	F	f/c	d	f/c	f/c	f/c	F	F	f/c	f/c	f/c		f/c*	F		f/c	f/c	f/c	
<i>Juniperus davurica</i>	f/c	f/c*		F	F	f/c	f/c*	f/c	f/c	f/c*		f/c		F				f/c	f/c*	F	F	f/c	f/c	f/c			f/c			f/c	f/c	
<i>Juniperus excelsa</i>				F	F	f/c		f/c				f/c		F				f/c	f/c*	F	F		f/c	f/c			f/c			f/c	f/c	
<i>Juniperus horizontalis</i>	f/c	f/c	f/c	F	F	f/c	f/c*	f/c	f/c*	Ø*	f/c	f/c	F*	F	f/c	d	f/c*	f/c	f/c	f/c	F	f/c	f/c	f/c	f/c*		f/c*	f/c	f/c	f/c	f/c	

Table 6-6. Preemergence Herbicides Registered for Use on Woody Ornamentals (continued)

F = registered for use in the field (or landscape)

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<i>Juniperus procumbens</i>				F	F	f/c	f/c*	f/c	f/c*	f/c	f/c	f/c		F				f/c	f/c*	F	F		f/c	f/c		f/c*	f/c*			f/c	f/c	
<i>Juniperus sabina</i>				F	F	f/c	f/c*	f/c	f/c*	f/c*	f/c	f/c		F			f/c*	f/c	f/c*	f/c	F		f/c	f/c	f/c*	f/c*	F*	f/c		f/c	f/c	
<i>Juniperus scopulorum</i>				F	F	f/c	f/c*	f/c	f/c*	f/c*	f/c	f/c		F				f/c	f/c*	F	F		f/c	f/c		F*	F	f/c		f/c	f/c	
<i>Juniperus squamata</i>			f/c	F	F	f/c	f/c	f/c	f/c*	f/c*		f/c	F*	F	f/c			f/c	f/c*	F	F		f/c	f/c	f/c*	f/c*	F*			f/c	f/c	
<i>Juniperus virginiana</i>		f/c*	f/c	F	F	f/c	F	f/c	f/c	f/c	f/c	f/c		F	f/c	d		f/c	f/c	f/c	F		f/c	f/c		f/c	f/c			f/c	F	
<i>Kalmia latifolia</i>					F		F		f/c	f/c		f/c		F				f/c	f/c	f/c						f/c	F			f/c	F	
<i>Kerria japonica</i>								f/c																								
<i>Koeleruteria paniculata</i>				F		F																		f/c			F					F
<i>Kolkwitzia amabilis</i>				F											f/c																	
<i>Laburnum anagyroides</i>						F																										
<i>Lagerstroemia indica</i>	f/c	f/c*	f/c*			f/c	F*	f/c	f/c	f/c*	F	f/c	F		f/c	d		f/c	f/c	F		f/c	Ø*	f/c*		f/c	f/c	f/c	f/c	f/c	f/c	f/c
<i>Lagerstroemia faurei</i>							F*																	f/c*								f/c
<i>Lagerstroemia X (hybrids)</i>	f/c*	f/c*				f/c									f/c																	f/c
<i>Lantana spp.</i>					F	F		f/c				f/c		Ø*												f/c			f/c	f/c		
<i>Lantana camara</i>		f/c*													f/c																	
<i>Lantana montevidensis</i>	f/c	f/c*			F	F						f/c							f/c			f/c		f/c	f/c*							f/c
<i>Larix spp.</i>																												f/c				
<i>Larix decidua</i>																								f/c								
<i>Larix kaempferi</i>						F						f/c																f/c		f/c		
<i>Laurus nobilis</i>																		f/c	f/c													

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<i>Lavandula aspp.</i>	f/c*							f/c*							Ø*			f/c*	f/c*			f/c				f/c*	f/c*		f/c					
<i>Leptospermum scoparium</i>							f/c*		f/c*																	f/c								
<i>Leucophyllum spp.</i>																																		
<i>Leucophyllum frutescens</i>									f/c	f/c								f/c	f/c															
<i>Leucophyllum laevigatum</i>									f/c	f/c																								
<i>Leucothoe spp.</i>				F		f/c		f/c												F										f/c				
<i>Leucothoe axillaris</i>				F		f/c			f/c	f/c		f/c						f/c	f/c	F				f/c		f/c	F			f/c	F			
<i>Leucothoe fontanesiana</i>				F		f/c	F		f/c	f/c		f/c						f/c	f/c	f/c				f/c		f/c	F		f/c	f/c	F			
<i>Leucothoe populifolia</i>															f/c	d																		
<i>Ligustrum spp.</i>				F		f/c		f/c*				f/c	Ø	F		d				F			f/c	f/c					f/c*	f/c				
<i>Ligustrum amurense</i>	f/c			F	F	f/c				f/c		f/c	Ø	F						F		f/c	f/c	f/c			f/c			f/c	f/c			
<i>Ligustrum japonicum</i>	f/c		f/c	F	F	f/c			f/c*			f/c	Ø	F	Ø*		f/c*	f/c	f/c	f/c		f/c	f/c	f/c	f/c*	f/c*	f/c*			f/c	f/c*			
<i>Ligustrum lucidum</i>	f/c			F	F	f/c	F	f/c	f/c	f/c		f/c	Ø	F				f/c	f/c	F		f/c	f/c	f/c	f/c	f/c	f/c	f/c		f/c	f/c	f/c		
<i>Ligustrum ovalifolium</i>				F	F	f/c			F	f/c		f/c	Ø	F				f/c	f/c	F			f/c	f/c		F	F		f/c	f/c	F			
<i>Ligustrum sinense</i>	f/c	f/c*	f/c*	F	F	f/c				f/c		f/c	Ø	F			f/c	f/c	f/c*	F		f/c	f/c	f/c	f/c*						f/c			
<i>Ligustrum vulgare</i>				F	F	F			f/c*	f/c		f/c	Ø	F						F			f/c	f/c		f/c					f/c			
<i>Ligustrum x ibolium</i>				F	F	f/c				f/c*		f/c	Ø	F			f/c*			F			f/c	f/c							f/c			
<i>Ligustrum x vicaryi</i>				F	F	f/c	F		F	f/c		f/c	Ø	F	f/c		f/c			F			f/c	f/c	f/c	F*	f/c				f/c	f/c		
<i>Liquidambar styraciflua</i>			f/c			F	F		F	f/c	F	f/c		F				f/c	f/c	F						F	f/c	f/c		f/c	f/c			

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<i>Liriodendron tulipifera</i>					F	F					F	f/c		F				f/c	f/c	F										f/c		
Lindera benzoin																d																
Lonicera spp.				F	F	F														F			f/c	f/c								
<i>Lonicera fragrantissima</i>				F	F	F			f/c								f/c			F	F		f/c	f/c		f/c	F				F	
<i>Lonicera japonica</i>	f/c		f/c	F	F	F	F*		F											F		f/c	f/c	f/c		F	F				F	
<i>Lonicera periclymenum</i>				F	F	F			f/c			f/c			f/c					F			f/c	f/c		f/c	F				F	
<i>Lonicera sempervirens</i>				F	F	F			f/c			f/c								F			f/c	f/c		f/c	F			f/c	F	
<i>Lonicera tatarica</i>	f/c			F	F	F	F*													F	F	f/c	f/c	f/c								
<i>Lonicera x xylosteoides</i>				F	F	F														F			f/c	f/c	f/c*							
<i>Lonicera xylosteum</i>				F	F	F	F*													F			f/c	f/c								
Loropetalum chinense	f/c*	f/c*						f/c	f/c*	f/c*					f/c	d	f/c*						f/c			f/c*	f/c	f/c		f/c		
Magnolia spp.	F			F	F			f/c*				f/c		F						F		F	f/c	f/c			F					
<i>Magnolia grandiflora</i>	F	f/c*		F	F			f/c	f/c	f/c		f/c		F		d		f/c	f/c	F		F	f/c	f/c		f/c	F		f/c	f/c	F	
<i>Magnolia liliflora</i>	F		f/c	F	F							f/c		F		d				F		F	f/c	f/c			F					
<i>Magnolia stellata & hybrids</i>	F			F	F				f/c	f/c*		f/c		F	f/c		Ø*	f/c	f/c	F		F	f/c	f/c	Ø*		F					
<i>Magnolia x soulangiana</i>	F			F	F			f/c	f/c	f/c		f/c		F			f/c	f/c	f/c	F		F	f/c	f/c			F					
Mahonia spp.			f/c					f/c*		f/c*											F		f/c									
<i>Mahonia aquifolium</i>			f/c					f/c	f/c	f/c								f/c	f/c		F		f/c	f/c	f/c	f/c*	F				F	
<i>Mahonia bealei</i>			f/c						f/c			f/c					f/c				F		f/c			f/c				f/c		
<i>Mahonia repens</i>			f/c						f/c	f/c		f/c					f/c				F		f/c		f/c	f/c				f/c		

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Malus spp. (crabapple)	f/c		f/c	F		F		f/c			F	f/c				d		f/c	f/c	F			f/c	f/c			F		f/c	f/c	F	
<i>Malus floribunda</i>	f/c		f/c	F		F					F	f/c						f/c	f/c	F			f/c	f/c			F			f/c	F	
<i>Malus sargentii</i>		f/c*		F*		F			f/c		F	f/c						f/c	f/c	F			f/c	f/c						f/c	F	
Malus pumila (apple)	f/c		f/c	F*		F	F		F		F							f/c	f/c	F						F	F			f/c	F	
Malus x domestica (apple)	f/c		f/c	F*		F		f/c	F		F					d		f/c	f/c	F						F	F		f/c	f/c	F	
Mandevilla splendens										f/c*																						
Meta-sequoia glyptostroboides																	d	f/c	f/c					f/c								
Michelia figo									f/c	f/c																						
Microbiota decussata																									f/c							
Morus alba			f/c						F	f/c		f/c														F	F			f/c	F	
Myoporum spp.																																
<i>Myoporum parvifolium</i>			f/c						f/c	f/c																		F*				F
Myrica spp.			Ø*						f/c												F											
<i>Myrica californica</i>							F														F											
<i>Myrica cerifera</i>			Ø						f/c	f/c		f/c	F		f/c	d		f/c	f/c	f/c						f/c					f/c	
<i>Myrica pensylvanica</i>		f/c*	f/c						f/c	f/c											F											
Myrtus communis																		f/c	f/c					f/c								f/c
Nandina domestica	f/c	f/c*	Ø*	F		f/c	F*	Ø*	f/c*	f/c		f/c*			f/c	d	f/c*	f/c	f/c	F			f/c	f/c*	f/c*	f/c	f/c			Ø*	f/c	f/c*

Table 6-6. Preemergence Herbicides Registered for Use on Woody Ornamentals (continued)

F = registered for use in the field (or landscape)
 C = registered for use in containers
 f/c = registered for both field and container use
 d = registered for directed applications only
 Ø = label prohibits use on this species
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Genus and species (Index of common names, by genus, is available in Table 6-9.)	Barricade	Biathlon	Broadstar	Casoron	Dacthal	Devrinol	Dimension	Freehand	Gallery	Gemini	Goal	HGH 75	Image	Kerb	Marengo/Specticle G	Marengo/Specticle SC	OH2	Pendulum (EC)	Pendulum (granule)	Pennant Magnum	Princep	Regalkade	Regal 00	Ronstar G	Rout	Snapshot TG	Surflan	Sureguard	Tower	Treflan	XL		
Nerium spp.	f/c	f/c*	f/c			F															F	f/c	f/c							f/c			
<i>Nerium oleander</i>	f/c		f/c			F	F*		f/c			f/c*			f/c		f/c	f/c	F	F	f/c	f/c	f/c	f/c	f/c	f/c	f/c			f/c	f/c		
Nyssa sylvatica												f/c				d		f/c	f/c												f/c		
Ochna serrulata																																	
Olea spp.	F		f/c			F			F	f/c								f/c*	f/c*							F	F			f/c	F*		
Osmanthus spp.				F		F		f/c*												F										f/c*			
<i>Osmanthus fragrans</i>			f/c	F		F		f/c	f/c	f/c					f/c	d		f/c	f/c	F					f/c					f/c			
<i>Osmanthus heterophyllus</i>	f/c			F		F				f/c										F		f/c		f/c	f/c*		F				F		
<i>Osmanthus x fortunei</i>				F		F			f/c			f/c								F						f/c				f/c			
Oxydendrum arboreum	f/c						F	f/c	f/c			f/c						f/c	f/c			f/c				f/c					f/c		
Pachysandra terminalis			f/c		F	f/c	F		f/c	f/c			F				f/c	f/c	f/c	f/c			f/c	f/c	f/c	f/c	f/c				f/c	F	
Parthenocissus tricuspidata					F																												
<i>Parthenocissus quinquefolia</i>									f/c																	f/c							
Paxistima canbyi				F	F																												
Philadelphus spp.				F	F		F					f/c		F										f/c*			f/c			f/c	f/c		
Phoenix roebelenii										f/c																							
Photinia spp.				F		f/c														F			f/c										
<i>Photinia x fraseri</i>	f/c		f/c	F		f/c	F	f/c	f/c			f/c	F		f/c		f/c	f/c	f/c	F		f/c	f/c	f/c	f/c	f/c	f/c	f/c			f/c	f/c	

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<i>Phyllostachys aurea</i>																d																
<i>Physocarpus opulifolius</i>									f/c	f/c					f/c					F												
<i>Picea spp.</i>	F		f/c*		F	F		f/c						F						F		F	f/c	f/c*						f/c	f/c	
<i>Picea abies</i>	F		f/c		F	F	F		f/c*	f/c*	F	f/c*		F		d		f/c	f/c	F	F	F	f/c	f/c*	f/c*	f/c	F	f/c	f/c	f/c	f/c*	F
<i>Picea engelmannii</i>	F				F	F								F						F		F	f/c	f/c			F					F
<i>Picea glauca</i>	F		f/c*		F	F	F*		f/c*	f/c*	F*	f/c		F		d	f/c*	f/c*	f/c*	F	F	F	f/c	Ø	f/c*	f/c*	F*	f/c*		f/c	F*	
<i>Picea glauca conica</i>	F		f/c		F	F			F		F	f/c		F			f/c	f/c	f/c	F		F	f/c	f/c	f/c	F	f/c	f/c		f/c	F	
<i>Picea mariana</i>	F				F	F								F						F		F	f/c	f/c								F
<i>Picea omorika</i>	F		f/c		F	F								F						F		F	f/c	f/c								
<i>Picea pungens</i>	F				F	F	f/c*		f/c*	f/c*	F	f/c*		F				f/c	f/c	F	F	F	f/c	f/c	f/c*	f/c*	F*	f/c	f/c	f/c*	F*	
<i>Picea rubens</i>	F				F	F								F						F	F	F	f/c	f/c								
<i>Picea sitchensis</i>	F		f/c		F	F					F			F						F		F	f/c	f/c					f/c			
<i>Pieris spp.</i>					F								Ø							F			f/c	f/c*								
<i>Pieris japonica</i>	f/c		f/c		F		F*	f/c	f/c*	f/c*		f/c*	Ø		f/c	d	f/c	f/c	f/c	F	F	f/c	f/c	Ø	f/c*	f/c*	f/c*		f/c	f/c	f/c*	
<i>Pieris taiwanensis</i>					F		F						Ø							F			f/c	f/c								
<i>Pinus spp.</i>				F*	F	f/c		f/c*						F						F			f/c	f/c			f/c		f/c*		f/c	
<i>Pinus aristata</i>				F*	F*	f/c			F	f/c		f/c		F						F			f/c	f/c		F	F			f/c	f/c	
<i>Pinus banksiana</i>			f/c	F*	F	f/c					F			F						F			f/c	f/c			f/c	f/c				f/c
<i>Pinus bungeana</i>			f/c	F*	F	f/c								F						F			f/c	f/c			f/c					f/c
<i>Pinus canariensis</i>										f/c						d																
<i>Pinus clausa</i>				F*	F*	f/c								F						F			f/c	f/c			f/c	f/c				f/c
<i>Pinus contorta</i>			f/c	F*	F	f/c			F	f/c	F	f/c		F						F	F		f/c	f/c		F	F	f/c		f/c	f/c	
<i>Pinus echinata</i>			f/c	F*	F	f/c					F			F						F			f/c	f/c			f/c	f/c				f/c
<i>Pinus elliottii</i>	f/c		f/c	F*	F	f/c	F			f/c	F			F						F			f/c	f/c		f/c	F			f/c	f/c	

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<i>Pinus halepensis</i>	f/c			F*	F	f/c				f/c				F			f/c			F		f/c	f/c	f/c			f/c				f/c	
<i>Pinus leucodermis</i>				F*	F	f/c			f/c	f/c		f/c		F						F			f/c	f/c		f/c	f/c			f/c	f/c	
<i>Pinus mugo</i>			f/c	F*	F	f/c	F	f/c	f/c*	f/c	F	f/c		F				f/c	f/c	F	F		f/c	f/c	f/c	f/c	f/c	f/c	f/c	f/c	f/c	
<i>Pinus nigra</i>	f/c			F*	F	f/c	f/c		f/c	f/c	F	f/c		F				f/c	f/c	F	F	f/c	f/c	f/c		f/c	f/c	f/c		f/c	f/c	
<i>Pinus palustris</i>	f/c		f/c	F*	F	f/c	F			f/c	F			F						F		f/c	f/c	f/c			f/c	f/c			f/c	
<i>Pinus pinea</i>				F*	F	f/c								F				f/c	f/c	F			f/c	f/c			f/c				f/c	
<i>Pinus ponderosa</i>			f/c	F*	F	f/c					F			F						F			f/c	f/c			f/c	f/c				f/c
<i>Pinus radiata</i>	f/c			F*	F	f/c			F	f/c	F	f/c		F				f/c	f/c	F	F	f/c	f/c	f/c	f/c	F	F			f/c	f/c	
<i>Pinus resinosa</i>				F*	F	f/c						f/c		F				f/c	f/c	F	F		f/c	f/c			f/c			f/c	f/c	
<i>Pinus strobus</i>	f/c		f/c	F*	F	F	f/c	f/c	f/c	f/c	F	f/c		F	f/c	d		f/c	f/c	f/c	F	f/c	f/c	f/c	f/c	f/c	f/c	f/c	f/c		f/c	f/c
<i>Pinus sylvestris</i>	f/c	f/c	f/c	F*	F	f/c	F		f/c*	f/c*	F	f/c		F		d		f/c	f/c	F	F	f/c	f/c	f/c	f/c	f/c	f/c	f/c	f/c		f/c*	f/c
<i>Pinus taeda</i>	f/c		f/c	F*	F	f/c	F	f/c		f/c	F	f/c		F	f/c			f/c	f/c	F		f/c	f/c	f/c			f/c	f/c			f/c	f/c
<i>Pinus thunbergiana</i>	f/c			F*	F	f/c	F		f/c	f/c		f/c		F			f/c			f/c		f/c	f/c	f/c	f/c	f/c	f/c	f/c			f/c	f/c
<i>Pinus virginiana</i>	f/c		f/c	F*	F	f/c	F			f/c	F			F				f/c	f/c	F		f/c	f/c	f/c			f/c	f/c				f/c
<i>Pinus wallichiana</i>				F*	F	f/c					F			F						F			f/c	f/c			f/c					f/c
<i>Pistacia spp.</i>	f/c		f/c*			F			F		F					d		f/c	f/c			f/c				F	F			f/c	F	
<i>Pittosporum spp.</i>				F	F	f/c			f/c*														f/c				f/c					f/c
<i>Pittosporum crassifolium</i>				F	F	f/c														F			f/c		f/c		f/c					f/c
<i>Pittosporum rhombifolium</i>	f/c			F	F	f/c				f/c										F		f/c	f/c				f/c					f/c
<i>Pittosporum tenuifolium</i>				F	F	f/c			f/c*	f/c*										F			f/c		f/c		f/c					f/c
<i>Pittosporum tobira</i>	f/c	f/c	f/c	F	F	f/c	f/c*	f/c	f/c*	f/c*		f/c*		f/c		d	f/c*	f/c	f/c	f/c		f/c	f/c	f/c	f/c	f/c*	f/c	F*			f/c	f/c
<i>Platanus spp.</i>					F				F*																			f/c				
<i>Platanus occidentalis</i>			f/c				F		F	f/c	F	f/c		F				f/c	f/c							F	F	f/c		f/c		F

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<i>Platanus racemosa</i>			f/c		F				F	f/c	F	f/c													F	F	f/c		f/c	F	
<i>Platanus x acerifolia (hybrida)</i>												f/c		F		d												f/c		f/c	
Platycladus orientalis see: Thuja orientalis			f/c	F	F	C	f/c*	f/c	f/c*	f/c*	f/c	f/c		F						F	F		f/c	f/c	f/c*	f/c*	f/c*	f/c		f/c*	f/c*
Plumbago spp.	Ø*						f/c*		f/c*			f/c*				Ø*										f/c*	F*			f/c	F*
Podocarpus spp.	f/c*		f/c		F	f/c					F	f/c					f/c			F						F	F			f/c	f/c*
<i>Podocarpus macrophyllus</i>	f/c		f/c		F	f/c		f/c	F*	f/c	F	f/c			f/c	d	f/c	f/c	f/c	F			f/c			f/c	f/c			f/c	f/c*
Polygala fruticosa										f/c																					
Populus spp.			f/c	F	F	F			F*					F						F				f/c				f/c			
<i>Populus deltoids</i>			f/c	F	F	F			F	f/c	F	f/c		F		d		f/c	f/c	F				f/c		F	F	f/c		f/c	F
<i>Populus grandidentata</i>			f/c	F	F	F					F			F				f/c	f/c	F				f/c				f/c			
<i>Populus nigra</i>			f/c	F	F	F					F			F				f/c	f/c	F				f/c				f/c			
<i>Populus tremuloides</i>			f/c	F		F					F			F		d		f/c	f/c	F				f/c				f/c			
Potentilla spp.			f/c		F		F*		f/c*			f/c								F			f/c*						f/c	f/c	F*
<i>Potentilla fruticosa</i>		Ø*	f/c		F		F		f/c			f/c			f/c		f/c*		f/c	F			f/c*	f/c	f/c*	f/c*	f/c		f/c	f/c	f/c
Prosopis chilensis										f/c		f/c														f/c					
Prunus spp.						F		f/c			F									F			f/c					f/c			
Prunus americana																d															
Prunus avia			f/c	F		F			F		F							f/c	f/c	F			f/c			F	F	f/c		f/c	F
Prunus cerasus				F		F			F		F							f/c	f/c	F			f/c			F	F	f/c		f/c	F
<i>Prunus caroliniana</i>							f/c*		f/c	f/c*	F	f/c		F						F			f/c				F	f/c		f/c	F
<i>Prunus laurocerasus</i>				F*					f/c*	f/c*	F			F		d		f/c	f/c*	F			f/c	f/c			F	f/c			F

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<i>Prunus mahaleb</i>											F									F			f/c					f/c			F	
<i>Prunus x incamp</i>																d																
<i>Prunus sargentii</i>											F			F		d				F			f/c	f/c				f/c				
<i>Prunus serotina</i>											F							f/c	f/c	F			f/c					f/c				
<i>Prunus serrulata</i>											F			F		d		f/c	f/c	F			f/c	f/c				f/c				
<i>Prunus subhirtella</i>											F			F						F			f/c					f/c				
<i>Prunus tomentosa</i>											F			F				f/c	f/c	F			f/c					f/c				
<i>Prunus virginiana</i>		f/c*									F			F				f/c	f/c	F			f/c					f/c				
<i>Prunus x cistena</i>											F			F		d	f/c*			F			f/c		f/c			f/c				
<i>Prunus yedoensis</i>									F	f/c	F	f/c		F		d				F			f/c			F	F	f/c		f/c	F	
Prunus armeniaca	f/c		f/c			F		f/c	F		F							f/c	f/c	F			f/c	f/c			F	F	f/c		f/c	F
Prunus persica	f/c		f/c			F	F	f/c	F		F							f/c	f/c	F			f/c	f/c			F	F	f/c	f/c		F
Prunus dulcis	f/c		f/c			F			F		F							f/c	f/c	F			f/c	f/c			F	F	f/c			F
<i>Prunus glandulosa (shrub)</i>				F			F		f/c	f/c		f/c					Ø			F			f/c	f/c		Ø	f/c	f/c	f/c		f/c	F
Prunus spp. (plum, prune)	f/c		f/c			F		f/c	F		F							f/c	f/c	F			f/c	f/c			F	F	f/c			F
<i>Prunus cerasifera</i>	f/c															d		f/c	f/c	F			f/c	f/c			F	F	f/c			F
Prunus maritima	f/c		f/c			F														F			f/c	f/c			F	F	f/c			F
Pseudotsuga menziesii	F		f/c		F	f/c	F	f/c			F	f/c		F				f/c	f/c	F	F	F		f/c				Ø	f/c	f/c	f/c	
Psidium cattleianum											f/c																					
Punica spp.									F		F*													f/c*		F	F				f/c	F
Pyracantha aaspp.			f/c	F		f/c	f/c*					f/c		F						F			f/c		f/c*						f/c	
<i>Pyracantha coccinea</i>	f/c		f/c	F		f/c	F*		f/c*	f/c*		f/c		F	f/c		f/c*	f/c	f/c	F			f/c	f/c	f/c			f/c			f/c	f/c

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Genus and species (Index of common names, by genus, is available in Table 6-9.)	Barricade	Biathlon	Broadstar	Casoron	Dacthal	Devrinol	Dimension	Freehand	Gallery	Gemini	Goal	HGH 75	Image	Kerb	Marengo/Specticle G	Marengo/Specticle SC	OH2	Pendulum (EC)	Pendulum (granule)	Pennant Magnum	Princep	Regalkade	Regal 00	Ronstar G	Rout	Snapshot TG	Surflan	Sureguard	Tower	Treflan	XL	
<i>Pyracantha fortuneana</i>	f/c		f/c	F		f/c			f/c*	f/c*		f/c		F						F		f/c	f/c		f/c*	f/c*	f/c*			f/c	f/c*	
<i>Pyracantha koidzumii</i>	f/c		f/c	F		f/c	f/c*			f/c*		f/c		F						F		f/c	f/c				f/c			f/c	f/c	
<i>Pyrus spp.</i>	f/c*		f/c*	F		F			F		F			F*		d		f/c*	f/c*	F		f/c*				F	F			f/c	F	
<i>Quercus spp.</i>				F	F			f/c						F								f/c	f/c	f/c			f/c	f/c	f/c		f/c	
<i>Quercus acutissima</i>				F	F									F			f/c			F		f/c	f/c	f/c			f/c	f/c			f/c	
<i>Quercus alba</i>				F	F									F				f/c	f/c	F		f/c	f/c	f/c			f/c	f/c			f/c	
<i>Quercus coccinea</i>				F	F							f/c		F						F		f/c	f/c	f/c			f/c	f/c		f/c	f/c	
<i>Quercus illicifolia</i>			f/c	F	F				F	f/c		f/c		F						F		f/c	f/c	f/c		F	f/c	f/c		f/c	f/c	
<i>Quercus laurifolia</i>				F	F		F							F						F		f/c	f/c	f/c			f/c	f/c			f/c	
<i>Quercus michauxii</i>				F	F									F				f/c	f/c	F		f/c	f/c	f/c			f/c	f/c			f/c	
<i>Quercus muehlenbergii</i>				F	F						F			F				f/c	f/c	F		f/c	f/c	f/c			f/c	f/c			f/c	
<i>Quercus nigra</i>				F	F						F			F				f/c	f/c	F		f/c	f/c	f/c			f/c	f/c			f/c	
<i>Quercus nuttallii</i>				F	F						F			F		d				F		f/c	f/c	f/c			f/c	f/c			f/c	
<i>Quercus pagoda</i>				F	F						F			F						F		f/c	f/c	f/c			f/c	f/c			f/c	
<i>Quercus palustris</i>			f/c	F	F	F	F		F	f/c	F	f/c		F				f/c	f/c	F		f/c	f/c	f/c		F	f/c	f/c		f/c	f/c	
<i>Quercus phellos</i>			f/c	F	F		F		f/c	f/c	F	f/c		F				f/c	f/c	f/c		f/c	f/c	f/c		f/c	f/c	f/c		f/c	f/c	
<i>Quercus prinus</i>				F	F						F			F						F		f/c	f/c	f/c			f/c	f/c			f/c	
<i>Quercus rubra</i>	f/c		f/c	F	F		F		f/c	f/c	F	f/c		F		d		f/c	f/c	F	F	f/c	f/c	f/c		f/c	f/c	f/c		f/c	f/c	
<i>Quercus shumardii</i>	f/c			F	F					f/c				F		d	f/c			F		f/c	f/c	f/c	f/c		f/c	f/c			f/c	
<i>Quercus virginiana</i>			f/c	F	F		F		f/c			f/c		F		d		f/c	f/c	F		f/c	f/c	f/c		f/c	f/c	f/c		f/c	f/c	
<i>Raphiolepis spp.</i>			f/c*			f/c			f/c*											F			f/c									
<i>Raphiolepis indica</i>	f/c		f/c			f/c	f/c*	f/c	f/c*	f/c*		f/c*	F		f/c	d	f/c*	f/c	f/c	F		f/c	f/c	f/c*	f/c*	f/c*	f/c*	f/c*		f/c		f/c*
<i>Raphiolepis ovata</i>						f/c			f/c	f/c		f/c								F			f/c			f/c	F			f/c	F	

Table 6-6. Preemergence Herbicides Registered for Use on Woody Ornamentals (continued)

F = registered for use in the field (or landscape)
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Raphiolepis umbellata	f/c					f/c														F		f/c	f/c	f/c							
Ravenea rivularis										f/c																					
Rhapis excelsa																								f/c							
Rhododendron spp. (azalea)			f/c*		F	f/c		f/c	f/c*	f/c*		f/c	Ø	F	f/c*	d*	f/c*	f/c	f/c	F			f/c*	f/c*	f/c*		f/c		f/c	f/c	f/c
Rhododendron spp. (hardy deciduous azaleas)				F		f/c		f/c				f/c	Ø	F						F			f/c*				f/c		f/c	f/c	f/c
Rhododendron (az) calendulaceum			f/c*		F	f/c	F	f/c	f/c*			f/c	Ø	F			f/c*	f/c	f/c	F			f/c*	f/c	f/c*	f/c*	F*		f/c	f/c	
Rhododendron (az) exbury			f/c		F	f/c	F	f/c	f/c*			f/c	Ø	F				f/c	f/c	F			f/c*	f/c	f/c	f/c*	f/c*		f/c	f/c	
Rhododendron (az) indica	f/c*	f/c*	f/c*		F	f/c		f/c	f/c*			f/c	Ø	F	f/c	d		f/c	f/c	f/c			f/c*	f/c*	f/c	f/c*	f/c*	f/c*		f/c	f/c
Rhododendron (az) Girard Hybrids	f/c*		f/c		F	f/c		f/c	f/c*			f/c	Ø	F				f/c	f/c	F			f/c*	f/c*		f/c*	f/c		f/c	f/c	
Rhododendron (az) Glen Dale Hybrids					F	f/c		f/c				f/c	Ø	F									f/c*	f/c		f/c*			f/c	f/c	
Rhododendron (az) obtusum	f/c*	f/c*	Ø	F	F	f/c	F	f/c	f/c*	f/c		f/c	Ø	F	f/c	d	f/c*	f/c	f/c	f/c			f/c*	f/c*	f/c*	f/c*	f/c*		f/c	f/c	
Rhododendron (az) Satsuki Hybrids	f/c*		f/c		F	f/c		f/c	f/c*			f/c	Ø	F			f/c	f/c	f/c	F			f/c*	f/c		f/c*	F*		f/c	f/c	
Rhododendron spp. (rhodie)	f/c*		f/c*	F*	F	f/c	F*	f/c	f/c*	Ø*		f/c		F		d	f/c*	f/c	f/c	f/c*			f/c*	f/c*	Ø*	f/c*	f/c*		f/c	f/c	f/c
Note: Some injury has been reported on certain cultivars / hybrids of R. carolinianum and catawbiense from Gallery, OH2, Rout and Snapshot TG. Check labels for details and precautions																															
Rhus spp.									f/c*																						
Rhus lancea									f/c			f/c															f/c	f/c		f/c	f/c

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<i>Rhus typhina</i>			f/c						f/c																							
Ribes spp.									F																	F	F			f/c	F	
Robinia spp.				F	F						F*	f/c*								F										f/c*		
Rosa spp.		f/c*	f/c	F	F	f/c		f/c	f/c*		F								f/c	F				f/c					f/c		F	
<i>Rosa banksiae</i>	f/c		f/c	F	F	f/c	F*	f/c		f/c	F								f/c	F		f/c		f/c							F	
<i>Rosa hybrids (Knockout)</i>		f/c*	f/c	F	F	f/c	f/c	f/c	f/c		F				f/c	d			f/c	F				f/c							F	
<i>Rosa rugosa</i>			f/c	F	F	f/c		f/c	f/c			f/c							f/c	F				f/c		f/c	F				F	
<i>Rosa virginiana</i>															f/c	d																
<i>Rosa wichuriama</i>																d																
Rosmarinus officinalis	f/c						F		F			f/c							f/c			f/c				F	F			f/c	F	
Rubus spp.			f/c	F					F																	F*	F*			f/c	F*	
<i>Ruscus hypophyllum</i>										f/c																						
Sabal minor								f/c																								
Salix spp.				F	F							f/c		F						F								f/c		f/c		
Salix babylonica				F	F				F	f/c		f/c		F				f/c	f/c	F						F	F	f/c		f/c	F	
Salix matsudana				F	F				F			f/c		F						F						F	F	f/c		f/c	F	
Samanea saman																																
Sambucus spp.								Ø	F						Ø*																	F
Santolina virens	f/c				F					f/c							f/c					f/c	f/c									
Sarcococca hookeriana		Ø*															Ø															
Sequoia sempervirens									f/c	f/c																	F					F
Sequoiadendron giganteum									F	f/c		f/c						f/c	f/c							F	F		f/c		F	

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Skimmia spp.									f/c*																					f/c		
<i>Skimmia japonica</i>									f/c	f/c		f/c														f/c				f/c		
<i>Skimmia revesiana</i>									f/c	f/c		f/c														f/c				f/c		
Sorbus aspp.				F										F																		
<i>Sorbus aucuparia</i>				F			F							F																		
Spiraea spp.				F	F			f/c	f/c*					F						F			f/c						f/c*			
<i>Spiraea japonica</i>		f/c*	Ø	F	F			f/c	f/c*	f/c*		f/c*		F	Ø*			f/c	f/c	F			f/c			f/c*				f/c*		
<i>Spiraea nipponica</i>				F	F		F*	f/c						F						F			f/c									
<i>Spiraea x arguta</i>				F	F		F	f/c						F						F			f/c									
<i>Spiraea x bumalda</i>	f/c*			F	F		F*	f/c	f/c*	f/c*		f/c		F			f/c*	f/c*	f/c*	F		f/c*	f/c		f/c*	f/c*				f/c*		
<i>Spiraea x cinerea</i>				F	F			f/c	f/c*					F						F			f/c			F*	f/c*					
<i>Spiraea x vanhouttei</i>		f/c		F	F		F	f/c	f/c	f/c		f/c		F				f/c	f/c	F			f/c			f/c	F			f/c	F	
Stewartia pseudocamellia								f/c																								
Styrax japonica																																
Swietenia mahogani									F	f/c		f/c														F	F			f/c	F	
Syagrus romanzoffianum							f/c		f/c												F										f/c	
Symphoricarpos albus																d					F											
Syringa spp.				F	F			f/c						F						F			f/c	f/c					f/c	f/c		
<i>Syringa josikaea</i>			f/c	F	F									F						F			f/c	f/c					f/c			
<i>Syringa laciniata</i>				F	F									F				f/c	f/c	F			f/c	f/c					f/c			
<i>Syringa meyeri</i>				F	F									F			f/c*			F			f/c	f/c	f/c*				f/c			
<i>Syringa reticulata</i>				F	F									F				f/c	f/c	F			f/c	f/c					f/c			
<i>Syringa vulgaris</i>		f/c		F	F				F	f/c	F	f/c		F			f/c	f/c	f/c	F			f/c	f/c		F	f/c	f/c		f/c	F	
<i>Syringa x (hybrids)</i>				F	F									F	f/c*	d*				F			f/c	f/c		f/c*		f/c		f/c		

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<i>Syzygium paniculatum</i>										f/c						d																
<i>Tamarix ramosissima</i>																d																
<i>Taxodium distichum</i>					F	f/c	F	f/c			f/c							f/c	f/c	F				f/c						f/c		
<i>Taxus spp.</i>				F	F	F		f/c			f/c			F						F	F		f/c	f/c						f/c		
<i>Taxus baccata</i>				F	F	F					f/c			F						F	F		f/c	f/c					f/c			
<i>Taxus canadensis</i>				F	F	F					f/c			F						F	F		f/c	f/c								
<i>Taxus cuspidata</i>	f/c		f/c	F	F	F	f/c*		F	f/c	f/c	f/c		F*		d	f/c*	f/c	f/c	f/c	F		f/c	f/c		F	F	f/c	f/c	f/c	F	
<i>Taxus x media</i>	f/c	f/c*		F	F	F	F*			f/c	f/c	f/c		F	f/c	d		f/c	f/c	F	F	f/c	f/c	f/c	f/c*		F		f/c	f/c	F	
<i>Tecomaria capensis</i>										f/c																						
<i>Ternstroemia gymnanthera</i>	f/c			F					f/c	f/c		f/c			f/c	d				F				f/c	f/c	f/c					f/c	
<i>Teucrium canadense</i>				Ø	Ø				f/c	f/c																						
<i>Thevitia neriifolia</i>										f/c																						
<i>Thuja spp.</i>				F		C	F*	f/c*						F	f/c	d				F	F		f/c	f/c							fc	
<i>Thuja occidentalis</i>	f/c	f/c*	f/c	F	F	C	F*	f/c	f/c*	f/c*	f/c	f/c*		F		d	f/c*	f/c	f/c	f/c	F	f/c	f/c	f/c	f/c*	f/c*	f/c*	f/c*	f/c	f/c	f/c*	F
<i>Thuja orientalis</i> (<i>Platycladus orientalis</i>)			f/c	F	F	C	f/c*	f/c	f/c*	f/c*	f/c	f/c		F						F	F		f/c	f/c	f/c*	f/c*	f/c*	f/c		f/c*	f/c*	
<i>Thuja plicata</i>			f/c	F	F	C		f/c						F				f/c	f/c	F	F		f/c	f/c			F		f/c		F	
<i>Tibouchina urvilleana</i>																																
<i>Tilia spp.</i>				F		F					f/c			F				f/c	f/c													
<i>Tilia cordata</i>				F		F					f/c			F				f/c	f/c					f/c			f/c				f/c	
<i>Trachelospermum spp.</i>																									f/c*							

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<i>Trachelospermum asiaticum</i>	f/c						F	f/c	f/c	f/c			F*		f/c				f/c							f/c				f/c		
<i>Trachelospermum jasminoides</i>						f/c	F						F				f/c							f/c	f/c		F				F	
Trachycarpus fortunei							F		f/c	f/c									f/c													
Tsuga spp.						F		f/c*						F						F	F			f/c*						f/c		
<i>Tsuga canadensis</i>	f/c		f/c			F	F		f/c	f/c	F	f/c		F			f/c	f/c	f/c	f/c	F	f/c			f/c	f/c	Ø	f/c	f/c	f/c		
<i>Tsuga caroliniana</i>						F								F						F	F											
<i>Tsuga heterophylla</i>			f/c			F					f/c			F						F	F						f/c	f/c				
<i>Tsuga mertensiana</i>			f/c			F		f/c						F						F	F											
Ulmus spp.				F	F									F										f/c						f/c		
<i>Ulmus americana</i>				F	F									F		d					F			f/c								
<i>Ulmus japonica</i>				F	F			f/c						F				f/c	f/c					f/c								
<i>Ulmus parvifolia</i>			f/c	F	F		F*		F	f/c		f/c		F		d								f/c		F	F			f/c	F	
<i>Ulmus pumila</i>				F	F	F								F							F			f/c								
Vaccinium spp.			f/c*	F			F*		F																f/c*	F	F				F	
Viburnum spp.								f/c				f/c	Ø	F						f/c			f/c	f/c						f/c	f/c	
<i>Viburnum awabuki</i>																																
<i>Viburnum carlesii</i>					F	F		f/c	f/c	f/c		f/c	Ø	F						f/c			f/c	f/c	f/c	f/c	f/c	f/c			f/c	
<i>Viburnum davidii</i>					F	F		f/c	f/c	f/c		f/c	Ø	F			f/c			f/c			f/c	f/c*	f/c	f/c	f/c	F			f/c	F
<i>Viburnum dentatum</i>			f/c		F	F	F	f/c				f/c	Ø	F						f/c			f/c	f/c							f/c	
<i>Viburnum dilatatum</i>					F	F	F	f/c				f/c	Ø	F						f/c			f/c	f/c							f/c	
<i>Viburnum japonicum</i>	f/c	f/c*			F	F		f/c	F	f/c		f/c	Ø	F						f/c		f/c	f/c	f/c		F	F			f/c	F	

Table 6-6. Preemergence Herbicides Registered for Use on Woody Ornamentals (continued)

F = registered for use in the field (or landscape)

C = registered for use in containers

f/c = registered for both field and container use

d = registered for directed applications only

Ø = label prohibits use on this species

F*, C*, or f/c* = registered for some species or cultivars; consult label for details

Ø* = prohibited for some cultivars within a species; consult label for details

Genus and species (Index of common names, by genus, is available in Table 6-9.)	Barricade	Biathlon	Broadstar	Casoron	Dacthal	Devrinol	Dimension	Freehand	Gallery	Gemini	Goal	HGH 75	Image	Kerb	Marengo/Specticle G	Marengo/Specticle SC	OH2	Pendulum (EC)	Pendulum (granule)	Pennant Magnum	Princep	Regalkade	Regal 00	Ronstar G	Rout	Snapshot TG	Surflan	Sureguard	Tower	Treflan	XL				
<i>Viburnum lantana</i>					F	F	F*	f/c	F	f/c		f/c	Ø	F		d				f/c				f/c	f/c		F				f/c				
<i>Viburnum macrocephalum</i>					F	F		f/c				f/c	Ø	F						f/c				f/c	f/c	f/c						f/c			
<i>Viburnum obovatum</i>		f/c																																	
<i>Viburnum odoratissimum</i>	f/c		f/c*		F	F		f/c		f/c		f/c	Ø	F	Ø	Ø				f/c			f/c	f/c								f/c			
<i>Viburnum opulus</i>					F	F	f/c*	f/c	F	f/c		f/c	Ø	F						f/c			f/c	f/c		F	F*				f/c	F*			
<i>Viburnum plicatum</i>	f/c				F	F		f/c*	F*	f/c		f/c	Ø	F	f/c	d				f/c			f/c	f/c	f/c*	f/c*	F*				f/c	F*			
<i>Viburnum prunifolium</i>					F	F		f/c				f/c	Ø	F				f/c	f/c	f/c				f/c	f/c							f/c			
<i>Viburnum rufidulum</i>					F	F		f/c				f/c	Ø	F				f/c	f/c	f/c				f/c	f/c								f/c		
<i>Viburnum setigerum</i>					F	F		f/c	F	f/c		f/c	Ø	F						f/c			f/c	f/c		F	F					f/c	F		
<i>Viburnum suspensum</i>	f/c				F	F		f/c		f/c		f/c	Ø	F				f/c	f/c	f/c			f/c	f/c			F					f/c	F		
<i>Viburnum tinus</i>	f/c				F	F		f/c	F*	f/c*		f/c	Ø	F				f/c	f/c	f/c			f/c	f/c		F*	f/c*			f/c	f/c	f/c*			
<i>Viburnum trilobium</i>	f/c	f/c*			F	F		f/c	f/c	f/c		f/c	Ø	F						f/c			f/c	f/c		f/c	F*					f/c	F		
<i>Viburnum wrightii</i>	f/c				F	F	F	f/c		f/c		f/c	Ø	F						f/c			f/c	f/c									f/c		
<i>Viburnum x bodnanstense</i>			f/c		F	F		f/c	f/c			f/c	Ø	F						f/c				f/c	f/c		f/c							f/c	
<i>Viburnum x burkwoodii</i>															f/c	d																			
<i>Viburnum x judd</i>					F	F		f/c	f/c			f/c	Ø	F						f/c				f/c	f/c		f/c	f/c						f/c	
<i>Viburnum x pragense</i>					F	F		f/c	f/c	f/c		f/c	Ø	F						f/c				f/c	f/c		f/c	F					f/c	F	
<i>Vinca major</i>	f/c								f/c	f/c							f/c*		f/c				f/c	f/c		f/c	F							F	
<i>Vinca minor</i>	f/c	f/c					F	Ø	F	f/c					f/c									f/c	Ø	F	F						f/c	F	

Table 6-6. Preemergence Herbicides Registered for Use on Woody Ornamentals (continued)

F = registered for use in the field (or landscape)

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Ø = label prohibits use on this species

F*, C*, or f/c* = registered for some species or cultivars; consult label for details

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Genus and species (Index of common names, by genus, is available in Table 6-9.)	Barricade	Biathlon	Broadstar	Casoron	Dacthal	Devrinol	Dimension	Freehand	Gallery	Gemini	Goal	HGH 75	Image	Kerb	Marengo/Specticle G	Marengo/Specticle SC	OH2	Pendulum (EC)	Pendulum (granule)	Pennant Magnum	Princep	Regalkade	Regal OO	Ronstar G	Rout	Snapshot TG	Surflan	Sureguard	Tower	Treflan	XL
<i>Vitex spp.</i>															f/c*			f/c	f/c												
<i>Vitis spp.</i>	F		f/c	F		F			F*		F							f/c	f/c			f/c			f/c*	F*	F*			f/c	F*
<i>Washingtonia spp.</i>						f/c*	F		f/c*	f/c		f/c*						f/c	f/c	F*	F					F	F			f/c	F*
<i>Weigela spp.</i>				F	F			f/c	f/c*			f/c				d				F			f/c						f/c	f/c	
<i>Weigela florida</i>	f/c	f/c*	f/c	F	F				f/c*	f/c		f/c					f/c*	f/c	f/c	F		f/c	f/c			f/c*	F*		f/c	f/c	F*
<i>Wisteria aspp.</i>																		f/c												f/c	
<i>Wisteria sinensis</i>						F		f/c										f/c		F				f/c							
<i>Xylosma senticosa</i>										f/c																					
<i>Yucca spp.</i>									f/c											f/c											f/c
<i>Yucca aloifolia</i>	f/c									f/c										f/c		f/c									f/c
<i>Yucca elata</i>																				f/c							f/c				f/c
<i>Yucca filamentosa</i>	f/c								f/c	f/c		f/c						f/c	f/c	f/c		f/c				f/c				f/c	
<i>Yucca pendula</i>													F					f/c	f/c	f/c										f/c	
<i>Yucca recurvifolia</i>									Ø	Ø										f/c						Ø	F			f/c	F
<i>Zamia furfuracea</i>										f/c																					
<i>Zelkova spp.</i>								f/c																							

Note: The information in this table is intended as a guide only. Information was extracted from listed herbicide labels available at the time of publication. Label changes occur and despite the authors' best efforts, error do occur. The user is encouraged to consult the herbicide label before application. The use of brand names does not imply an endorsement of these products nor discrimination against similar products.

Table 6-7. Postemergence Herbicides Registered for Use on Woody Ornamentals

OT = registered for over-the-top use

D = registered for directed applications

O* = registered for over-the-top use on certain species within the genus; consult label for details

D* = registered for directed applications on certain species within the genus; consult label for details

	Acclaim Extra	Envoy	Fusilade II	Segment	Basagran TO	Casoron	Dismiss	Goal	Lontrel	Sedge-hammer	Common Name
<i>Abelia x grandiflora</i>		OT	OT	OT	D		D			D	abelia, glossy
<i>Abies spp.</i>		OT	O*	O*	D			O*	O*	D	fir species
<i>Abies balsamea</i>		OT	OT	OT	D		D		OT	D	fir, balsam
<i>Abies concolor</i>		OT	OT	OT	D					D	fir, white (concolor)
<i>Abies fraseri</i>		OT	D	OT	D		D	OT	OT	D	fir, fraser
<i>Abies grandis</i>		OT		OT	D			OT	OT	D	fir, grand
<i>Abies magnifica</i>		OT		OT	D					D	fir, red
<i>Abies nordmanniana</i>		OT		OT	D					D	fir, Nordmann
<i>Abies procera</i>		OT	OT	OT	D			OT	OT	D	fir, Noble
<i>Acer spp.</i>	O*	OT	D*	O*	D	OT		D*	D*	D	maple species
<i>Acer ginnala</i>		OT	OT		D	OT				D	maple, Amur
<i>Acer negundo</i>		OT			D	OT				D	boxelder
<i>Acer nigrum</i>		OT			D	OT		D*		D	maple, black
<i>Acer palmatum</i>	OT	OT	OT	OT	D	OT				D	maple, Japanase
<i>Acer platanooides</i>		OT	OT		D	OT				D	maple, Norway
<i>Acer rubrum</i>	OT	OT	D	OT	D	OT		D*	D	D	maple, red
<i>Acer saccharinum</i>		OT	OT	OT	D	OT				D	maple, silver
<i>Acer saccharum</i>		OT	OT		D	OT		D		D	maple, sugar
<i>Aesculus spp.</i>					D					D	buckeye species
<i>Agave americana</i>			OT		D					D	century plant
<i>Albizia julibrissin</i>				OT	D					D	mimosa tree
<i>Alnus rubra</i>		OT			D					D	alder, red
<i>Arbutus unedo</i>			D	OT	D					D	strawberry tree
<i>Arctostaphylos uva-ursi</i>			OT		D	OT				D	bearberry (kinnikinnick)
<i>Ardisia crenata</i>		OT			D					D	coralberry
<i>Arecastrum romanzoffianum</i>			OT	OT	D					D	palm, queen
<i>Aucuba spp.</i>		OT	O*		D					D	golddust species
<i>Aucuba japonica</i>		OT	O*		D					D	golddust, Japanese
<i>Baccharis pilularis</i>		OT			D					D	coyote brush
<i>Bambusa spp.</i>		OT			D					D	bamboo species
<i>Berberis spp.</i>	OT	O*	O*	O*	D	OT				D	barberry species
<i>Berberis buxifolia</i>		OT			D	OT				D	barberry, Magellan
<i>Berberis julianae</i>	OT				D	OT				D	barberry, wintergreen
<i>Berberis thunbergii</i>	OT	OT	OT	OT	D	OT				D	barberry, Japanese
<i>Berberis x mentorensis</i>	OT		OT	OT	D	OT				D	barberry, Mentor
<i>Betula spp.</i>		O*		OT	D	OT		D*		D	birch species
<i>Betula nigra</i>		OT		OT	D	OT		D		D	birch, river
<i>Betula papyrifera</i>		OT		OT	D	OT				D	birch, paper
<i>Betula pendula</i>		OT	OT	OT	D	OT				D	birch, European white
<i>Betula playtphylla</i>				OT	D	OT				D	birch, Asian white
<i>Bougainvillea spp.</i>			OT	OT	D					D	bougainvillea
<i>Buddleija spp.</i>							D			D	butterfly bush
<i>Buxus spp.</i>	O*	O*	O*	O*	D	OT	D			D	boxwood species
<i>Buxus harlandii</i>					D	OT	D			D	boxwood, harland

Table 6-7. Postemergence Herbicides Registered for Use on Woody Ornamentals (continued)

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D* = registered for directed applications on certain species within the genus; consult label for details

	Acclaim Extra	Envoy	Fusilade II	Segment	Basagran TO	Casoron	Dismiss	Goal	Lontrel	Sedge- hammer	Common Name
<i>Buxus microphylla</i>	O*		O*	OT	OT	OT	D		OT	D	boxwood, littleleaf
<i>Buxus sempervirens</i>		OT	O*	OT	D	OT				D	boxwood, common
<i>Callistemon</i> spp.		O*	D*	O*	D					D	bottlebrush
<i>Callistemon lanceolatus</i>			OT	OT	D					D	bottlebrush,
<i>Calluna</i> spp.			O*		D	OT				D	heather species
<i>Camellia</i> spp.		O*	O*	O*	D	OT				D	camellia species
<i>Camellia japonica</i>		OT	OT	OT	D	OT				D	camellia, Japanese
<i>Camellia sasanqua</i>			OT	OT	D	OT				D	camellia, Sasanqua
<i>Caragana arborescens</i>					D	OT				D	pea-shrub, Siberian
<i>Carissa</i> spp.			O*	OT	D					D	carissa species
<i>Carissa grandiflora</i>			OT	OT	D					D	plum, Natal
<i>Carya illinoensis</i>		D		OT	D			D*		D	pecan
<i>Caryopteris clandonensis</i>				OT	D					D	bluebeard
<i>Cassia</i> spp.			D*	O*	D					D	senna
<i>Castanea mollissima</i>					D			D*		D	chestnut, Chinese
<i>Catalpa bignoniodes</i>				OT	D					D	catalpa, southern
<i>Ceanothus americanus</i>					D	OT				D	redroot (squawcarpet)
<i>Ceanothus griseus</i>			D		D					D	ceanothus, Carmel
<i>Cedrus</i> spp.		OT			D					D	cedar species
<i>Cedrus atlantica</i>		OT			D					D	cedar, Atlas
<i>Cedrus deodara</i>		OT			D					D	cedar, deodar
<i>Celtis occidentalis</i>			OT	OT	D	OT				D	hackberry
<i>Ceratonia siliqua</i>				OT	D					D	carob tree
<i>Cercis canadensis</i>		OT	OT		D			D		D	redbud, eastern
<i>Chaenomeles speciosa</i>			OT		D	OT		D		D	quince, flowering
<i>Chamaecyparis</i> spp.	OT		O*	O*	D	O*				D	cypress, false
<i>Chamaecyparis lawsoniana</i>	OT		OT		D					D	cypress, Lawson
<i>Chamaecyparis obtusa</i>	OT		OT		D					D	cypress, Hinoki
<i>Chamaecyparis pisifera</i>	OT		D	OT	D					D	cypress, Japanese false
<i>Chamaerops humilis</i>			OT	OT	D					D	palm, Mediterranean fan
<i>Cistus</i> spp.			O*	O*	D	OT				D	rockrose
<i>Citrus</i> spp.		D	O*	OT	D			D		D	citrus, ornamental
<i>Cornus</i> spp.	O*	O*	O*	O*	D	OT		D*		D	dogwood species
<i>Cornus alternifolia</i>				OT	D	OT				D	dogwood, pagoda
<i>Cornus amomum</i>				OT	D	OT				D	dogwood, silky
<i>Cornus florida</i>	OT	OT	OT	OT	D	OT		D	D	D	dogwood, flowering
<i>Cornus kousa</i>					D	OT				D	dogwood, Korean
<i>Cornus mas</i>			OT		D	OT				D	dogwood, European
<i>Cornus sericea</i>			O*	OT	D	OT				D	dogwood, redosier
<i>Corylus</i> spp.		D*			D	OT		D*		D	filbert (hazelnut)
<i>Cotinus coggygria</i>					D					D	smokebush
<i>Cotoneaster</i> spp.	OT		O*	O*	D	OT				D	cotoneaster species
<i>Cotoneaster apiculatus</i>	OT		OT	OT	D	OT				D	cotoneaster, cranberry
<i>Cotoneaster dammeri</i>	OT		O*	OT	D	OT				D	cotoneaster, bearberry

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D* = registered for directed applications on certain species within the genus; consult label for details

	Acclaim Extra	Envoy	Fusilade II	Segment	Basagran TO	Casoron	Dismiss	Goal	Lontrel	Sedge- hammer	Common Name
<i>Cotoneaster horizontalis</i>	OT				D	OT				D	cotoneaster, rockspray
<i>Cotoneaster microphyllus</i>	OT		OT		D	OT				D	cotoneaster, littleleaf
<i>Cotoneaster salicifolius</i>	OT		O*		D	OT				D	cotoneaster, willowleaf
<i>Crataegus spp.</i>	OT				D					D	hawthorn species
<i>Cryptomeria japonica</i>					D					D	cedar, Japanese
<i>Cupressocyparis leylandii</i>			D	OT	D					D	cypress, Leyland
<i>Cupressus spp.</i>			O*	O*	D					D	cypress species
<i>Cupressus sempervirens</i>			OT	OT	D					D	cypress, Italian
<i>Cycas revoluta</i>			OT	OT	D					D	palm, sago
<i>Cytisus spp.</i>					D					D	broom species
<i>Deutzia spp.</i>			O*		D	OT				D	deutzia species
<i>Diervilla lonicera</i>			OT	OT	D					D	honeysuckle bush
<i>Diospyros virginiana</i>					D			D		D	persimmon
<i>Elaeagnus spp.</i>		O*	O*	O*	D	OT		D*		D	olive, elaeagnus species
<i>Elaeagnus angustifolia</i>		OT	OT	OT	D	OT		D		D	olive, Russian
<i>Elaeagnus pungens</i>			OT	OT	D	OT				D	olive elaeagnus, thorny
<i>Elaeagnus umbellata</i>				OT	D	OT				D	eleagnus, Autumn
<i>Erica spp.</i>					D					D	heath species
<i>Eriobotrya japonica</i>				OT	D			D		D	loquat
<i>Escallonia spp.</i>			O*	O*	D					D	escallonia species
<i>Escallonia rubra</i>			OT		D					D	escallonia, red
<i>Escallonia x exoniensis</i>				O*	D						escallonia, pink princess
<i>Eucalyptus spp.</i>		O*	D*	O*	D			D*		D	eucalyptus species
<i>Eucalyptus microtheca</i>			OT		D					D	eucalyptus, Coolibah
<i>Eucalyptus nicholii</i>			D	OT	D					D	eucalyptus, willow peppermint
<i>Eucalyptus rudis</i>			OT		D					D	eucalyptus, desert gum
<i>Eucalyptus viminalis</i>					D			D		D	eucalyptus, ribbon gum
<i>Euonymus spp.</i>	OT	OT	D*	O*	D	OT				D	euonymus species
<i>Euonymus alata</i>	OT	OT	D	O*	D	OT				D	euonymus, winged
<i>Euonymus fortunei</i>	OT	OT	OT		D	OT				D	euonymus, wintercreeper
<i>Euonymus japonica</i>	OT	OT	OT	O*	D	OT				D	euonymus, Japanese
<i>Euonymus kiautschovica</i>	OT	OT	OT	OT	D	OT				D	euonymus, spreading
<i>Fagus spp.</i>					D					D	beech species
<i>Fatshedera lizei</i>			OT		D					D	tree-ivy
<i>Ficus spp.</i>		O*			D			D*		D	fig species
<i>Forsythia spp.</i>	OT		OT	O*	D	OT				D*	forsythia species
<i>Forsythia intermedia</i>	OT		OT		D	OT				D*	forsythia, border
<i>Forsythia viridissima</i>	OT		OT	O*	D	OT				D	forsythia, greenstem
<i>Fraxinus spp.</i>		OT	O*	O*	D	OT		D*		D	ash species
<i>Fraxinus americana</i>		OT	OT	OT	D	OT		D		D	ash, white
<i>Fraxinus pennsylvanica</i>		OT	OT	OT	D	OT		D		D	ash, green
<i>Gardenia spp.</i>		OT	O*	O*	D	OT				D	jasmine species
<i>Gardenia jasminoides</i>		OT	OT	OT	D	OT				D	jasmine, cape
<i>Gelsemium sempervirens</i>			OT	OT	D					D	jessamine, Carolina

Table 6-7. Postemergence Herbicides Registered for Use on Woody Ornamentals (continued)

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D* = registered for directed applications on certain species within the genus; consult label for details

	Acclaim Extra	Envoy	Fusilade II	Segment	Basagran TO	Casoron	Dismiss	Goal	Lontrel	Sedge- hammer	Common Name
<i>Ginkgo biloba</i>					D					D	ginkgo
<i>Gleditsia triacanthos</i> var. <i>inermis</i>			OT	OT	D					D	honeylocust, thornless
<i>Grevillea robusta</i>		OT	OT		D	OT				D	oak, silk
<i>Gymnocladus dioica</i>				OT	D					D	coffee tree, Kentucky
<i>Hamamelis virginiana</i>					D					D	witchhazel
<i>Hedera canaiensis</i>			OT	OT	D					D	ivy, Algerian
<i>Hedera helix</i>	OT	OT	O*	OT	OT	OT				D	ivy, English
<i>Hemigraphis alternata</i>					D					D	red-ivy
<i>Hibiscus syriacus</i>			OT		D					D	rose-of-sharon (althea)
<i>Hydrangea</i> spp.	OT		O*	O*	D					D	hydrangea
<i>Hydrangea paniculata</i>	OT		OT		D					D	hydrangea, panicle
<i>Hydrangea quercifolia</i>	OT		OT		D					D	hydrangea, oakleaf
<i>Hypericum</i> spp.				O*	D					D	St. Johnswort
<i>Iberis sempervirens</i>		OT	OT	OT	D					D	candytuft
<i>Ilex</i> spp.	O*	OT	O*	O*	D	O*				D	holly species
<i>Ilex aquifolium</i>		OT			D	OT				D	holly, English
<i>Ilex aquifolium</i> x <i>cornuta</i>		OT			D	OT				D	holly, English x Chinese
<i>Ilex cassine</i>		OT			D	OT				D	holly, dahoon
<i>Ilex cornuta</i>		OT	OT	O*	O*		D*			D	holly, Chinese
<i>Ilex crenata</i>	OT	OT	O*	O*	OT					D	holly, Japanese
<i>Ilex glabra</i>		OT	OT		D					D	inkberry
<i>Ilex latifolia</i>		OT			D	OT				D	holly, lusterleaf
<i>Ilex meserveae</i>	OT	OT	OT		D	OT	D			D	holly, blue boy/girl
<i>Ilex opaca</i>	OT	OT	OT		D	OT				D	holly, American
<i>Ilex vomitoria</i>		OT	OT	OT	D	OT	D			D	holly, yaupon
<i>Ilex</i> x <i>attenuata</i>		OT	OT		D	OT				D	holly, Foster's hybrid
<i>Illicium</i> spp.		O*			D					D	anise tree
<i>Illicium floridanum</i>		OT			D					D	anise, Florida
<i>Jasminum</i> spp.		OT		O*	D					D	jasmine species
<i>Juglans nigra</i>		D		OT	D			D*		D	walnut, black
<i>Juglans</i> spp.		D		OT	D	O*		D*		D	walnut species
<i>Juniperus</i> spp.	O*	OT	D*	O*	D	OT	D	O*	OT*	D*	juniper species
<i>Juniperus chinensis</i>	O*	OT	D*	O*	D	OT	D	OT		D*	juniper, Chinese
<i>Juniperus conferta</i>	O*	OT	D*	O*	D	OT	D		OT	D*	juniper, shore
<i>Juniperus davurica</i> 'Parsoni'	OT	OT			D	OT	D			D	juniper, Parson
<i>Juniperus excelsa</i>		OT		OT	D	OT	D			D*	juniper, Greek
<i>Juniperus horizontalis</i>	O*	OT	D*	O*	D	OT	D	OT	OT	D*	juniper, creeping
<i>Juniperus procumbens</i>		OT		O*	D	OT	D	OT		D*	juniper, Japanese garden
<i>Juniperus sabina</i>		OT	D*	O*	D	OT	D	OT		D*	juniper, Savin
<i>Juniperus scopulorum</i>		OT	D*		D	OT	D	OT		D	juniper, Rocky Mountain
<i>Juniperus squamata</i>		OT		OT	D	OT	D		OT	D*	juniper, singleseed
<i>Juniperus virginiana</i>		OT	D*	O*	D	OT	D	OT		D	cedar, eastern red
<i>Justica</i> spp.		O*	D*	O*	D					D	shrimp species
<i>Justicia brandegeana</i>		OT	D	OT	D					D	shrimp plant

Table 6-7. Postemergence Herbicides Registered for Use on Woody Ornamentals (continued)

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	Acclaim Extra	Envoy	Fusilade II	Segment	Basagran TO	Casoron	Dismiss	Goal	Lontrel	Sedge- hammer	Common Name
<i>Kalmia latifolia</i>					D	OT				D	laurel, mountain
<i>Koelreuteria paniculata</i>			OT	OT	D	OT				D	golden raintree
<i>Kolkwitzia amabilis</i>					D	OT				D	beautybush
<i>Laburnum anagyroides</i>		OT			D					D	laburnum (golden-chaintree)
<i>Lagerstroemia indica</i>		OT	OT	OT	D		D	D		D	myrtle, common crape
<i>Lantana spp.</i>		OT	D*	O*	D					D	lantana
<i>Larix spp.</i>				O*	D					D	larch species
<i>Lavendula spp.</i>				O*	D					D	lavender species
<i>Leucophyllum frutescens</i>			OT		D					D	sage, Texas
<i>Leucothoe spp.</i>			D*		D	OT				D	leucothoe species
<i>Leucothoe axillaris</i>			D		D	OT				D	leucothoe, coast
<i>Ligustrum spp.</i>	OT	OT	D*	O*	D	OT				D	privet species
<i>Ligustrum amurense</i>		OT	OT		D	OT				D	privet, Amur
<i>Ligustrum japonicum</i>	OT	OT	D*	OT	D	OT				D	privet, Japanese
<i>Ligustrum lucidum</i>	OT	OT	OT	OT	D	OT				D	privet, waxleaf
<i>Ligustrum ovalifolium</i>	OT	OT	OT		D	OT				D	privet, California
<i>Ligustrum sinense</i>	OT	OT			D	OT				D	privet, Chinese
<i>Ligustrum x vicaryi</i>	OT	OT	OT		D	OT				D	privet, golden
<i>Liquidambar styraciflua</i>		OT	OT	OT	D			D		D	sweetgum, American
<i>Liriodendron tulipifera</i>				OT	D	OT		D		D	poplar, tulip
<i>Livistona chinensis</i>			OT		D					D	palm, Chinese fan
<i>Lonicera spp.</i>		O*	D*	O*	D	OT				D	honeysuckle species
<i>Lonicera japonica</i>					D	OT				D	honeysuckle, Japanese
<i>Lonicera morrowii</i>			OT	OT	D	OT				D	honeysuckle, Morrow
<i>Lonicera pileata</i>		OT			D	OT				D	honeysuckle, privet
<i>Lonicera xylosteum</i>			OT		D	OT				D	honeysuckle, European fly
<i>Maclura pomifera</i>				OT	D					D	osage orange
<i>Magnolia spp.</i>	OT		D*	O*	D	OT				D	magnolia species
<i>Magnolia grandiflora</i>	OT		D*	OT	D	OT	D			D	magnolia, southern
<i>Magnolia stellata</i>	OT		OT		D					D	magnolia, star
<i>Mahonia spp.</i>		O*	O*	O*	D					D	mahonia species
<i>Mahonia aquifolium</i>		OT	OT	OT	D					D	grape-holly, Oregon
<i>Mahonia x wagneri</i>			OT		D					D	grape-holly
<i>Malus spp.</i>		O*	O*	OT	D	OT		D*		D	crabapple species
<i>Malus floribunda</i>			OT	OT	D	OT		D		D	crabapple, Japanese
<i>Malus halliana</i> var. <i>parkmanii</i>		OT		OT	D					D	crabapple, parkmanii
<i>Malus x domestica</i>		D		OT	D			D*		D	apple, common
<i>Morus alba</i>		OT			D	OT				D	mulberry, white
<i>Myoporum spp.</i>			O*	O*	D					D	myoporum species
<i>Myrica cerifera</i>			OT		D					D	myrtle, wax
<i>Myrica pensylvanica</i>		OT			D					D	myrtle (bayberry)
<i>Myrtus communis</i>				O*	D					D	myrtle, common
<i>Nandina domestica</i>	OT	OT	D	OT	D	OT				D	nandina (heavenly bamboo)
<i>Nerium oleander</i>	OT	OT	D*	OT	D					D	oleander

Table 6-7. Postemergence Herbicides Registered for Use on Woody Ornamentals (continued)

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	Acclaim Extra	Envoy	Fusilade II	Segment	Basagran TO	Casoron	Dismiss	Goal	Lontrel	Sedge- hammer	Common Name
<i>Nyssa sylvatica</i>					D					D	tupelo, black
<i>Ochna serrulata</i>				OT	D					D	bird's-eye bush
<i>Olea spp.</i>		D	O*	OT	D			D*		D	olive
<i>Osmanthus spp.</i>		O*	O*	O*	D	OT				D	osmanthus species
<i>Osmanthus fragrans</i>		OT	OT	OT	D	OT				D	olive, fragrant tea
<i>Osmanthus heterophyllus</i>				OT	D	OT				D	osmanthus (false-holly)
<i>Oxydendrum arboreum</i>					D					D	sourwood
<i>Pachysandra terminalis</i>		OT	OT	OT	OT					D	pachysandra, Japanese
<i>Parkensonia aculeata</i>			OT	OT	D					D	palo verde, green
<i>Parthenocissus tricuspidata</i>				OT	D					D	ivy, Boston
<i>Paulownia tomentosa</i>				OT	D					D	princess tree
<i>Paxistima canbyi</i>					D	OT				D	paxistima (pachistima)
<i>Phellodendron amurense</i>					D	OT				D	corktree, Amur
<i>Philadelphus spp.</i>			O*	OT	D	OT				D	mockorange
<i>Phoenix roebelenii</i>			OT	OT	D					D	palm, pygmy date
<i>Photinia fraseri</i>	OT	OT	OT	OT	D	OT				D	photinia, fraser (red-tip)
<i>Photinia glabra</i>	OT	OT		OT	D	OT				D	photinia, smooth
<i>Phyllostachys aurea</i>			OT		D					D	bamboo, golden
<i>Physocarpus spp.</i>			O*	O*	D					D	ninebark species
<i>Physocarpus opulifolius</i>			OT	O*	D					D	ninebark
<i>Picea spp.</i>		OT	O*	O*	D			O*	O*	D*	spruce species
<i>Picea abies</i>		OT	OT	OT	D		D	OT	OT	D	spruce, Norway
<i>Picea glauca</i>		OT	OT	OT	D			O*	OT	D*	spruce, white
<i>Picea pungens</i>		OT	OT	OT	D			OT	OT	D	spruce, Colorado blue
<i>Picea rubens</i>		OT			D					D	spruce, red
<i>Picea sitchensis</i>		OT			D			OT		D	spruce, Sitka
<i>Pieris japonica</i>			OT	OT	D					D	andromeda, Japanese
<i>Pieris spp.</i>			O*	O*	D					D	andromeda species
<i>Pinus spp.</i>	O*	OT	O*	O*	D	O*		O*	O*	D*	pine species
<i>Pinus banksiana</i>		OT		OT	D	OT		OT		D	pine, Jack
<i>Pinus clausa</i>		OT			D						pine, sand
<i>Pinus contorta</i>		OT		OT*	D	OT		OT	OT	D	pine, Lodgepole
<i>Pinus echinata</i>		OT			D	OT		OT		D	pine, shortleaf
<i>Pinus elliotii</i>		OT	OT	OT	D	OT		OT		D	pine, slash
<i>Pinus mugo</i>		OT	OT	OT	OT	OT		OT	OT	D*	pine, mugo
<i>Pinus nigra</i>		OT	OT	OT	D	OT		OT		D	pine, Austrian
<i>Pinus omorika</i>		OT	OT		D						pine, Serbian
<i>Pinus palustris</i>		OT	OT	OT	D	OT		OT		D	pine, longleaf
<i>Pinus parviflora</i>		OT		OT	D	OT				D	pine, Japanese white
<i>Pinus pinea</i>		OT		OT	D	OT				D	pine, Italian stone
<i>Pinus ponderosa</i>		OT	OT	O*	D	OT		OT	OT	D	pine, Ponderosa
<i>Pinus pungens</i>		OT	OT		D						pine, table-mountain
<i>Pinus radiata</i>		OT	OT	OT	D	OT		OT		D	pine, Monterey
<i>Pinus resinosa</i>		OT	OT	OT	D	OT				D	pine, red (Norway)

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	Acclaim Extra	Envoy	Fusilade II	Segment	Basagran TO	Casoron	Dismiss	Goal	Lontrel	Sedge- hammer	Common Name
<i>Pinus rigida</i>		OT	OT		D	OT					pine, pitch
<i>Pinus serotina</i>		OT	OT		D	OT					pine, pond
<i>Pinus strobiformus</i>		OT			D	OT					pine, Southwestern white
<i>Pinus strobus</i>	OT	OT	OT	OT	D	OT		OT	OT	D	pine, white
<i>Pinus sylvestris</i>		OT	OT	OT	D	OT		OT	OT	D	pine, Scotch
<i>Pinus taeda</i>		OT	OT	OT	D	OT		OT		D	pine, loblolly
<i>Pinus thunbergii</i>		OT		OT	D	OT				D	pine, Japanese black
<i>Pinus virginiana</i>		OT	OT	OT	D	OT		OT		D	pine, scrub (Virginia)
<i>Pinus wallichiana</i>		OT			D	OT		OT		D	pine, Himalayan white
<i>Pistacia spp.</i>		D*		OT	D			D*		D	pistachio
<i>Pittosporum spp.</i>		OT	O*	O*	D	OT				D	pittosporum
<i>Pittosporum tobira</i>		OT	OT	OT	D	OT				D	pittosporum, Tobira
<i>Platanus occidentalis</i>			OT	OT				D	D	D	sycamore
<i>Platanus x acerifolia</i>			OT							D	planetree, London
<i>Playtcladus orientalis</i>			OT	OT	D	OT		OT		D*	arborvitae, Oriental
<i>Plumbago spp.</i>			O*		D					D	plumbago
<i>Podocarpus gracilor</i>		OT	D		D					D	podocarpus species
<i>Podocarpus macrophyllus</i>			OT	OT	D						podocarpus, Chinese
<i>Populus alba</i>				OT	D			D*			poplar, white
<i>Populus spp.</i>				O*	D	OT		D		D	poplar species
<i>Populus deltoides</i>					D	OT		D		D	cottonwood, eastern
<i>Potentilla spp.</i>		OT	O*	O*	D				D*	D	potentilla (cinquefoil)
<i>Potentilla fruticosa</i>		OT	O*		D				D	D	potentilla, bush
<i>Potentilla verna</i>			OT	O*	D						potentilla (cinquefoil) verna
<i>Prosopis chilensis</i>			OT		D					D	mesquite, Chilean
<i>Prunus spp.</i>		D		OT	D			D		D	apricot (Stone)
<i>Prunus spp.</i>				OT	D			D		D	nectarine
<i>Prunus spp.</i>		D*	D*	OT	D			D*		D	cherry species
<i>Prunus avium</i>		D		OT	D						cherry, sweet
<i>Prunus caroliniana</i>			O*	O*	D					D	cherry-laurel, Carolina
<i>Prunus cerasifera</i>				OT	D			D		D	plum, cherry
<i>Prunus glandulosa</i>				OT	D	OT		D*		D	almond, flowering
<i>Prunus laurocerasus</i>				OT	D					D	cherry-laurel, common
<i>Prunus persica</i>		D		OT	D	OT		D*		D	peach, common
<i>Prunus sargentii</i>				OT	D			D		D	cherry, sargent
<i>Prunus serotina</i>				OT	D			D		D	cherry, black
<i>Prunus serrulata</i>				OT	D			D		D	cherry, Japanese
<i>Prunus spp.</i>		D		OT	D			D		D	prunes
<i>Prunus subhirtella pendulata</i>				OT	D			D		D	cherry, Higan
<i>Prunus tomentosa</i>				OT	D						cherry, Manchu
<i>Prunus triloba</i>		OT	OT	OT	D	OT		D*		D	almond
<i>Prunus x cistena</i>				OT	D			D		D	cherry, purpleleaf sand
<i>Prunus yedoensis</i>				OT	D			D		D	cherry, Yoshino
<i>Pseudotsuga menziesii</i>		OT	OT	OT	D		D	OT	OT	D*	fir, Douglas

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	Acclaim Extra	Envoy	Fusilade II	Segment	Basagran TO	Casoron	Dismiss	Goal	Lontrel	Sedge- hammer	Common Name
<i>Pyracantha</i> spp.	OT	OT	O*	O*	D	OT				D	pyracantha species
<i>Pyracantha coccinea</i>	OT	OT	O*		D	OT				D	pyracantha, scarlet
<i>Pyracantha fortuneana</i>		OT		O*	D	OT				D	pyracantha, Chinese
<i>Pyracantha</i> 'Mohave'			OT		D	OT				D	pyracantha, Mohave
<i>Pyrus</i> spp.		D*	O*	OT	D			D*		D	pear species
<i>Pyrus calleryana</i> 'Bradford'			OT	OT	D			D		D	pear, Bradford
<i>Pyrus communis</i>		D		OT	D			D*		D	pears
<i>Quercus alba</i>		OT		OT	D	OT				D	oak, white
<i>Quercus</i> spp.		OT	O*	O*	O*	OT		D*	D*	D	oak species
<i>Quercus coccinea</i>		OT			D	OT				D	oak, scarlet
<i>Quercus nigra</i>		OT		OT	D	OT		D		D	oak, water
<i>Quercus pagoda</i>		OT			D	OT		D		D	oak, cherrybark
<i>Quercus palustris</i>		OT	OT		D	OT		D		D	oak, pin
<i>Quercus phellos</i>		OT		OT	D	OT		D	D	D	oak, willow
<i>Quercus prinus</i>		OT			D	OT		D		D	oak, Chestnut
<i>Quercus rubra</i>		OT		OT	OT	OT		D	D	D	oak, red
<i>Quercus virginiana</i>		OT	OT		D	OT				D	oak, live
<i>Raphiolepis indica</i>		OT	OT	OT	D					D	hawthorn, Indian
<i>Raphiolepis umbellata</i>			OT		D					D	hawthorn, Yedda
<i>Rhamnus frangula</i>				O*	D						buckthorn, tallhedge
<i>Rhamnus</i> spp.			OT	O*	D					D	buckthorn species
<i>Rhododendron</i> (spp.) (azalea)	OT	OT	D*	O*		O*	D			D	azalea spp.
<i>Rhododendron</i> (azalea) Gable hybrids	OT	OT	O*			OT	D				azalea, Gable hybrids
<i>Rhododendron</i> (azalea) Girard hybrids	OT	OT	O*			OT	D				azalea, Girard hybrids
<i>Rhododendron</i> (azalea) Glend Dale hybrids	OT	OT	OT			OT	D				azalea, Glend Dale hybrids
<i>Rhododendron</i> (azalea) Kurume hybrids	OT	OT	D	O*		OT	D				azalea, Kurume hybrids
<i>Rhododendron</i> (azalea) Northern Lights hybrid	OT	OT		O*		OT	D				azalea, Pericat hybrids
<i>Rhododendron</i> (azalea) Pericat hybrids	OT	OT	O*			OT	D				azalea, Northern Lights hybrid
<i>Rhododendron</i> (azalea) Ruthfordiana hybrids	OT	OT	O*			OT	D				azalea, Ruthfordiana hybrids
<i>Rhododendron</i> (azalea) Satsuki hybrids	OT	OT	O*			OT	D				azalea, Satsuki hybrids
<i>Rhododendron</i> (azalea) southern indica types	OT	OT	O*			OT	D				azalea, southern indica types
<i>Rhododendron</i> spp.	OT	OT	D*	O*		OT	D			D*	rhododendron species
<i>Rhododendron carolinianum</i>	OT	OT		O*		OT	D			D*	rhododendron, Carolina
<i>Rhododendron catawbiense</i>	OT	OT	O*	O*		OT	D		OT*	D*	rhododendron, Catawba
<i>Rhododendron indicum</i>	OT	OT	D*	O*		O*	D			D	azalea, Macranthum
<i>Rhododendron maximum</i>	OT	OT		O*		OT	D			D*	rhododendron, rosebay
<i>Rhododendron molle</i>	OT	OT		O*		O*	D			D	azalea, Chinese
<i>Rhododendron obtusum</i>	OT	OT	D*	O*		O*	D		OT*	D	azalea, Hiryu
<i>Rhododendron</i> PJM group	OT	OT	D*			OT	D			D	rhododendron, PJM
<i>Rhus</i> spp.			O*	O*	D					D	sumac
<i>Ribes alpinum</i>				OT	D					D	currant, alpine
<i>Robinia</i> spp.				O*	D	OT		D*		D	locust species
<i>Robinia pseudoacacia</i>				OT	D	OT		D			locust, black
<i>Rosa banksiae</i>			OT		D		D			D	rose, Banks

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	Acclaim Extra	Envoy	Fusilade II	Segment	Basagran TO	Casoron	Dismiss	Goal	Lontrel	Sedge- hammer	Common Name
<i>Rosa</i> spp.	OT	OT	O*		D	OT	D			D	rose species
<i>Rosmarinus</i> spp			O*		D					D	rosemary
<i>Rubus</i> spp.		D		OT	D					D	blackberry, dewberry, raspberry
<i>Salix</i> spp.	OT		D*	O*	D	OT				D	willow species
<i>Salix alba</i>	OT		OT		D	OT				D	willow, white
<i>Salix babylonica</i>	OT		OT		D	OT				D	willow, weeping
<i>Salix babylonica</i>	OT		OT		D	OT				D	willow, Babylon weeping
<i>Salix matsudana</i>	OT			O*	D	OT				D	willow, Hankow
<i>Salix purpurea</i>	OT		OT		D	OT				D	willow, purpleosier
<i>Samanea saman</i>					D					D	rain-tree (ohai)
<i>Sambucus</i> spp.					D					D	elderberry species
<i>Santolina chamaecyparissus</i>			OT	OT	D					D	lavender, cotton
<i>Sequoia sempervirens</i>				OT	D					D	redwood, coast
<i>Sophora japonica</i>			OT		D					D	pagoda, Japanese
<i>Sorbus americana</i>				OT	D	OT					mountain-ash, American
<i>Sorbus</i> spp.			O*	O*	D	OT				D	mountain-ash species
<i>Sorbus aucuparia</i>				OT	D	OT				D	mountain-ash, European
<i>Sorbus decora</i>				OT	D	OT				D	mountain-ash showy
<i>Spiraea</i> spp.		O*	D*	O*	D	OT	D		D*	D	spirea species
<i>Spiraea japonica</i>			O*	O*	D	OT	D		D*	D	spirea, Japanese
<i>Spiraea nipponica</i>			OT	O*	D	OT	D			D	spirea, Snowmound
<i>Spiraea thunbergii</i>		O*	OT		D	OT	D			D	spirea, Thunburg
<i>Spiraea vanhouttei</i>			D*	OT	D	OT	D			D	spirea, Vanhoutte
<i>Spirea x bumalda</i>					D	OT	D			D	spirea,
<i>Symphoricarpos albus</i>					D					D	snowberry
<i>Syringa</i> spp.			O*	O*	D	OT		D*		D	lilac species
<i>Syringa chinensis</i>			D	OT	D	OT				D	lilac, Chinese
<i>Syringa meyeri</i>			OT	OT	D	OT				D	lilac, Meyer
<i>Syringa patula</i>					D	OT				O*	lilac, Korean
<i>Syringa pubescens</i> subsp. <i>patula</i>					D	OT				D	lilac, Manchurian
<i>Syringa villosa</i>			OT		D	OT				D	lilac, late
<i>Syringa vulgaris</i>				O*	D	OT		D		D	lilac, common
<i>Syringa x persica</i>					D	OT				D	lilac, Persian
<i>Syzygium paniculatum</i>			OT	OT	D					D	cherry, magenta
<i>Taxodium distichum</i>		OT			D					D	cypress, bald
<i>Taxus</i> spp.	OT	OT	O*	O*	O*	OT	D	OT	OT*	D*	yew species
<i>Taxus baccata</i>	OT	OT		OT	D	OT	D	OT			yew, English
<i>Taxus canadensis</i>	OT	OT			D	OT	D	OT		D*	yew, American
<i>Taxus cuspidata</i>	OT	OT	OT	O*	OT	OT	D	OT		D*	yew, Japanese
<i>Taxus x media</i>	OT	OT	O*		O*	OT	D	OT	OT	D*	yew, Anglojap
<i>Temstroemia gymnanthera</i> (<i>Cleyera japonica</i>)		OT	OT		D	OT				D	cleyera, Japanese
<i>Thuja</i> spp.		O*	O*	O*	O*	OT	D	O*		D*	arborvitae species
<i>Thuja occidentalis</i>		OT	O*	O*	OT	OT	D	OT	OT*	D*	arborvitae, American
<i>Tilia americana</i>		OT	OT	OT	D	OT					basswood (linden), American

Table 6-7. Postemergence Herbicides Registered for Use on Woody Ornamentals (continued)

OT = registered for over-the-top use

D = registered for directed applications

O* = registered for over-the-top use on certain species within the genus; consult label for details

D* = registered for directed applications on certain species within the genus; consult label for details

	Acclaim Extra	Envoy	Fusilade II	Segment	Basagran TO	Casoron	Dismiss	Goal	Lontrel	Sedge- hammer	Common Name
<i>Tilia</i> spp.		OT	OT	O*	D	OT				D	basswood (linden)
<i>Tilia cordata</i>		OT	OT	OT	D	OT					basswood (linden), littleleaf
<i>Trachelospermum asiaticum</i>		OT	OT	OT	D					D	jasmine, Asiatic
<i>Trachelospermum jasminoides</i>		OT	OT	OT	D					D	jasmine, star
<i>Trachycarpus fortunei</i> (<i>Chamaerops excelsa</i>)			OT	OT	D					D	palm, windmill
<i>Tsuga</i> spp.		O*	O*	O*	D			O*		D*	hemlock species
<i>Tsuga canadensis</i>		OT	OT	OT	D			OT		D*	hemlock, Canada
<i>Tsuga caroliniana</i>					D					D*	hemlock, Carolina
<i>Tsuga heterophylla</i>		OT			D			OT		D	hemlock, Western
<i>Ulmus americana</i>					D	OT				D	elm, American
<i>Ulmus</i> spp.				O*	D	OT				D	elm species
<i>Ulmus pumila</i>					D	OT				D	elm, Siberian
<i>Vaccinium</i> spp.		D	D*	OT	D					D	blueberry
<i>Viburnum</i> spp.	OT	O*	D*	O*	D					D	viburnum species
<i>Viburnum dentatum</i>	OT		OT	OT	D					D	viburnum, arrowwood
<i>Viburnum japonicum</i>	OT		OT	OT	D					D	viburnum, Japanese snowball
<i>Viburnum lantana</i>	OT		O*	OT	D					D	viburnum, Wayfaringtree
<i>Viburnum lentago</i>	OT		OT	OT	D					D	viburnum, nannyberry
<i>Viburnum opulus</i>	OT		OT	O*	D					D	viburnum, European cranberrybush
<i>Viburnum plicatum</i>	OT		OT		D					D	viburnum, doublefile
<i>Viburnum suspensum</i>	OT		OT	O*	D					D	viburnum, Sandankwa
<i>Viburnum tinus</i>	OT	OT		OT	D					D	viburnum, laurustinus
<i>Viburnum trilobum</i>	OT		OT	OT	D					D	viburnum, American cranberry bush
<i>Viburnum wrightii</i>	OT				D					D	viburnum, Wright
<i>Viburnum x juddi</i>	OT		OT		D					D	viburnum, Judd
<i>Viburnum x rhytidophylloides</i>	OT		OT		D					D	viburnum, Lantanaphyllum
<i>Vinca major</i>	OT				D					D	periwinkle, large
<i>Vinca minor</i>	OT	OT	O*	O*	D					D	periwinkle, common
<i>Vitis</i> spp.		D		OT	D			D*		D	grapes
<i>Weigela florida</i>	OT		OT		D	OT				D	weigela, old fashioned
<i>Weigela</i> spp.	OT		O*		D	OT				D	weigela species
<i>Wisteria</i> spp.		OT		O*	D					D	wisteria
<i>Yucca</i> spp.			O*		D					D	yucca species
<i>Yucca filamentosa</i>			OT		D					D	yucca, Adam's needle
<i>Yucca gloriosa</i>			OT		D					D	yucca, Spanish-dagger
<i>Yucca recurvifolia</i>			OT		D					D	yucca, curveleaf

Table 6-8. Herbicides registered for use on herbaceous ornamentals

y = registered for some species of this genus
 e = registered for some species of this genus, apply only after established
 d = registered for some species of this genus, directed application only
 x = NOT registered/prohibited from use on some species

Genus	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Post	Post	Post	Post	Post	Post	Post			
(index of common names, by genus, is available in Table 6-9)	Barricade	Corral	Dacthal	Devrinol	Dimension	Freehand	Gallery	Gemini	Jewel	Marengo G	Marengo SC	OH2	Pendulum EC,ACS	Pendulum 2G	Pennant Magnum	Ronstar G	Snapshot	Surflan	Tower	PREN Garden	Treflan 5G	Preen Southern	XL	Acclaim Extra	Basagran T/O	Envoy	Fusilade II	Lontrel	Scythe	Segment	
<i>Acanthus mollis</i>																															
<i>Achillea</i>	y	y	y		d	y	y	y	e					e	y		e	e			y	e	e	e	e	d	y	y		d	y
<i>Acorus</i>		y			d									e									e			d	y			d	y
<i>Agapanthus</i>	y	y		y	d	y	y	y	e				e	e	y	e	e	e	y	y	e	e	e		d		y		d	y	
<i>Agastache</i>						y								e											d					d	
<i>Ageratum</i>			y	y					e			x		e	y						y	e			d	y	y			d	
<i>Ajuga</i>		y	x	y	d		x	x	e				e	e	y	e		e			y		e	e	e	y	y	d		d	y
<i>Alcea</i>																					y				d		y			d	
<i>Allium</i>	y							y							y										d					d	
<i>Alstroemeria</i>				y													e								d					d	
<i>Alyssum (Lobularia)</i>			y											e	y					e	y	e		e	d	y	y			d	y
<i>Amaranthus</i>																									d					d	
<i>Ammophila</i>		y			d	x							e	e			e		x	y	e			d						d	
<i>Anagallis</i>																								e	d					d	
<i>Anemone</i>	y					y								e										d						d	
<i>Angelonia</i>						y													y												
<i>Antirrhinum</i>			y		d									e	y	e	e	e			y	e	e	e	e	y		y		d	y
<i>Aptenia</i>								y																							
<i>Aquilegia</i>	y		y		d	x	y		e		x			e	y				x				e	e	d			d		d	y
<i>Arctotheca</i>	y	y					y	y					e	e			e	e			y	e		e	d		y			d	y
<i>Arctotis</i>				y																	y	e			d					d	
<i>Argyranthemum</i>								y																							
<i>Amsonia</i>						x																									
<i>Arenaria</i>																	x								d		y			d	
<i>Arisaema</i>																									d					d	y
<i>Ameria</i>						x		y						e								e		d						d	y
<i>Artemesia</i>	y		y					y	e					e	y		e				y				d					d	

Table 6-8. Herbicides registered for use on herbaceous ornamentals (continued)

y = registered for some species of this genus

e = registered for some species of this genus, apply only after established

d = registered for some species of this genus, directed application only

x = NOT registered/prohibited from use on some species

	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Post	Post	Post	Post	Post	Post	Post		
Genus (index of common names, by genus, is available in Table 6-9)	Barricade	Corral	Dacthal	Devrinol	Dimension	Freehand	Gallery	Gemini	Jewel	Marengo G	Marengo SC	OH2	Pendulum EC,ACS	Pendulum 2G	Pennant Magnum	Ronstar G	Snapshot	Surflan	Tower	PREEN Garden	Treflan 5G	Preen Southern	XL	Acclaim Extra	Basagran T/O	Envoy	Fusilade II	Lontrel	Scythe	Segment	
<i>Arundo</i>		y											e	e				x	y						d				d		
<i>Asclepias</i>		y				x								e	y											d				d	y
<i>Asparagus</i>		y		y	d		y	y		y	d		e	e		e	e			y	e	e			d	y	y		d	y	
<i>Aspidistra</i>							y	y						e												d				d	
<i>Aster</i>	y	y	y	y			y	y	e					e	y		e	e		y	e	e			d				d	y	
<i>Astilbe</i>					d	y			e	x				e			e	e			e		e	e	d				d		
<i>Athyrium</i>	y			y														e			e	e			d				d		
<i>Aurinia (Alyssum)</i>																										d				d	
<i>Baptisia</i>									e					e												d				d	
<i>Begonia</i>	y				d	x	y		x					e		e		x	y	e	e	x	e	d		d		d	y		
<i>Bergenia</i>	y						y		e					e											d				d	y	
<i>Bidens</i>								y																							
<i>Boltonia</i>	y			y																					d	y			d		
<i>Bougainvillea</i>	y			y	y			y							y	e							e		d		y		d	y	
<i>Bouteloua</i>																									d			e	d		
<i>Brachyscome</i>								y																							
<i>Brassica</i>							x	x						e		x	e								y				d		
<i>Caladium</i>						y								e			e	y				e		d					d		
<i>Calamagrostis</i>						x			e	x								x	y						d		e	d			
<i>Calendula</i>																				y	e				d		y		d	y	
<i>Callistephus</i>					d		y							e		e	e	e							d				d		
<i>Calluna</i>	y			y					x				e	e		e					e	e			d		y		d		
<i>Campanula</i>	y		y	y		y			x					e	y			e		y	e		e	e	d		y		d	y	
<i>Canna</i>						y			e				e	e	y										d				d	y	
<i>Capsicum</i>																									d				d		
<i>Carex</i>					d		y	y	x	y	x			e	y		e		y	y	e	e			d				d		
<i>Carpobrotus</i>								y	e																						

Table 6-8. Herbicides registered for use on herbaceous ornamentals (continued)

y = registered for some species of this genus
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Genus	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Post	Post	Post	Post	Post	Post	Post		
(index of common names, by genus, is available in Table 6-9)	Barricade	Corral	Dacthal	Devrinol	Dimension	Freehand	Gallery	Gemini	Jewel	Marengo G	Marengo SC	OH2	Pendulum EC,ACS	Pendulum 2G	Pennant Magnum	Ronstar G	Snapshot	Surflan	Tower	PREEN Garden	Treflan 5G	Preen Southern	XL	Acclaim Extra	Basagran T/O	Envoy	Fusilade II	Lontrel	Scythe	Segment	
<i>Catharanthus</i>						x	y	y		y				e			e			y				d		d		d	y		
<i>Celosia</i>					d	x						x		e			x		y			e			d				d	y	
<i>Centaurea</i>					d															y	e	e		e	d				d	y	
<i>Cerastium</i>																	e			y	e			e	d	y	y		d		
<i>Ceratostigma</i>								y									e				e				d				d	y	
<i>Chasmanthium</i>						x													x	y					d			e	d		
<i>Chelone</i>						y																									
<i>Chrysanthemum</i>			y	y		y			x			x		e	y	e	e	e	y	y	e			e	e	d	y			d	y
<i>Cirsium</i>																										d				d	
<i>Clarkia</i>																									e	d				d	
<i>Clematis</i>						y						x					e		y						d				d		
<i>Clivia</i>																															
<i>Codiaeum</i>										x	x																				
<i>Consolida</i>																										d				d	
<i>Convallaria</i>																										d				d	
<i>Coreopsis</i>	y		y		d	x	y		e	x	x	y		e	y	e	e	e		y	e	e	e	e	d	y	y		d	y	
<i>Coronilla (Vicia)</i>														e							y	e				d				d	
<i>Cortaderia</i>	y	y			d	x	y					y	e	e	y		e	e	x	y	e	e	e		d			e	d		
<i>Cosmos</i>			y																		y	e			e	d				d	y
<i>Crococsmia</i>	y												e	e												d				d	
<i>Crocus</i>														e	y											d				d	
<i>Codiaeum</i>										x																					
<i>Cuphea</i>							y	y									e	e								d	y			d	y
<i>Cyperus</i>							y	y									e									d		d		d	
<i>Cyrtomium</i>								y																							
<i>Dahlia</i>			y	y			y							e		e	e		e	y	e					d	y			d	y
<i>Dalea greggii</i>								y																							

Table 6-8. Herbicides registered for use on herbaceous ornamentals (continued)

y = registered for some species of this genus
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Genus (index of common names, by genus, is available in Table 6-9)	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Post	Post	Post	Post	Post	Post	Post								
	Barricade	Corral	Dacthal	Devrinol	Dimension	Freehand	Gallery	Gemini	Jewel	Marengo G	Marengo SC	OH2	Pendulum EC,ACS	Pendulum 2G	Pennant Magnum	Ronstar G	Snapshot	Surflan	Tower	PREEN Garden	Treflan 5G	Preen Southern	XL	Acclaim Extra	Basagran T/O	Envoy	Fusilade II	Lontrel	Scythe	Segment							
<i>Daucus</i>															y														d					d	y		
<i>Delosperma</i>	y			y	y	y	y							e			e	e	y	y			e	e										d			
<i>Delphinium</i>	y				d				x						y								e												d		
<i>Dennstaedtia</i>				y																			e												d		
<i>Deschampsia</i>		y			d	x	y						e	e			e		x	y	e	e													d	e	
<i>Dianthus</i>	y		x			y	y			x	x	x				y					y	e	e												d	y	
<i>Dianthus</i>	y		x			y	y			x	x						e	e			e	e		e	d	y									d	y	
<i>Dianthus</i>			x		d	y	y		e	x	x			e	y	e		e		y	e	e	e	e	e	d									d	y	
<i>Dicentra</i>			y	y									e	e			x	e		y			e	e	d	y									d	y	
<i>Dietes</i>								y																													
<i>Digitalis</i>			y						e			x		e		e	x	e		y																d	y
<i>Dimorphotheca</i>																				e	e		e													d	
<i>Doronicum</i>				y					e					e		y		e						e	d											d	
<i>Drosanthemum</i>																																					
<i>Dryopteris</i>				y		y	y												y				e													d	
<i>Duranta</i>										x																											
<i>Dymondia</i>								y																													
<i>Echinacea</i>	y		y	y	y	y	x	x	x	x	x	x		e			x	e	x	y			e	e	d											d	y
<i>Ensete</i>								y																													
<i>Epilobium</i>						x													x																		
<i>Epimedium</i>									e																												d
<i>Equisetum</i>								y											e																		d
<i>Erianthus</i>						x	y	y									e		x	y																	d
<i>Erica</i>					d			y				x																									d
<i>Erigeron</i>								y																													
<i>Eryngium</i>						x													x																		
<i>Erysimum</i>				y													e							e	d											d	

Table 6-8. Herbicides registered for use on herbaceous ornamentals (continued)

y = registered for some species of this genus
 e = registered for some species of this genus, apply only after established
 d = registered for some species of this genus, directed application only
 x = NOT registered/prohibited from use on some species

	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Post	Post	Post	Post	Post	Post	Post			
Genus (index of common names, by genus, is available in Table 6-9)	Barricade	Corral	Dacthal	Devrinol	Dimension	Freehand	Gallery	Gemini	Jewel	Marengo G	Marengo SC	OH2	Pendulum EC,ACS	Pendulum 2G	Pennant Magnum	Ronstar G	Snapshot	Surflan	Tower	PREEN Garden	Treflan 5G	Preen Southern	XL	Acclaim Extra	Basagran T/O	Envoy	Fusilade II	Lontrel	Scythe	Segment		
<i>Eschscholzia</i>														e						y	e			e	d				d	y		
<i>Eupatorium</i>						y			e					e												d				d		
<i>Euphorbia</i>							x	x									x				y	e			e	d		y		d		
<i>Eustoma</i>							y										e									d				d		
<i>Festuca</i>		y			d	x	y	y	e	x	x		e	e			e	e	x		y	e	e	e		d				d	y	
<i>Fragaria</i>		y										y		e							y	e				d				d		
<i>Freesia</i>													e	e												d				d		
<i>Gaillardia</i>	y		y	y	d	y	y		e					e	y	y	e	e			y	e	e		e	d				d	y	
<i>Galium</i>					d																					d				d		
<i>Gaultheria</i>								y																		d				d		
<i>Gaura</i>	y					y			e	y	d						e				y					d				d		
<i>Gazania</i>		y		y		y	y		e				e	e	y	y	e	e			y	e		e	e	d	y	d		d	y	
<i>Gentiana</i>	y																									d				d		
<i>Geranium</i>	y						y		x			x			y		e						e			d	y	y		d	y	
<i>Gerbera</i>																										d				d	y	
<i>Geum</i>							y							e	y			e			y	e		e		d				d	y	
<i>Gilia</i>																									e	d				d		
<i>Gladiolus</i>	y		y	y		y	y		e					e	y	e		e			y	e		e		d			d		d	y
<i>Glandularia</i>						y																										
<i>Gomphrena</i>						x											x			y						d				d		
<i>Goniolimon</i>																										d				d		
<i>Gypsophila</i>	y		y				y		e					e		e	x	e			y	e		e	e	d				d	y	
<i>Hakonechloa</i>								y																								
<i>Hedera</i>	y	y	y	y	d		y		e				e	e	y	y	e	e			y	e	e	e	e	y	y	y		d	y	
<i>Helianthemum</i>	y							y																		d				d		
<i>Helianthus</i>														e							y	e				d				d		
<i>Helichrysum</i>							y										e									d				d		

Table 6-8. Herbicides registered for use on herbaceous ornamentals (continued)

y = registered for some species of this genus

e = registered for some species of this genus, apply only after established

d = registered for some species of this genus, directed application only

x = NOT registered/prohibited from use on some species

Genus (index of common names, by genus, is available in Table 6-9)	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Post	Post	Post	Post	Post	Post	Post		
	Barricade	Corral	Dacthal	Devrinol	Dimension	Freehand	Gallery	Gemini	Jewel	Marengo G	Marengo SC	OH2	Pendulum EC,ACS	Pendulum 2G	Pennant Magnum	Ronstar G	Snapshot	Surflan	Tower	PREEN Garden	Treflan 5G	Preen Southern	XL	Acclaim Extra	Basagran T/O	Envoy	Fusilade II	Lontrel	Scythe	Segment	
<i>Helichrysum</i>								y																							
<i>Heliotropium</i>							y								e		e								d				d		
<i>Hemerocallis</i>	y	y		y	d	y	y	y		d	d	y		e	y		e	e	y	y	e	e	e	e	d	y	y		d	y	
<i>Herniaria</i>																				y	e				d		d		d	y	
<i>Hesperis</i>																							e	d					d		
<i>Heuchera</i>						y	y							e		e	e			y					d	y			d	y	
<i>Heucherella</i>	y																								d				d		
<i>Hibiscus</i>	y									y					y	e		e							d				d		
<i>Hibiscus</i>	y			y	d					y					y	e		e							d				d		
<i>Hibiscus</i>										y					y	e									d				d		
<i>Hosta</i>	y	y		y	d	y	y	y	e	d			e	e	y		e	e	y	y	e	e	e	e	d	y	y		d	y	
<i>Houttuynia</i>	y						y	y																	d				d		
<i>Hyacinthoides (Endymion)</i>															y										d				d		
<i>Hyacinthus</i>							y								y			y		y	y		y		d				d		
<i>Hypericum</i>		y		y			y		e			y		e	y		e	e		y			e		d				d	y	
<i>Iberis</i>			y		d	y	x	x								e	x	e	x			e		e	d	y	y		d	y	
<i>Impatiens</i>					d	x	y							e	y		e	e	x	y	e	e	e		y	y			d	y	
<i>Imperata</i>						x	y												x	y					d			e	d		
<i>Inula</i>								y																							
<i>Ipomea</i>			y			y	y	y											y		e				d				d		
<i>Iris</i>	y		y	y	d	y	y								y		e	y	y	y	y	e	y	e	d	y	y		d	y	
<i>Iris</i>	y		y	y	d	y	y	y							y		e	e	y		e	e	e	e	d	y	y		d	y	
<i>Justicia</i>								y																							
<i>Kniphofia</i>			y				y	y						e											d				d		
<i>Lamium</i>						x			e																d				d		
<i>Lantana</i>	y		y	y	d	y				y		x		e		e			y		e	e			d	y	d		d	y	

Table 6-8. Herbicides registered for use on herbaceous ornamentals (continued)

y = registered for some species of this genus
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Genus	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Post	Post	Post	Post	Post	Post	Post	
(index of common names, by genus, is available in Table 6-9)	Barricade	Corral	Dacthal	Devrinol	Dimension	Freehand	Gallery	Gemini	Jewel	Marengo G	Marengo SC	OH2	Pendulum EC,ACS	Pendulum 2G	Pennant Magnum	Ronstar G	Snapshot	Surflan	Tower	PREN Garden	Treflan 5G	Preen Southern	XL	Acclaim Extra	Basagran T/O	Envoy	Fusilade II	Lontrel	Scythe	Segment
<i>Lathyrus</i>			y																	y	e			d				d		
<i>Laurentia (Isotoma)</i>																									d		y		d	
<i>Lavandula</i>	y					y		y	e	x	x		e	e			e	y	y	e				d				d	y	
<i>Layia</i>																								e	d			d	y	
<i>Leucanthemum (Chrys.)</i>									x			x		e						y			e	e	d		y		d	y
<i>Leymus</i>						x													x	y				d			e	d		
<i>Liatris</i>							y		e					e		e	e	e		y			e	e	d		y		d	y
<i>Lilium</i>	y		y	y			y		e			x	e	e	y				y					d			y	d		
<i>Limonium (Statice)</i>							y	y						e	y	e	e	e	e	y	e			e	d		y		d	y
<i>Linum</i>														e										e	d				d	y
<i>Liriope</i>	y	y		y	y	y	y	y		x	x		e	e	y		e	e	y	y	e	e	e	e	y	y	y		d	y
<i>Lithodora diffusa</i>																														
<i>Lobelia</i>	y	y				x		y									e	e			e			d					d	
<i>Lobularia</i>						y																								
<i>Lonicera</i>	y			y	d		y	y	e			y		y	e	e	e			e	e	e	e	d	y	d		d	y	
<i>Lupinus</i>			y									y		e	y					y	e			d					d	y
<i>Lysimachia</i>							y	y						e			e							d	y	y		d	y	
<i>Lythrum</i>	y	y												e	y									d	y			d	y	
<i>Malephora</i>								y																						
<i>Matricaria</i>																								e	d				d	
<i>Matthiola</i>						x	y										e			y	e			d				d	y	
<i>Matteuccia</i>								y																						
<i>Mertensia</i>																								e	d				d	
<i>Mentha</i>										x	x																			
<i>Melampodium</i>																														
<i>Mirabilis</i>			y																	y	e			d					d	
<i>Miscanthus</i>	y	y			d	x	y	y	e					e			e		x	y	e			d			e	d		

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	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Pre	Post	Post	Post	Post	Post	Post	Post			
Genus (index of common names, by genus, is available in Table 6-9)	Barricade	Corral	Dacthal	Devrinol	Dimension	Freehand	Gallery	Gemini	Jewel	Marengo G	Marengo SC	OH2	Pendulum EC,ACS	Pendulum 2G	Pennant Magnum	Ronstar G	Snapshot	Surflan	Tower	PREN Garden	Treflan 5G	Preen Southern	XL	Acclaim Extra	Basagran T/O	Envoy	Fusilade II	Lontrel	Scythe	Segment		
<i>Pennisetum</i>	y	y			y	x	y		e	x	x		e	e		e	e	e	x	y	e	e			d		d	e	d	y		
<i>Penstemon</i>		y		y			y	y	e			x		e			e				y				e	d				d		
<i>Pentas</i>						x																										
<i>Perovskia</i>	y			y			y		e		d			e			e				y					d				d		
<i>Petunia</i>			y	y	d	y	y		x			x		e	y		e	e	y	y	e	e	e	e	e	y	y	y		d	y	
<i>Phalaris</i>		y		y	d	x	y						e	e			e		x	y	e	e				d			e	d		
<i>Phlox paniculata</i>			x			x			x					e			x									d				d		
<i>Phlox subulata</i>			x			y	y	y	e					e	y	e	x				y	e				d	y			d	y	
<i>Phormium</i>								y																								
<i>Physostegia</i>	y							y						e	y											d				d		
<i>Platycodon</i>														e												d				d		
<i>Plectranthus</i>			y		d	y										x			y				e	x	e	d	y	y		d	y	
<i>Plumbago</i>						x		y		x	x																					
<i>Polianthes</i>																										d				d		
<i>Polygonum</i>																										d		y		d		
<i>Polystichum</i>				y			y	y														e	e			d				d		
<i>Portulaca</i>			y		d	y								e				e	e	y	e	e	e		d	y	y		d	y		
<i>Potentilla</i>		y			d	y		y	e				e	e	y	e			y		e		e		d	y	d		d			
<i>Primula</i>																										d				d		
<i>Ranunculus</i>																				e			e		d				d			
<i>Ratibida</i>							y	y									e							e	d				d			
<i>Rosa</i>	y		y	y	d				e					e	y	e		e			e		e	e	e	d	y	y		d		
<i>Pulmonaria</i>																																
<i>Rosmarinus</i>	y	y			d									e				e			y	e		e		d		y		d	y	
<i>Rubus calycinoides</i>																			e			e		e		d	y			d	y	
<i>Rudbeckia</i>	y				d	x	y		e	x		x		e			e	e			y	e	e	e	e	d				d	y	
<i>Rumohra</i>	y							y					e	e	y								e			d		y		d		

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(index of common names, by genus, is available in Table 6-9)	Barricade	Corral	Dacthal	Devrinol	Dimension	Freehand	Gallery	Gemini	Jewel	Marengo G	Marengo SC	OH2	Pendulum EC,ACS	Pendulum 2G	Pennant Magnum	Ronstar G	Snapshot	Surflan	Tower	PREEN Garden	Treflan 5G	Preen Southern	XL	Acclaim Extra	Basagran T/O	Envoy	Fusilade II	Lontrel	Scythe	Segment	
<i>Salvia</i>			y			y	y			x	x			e				e	y	y	e	e	e	x	d	y	y		d	y	
<i>Salvia</i>					d	y	y		e	x	x						e	e	y	y	e	e	e	x	d	y	y		d		
<i>Sanguisorba</i>																								e	d				d		
<i>Santolina</i>	y		y									y													d		y		d	y	
<i>Sanvitalia</i>																								e	d				d		
<i>Saponaria</i>																					e				d				d		
<i>Sasa</i>								y																							
<i>Saxifraga</i>	y																									d	y			d	
<i>Scabiosa</i>	y		y	y		x			e												y	e			d				d		
<i>Scaevola</i>						x																									
<i>Schizachyrium</i>																									d			e	d		
<i>Scilla</i>															y											d				d	
<i>Scutellaria</i>								y																							
<i>Sedum</i>	y		y	y	d	y	y	x	x			x		e	y	e	e	e			y	e	e	e		d	y	y		d	y
<i>Sempervivum</i>																									d		y		d		
<i>Senecio</i>					y	y								e				e			y		e			d	y			d	
<i>Silene</i>																								e	d				d	y	
<i>Solanum</i>		y						y						e												d				d	
<i>Solidago</i>						y																									
<i>Stachys</i>															y	e					y	e				d				d	y
<i>Stipa</i>																			x		y					d		e	d		
<i>Stokesia</i>		y												e								e		e		d				d	
<i>Strelitzia</i>				y																	e			e		d		y		d	
<i>Tagetes</i>			y		d	y	y		x			x		e	y		e	e	y	y	e	e	e		y	y	y		d	y	
<i>Tetraeneuris</i>								y																							
<i>Teucrium</i>	y		x			y																				d				d	
<i>Thalictrum</i>	y							y																		d				d	

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Genus (index of common names, by genus, is available in Table 6-9)	Barricade	Corral	Dacthal	Devrinol	Dimension	Freehand	Gallery	Gemini	Jewel	Marengo G	Marengo SC	OH2	Pendulum EC,ACS	Pendulum 2G	Pennant Magnum	Ronstar G	Snapshot	Surflan	Tower	PREEN Garden	Treflan 5G	Preen Southern	XL	Acclaim Extra	Basagran T/O	Envoy	Fusilade II	Lontrel	Scythe	Segment
<i>Thymus</i>			y												e								e	d					d	
<i>Trachelospermum spp.</i>						y		y	e									y												
<i>Tradescantia</i>			y						e						e									d					d	y
<i>Trientalis</i>																								d					d	
<i>Tropaeolum</i>			y																	y	e			d					d	
<i>Tulbaghia</i>								y																						
<i>Tulipa</i>	y			y	d		y							e	y			y		y	y	e	y		d				d	y
<i>Verbena</i>		y			d	y	y			y				e		e	e			y	e	e			d	y			d	y
<i>Veronica</i>	y			y		x			e				e	e	y			e		y	e				d		y		d	y
<i>Vinca</i>	y	y		y	d	x	y	y						e	y	y	e	e	e	y	e	e	e		d	y	y		d	y
<i>Viola</i>					d									e	y			x					e	e	d	y			d	y
<i>Yucca</i>	y	y												e	y			e					e	e	d				d	
<i>Zantedeschia</i>													e	e					y						d				d	
<i>Zinnia</i>			y	y		y			x			x		e	y		e	e	y	y	e		e	e	d	y	y		d	y

Table 6-9. Index of weed names, by genus

Genus	Common Name
Broadleaf weeds	
<i>Ageratum</i>	Ageratum, tropic
<i>Abutilon</i>	Velvetleaf
<i>Acalypha</i>	Copperleaf
<i>Amaranthus</i>	Pigweed spp.
<i>Amaranthus</i>	Waterhemp, common
<i>Amaranthus</i>	Waterhemp, tall
<i>Ambrosia</i>	Bursage, Annual
<i>Ambrosia</i>	Ragweed, common
<i>Amsinckia</i>	Fiddleneck
<i>Anagallis</i>	Pimpernel, scarlet
<i>Anthemis</i>	Chamomile, mayweed
<i>Anthemis</i>	Mayweed (chamomile)
<i>Aphanes</i>	Parsley-piert
<i>Artemisia</i>	Mugwort (from rhizome)
<i>Asclepias</i>	Milkweed
<i>Aster</i>	Aster
<i>Barabea</i>	Yellow Rocket
<i>Berteroa</i>	Allysum, hoary
<i>Bidens</i>	Spanishneedles
<i>Brassica</i>	Mustard, black
<i>Brassica, others</i>	Mustard, wild
<i>Calandrinia</i>	Redmaids
<i>Calystegia</i>	Bindweed, hedge (from roots)
<i>Capsella</i>	Shepherdspurse
<i>Cardamine</i>	Bittercress
<i>Carduus</i>	Thistle, Musk
<i>Centaurea</i>	Knapweed, Russian or spotted
<i>Cerastium</i>	Chickweed, mouseear
<i>Chamaesyce</i>	Spurge, garden
<i>Chamaesyce</i>	Spurge, hyssop
<i>Chamaesyce</i>	Spurge, spotted
<i>Chenopodium</i>	Goosefoot
<i>Chenopodium</i>	Lambsquarters
<i>Cirsium</i>	Thistle, Bull
<i>Cirsium</i>	Thistle, Canada (from seed)
<i>Convolvulus</i>	Bindweed, field (from roots)
<i>Conyza</i>	Horseweed (marestail)
<i>Coronopus</i>	Swinecress
<i>Cotula</i>	Southern waterbuttons
<i>Crassocephalum</i>	Thickhead
<i>Croton</i>	Turkey mullein

Table 6-9. Index of weed names, by genus(cont.)

Genus	Common Name
Broadleaf weeds (continued)	
<i>Cuscuta</i>	Dodder
<i>Cyclosporum</i>	Marsh parsley
<i>Datura</i>	Jimsonweed
<i>Daucus</i>	Carrot, wild
<i>Descurainia</i>	Flixweed
<i>Descurainia</i>	Tansymustard, green
<i>Desmodium</i>	Beggarweed, Florida
<i>Eclipta</i>	Eclipta
<i>Emilia</i>	Tassleflower
<i>Epilobium</i>	Willowherb
<i>Erechtites</i>	Burnweed, American
<i>Erigeron</i>	Fleabane
<i>Erodium</i>	Filaree, redstem
<i>Erodium</i>	Filaree, whitestem
<i>Eupatorium</i>	Dogfennel
<i>Euphorbia</i>	Poinsettia, wild
<i>Euphorbia</i>	Spurge, petty
<i>Fatoua</i>	Mulberryweed
<i>Galinsoga</i>	Galinsoga, hairy
<i>Galinsoga</i>	Galinsoga, smallflower
<i>Galium</i>	Bedstraw
<i>Geranium</i>	Geranium, Carolina
<i>Gnaphalium</i>	Cudweed
<i>Helianthus</i>	Sunflower
<i>Heterotheca</i>	Camphorweed
<i>Heterotheca</i>	Telegraphplant
<i>Hibiscus</i>	Venice mallow
<i>Hydrocotyle</i>	Pennywort (from seed)
<i>Hypochoeris</i>	Catsear dandelion
<i>Ipomoea</i>	Morningglory, annual
<i>Kochia</i>	Kochia
<i>Lactuca</i>	Lettuce, prickly
<i>Lamium</i>	Deadnettle, purple
<i>Lamium</i>	Henbit
<i>Lepidium</i>	Pepperweed
<i>Malva</i>	Mallow
<i>Marchantia</i>	Liverwort (from spores)
<i>Matricaria</i>	Chamomile, false
<i>Matricaria</i>	Pineappleweed
<i>Medicago</i>	Burclover
<i>Medicago</i>	Medic, black

Table 6-9. Index of weed names, by genus(cont.)

Genus	Common Name
Broadleaf weeds (continued)	
<i>Melilotus</i>	Sweetclover, yellow
<i>Melochia</i>	Redweed
<i>Mollugo</i>	Carpetweed
<i>Oenothera</i>	Evening primrose
<i>Oxalis</i>	Woodsorrel (Oxalis)
<i>Parthenium</i>	Parthenium
<i>Passiflora</i>	Maypops
<i>Phyllanthus</i>	Chamberbitter
<i>Phyllanthus</i>	Phyllanthus, long stalked
<i>Physalis</i>	Groundcherry
<i>Phytolacca</i>	Pokeweed, common
<i>Picris</i>	Bristly oxtongue
<i>Pilea</i>	Artilleryweed
<i>Plantago</i>	Plantain
<i>Polygonum</i>	Buckwheat, wild
<i>Polygonum</i>	Knotweed, prostrate
<i>Polygonum</i>	Ladysthumb
<i>Polygonum</i>	Smartweed
<i>Portulaca</i>	Purslane, common
<i>Pyrrhappus</i>	Dandelion, false
<i>Ranunculus</i>	Buttercup
<i>Raphanus</i>	Radish, wild
<i>Richardia</i>	Pusley, Florida
<i>Rorippa</i>	Yellow cress, annual
<i>Rumex</i>	Dock, curly or broadleaf
<i>Rumex</i>	Sorrel, red
<i>Sagina</i>	Pearlwort
<i>Salsola</i>	Thistle, Russian
<i>Scleranthus</i>	Knawel
<i>Sencio</i>	Groundsel, common
<i>Senna</i>	Coffeeweed
<i>Sesbania</i>	Sesbania, hemp
<i>Sibara</i>	Virginia winged rockcress
<i>Sida</i>	Sida, prickly
<i>Solanum</i>	Nightshade, black
<i>Solanum</i>	Nightshade, cutleaf
<i>Solanum</i>	Nightshade, Eastern black
<i>Solanum</i>	Nightshade, hairy
<i>Soliva</i>	Burweed, lawn
<i>Sonchus</i>	Sowthistle, annual
<i>Spergula</i>	Spurry, corn

Table 6-9. Index of weed names, by genus(cont.)

Genus	Common Name
Broadleaf weeds (continued)	
<i>Spurgularia</i>	Spurry, sand
<i>Stachys</i>	Florida Betony
<i>Stellaria</i>	Chickweed, common
<i>Sysimbrium</i>	London rocket
<i>Sysimbrium</i>	Rocket, London
<i>Taraxacum</i>	Dandelion (seedling)
<i>Tribulus</i>	Puncturevine
<i>Trifolium</i>	Clover, hop
<i>Trifolium</i>	Clover, white (from seed)
<i>Urtica</i>	Nettle, stinging
<i>Verbascum</i>	Mullein, common
<i>Veronica</i>	Speedwell spp.
<i>Vicia</i>	Vetch
<i>Xanthium</i>	Cocklebur, common
Grasses	
<i>Brachiaria</i>	Signalgrass, broadleaf
<i>Bromus</i>	Brome, California
<i>Bromus</i>	Brome, downy
<i>Bromus</i>	Brome, foxtail
<i>Bromus</i>	Cheat
<i>Bromus</i>	Rescuegrass
<i>Cenchrus</i>	Sandbur
<i>Cynodon</i>	Bermudagrass (from rhizomes)
<i>Dactylis</i>	Orchardgrass
<i>Dactyloctenium</i>	Crowfootgrass
<i>Digitaria</i>	Crabgrass, large
<i>Digitaria</i>	Crabgrass, smooth
<i>Echinochloa</i>	Barnyardgrass
<i>Echinochloa</i>	Junglerice
<i>Eleusine</i>	Goosegrass
<i>Elymus</i>	Quackgrass (from rhizome)
<i>Elymus</i>	Quackgrass (from seed)
<i>Eragrostis</i>	Lovegrass
<i>Eriochloa</i>	Cupgrass, Southwestern
<i>Eriochloa</i>	Cupgrass, wooly
<i>Festuca (=Schedonorus)</i>	Fescue, tall (from seed)
<i>Hordeum</i>	Barley, mouse
<i>Leptochloa</i>	Sprangletop
<i>Lolium</i>	Ryegrass, annual
<i>Lolium</i>	Ryegrass, perennial
<i>Microstegium</i>	Stiltgrass, Japanese

Table 6-9. Index of weed names, by genus (cont.)

Genus	Common Name
Grasses (continued)	
<i>Oryza</i>	Red rice
<i>Panicum</i>	Guineagrass
<i>Panicum</i>	Millet, wild
<i>Panicum</i>	Panicum, browntop
<i>Panicum</i>	Panicum, fall
<i>Panicum</i>	Panicum, Texas
<i>Panicum</i>	Witchgrass
<i>Poa</i>	Bluegrass, annual
<i>Poa</i>	Bluegrass, roughstalk
<i>Rottboellia</i>	Itchgrass
<i>Setaria</i>	Foxtail (yellow, green)
<i>Setaria</i>	Foxtail, giant
<i>Sorghum</i>	Johnsongrass (rhizome)
<i>Sorghum</i>	Johnsongrass (seedling)
<i>Sorghum</i>	Shattercane
<i>Sporobolus</i>	Smutgrass
<i>Vulpia</i>	Fescue, ratttail
Sedges and other monocots	
<i>Allium</i>	Onion or garlic, wild
<i>Cyperus</i>	Nutsedge, purple
<i>Cyperus</i>	Nutsedge, yellow
<i>Cyperus</i>	Sedge, annual
<i>Cyperus</i>	Sedge, rice flat-
<i>Kyllinga</i>	Kyllinga (from seed)
<i>Murdannia</i>	Doveweed
Non-flowering plants	
<i>Equisetum</i>	Horsetail (Equisetum) (from rhizomes)
<i>Pteridium</i>	Bracken Fern

Table 6-10. Cross reference of herbicide trade names and common names

Trade Name	Common Name	NC State University product information fact sheet
Acclaim Extra	fenoxaprop	
Axxe	ammonium nonanoate	
Barricade, Factor, Endurance, Regalkade	prodiamine	https://content.ces.ncsu.edu/barricade-prodiamine-regalkade-g-prodiamine
Basagran T/O	bentazon	
Basamid Granular	dazomet	
Betasan, Bensumec, Pre-San, others	bensulide	
Biathlon	oxyfluorfen + prodiamine	https://content.ces.ncsu.edu/biathlon-oxyfluorfen-prodiamine
Broadstar, SureGuard	flumioxazin	https://content.ces.ncsu.edu/broadstar-flumioxazin
Casoron, Barrier	dichlobenil	https://content.ces.ncsu.edu/casoron-dichlobenil
Certainty	sulfosulfuron	
Devrinol	napropamide	https://content.ces.ncsu.edu/devrinol-napropamide
Dimension	dithiopyr	https://content.ces.ncsu.edu/dimension-dithiopyr
Dismiss	sulfentrazone	
Envoy	clethodim	https://content.ces.ncsu.edu/envoy-plus-clethodim
Eptam	EPTC	
Finale	glufosinate	
FreeHand	pendimethalin + dimethenamid-p	https://content.ces.ncsu.edu/freehand-dimethenamid-p-pendimethalin
Fusilade II, Ornamec, others	fluzifop-P-butyl	https://content.ces.ncsu.edu/fusilade-ii-fluzifop-p-butyl
Gallery	isoxaben	https://content.ces.ncsu.edu/gallery-isoxaben
Garlon	triclopyr	
Gemini	prodiamine + isoxaben	
Goal	oxyfluorfen	https://content.ces.ncsu.edu/goal-goaltender-oxyfluorfen
Gramoxone Extra	paraquat	
HGH 75	oxyfluorfen + trifluralin	https://content.ces.ncsu.edu/hgh-75-oxyfluorfen-trifluralin
Image	imazaquin	
Kerb	pronamide	
Lontrel	clopyralid	https://content.ces.ncsu.edu/lontrel-clopyralid
Marengo, Marengo G, Spectilce FLO, Specticle G	indaziflam	https://content.ces.ncsu.edu/marengo-indaziflam
Metham sodium	metham	
Ornamental Herbicide II (OH2)	oxyfluorfen + pendimethalin	https://content.ces.ncsu.edu/ornamental-herbicide-ii-oxyfluorfen-pendimethalin
Pendulum, Ornamental Weedgrass Control, others	pendimethalin	https://content.ces.ncsu.edu/pendulum-aquacap-corr-al-pendimethalin
Pennant Magnum	s-metolachlor	https://content.ces.ncsu.edu/pennant-magnum-s-metolachlor
Predict	norflurazon	
Princep, Simazine, Princep Caliber 90	simazine	https://content.ces.ncsu.edu/princep-simazine-simazine
Regal O-O	oxyfluorfen + oxadiazon	https://content.ces.ncsu.edu/regal-o-o-oxyfluorfen-oxadiazon
Regalkade G	prodiamine	https://content.ces.ncsu.edu/barricade-prodiamine-regalkade-g-prodiamine
RegalStar	oxadiazon + prodiamine	
Reward	diquat dibromide	
Ronstar	oxadiazon	
Roundup-Pro, others	glyphosate	https://content.ces.ncsu.edu/glyphosate-1
Rout	oxyfluorfen + oryzalin	

Table 6-10. Cross reference of herbicide trade names and common names (continued)

Trade Name	Common Name	NC State University product information fact sheet
Scythe	pelargonic acid	
Sedgehammer, Prosedge	halosulfuron	https://content.ces.ncsu.edu/sedgehammer-halosulfuron
Segment	sethoxydim	https://content.ces.ncsu.edu/segment-sethoxydim
Snapshot TG	isoxaben + trifluralin	https://content.ces.ncsu.edu/snapshot-tg-isoxaben-trifluralin
Surflan, Oryzalin 4Pro	oryzalin	https://content.ces.ncsu.edu/surflan-oryzalin
Tower	dimethenamid-p	https://content.ces.ncsu.edu/tower-dimethenamid-p
Treflan, Preen, Trifluralin, others	trifluralin	
XL	benefin + oryzalin	

7. Wildlife Management

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Forestry Extension

White-tailed Deer (*Odocoileus virginianus*)

Species Description

The easily recognized white-tailed deer is common throughout most of the Southeast. They have a reddish brown summer coat and grayish brown fall and winter coat. Fawns are also easily recognizable with a brown coat covered in white spots to help conceal them from predators when for the first few months they are alive. By three to four months of age, the fawn replaces this coat with a fall/winter coat. The underparts of the tail, belly, chin, and throat are white. It is easy to tell the difference between male and female deer because bucks grow antlers from April through August. White-tailed deer lack upper incisors, which results in a distinctive feeding pattern that looks like the plant was torn. Rabbits and rodents, on the other hand, make a sharp, clean, knife-like cut on plants.

White-tailed deer breed from October through January. One buck may mate with a number of does and no pair bonds are formed. Most deer breed their second fall, although about 30-40% of female fawns may breed their first fall. Healthy adult females, referred to as does, will typically bear twins in the late spring early summer. Fawns from the previous year will usually bear a single fawn. The reproductive potential of white-tailed deer is greatly influenced by the amount and quality of food present the preceding year. Once the fawns are born, they gain weight quickly and reach an adult weight that varies from 180 to 250 lbs.

Deer are most active early in the morning and late in the evening. They are habitat generalists and prefer the forest edge over dense, old-growth forests and do exceptionally well in most parts of the Southeast. They favor brushy areas or edge habitat since these areas provide large amounts of cover and food. Deer are browsing animals with over 650 different plant items being identified in their diets. Broadleaved "weeds," or forbs, are preferred food items and are eaten whenever available in the spring and summer. Most of the time deer eat the leaves, stems, and buds of woody plants because they are available year round. During the fall, acorns, beechnuts, hickory nuts, persimmon fruits, and other nuts or berries are favorite food items. Grasses are relatively unimportant in a deer's diet, although they will eat agricultural grain crops and fruit trees if these are available. They readily consume agricultural crops such as corn, soybeans, grain sorghum, milo, and alfalfa.

Damage

Deer damage is generally in two forms: consumption of plants, and damage done to trees by males with their antlers. As mentioned above deer consume a large variety of plants. Deer will be selective feeders eating only certain plants or plant parts but when too many deer live in an area they will consume almost every piece of vegetation within reach to survive. Nurseries that are producing native plants, especially trees, will be the most susceptible to deer damage as these are preferred food items. To identify damage to plants from deer, look for bites at the ends of stems and buds. As mentioned previously, deer lack upper incisors and have a distinctive angular cut when they bite a plant giving it a torn appearance. It is possible for them to browse plants to the ground when they are food stressed. Damage from males during the fall rut will appear as rubs on the tree's bark, and they may also break branches 3-5 feet off the ground. The bark will be rubbed from 1 foot off the ground

up to about 3 feet off the ground. Damages to the tree bark may allow diseases or insects to become established, causing more issues later on.

Damage Control and Management

When dealing with white-tailed deer, multiple control options exist but there is no silver bullet to deal with every situation. It is more effective to incorporate multiple methods to increase success.

Exclusion

Permanent 8 Foot Fence — Erecting a metal or plastic fence around your nursery will limit the possibility of deer damage inside the fence. Plastic fences (Figure 7-1) are much cheaper to construct but do not hold up as well over time. Metal fences will provide longer lasting protection but come with a higher upfront cost.



Figure 7-1. Plastic fences (as shown here) or other more permanent fences will deter deer feeding. However, deer can jump fences less than eight feet in height.

Electric Fence Designs — Several electric fence designs exist with the off-set design being the most successful. These fences can be powered by several different methods including directly connecting to a power line or via a solar powered battery. The simplest and cheapest design has one wire constructed roughly 2 feet off the ground around the area you want to protect. You then want to bait this wire with a vegetable oil and peanut butter mixture on pieces of aluminum foil to entice the deer to lick the wire and get shocked. After being shocked, the hope is that the deer will avoid the fence and not enter the area. This is not guaranteed, especially if the deer are food stressed. Another option is to have a higher fence with multiple electrified wires to prevent the deer from entering the nursery. As with all electric fences make sure vegetation is kept clear of wires to help prevent grounding. These fences use high-tensile smooth wire (200,000 psi, 12½ gauge) and special accessories help to maintain a 150- to 250-pound tension so the fence can absorb the impact of running deer and spring back to its original position. Baiting the lines will help increase the effectiveness, but unless the fence is 8 feet tall deer can still just jump the fence. The most successful strategy is to use an offset design as seen in Figure 7-2. The offset design has electrified wire on the outside at 18 inches off the ground, and 3 feet inside there is another 4 foot fence that is also electrified. This setup works well because the deer's depth perception is not very good, which means they are unlikely to jump both fences, and the fences are close enough that they will not jump one at a time. The electrified lines also make it so the deer cannot simply duck under the wires to gain access. This setup is effective on many wildlife species including coyotes, bears, elk, raccoons, and foxes. These electric fence designs should be used with pressure-treated posts that have a life expectancy of 35 to 40 years. High-tensile electric fences are useful in protecting orchards, vegetable crops, nurseries, and other high-dollar crops.



Figure 7-2. An off-set electric fence design is generally more effective fences for excluding deer are other fencing designs.

Seedling Protection — Homeowners and small orchard owners may decide to protect only individual high-value trees using a plastic tree guard tube or mesh netting (plastic or ½-inch hardware cloth). This is a relatively cheap option with sleeves costing roughly \$2-\$3. Each tree is covered or enclosed to prevent deer from browsing on the young seedlings. This will help to protect the plants when they are most vulnerable, but it is important to keep in mind that any part of the tree not protected by the tube can still be browsed upon.

Chemical and Auditory Repellents/Home Remedies

There are several commercial products available to be used to help deter deer browsing on plants. These products can be expensive to implement over large areas or extended periods of time, and results are mixed on their effectiveness. Generally there is a short term effectiveness as the smells or tastes are novel to the animals causing them to be wary. Animals over time then become habituated to these smells and their effectiveness decreases or disappears. If you use these products, make sure you apply before damage occurs and reapply after rain or after an extended period of time as their effectiveness does diminish. Table 7-1 has a list of common repellents. Propane cannons also offer another option to help deter deer presence in areas. These cannons will emit a loud boom at differing intervals to scare wildlife away from an area. This method is effective over short periods of time as deer become habituated to the noise.

Table 7-1. Commonly available commercial repellents for white-tailed deer, rabbits, and other mammals that may browse plant material

Common Name	Product Name	EPA Reg #
13.8% ammonia soap	Hinder	4-15
37% egg solids	Rockland Deer Guard	4866-10
20% thiram	Chew-Not	358-105
11% thiram, 11% acylic polymers	Bonide Rabbit-Deer Repellent	4-136
2.5% capsaicin	Hot Sauce Animal Repellent	72-574
Dried blood meal	Plantskydd Repellent	exempt

Trapping/Hunting

Hunting is the most efficient and pragmatic way to control deer populations over the long term and also offers a potential additional source of income if you hunt lease out your land. To ensure the most success in controlling populations through hunting, make sure the deer harvest is dominated by adult females. Adult female population numbers are what drives population growth the next year so harvesting more adult females will drive your population down the following spring and summer. For each adult female removed during the hunting season, the benefit is the equivalent of removing three deer from feeding on plants the next summer. Outside of hunting season, contact your state's Department of Natural Resources to discuss alternative damage control options via damage permits.

Voles

Species Description

In the Southeast there are 3 different species of voles that nurseries and landscapers should be aware of. The prairie vole (*Microtus ochrogaster*), meadow vole (*Microtus pennsylvanicus*), and pine vole (*Microtus pinetorum*). These vole species prefer grassy areas with heavy ground cover. Multiple species can be found in the same area, however they may segregate themselves to different habitat types. Pine voles are found more often in deciduous or pine forests, abandoned fields and shrubby areas, and orchards. Meadow voles prefer areas that are dominated more by grasslands such as infrequently mowed fields or orchards. Prairie voles are found in old fields and marshy areas but can also be found orchards and unmanaged grassy fields.

Damage

Vole damage appears as a girdling or gnaw marks present at the base of trees or on roots underneath the soil surface. Gnaw marks are smaller and random in direction compared to rabbit damage. Cuts will appear to be at multiple different angles. Damage will remain at ground level or on roots just under the soil. Pine voles will feed on the roots which may mean the issue will not be visible until the plants start to show signs of distress. Damage will generally only occur during winter months when other preferred food items are not available. A combination of habitat modification and rodenticides may be necessary to keep vole populations in check.

Population Management

Vole populations, as with most rodents, increase drastically during spring through fall but tend to decrease during the winter. During mild winters voles may continue to breed. Large population fluctuations are common for all of these species, which may mean you only have issues every so often and not every year.

Exclusion/Habitat Management

Tree guards made of metal can be placed around the bases of trees to keep voles from feeding on the bark. Ensure that these guards give enough space for the trees to grow. Habitat modification is also effective at controlling vole populations within nurseries. Limit the amount of tall grass, brush piles, dense bushes, and hedgerows around your nursery. In addition, frequently mowing any areas within or immediately adjacent to the nurseries will aid in limiting vole presence. Keeping grass short also helps to identify when voles are present as their tunnels will be easier to locate.

Chemical

Chemical repellents to deter damage are not effective for voles.

Rodenticides/Trapping

Trapping is an effective method at a very small scale, such as in the backyards of houses, but not effective on any commercial scale. It is a useful method to help determine what species of vole are present in an area, which can help to guide damage monitoring and other population management strategies. To trap a vole, use of a mouse size snap trap is all that is necessary. Place the traps perpendicular along their runs, or bait the traps with peanut butter and oats and place them at their run openings.

There are several different rodenticides labeled for use on voles. Rodenticides come in three general varieties and fall under two classifications. The general varieties are anticoagulants that only require a one-time feeding (called 2nd Generation); anticoagulants that require multiple feedings over time (called 1st Generation); and non-anticoagulants that kill by either interfering with the nervous system, calcium levels in blood, or by generating toxic gas internally after ingestion. The classifications are either General Use Pesticides (GUD) or Restricted Use Pesticides (RUD). These rodenticides can be effectively distributed using several methods, but non-target animals are a concern with all methods of distribution. It is imperative that label instructions are followed at all times. The use of bait stations is highly recommended to distribute the rodenticide as it helps to limit the risk of non-target animals accessing the baits. These come in several forms but an effective design for field use is the T-feeder made of PVC.

Zinc phosphide baits are the most commonly used for vole control. They are an EPA restricted agent that can only be used by, or under the supervision of, someone with a certified pesticide applicator permit. Zinc phosphide represents a serious health risk to humans and other wildlife. Make sure you check your state's regulations regarding zinc phosphide and any other potential rodenticide you decide to use. Prebaiting tubes is a good idea when using zinc phosphide, as it will increase the likelihood of the voles consuming a lethal dose when applied. Prebait a few weeks before in the same areas you will place the zinc phosphide. For pine voles you should place the zinc phosphide directly in holes or trails to ensure they encounter it, as they spend the majority of their time underground. Bait shyness can occur if voles do not receive a lethal dose. This means that if you still have a vole issue after using zinc phosphide you should follow up with an anticoagulant instead of another round of zinc phosphide.

Diaphacinone baits (there are multiple commercial options) are an anticoagulant option available for use in most states. These should be used in a similar manner as zinc phosphide baits either delivered through bait stations or directly into tunnels. Once again, make sure to check for local or state restrictions and follow labeled instructions.

For more information about rodenticide use and bait distribution plans refer to the following: VanTassel, S.M., S.E. Hygnstrom, and D. M. Ferraro. 2012. "[Bait stations for controlling rats and mice.](#)" University of Nebraska-Lincoln Extension Publ. G1646, 4pp.

Biocontrol

Voles are a prey species for many raptors, bobcats, foxes, and coyotes. Encouraging the presence of these species will help to naturally control the populations of voles as well as rabbits. If you take this route, you should no longer use rodenticides of any kind as they will work their way up the food chain and kill the predators as well.

Eastern Cottontail Rabbit (*Sylvilagus floridanus*)

Species Description

Eastern cottontail rabbits weigh between 2-4 lbs and are about 15-19 in long. They are grey to brownish gray in appearance, with a small white tail. Their diet consists of a wide variety of green vegetation, which may vary seasonally based on availability of food resources. Clovers, grass, and broad-leafed weeds are the preferred summer diet, while in winter they will feed on the bark of trees (apple trees are a preferred species), raspberry and blackberry plants, and buds that are close to the ground. Rabbits reproduce quickly with 4 or more litters per year ranging in size from 3 to 8 young. This reproductive rate is counted by their low survival rates as they are a preferred source of prey for many raptors and mesocarnivores like bobcats, foxes, and coyotes.

Damage

Rabbit damage will occur during winter and appears as either girdled or gnaw marks present at the base of trees. Gnaw marks are larger, cleaner, and more uniform in direction than vole damage to the bases of trees. Cuts will appear at close to a 45-degree angle. Damage will also extend further up the bark from the ground because of the size difference between the species. Another telltale sign is that rabbits will also gnaw on any terminal buds present.

Population Management

Rabbits are capable of increasing their populations quickly over short periods of time with most individuals having multiple litters each year. Their populations tend to grow during spring through fall but start to drop off during winter because of predation and lack of reproduction. Localized hunting and trapping following state regulations can lower population levels where hunting is occurring during winter but eradication is not usually possible.

Exclusion/Habitat Management

Tree guards made of metal can be placed around the bases of trees to keep rabbits from feeding on the bark. Ensure that these guards give enough space for the trees to grow. A 3 foot high fence made of chicken wire with a 6 inch portion buried and bent outward can also exclude rabbits from an area. Constructing these exclusions around higher value crops may be a worthwhile investment if rabbit population and damage are high. One of the most effective methods of reducing rabbit damage is to simply reduce the available habitat for rabbits. Rabbits do not like to venture out into open areas because of predation risk, so limiting the amount of tall grass, brush piles, dense bushes, and hedgerows around your nursery will help limit rabbits from entering your nurseries.

Chemical

Certain taste repellents have been shown to be effective over short periods of time. Spray during late fall through winter as this is the time rabbits are most likely to damage plants. Refer to Table 7-1 for options.

Biocontrol

Rabbits as well as voles are a prey species for many raptors, bobcats, foxes, and coyotes. Encouraging the presence of these predator species will help to naturally control the populations of rabbits and voles. If you decide to go the biocontrol route and encourage the presence of owls and other birds of prey, do not use rodenticides anymore to control populations on the property. Owls and other raptors will have a high mortality risk if they consume any poisoned rodents.

Beavers (*Castor canadensis*)

Species Description

Historically, the beaver was North America's most important fur resource. During the 1800s, the unrelenting pursuit and uncontrolled harvest of beavers for their pelts led to extermination throughout much of the animal's range. Beaver numbers today are at, or exceed, their population levels before the arrival of white settlers in North America. With the recovered population, beavers sometimes cause problems or become a nuisance when their feeding and dam-building activities conflict with man. This publication provides information on the identification, biology, and natural history of beavers and how their feeding and dam-building activities can be prevented or controlled.

The beaver, fairly common in much of the Southeast, is North America's largest rodent. Adult beavers weigh between 35 and 60 pounds but can be as large as 80 pounds. Beavers typically have large heads, indistinct necks, thick, stout bodies, small ears and eyes, and a distinct paddle-shaped tail. Like many other rodent species, beavers have a pair of continually growing, large, orange front teeth (incisors). The beaver must keep the incisors worn back by using them daily. Beaver fur is composed of a gray, soft, dense undercoat protected by long, coarse reddish-brown guard hairs. Color can vary from blond to almost pure black.

The beaver is one of a few mammals capable of modifying its habitat to suit its needs. When beavers move into an area, they quickly begin building dams to modify the habitat. Home to a beaver is its lodge or bank den, depending on the situation. Lodges are dome-shaped structures built of sticks and mud with a large interior chamber above the water line. Lodges vary in size from 6 to 40 feet, depending on the number of beavers in the colony. Beavers sometimes dig burrows into the banks of ponds, rivers, and drainage ditches instead of building a lodge. All lodge and bank den entrances, normally two or more, are located underwater.

Primarily nocturnal animals, beavers are active for approximately 12 hours each night, feeding and working on the dam. It is not uncommon to see beavers during daylight hours, particularly in large reservoirs. Beavers feed on the cambium layer (just under the bark) of woody plants and a variety of aquatic and upland vegetation. Preferred woody foods include willow, birch, maple, alder, cherry, and poplar, although they can and will feed on the leaves, twigs, and bark of most species of woody plants. During the summer beavers will also eat water lilies, pond weeds, and cattails. Sometimes beavers will travel substantial distances from the pond or stream to get to corn or soybean fields, where they cut the plant off at ground level and drag it back to the water. What they do not eat, they use for construction material in dams and lodges.

Damage

Areas that may encounter beaver damage will be limited to nurseries or plantings close to water sources like rivers, ponds, and lakes. Most beaver damage is relatively easy to identify. Much of the damage will be associated with or is a result of dam building, bank burrowing, tree cutting, or flooding. Spring and fall are the periods when the most severe damage from beavers will occur. Damage includes cutting or girdling of ornamental and shade trees or shrubs. Because beavers are rodents with large, sharp incisors, damage to trees appears as clean, knife-like cuts at a 45-degree angle (Figure 7-3). In rural areas, beavers may dam drainage ditches and small streams and plug drain pipes or culverts. This can lead to localized flooding of roads, timber lands or agricultural cropland.



Figure 7-3. Typical beaver damage to a young tree. Beavers have large, sharp incisors producing knife-like cuts at a 45-degree angle.

Population Management

Beavers are classified as furbearing animals. An open trapping season is established for the legal harvesting of these animals, and they are subject to all applicable state laws and regulations. Consult your state's Department of Natural Resources for regulations on removal of beavers during the legal trapping season. If a beaver pond has been in existence for a considerable period of time (even if it is flooded cropland), the area may be officially classified as a wetland. Under the provisions of the 1985 Food Security Act, Conservation Reserve Provision, it may be illegal to destroy the dam and drain the wetland. Contact the U.S. Army Corps of Engineers, your local Agricultural and Soil Conservation Service, Soil Conservation Service, or Department of Natural Resources for an on-site visit and recommendation.

Lethal Control

Trapping is an efficient method to control beaver populations, and fumigation or poisoning is not recommended. The most effective trap is a number 330 Conibear (instant-kill-type) trap. This trap is designed to be placed underwater near a break in the dam, at the lodge entrance, near a slide or on a beaver run. Trapping should be done by an experienced trapper because these traps exert a tremendous pressure and impact when tripped. Therefore, appropriate care must be taken when setting and placing the trap. Check your state's trapping regulations to determine the legality of damaging dams or lodges.

Nonlethal Prevention and Control

Several methods exist that may deter beavers from becoming established in an area. One method is to install a device to manipulate the water level of a pond. This can be accomplished by installing a three-log drain or wire mesh culvert that the beavers cannot plug. Individual high-value shade or ornamental trees can be protected from beavers by wrapping them with ¼- or ½-inch hardware cloth to a height of 4 feet. Small areas around culverts, drains, and ponds in urban areas can be fenced using netwire with small mesh wire.

One innovative way to discourage beavers is the use of a high tensile electric fence. Stake a portable battery or solar-powered charging unit some distance from a run (slide) or a hole knocked into the dam. If you are placing the wire across a slide, mow or trim the vegetation very close to the ground. Finally, string a single strand of wire 3 inches above the ground or water's surface so the beavers will strike it as they pass through the slide or attempt to repair the hole in the dam. This electric shock acts to repel the animals; if they are shocked enough, they will move to another area.

Daily tearing out dams and removing dam construction materials may cause a colony or individual beaver to move. This is very dangerous and potentially illegal, depending on your state, and not recommended. Even if this procedure is effective, the beavers may move into a new area and become even more troublesome.

Chemical

There are no chemical repellents or toxicants (poisons) registered for controlling beavers.

Suggested Readings and References

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