



Managing Weeds in Landscape Plantings and Nursery Crops

Commercial landscape contractors, landscape maintenance personnel, and nursery operators consider weeds to be their most common and bothersome pest problem. Weeds are ubiquitous, infesting beds of ornamental plants, turf areas, and cracks in paved areas such as sidewalks and parking lots. Landscape maintenance personnel will find it necessary to control weeds at various times throughout the growing season to protect their investments and to preserve the aesthetic and social benefits of landscape plants.

This chapter has been prepared for Illinois commercial lawn- and tree-care personnel, municipal arborists, urban foresters, and nursery operators. It is not for homeowners or home gardeners. This chapter presents the herbicide application intervals and rates for various crops as approved by the Food and Drug Administration (FDA) and the U.S. Environmental Protection Agency as of September 1, 1997, to the best of our knowledge.

Weed Biology

A weed is a plant that interferes with the intended use of an area. Besides being unsightly and giving an unmanicured appearance to commercial and residential landscape sites, weeds compete with desirable ornamental plants for nutrients, light, and growing space. They also can harbor insect and disease pests; they can be fire hazards; and noxious weeds such as poison ivy and ragweed can be health hazards. In nurseries, weeds are most troublesome when plants are young and growing close together.

The first step in weed control is identification. It is essential to determine, for example, whether a weed is a broadleaf or a narrowleaf plant. *Broadleaf weeds* have netted veins, whereas *narrowleaf weeds*, or

grasses, have long, thin leaves with parallel veins. Knowing a weed's life cycle is also important in choosing a control method. *Annual weeds* germinate, grow, set seed, and die in the same year and are relatively easy to control. *Biennial weeds* require two years to complete their life cycle. In the first season, the seed germinates and the plant assumes a compact or rosette growth habit. The plant overwinters, and in the second growing season the stems elongate, flower, set seed, and die. Perennial weeds are the most difficult weeds to control. They live for two or more years and may be either herbaceous (die to the ground each winter) or woody (have persistent stems).

Most plants produce viable seed, whether they are annuals, biennials, or perennials. One plant may deposit thousands of seeds on the soil surface. Freezing and thawing buries these seeds in the soil, where many remain viable for years. Obviously, then, controlling weeds before they produce seed is an important step in a comprehensive weed-control program.

Weeds are most susceptible to herbicide treatments when they are seedlings. Emerging seedlings can be controlled with soil-applied herbicides, and small emerged weeds can be controlled with foliar-applied herbicides. Whether a seedling is a broadleaf or narrowleaf plant also affects its susceptibility. The meristem of many emerged seedling grasses is protected below ground from contact herbicide treatment or mowing, whereas most emerged broadleaf weeds have exposed meristems that are vulnerable to properly applied mechanical or chemical treatments. Annuals, biennials, and perennials (woody or herbaceous) all have about the same susceptibility during germination. After germination, the life cycle of the plant is crucial to the timing of herbicide applications.

The information in this chapter is provided for educational purposes only. Product trade names have been used for clarity, but reference to trade names does not imply endorsement by the University of Illinois; discrimination is not intended against any product. The reader is urged to exercise caution in making purchases or evaluating product information.

Label registrations can change at any time. Thus, the recommendations in this chapter may become invalid. The user must read carefully the entire, most recent label and follow all directions and restrictions. Purchase only enough pesticide for the current growing season.

Because *annual weeds* become progressively more resistant to herbicides as they approach maturity, treatments should be made as early as possible. Summer annuals flower from middle to late summer, and winter annuals flower in early spring. Herbicides should be applied to annual weeds before they flower and produce seeds.

Biennial weeds that are past the seedling stage are most susceptible to postemergence herbicide treatments when they are in the rosette stage, either before frost the first year or early in the second year before the plant puts up a flower stalk (bolts).

Most *perennial weeds* propagate from seed, and many also reproduce vegetatively by means of rhizomes, bulbs, tubers, stolons, or runners. These organs, sometimes called propagules, have buds that produce new shoots. Propagules also store carbohydrates to supply energy to the shoots. These nutrients move from the storage organs to the new shoots until leaves develop sufficiently to intercept sunlight and begin producing food. Carbohydrates that are not needed for the growth and development of plant shoots, buds, flowers, and fruits are translocated to the storage organs for later use.

Whether herbaceous or woody, perennials are most readily controlled as seedlings, while they are still succulent and before propagules form. Once the propagules have developed (as early as four weeks after germination for some herbaceous perennials), the plant will usually survive even if the above-ground portion is destroyed by mowing, cutting, freezing, or contact herbicide application. New shoots develop from untreated or uninjured buds using the food that is stored in the propagules.

If perennials are to be controlled after the seedling stage, the food reserves must be depleted; the storage organs must be destroyed by freezing, desiccation, or tillage; or a herbicide that interferes with plant growth must be applied. Easy-to-control perennial weeds can be eliminated by repeated cultivation to deplete the food reserves of the propagules. In most cases, however, cutting up propagules such as rhizomes, tillers, or roots helps the plants multiply. Control of top growth with contact herbicides or mowing will not kill most perennial weeds.

Treating perennials with a translocated systemic herbicide may be the most efficient method of controlling these plants. Perennial weeds are usually most susceptible to herbicides when food reserves are low. This situation occurs in woody perennials after the leaves have fully expanded in late spring and in herbaceous perennials when plants are in the bud-to-bloom stage.

Integrated Pest Management

Efficient and successful weed-control programs can involve the use of nonchemical control, chemical control, or both. Cultural (nonchemical) control methods include hand or mechanical elimination of weeds (pulling, hoeing, rototilling, and disking), use of herbaceous groundcovers, cover crops, and mulching. A combination of nonchemical procedures can sometimes eliminate or reduce the need for chemical control. Whether chemical or nonchemical methods of weed control are used is usually an economic decision. The best weed-control programs integrate cultural and chemical control methods.

Nonchemical Control

Many cultural practices used in growing a crop are nonchemical methods of weed control. In some crops, chemical control is impossible because the appropriate chemicals are not available, are not registered, cannot be used selectively where many plant species are grown together, are injurious to the crop, or are not accepted by the client. In these cases, the grower or landscape manager must depend on nonchemical weed-control practices.

If you can choose your planting area, select a site that is free of perennial weeds such as nutsedge, bermudagrass, quackgrass, mugwort, or field bindweed. Growers of field-grown ornamentals should look for land that is free of perennial weeds. Sometimes perennial weeds can be eliminated by growing other crops for one or more growing seasons.

Cultivating (removing weeds mechanically), whether by rototilling, disking, hoeing, weeding by hand, or digging with a shovel, is a very effective way of controlling young weeds. The best control is achieved if the weeds are small (in the 2- to 4-leaf stage) and if the soil surface is allowed to dry after cultivation. Care should be taken to prevent damage to landscape or crop plants by cultivation equipment.

Proper management encourages desirable plants and discourages weeds. It involves preparing the seedbed properly, planting desirable plants at the right time, using transplants rather than seed, using adapted species, and applying the proper amount of water and fertilizer at the proper time. Insect and disease control also must be practiced to maintain healthy, vigorously growing plants. If the soil is allowed to become bare and exposed to the sun through improper management, then weeds will germinate and grow. But if desirable species are properly managed, they can shade or crowd out many weed species. Most annual weeds will not become established in well-managed ornamental groundcover plantings.

Cover crops can be used as seasonal or permanent groundcovers to prevent soil erosion and control weeds. Cover crops are particularly valuable for use in traditional cropping systems that result in large areas of bare soil such as in the production of shade and flowering trees. A variety of plant materials are suitable for this use. The bunch- or clump-forming grasses recommended for this are tall fescue, hard fescue, sheep's fescue, and orchard grass. Rhizomaceous grasses are not recommended due to their tendency to spread into the crop rows. Grasses can tolerate more traffic than other plants used as cover crops; this is particularly important during the harvest period, when heavy equipment traffic and muddy conditions are common. Legumes such as clover and birdsfoot trefoil are also recommended. The legumes have the additional advantage of being able to fix atmosphere nitrogen, thus improving soil fertility.

Mulches also help control weeds because they prevent sunlight from reaching weed seeds. They also keep the soil surface cool, reduce loss of soil moisture through evaporation, and prevent large fluctuations in soil temperature. Examples of commonly used mulches are wood chips, shredded bark, compost, black plastic sheets, and geotextile materials designed to control weeds.

Mulches for woody plants are put down after the plants are in place. If plastic is put under organic mulches, it should be punctured to allow for air and water drainage; if plastic is not used, the organic mulch should be at least 4 to 6 inches deep. Organic mulches are especially helpful under long-season annual or perennial crops or under permanent landscape plantings such as woody shrubs. When using organic mulches, it may be necessary to apply a nitrogen-containing fertilizer late in the season because materials high in organic content may greatly reduce the nitrogen available to plants. Organic mulches also increase soil tilth over time by breaking down and mixing into the soil surface.

To reduce the quantity of weed seeds in the soil, cultivate or mow frequently enough to prevent weeds from producing seed. Studies have shown that if seed production is stopped, 20 to 30 percent of the weed population in the soil can be removed each year. If weeds have been allowed to seed for many years, however, it takes 2 to 3 years to see an appreciable reduction in new germination.

Cultivation is one way to keep weeds from producing seed. Shallow cultivation is the best method because deep cultivation such as spading can bring buried seed to the surface, where it may germinate. Deep cultivation can also damage the roots of desirable landscape plants or nursery plantings. When cultivat-

ing the soil, be careful not to introduce weeds by adding weed-infested topsoil, compost, or manure, or by using purchased plant materials that contain weed seeds.

Mowing and cutting also are excellent methods of reducing weeds, especially when they are 3 or more inches tall. Mow or cut after the soil surface is dry but before weeds set seed. Although mowing seldom eliminates weeds, it discourages tall weeds and encourages shorter weeds. Shorter weeds are less competitive for space and light than taller landscape species. Mowing often causes a shift in population to low-growing species that can tolerate mowing.

A pest-management program includes the wise and timely selection of cultural, mechanical, biological, and chemical control measures to ensure maximum effectiveness against the pest and to minimize cost and environmental effects.

In some cases, chemical control may not be necessary. Planting of resistant varieties and use of natural enemies or cultural methods may provide adequate control. In other cases, with high-value specimen plants, chemicals may be an integral part of the pest-management program. Familiarization with the habits and life history of the pest can aid in these decisions.

Chemical Control

Herbicides can be used to eliminate or reduce weed populations; if herbicides are used, however, they should be integrated with nonchemical practices whenever possible. The efficacy of chemical weed control depends on what type of herbicide is used, where it is placed, when it is applied, and what environmental conditions are prevailing at the time of application.

Herbicides can be classified into three categories, depending on when they are used. *Preplant herbicides* are used before planting, *preemergence herbicides* are used after planting but before weed seedlings emerge, and *postemergence* herbicides are used after planting and after weeds have emerged.

Herbicide Classification and Selection

Herbicides provide an efficient means of controlling weeds. They are precise in their activity, but satisfactory results can be achieved only if herbicides are used properly. The first step in selecting a herbicide is to identify your weed problem.

Herbicides are classified as selective or nonselective, depending on the range of plants they kill. *Selective herbicides* kill certain plants with little or no injury to others. This is of the utmost importance when ap-

plying herbicides to areas containing ornamental plants. Selective herbicides include both foliage- and soil-applied herbicides.

Nonselective herbicides are toxic to almost all plants. Some herbicides that are selective at a low rate may be nonselective when applied at a high rate. Nonselective herbicides are useful in areas where total vegetation control is desired, such as in industrial areas, along fences, around buildings, and in other noncrop areas. Nonselective herbicides can be either foliage- or soil-applied.

Herbicides are also classified according to when and how they are applied to the ornamental plants or weeds. *Preplant herbicides* are applied before the ornamental plants are planted. They are frequently incorporated into the soil and then are referred to as preplant-incorporated (PPI). Preplant herbicides can also be *fumigants* applied to or injected into the soil. Fumigants are gases or gas-forming compounds that are toxic to all living plant tissue. They work by killing seeds and plant parts such as rhizomes and roots that develop into weeds. They should not be used near roots of plants that will remain in the landscape. Most fumigants are extremely toxic to humans and should be handled with great care. Fumigation is quite common in production nurseries but is seldom used in landscape beds because of the toxicity problems.

Preemergence refers to the use of a herbicide before direct-seeded ornamental plants or weeds emerge, or before the weeds appear in landscape or nursery plantings. Most soil-applied herbicides require moisture to facilitate absorption by emerging weed seedlings. Rainfall can move the herbicide into the soil and provide the moisture for absorption. Mechanical incorporation can also move the herbicide into the soil, and, if sufficient soil moisture is available, this can mean less dependence on rainfall. Soil texture and organic-matter content affect the activity of soil-applied herbicides. The residual activity of the preemergence herbicides can vary from several weeks to several months.

Postemergence refers to the use of a herbicide after the crop or weeds have emerged. Postemergence herbicides are applied to the foliage of the weeds and must remain on the weed foliage for several hours to be effective. If rain falls shortly after application, re-treatment may be necessary. If postemergence herbicides are sufficiently selective to kill weeds without significantly affecting the ornamental plants, they may be broadcast *over-the-top* of both ornamental plants and weeds. Some herbicides that are less selective may be applied as *directed postemergence*, with the spray directed onto the weeds and kept off the ornamental plants as much as possible. For directed

sprays, it is helpful to have a height differential. Spot treatments are applied to individual weeds or to small patches of weeds.

Herbicides are also classified by their type of activity. *Translocated* or *systemic* herbicides move (translocate) in the plant from the site of uptake. The site of uptake can be either the roots or emerging shoots when the herbicide is applied to the soil, or the foliage, stem, or both when an above-ground treatment is made. Given that the plant must be actively growing for these herbicides to translocate to sites of action, most are applied during the growing season. Injury symptoms may take several days to several weeks to develop, depending on the type of herbicide. As translocated herbicides can move throughout the plant system, they are effective against annuals, biennials, and perennials. Depending on the particular herbicide, activity may be selective or nonselective. Nontranslocated herbicides are active at the site of absorption or contact. They do not translocate within the plant. They are either soil-applied or foliage-applied. They can be applied at various times.

Foliar-applied nontranslocated herbicides are called *contact herbicides*. They nonselectively kill green foliage on contact by killing the plant tissue. They also can damage the bark of young trees such as thornless honeylocust and linden. As only the tissue that the herbicide actually contacts will be killed, surfactants are often added to improve coverage of the foliage. Contact herbicides can be effective for the control of annual plants if all the growing points are above ground and thoroughly sprayed. They also burn back the above-ground portions of biennial and perennial plants, but regrowth may occur because these plants have growing points that are underground and therefore protected. The injury symptoms of a plant treated with a contact herbicide are usually visible within a matter of hours. Contact herbicides usually have little or no residual soil activity.

To ensure that the proper herbicide is chosen for the ornamental planting and the particular weed problem, always read the label. The label gives rates and directions for use, as well as precautions to prevent possible harm to the applicator, other people, animals, and the environment.

Herbicide Names

Herbicides, as with all pesticides, have chemical, common, and trade names. A pesticide with only one common name may have several trade names, depending on which company or companies market the product. To help you identify a particular herbicide, common names and their corresponding trade names are listed in Table 1.

Preemergence Herbicides

Atrazine (Aatrex) is available in many formulations. It is labeled for use in newly planted and a few established conifer species. This herbicide is used quite often in Christmas tree production. Atrazine is a restricted use pesticide (RUP).

Bensulide (Bensumec, Betasan) is used primarily for control of annual grasses. Apply at a rate of 10 to 12 pounds active ingredient per acre (lb a.i./A), and irrigate after application. Bensulide can be used in established flower beds and carpet bugle, ivy, pachysandra, and sedum groundcovers. It is commonly used for preemergence crabgrass control in lawns.

DCPA (Dacthal) is available in wettable powder for flowable formulations. Apply at 10 to 12 lb a.i./A to a weed-free area, primarily for the control of annual grasses. DCPA has a very extensive list of established flower species on its label. It is also labeled for use on many woody species. In areas without vegetative cover, more than one application per growing season is needed.

Dichlobenil (Barrier, Casoron, Dyclomec, Norosac) is available as a granular formulation. Apply at 4 to 6 lb a.i./A to control annual and perennial grasses and many broadleaf weeds. Use only on woody plants listed on the label. Dichlobenil is recommended for use in late fall and winter. If it is applied in warm weather, it should be incorporated into the soil or covered with mulch. This compound also can be used to control some aquatic weeds in nonflowing water.

EPTC (Eptam) is available in emulsifiable concentrate and granular formulations. Apply at 5 lb.a.i./A for control of annual weeds and suppression of certain perennial weeds such as nutsedge and quackgrass. Incorporation is necessary for good control.

Imazaquin (Image) is a preemergence herbicide for use in landscape beds. There are a number of both woody plants and herbaceous groundcovers on the label. Apply at a rate of 1 to 1.3 ounce a.i./A or 1 ounce per 1,000 square feet. It comes in a 1.5 LC (liquid concentrate) formulation

Isoxaben (Gallery, RegalKade G) is recommended for fall and spring application for preemergence control of broadleaf weeds. An application of 1 lb a.i./A should result in season-long or near season-long weed control. To increase the spectrum of weed control, isoxaben is available in a premix formulation. Snapshot 2.5TG is a granular containing trifluralin (2 percent) and isoxaben (0.5 percent).

Metolachlor (Pennant) is labeled for use on a number of landscape plants. It effectively controls annual grasses, a number of broadleaf weeds, and nutsedge. Applications of 4 lb a.i./A last for one growing season. Liquid and granular formulations are available. Pen-

nant (4 percent) is available in a premix called Derby, with simazine (1 percent), for use in nurseries and landscape plantings.

Napropamide (Devrinol, Ornamental Herbicide 5G) is available in emulsifiable concentrate, wettable powder, and granular formulations. It is labeled for use in annual and perennial flower beds, groundcovers, and woody plants. Apply at 4 to 6 lb a.i./acre for control of annual grasses and some broadleaf weeds. Incorporate to a depth of 2 inches, or irrigate following application to improve control.

Norflurazon (Predict) is a preemergence herbicide that should not be applied until the fall following the first full season of field growth. It is used to control annual grasses and some broadleaf weeds. Apply 3 lb/A in the fall.

Oryzalin (Surflan) can be used to control annual grasses and some broadleaf weeds in established plantings of many landscape plants. It does not require incorporation, but it should be irrigated into the soil if there is no rainfall within 2 weeks of application. Oryzalin (1 percent) is formulated in combination with oxyfluorfen (2 percent) to produce the product Rout, which is commonly recommended for use in container-plant production. (See isoxaben for information about Snapshot 80DF.) Oryzalin (1 percent) is available with benefin (1 percent) in a premix called XL2G.

Oxadiazon (Chipco-Ronstar) is used in new and established plantings of groundcovers and woody ornamentals. Apply at 4 lb a.i./A. Two applications may be needed for season-long weed control. It controls a broad spectrum of weed species. Oxadiazon is available in different combination products—Regal, in which it is combined with oxyfluorfen, and Regalstar II, in which it is combined with prodiamine.

Oxyfluorfen (Goal T/O) can be used both as a preemergence and a postemergence herbicide. Its postemergence activity is limited to young broadleaf weeds. Groundsel and chickweed are controlled by this herbicide. The granular formulation is recommended for deciduous plants. Either the emulsifiable concentrate (EC) or granular formulation can be used on conifers. Oxyfluorfen is commercially available in two premixed materials—Rout, which contains oryzaline, and Regal O-O, which contains oxadiazon.

Pendimethalin (Pendulum, Pre-M, Progrow Weedgrass Control, Stomp) is used for the preemergence control of grasses and some broadleaf weeds. It is labeled for use over-the-top of several established plants. Pendimethalin (1 percent) is combined with oxyfluorfen (2 percent) to form the commercial product Progrow Ornamental Herbicide II. This product is labeled for use in both container- and field-grown nursery crops.

Prodiamine (Barricade, Endurance, Factor) is a preemergence herbicide used for the control of annual grasses. Apply at a rate of 0.5 to 2.5 lb a.i./A. This product also can be used on established turf to prevent annual grasses. Prodiamine is available in combination with oxadiazon as Regalstar II.

Pronamide (Kerb) should be applied in the fall at 2 lb a.i./A for the control of winter annuals, chickweed, and quackgrass. It is a selective herbicide that controls quackgrass in established landscape plantings. Kerb is a restricted use pesticide (RUP).

Simazine (Princep) is available in wettable powder, liquid, and water-dispersible granule formulations. Spring or fall application at 2 lb a.i./A to weed-free, established woody plants controls a broad spectrum of weeds. Be careful to apply only to labeled species and at recommended rates because simazine injures many ornamental species. This herbicide is also used for weed control on staging areas for container-grown plant production. (See metolachlor for information about Derby.)

Trifluralin (Treflan or Preen) is available in granular and emulsifiable-concentrate formulations. Apply at 1 lb a.i./A, and incorporate into the soil. It is used in flower beds, groundcovers, and woody ornamental plantings. It is not easy to use in thickly established plantings because it requires incorporating. Although mechanical incorporation is preferred, Preen can be watered in.

Postemergence Herbicides

Bentazon (Basagran T/O, Lescogran, Prompt) is a selective postemergence herbicide intended for control of broadleaf weeds, annual sedges, and yellow nutsedge. Make applications after emergence, but before yellow nutsedge, annual sedge, and Canada thistle are 8 inches tall and annual broadleaf weeds are 4 inches tall. Additional applications may be necessary for desired control of yellow nutsedge and Canada thistle as indicated on the label. Bentazon works mainly through contact action; therefore, weeds must be thoroughly covered with spray.

Fenoxaprop (Acclaim) is a postemergence, grass-selective herbicide. It controls crabgrass, goosegrass, foxtail species, barnyardgrass, and panicum species.

Fluazifop-butyl (Fusilade, Ornamec 170, Take-Away) is a grass-selective postemergence herbicide that is effective at controlling a wide range of grass species. It should be applied to young grasses in the 3- to 5-leaf stage.

Glufosinate-ammonium (Finale) is a nonselective contact postemergence herbicide. It works in 1 to 4 days and it is rainfast. It comes in ready-to-use concentrate and super concentrate formulations. It is

most often used in landscape maintenance situations for postemergence weed control in landscape beds and sidewalk cracks and for bed edging.

Glyphosate (Roundup Pro, Kleenup, Avail) is a nonselective systemic postemergence herbicide. After it is applied to the foliage of weeds, it is translocated into the root system, and the entire plant is killed. Even though enough of this herbicide to kill the plant enters the tissue within hours, it may take 10 days to 2 weeks for the weed to appear completely dead. Keep this herbicide off the foliage of ornamental plants. There is no soil activity; therefore, it can be applied over the root systems of herbaceous and woody ornamental plants. It can be used to remove grass from around the base of mature trees because it does not injure the tree bark. However, applicators should avoid spraying glyphosate on the foliage of suckers at the base of trees. Applicators such as rope wicks, wipers, and lighting hoes have been developed to place glyphosate selectively on weed foliage but not on the foliage of ornamental and crop plants.

Oxyfluorfen (Goal T/O) has postemergence as well as preemergence herbicide activity. It controls many broadleaf weeds when they are in the seedling stage. It does not control mature plants postemergence. A combination of oxyfluorfen plus oryzalin is sold as the product Rout, which is commonly used for weed control in container-plant production.

Paraquat (Gramoxone Extra) is a contact nonselective herbicide. It gives excellent control of annual weeds and weeds in the seedling stage. Perennial weeds often grow back from the root system. Apply 0.5 to 1.0 lb a.i./A. This is a restricted use pesticide (RUP).

Pelargonic acid (Scythe) is a contact herbicide to control succulent young, actively growing weeds. It is used to control weeds in walkways, driveways, flower beds, and around the base of trees and shrubs. Pelargonic acid is one of the few herbicides labeled for use inside of greenhouses. It should be noted that when used in enclosed areas, pelargonic acid has an objectionable odor.

Potassium salts of fatty acids (DeMoss) is used for spot treatments to control mosses, algae, lichens, and liverworts growing on containers, benches, patios, and lawns. Apply at a rate of 4 to 6 oz/gal. Be careful not to treat the foliage of desirable plants. Do not apply when air temperatures are above 85°F.

Sethoxydim (Vantage) is a grass-selective postemergence herbicide labeled for a number of ornamental plants. Grasses are best controlled in the 3- to 5-leaf stage.

The different herbicide categories are discussed in greater detail in the following section. Table 2 lists the current registration for herbicides used on environ-

mental (ornamental) plants commonly grown in the Midwest.

Whenever you use herbicides, follow the directions on the label, which is the best source of information concerning the product. If you need further information, contact your local Cooperative Extension Service office or the manufacturer. Yearly updates of herbicide recommendations are available through your local Extension office or by calling (217)333-2126.

Integrated Weed-Control Programs for Environmental Plant Production and Landscape Maintenance

Weed-management programs for environmental plant production and landscape sites include methods for both the eradication and prevention of weeds. The goal of a successful weed-control program should be to integrate cultural decisions, mechanical methods, and chemical methods into an efficient and effective strategy to control weeds with a minimum of labor, cost, and environmental hazard.

Seedbed Preparation

Rototill and prepare the soil for fumigation. As the seedbed is fumigated or shortly thereafter, the treated area should be covered with a plastic tarp to keep fumes in the soil. Remove the tarp consistent with label recommendations for the fumigant. After removing the tarp, allow at least 1 week for the soil to be completely aerated before planting. If time is critical, repeated tilling can be done to speed up the aeration process. Fumigation has the added advantage of controlling not only weeds but also diseases, insect larvae, and nematodes. Table 3 lists the common and trade names of fumigants used in preplant bed preparation. Methyl bromide, chloropicrin, metam-sodium, and Vorlex are fumigants available for this purpose. Methyl bromide and methyl bromide-chloropicrin combinations are most commonly used for this purpose.

The herbicide oxyfluorfen can be used for postemergence weed control in conifer seedbeds.

Nursery Plantings

Nursery crops grown in rows too narrow to mow or grow cover crops most commonly use a combination of mechanical and chemical weed control. Preemergence herbicides are applied in the spring, autumn, or both. Some weeds will not be controlled by these treatments, and they are usually controlled by cultivation with a high-clearance tractor and hoeing. The fall application of preemergence herbicides is particularly

critical for an effective herbicide program because many winter annual weeds germinate in the autumn, and spring field conditions often prevent timely spring applications of herbicides.

A preemergence herbicide may or may not need to be incorporated into the soil to be effective. If it is the kind that requires incorporation, it should be applied as a preplant herbicide. Incorporation may be achieved mechanically by rototilling, disking, or hoeing. It can also be achieved by irrigation, in which case the water movement through the soil profile carries the herbicide downward.

It should be remembered that no preemergence herbicide controls all species of weeds. A combination of two herbicides controlling different weed species provides a greater spectrum of weed control. If two preemergence herbicides are used together, use each of them at one-half the rate recommended when they are used alone. Combinations for broad-spectrum weed control are simazine + metolachlor, simazine + napropamide, simazine + oryzalin, simazine + DCPA, oryzalin + oxadiazon, oryzalin + isoxaben, metolachlor + isoxaben, pendimethalin + isoxaben, or pendimethalin + oxyfluorfen.

Shade and flowering trees are grown with field spacings that provide nursery operators with a different set of weed-control program options. One common production system grows the trees in a grid system, allowing growers to cross-cultivate the crop in two directions, resulting in system that uses just mechanical means for controlling weeds. In this system, a few weeds will result at the base of the trees, and they can be easily controlled by hoeing or the use of a postemergence herbicide.

Care must be taken if a contact herbicide is used because it can kill the green parts of the plant that it touches. Herbicides such as paraquat can also damage tree bark that is thin or green. Quite often, plants treated with contact herbicides produce new sprouts from the roots. Therefore, if you want to completely eliminate a weed, contact herbicides may not give long-lasting results. Care should be taken not to treat suckers or root sprouts of trees when using systemic herbicides. The uptake of systemic postemergence herbicides by tree suckers often results in reduced growth and a less vigorous plant that is more readily affected by environmental and biotic stresses.

In another common production system, growers plant trees in rows with wider spacings between the rows than between the trees in the rows. In this system, weeds in the tree rows are prevented or reduced by preemergence herbicides applied in a 2- to 3-foot-wide band, and weeds that do grow are controlled by a combination of postemergence herbicides and me-

chanical means. Weeds that develop between the rows are usually controlled by mechanical means or the planting of a cover crop.

The production of landscape plants in containers is increasing in popularity. Weed control in container-plant production systems is divided into three areas. The first is control of weeds in the staging area. Weed control on the staging area is usually achieved by applying high rates of selective preemergence chemicals. It is good practice to use the same chemicals that are labeled on the crop being grown because plant roots routinely grow out of the container and into the staging area. The second concern is the prevention of weeds in the growing medium in the containers. It is essential that the initial potting medium be weed-free. This can be accomplished by buying a weed-free medium or by sterilizing the medium that the grower prepares. Medium sterilization is either by fumigation or pasteurization. The fumigants used are the same materials mentioned in the seedbed preparation section. Pasteurization is completed by heating the medium with steam to a temperature of 180°F for a minimum of 30 minutes. Weeds eventually develop in the container medium. These weeds are controlled either by hand pulling or by the use of a preemergence herbicide. Hand weeding is often cost-prohibitive. All preemergence herbicides labeled for use in the production of field-grown nursery crops are not labeled for use in container-grown nursery crops. Carefully read and follow the label when applying preemergence herbicides to container-grown crops. The final component of a weed-control program in container-grown crops is the application of selective postemergence herbicides. There are a number of grass-selective herbicides that are useful for the control of annual grasses in container-plant production systems.

Landscape Beds

Selective preemergence herbicides are used in plantings of woody ornamentals, groundcovers, herbaceous plants, lawns, and vegetable gardens. The problematic periods for weed control in plantings of annual and perennial bedding plants and groundcovers occur during establishment and then during maintenance of the plantings. As many weeds as possible should be controlled prior to planting. New bed areas are often developed in locations covered with turf that is full of perennial weeds. Spading or rototilling is not adequate to control perennial weeds. There are two approaches to controlling perennial weeds before planting. The first is to treat the perennial weeds with a systemic postemergence herbicide before preparing the soil in the bed area. The best herbicide for this is glyphosate. If the weed infes-

tation is heavy and there is a significant perennial weed population, use two applications of glyphosate 1 month apart prior to planting. The first is to treat the perennial weeds with a systemic postemergence herbicide before preparing the soil in the bed area. The best herbicide for this is glyphosate. If the weed infestation is heavy and there is a significant perennial weed population, use two applications of glyphosate 1 month apart prior to planting.

The second approach to controlling perennial weeds prior to planting is to fumigate the beds. Follow the recommendations listed under seedbeds.

After the bed is prepared, preemergence herbicides may be used either before or after planting, depending on the herbicide. If the preemergence herbicides are used prior to planting, they should be incorporated into the upper 4 inches of soil. If the preemergence herbicides are applied after planting, they should be incorporated into the soil and irrigated. Mulch before planting, for it is easier to plant through a mulch than to place mulch on small plants.

Preemergence herbicides recommended for use in herbaceous plantings are bensulide, DCPA, metolachlor, napropamide, oryzalin, pendimethalin, and trifluralin. Other herbicides may be labeled for use, but the aforementioned compounds represent those materials with the most extensive list of herbaceous ornamental plants on their labels.

Landscape beds planted with woody plants should be cleaned of weeds, treated with a preemergence herbicide, and mulched. This provides weed control for one season. Future applications of preemergence herbicides can be made in the fall or spring, depending on the herbicide used and the time available. Ideally, a fall treatment for the control of winter annuals, followed by a spring application to control summer annuals, gives the most satisfactory results.

Mechanical edging of the bed with a spade provides a sharp, clean-looking appearance. Glyphosate and glufosinate-ammonium are herbicides that are often used to chemically edge landscape beds. Because glyphosate is a systemic herbicide, untreated parts of the treated plants will show symptoms and die, often leaving a ragged-looking edge. Glyphosate is highly soluble in water, and it can therefore move with surface water to damage untreated areas. Glufosinate-ammonium is not a systemic herbicide, and only the plant tissues treated with this herbicide are damaged, making it easier to get a sharp, clean-looking edge with this compound.

All of the postemergence herbicides should be used with care. Glyphosate and glufosinate-ammonium should be kept off the foliage of landscape plants. When spraying the base of trees with glyphosate, avoid

spraying suckers. Combinations of postemergence and preemergence herbicides control existing weeds, as well as weeds that are yet to germinate.

Avoid using nonselective preemergence herbicides near trees, shrubs, or lawns. Valuable landscape plantings can be lost through careless use of these herbicides.

Successful use of herbicides depends on their proper selection and application. Weed-control programs in landscape plantings are only as good as the people who plan, administer, and implement them. Remember, the key to a good weed-control program is people and their willingness to keep current with the ever-changing field of herbicide technology.

Table 1. Common and Trade Names of Herbicides

Common name	Trade names	Classification
atrazine*	Aatrex	preemergence
bensulide	Bensumec	preemergence
bentazon	Basagran T/O, Lescogran, Prompt	postemergence
dazomet	Basamid	fumigant
DCPA	Dacthal	preemergence
dichlobenil	Barrier, Casoron, Dyclomec, Norosac	preemergence
EPTC	Eptam	preemergence
fenoxaprop	Acclaim	postemergence
fluazifop-butyl	Fusilade, Ornamec 170, Take-Away	postemergence
glufosinate-ammonium	Finale	postemergence
glyphosate	Roundup Pro, Kleenup, Avail	postemergence
imazaquin	Image	preemergence
isoxaben	Gallery, RegalKade G	preemergence
metolachlor	Pennant	preemergence
napropamide	Devrinol, Ornamental Herbicide 5G	preemergence
norflurazon	Predict	preemergence
oryzalin	Surflan	preemergence
oxadiazon	Chipco-Ronstar	preemergence
oxyfluorfen	Goal T/O	preemergence and postemergence
paraquat*	Gramoxone Extra	postemergence
pelargonic acid	Scythe	postemergence
pendamethalin	Pendulum, Pre-M, Progrow Weedgrass Control, Stomp	preemergence
potassium salts of fatty acids	DeMoss	postemergence
proflaminate	Barricade, Endurance, Factor	preemergence
pronamide*	Kerb	preemergence
sethoxydim	Vantage	postemergence
simazine	Princep	preemergence
trifluralin	Treflan, Preen	preemergence
Combination products		
isoxaben + trifluralin	Snapshot 2.5TG	preemergence
oxyfluorfen + pendimethalin	Ornamental Herbicide II	preemergence
oxyfluorfen + oryzalin	Rout	preemergence
oryzalin + benefin	XL 2G	preemergence
oxyfluorfen + oxadiazon	Regal O-O	preemergence
oxadiazon + proflaminate	Regalstar II	preemergence

*Restricted use pesticide (RUP). Only certified pesticide applicators or operators may use RUPs.

Table 2a. Herbicides Labeled for Use on Evergreens

	Postemergence						Preemergence						
	Acclaim	Avail, Roundup Pro, Kleenup	Basagran T/O, Lescogran	Bensumec	Goal T/O*	Vantage	Atrazine	Barricade	Barrier	Casoron	Chipco Ronstar	Dacthal	Dyclomec
KEY TO TABLE 2A ON P. 30.													
<i>Abies</i> spp.		P,D	D			D,O						C,F	
<i>A. balsamea</i>		P,D	D			D,O							
<i>A. concolor</i>		P,D	D			D,O	F						
<i>A. fraseri</i>		P,D	D**		S,T	D,O							
<i>A. grandis</i>		P,D	D		S,T	D							
<i>A. lasiocarpa</i>		P,D	D			D							
<i>A. procera</i>		P,D	D		S,T	D							
<i>A. veitchi</i>		P,D	D			D							
<i>Cedrus</i> spp.		P,D	D			D							
<i>C. atlantica</i>		P,D	D			D				E			
<i>Chamaecyparis</i> spp.	O	P,D	D			D							
<i>C. lawsoniana</i>		P,D	D			D							
<i>C. obtusa</i>		P,D	D			D				E			
<i>C. pisifera</i>		P,D	D			D,O	F			E			
<i>C. pisifera filifera</i>		P,D	D			D							
<i>C. thyoides</i>		P,D	D			D							
<i>Cryptomeria japonica</i>		P,D	D			D							
<i>Ilex</i> spp.	O	P,D	D	O		D,O				E,T	C,F		
<i>I. aquifolium</i>		P,D	D			D		F	F			F	
<i>I. x aquipernyi</i>		P,D	D			D							
<i>I. cornuta</i>		P,D	D**,O			D,O	F	F	F			F	
<i>I. crenata</i>	O	P,D	D**,O			D,O	F						
<i>I. glabra</i>		P,D	D			D		F	F			F	
<i>I. x meserveae</i>	O	P,D	D			D		F	F			F	
<i>I. opaca</i>	O	P,D	D			D	F	F	F			F	
<i>Juniperus</i> spp.		P,D	D**	O		D,O		F	F	E,T	C,F	F	
<i>J. chinensis</i>	O	P,D	D**		T	D,O	F						
<i>J. conferta</i>	O	P,D	D**			D,O	F						
<i>J. horizontalis</i>	O	P,D	D**		T	D,O	F						
<i>J. procumbens</i>		P,D	D		T	D							
<i>J. sabina</i>		P,D	D		T	D,O							
<i>J. scopulorum</i>		P,D	D**		T	D,O							
<i>J. squamata</i>		P,D	D			D							
<i>J. virginiana</i>		P,D	D		T	D,O		F	F	E,T	C,F	F	
<i>Microbiota decussata</i>		P,D	D										
<i>Picea</i> spp.		P,D	D			D				E,T	C,F		
<i>P. abies</i>		P,D	D**		S,T	D,O	F						
<i>P. englemanni</i>		P,D	D			D							
<i>P. glauca</i>		P,D	D**		S,T	D,O							
<i>P. mariana</i>		P,D	D			D							
<i>P. omorika</i>		P,D	D			D							
<i>P. pungens</i>		P,D	D**		S,T	D,O	F						
<i>Pinus</i> spp.		P,D	D			D		F	F	E,T	C,F	F**	
<i>P. aristata</i>		P,D	D			D							
<i>P. banksiana</i>		P,D	D**		S,T	D							
<i>P. caribaea</i>		P,D	D			D,O				E,T			

Table 2a. Herbicides Labeled for Use on Evergreens (cont.)

	Postemergence						Preemergence						
	Acclaim	Avail, Roundup Pro, Kleenup	Basagran T/O, Lescogran	Bensumec	Goal T/O*	Vantage	Atrazine	Barricade	Barrier	Casoron	Chipco Ronstar	Dacthal	Dyclomec
<i>P. contorta</i>		P,D	D**		S,T	D							
<i>P. echinata</i>		P,D	D		S,T	D							
<i>P. elliotii</i>		P,D	D**		S,T	D							
<i>P. leucodermis</i>		P,D	D			D							
<i>P. mugo</i>		P,D	D**,O		S,T	D,O							
<i>P. nigra</i>		P,D	D**		S,T	D,O	F	F					
<i>P. palustris</i>		P,D	D**		S,T	D							
<i>P. parviflora</i>		P,D	D**			D,O							
<i>P. ponderosa</i>		P,D	D**		S,T	D,O							
<i>P. radiata</i>		P,D	D		S,T	D							
<i>P. resinosa</i>		P,D	D**			D,O	F						
<i>P. rigida</i>		P,D	D			D							
<i>P. strobus</i>	O	P,D	D**		S,T	D,O		F			E		
<i>P. sylvestris</i>		P,D	D**		S,T	D,O	F	F					
<i>P. taeda</i>		P,D	D**		S,T	D,O					E		
<i>P. thunbergii</i>		P,D	D**			D,O		F					
<i>P. virginiana</i>		P,D	D**		S,T	D,O							
<i>Platycladus orientalis</i>		P,D	D,O			D,O							
<i>Sequoia sempervirens</i>		P,D	D			D,O							
<i>Sequoiadendron giganteum</i>		P,D	D			D							
<i>Taxus</i> spp.	O	P,D	D		T	D		F	F		E,T	C,F	F
<i>T. baccata</i>		P,D	D			D,O							
<i>T. cuspidata</i>		P,D	D**,O			D,O		F					
<i>T. media</i>		P,D	D,O			D		F					
<i>Thuja</i> spp.		P,D	D			D			F	F	E	C,F	F
<i>T. occidentalis</i>		P,D	D**,O		T	D,O		F					
<i>T. orientalis</i>		P,D	D		T	D,O							
<i>T. plicata</i>		P,D	D			D							
<i>Tsuga</i> spp.		P,D	D			D					E		
<i>T. canadensis</i>		P,D	D**		S,T	D,O		F			E,T		
<i>T. caroliniana</i>		P,D	D			D							

^aCheck the label for differences in formulations.

*Apply after budbreak.

C = Container-grown plants.

D = Directed spray.

D** = Directed spray with Lescogran.

E = Established plants.

F = Field-grown plants.

F** = Established field-grown plants.

O = Over-the-top spray.

P = Preplant.

S = Seedbed.

T = Transplants.

Table 2b. Herbicides Labeled for Use on Flowers and Groundcovers (cont.)

	Postemergence						Preemergence						
	Acclaim	Avail, Roundup Pro, Kleenup	Basagran T/O, Lescogran	Bensumec	Goal T/O*	Vantage	Atrazine	Barricade	Barrier	Casoron	Chipco Ronstar	Dacthal	Dyclomec
<i>Santolina</i> spp.		P,D	D		D								
<i>S. chamaecyparissus</i>		P,D	D		D,O							C,F	
<i>S. virens</i>		P,D	D		D			F					
<i>Sanvitalia</i> spp.	O	P,D	D		D								
<i>Saponaria</i> spp.	O	P,D	D		D								
<i>Scabiosa</i> spp.		P,D	D		D								
<i>S. atropurpurea</i>		P,D	D		D							C,F	
<i>Scilla siberica</i>		P,D	D		D								
<i>Sedum</i> spp.		P,D	D	O	D							C,F	
<i>S. acre</i>		P,D	D		D								
<i>S. album</i>		P,D	D		D			F		E			
<i>S. spurium</i>		P,D	D		D								
<i>Sempervivum tectorum</i>		P,D	D		D,O								
<i>Senecio cineraria</i>		P,D	D,O		D,O								
<i>Silene</i> spp.	O	P,D	D		D								
<i>Stachys byzantina</i>		P,D	D		D,O								
Stock		P,D	D	O	D								
<i>Stokesia laevis</i>		P,D	D		D,O								
Sweet pea		P,D	D	O	D							C,F	
<i>Syzygium paniculatum</i>		P,D	D		D					E			
<i>Tagetes</i> spp. (marigold)		P,D	D,O	O	D,O							C,F	
<i>Teucrium chamaedrys</i>		P,D	D		D								
<i>Thymus serpyllum</i>	O	P,D	D		D							C,F	
<i>Tradescantia virginiana</i>		P,D	D		D,O							C,F	
<i>Tropaeolum</i> spp.		P,D	D		D								
<i>Tulipa</i> spp.		P,D	D	O	D,O								
<i>Verbena x hybrida</i>		P,D	D		D,O								
<i>Veronica</i> spp.		P,D	D		D								
<i>V. spicata</i>		P,D	D		D,O								
<i>Vinca</i> spp.	O	P,D	D		D								
<i>V. minor</i>		P,D	D	O	D,O			F		E,T			
<i>Viola</i> spp. (pansy)		P,D	D	O	D								
<i>V. x wittrockiana</i>		P,D	D		D,O								
Wallflower		P,D	D	O	D								
<i>Walsteinia ternata</i>		P,D	D		D								
<i>Yucca</i> spp.		P,D	D		D								
<i>Y. filamentosa</i>		P,D	D		D			F					
<i>Zantedeschia aethiopica</i>		P,D	D		D								
<i>Zinnia elegans</i>	O	P,D	D		D,O							C,F	

^aCheck the label for differences in formulations.

F = Field-grown plants.

*Apply prior to budbreak.

O = Over-the-top spray.

C = Container-grown plants.

O*** = Over the top spray with Lescogran.

D = Directed spray.

P = Preplant.

E = Established plants.

T = Transplants.

Table 2c. Herbicides Labeled for Use on Ornamental Grasses

	Postemergence						Preemergence						
	Acclaim	Avail, Roundup Pro, Kleenup	Basagran T/O, Lescogran	Bensumec	Goal T/O	Vantage	Atrazine	Barricade	Barrier	Casoron	Chipco Ronstar	Dacthal	Dyclomec
<i>Arundo</i> spp.		P,D	D			D							
<i>Carex</i> spp.		P,D	D			D							
<i>Cortaderia sellonana</i>		P,D	D			D,O		F					
<i>Festuca ovina glauca</i>		P,D	D			D,O							
<i>Hakonechloa macroaureola</i>		P,D	D			D							
<i>Miscanthus</i> spp.		P,D	D			D							
<i>M. sinensis</i>		P,D	D			D							
<i>Ophiopogon japonicus</i>		P,D	D			D,O							
<i>Pennisetum</i> spp.		P,D	D			D							
<i>P. alopecuroides</i>		P,D	D			D							
<i>P. setaceum</i>		P,D	D			D,O							
<i>Phalaris arundinacea picta</i>		P,D	D			D							

^aCheck the label for differences in formulations.

C = Container-grown plants.

D = Directed spray.

E = Established plants.

F = Field-grown plants.

O = Over-the-top spray.

P = Preplant.

T = Transplants.



Preemergence																			
Endurance	Factor	Gallery	Goal T/O	Image	Kerb	Norosac	Ornamental Herbicide II	Ornamental Herbicide 5G	Pendulum, Pre-M ^a	Predict	Pennant	Preen (Treflan)	Princep	Regal O-O	Regalstar II	Rout	Snapshot 2.5 TG	Surflan	XL
								C,F	C,F										
		C,F							C,F		C						C,F		
E	C,F	C,F					C,F		C,F		F,T						C,F	F	F
		C,F							C,F								C,F	F	F
		C,F															C,F		
		C,F							C,F								C,F		
		C,F		E					C,F		C,F,T						C,F	F	F
								C,F	C,F										
		C,F															C,F		
									C,F										
		C,F							C,F								C,F		

Table 2d. Herbicides Labeled for Use on Shrubs

	Postemergence					Preemergence							
	Acclaim	Avail, Roundup Pro, Kleenup	Basagran T/O, Lescogran	Bensumec	Goal T/O	Vantage	Atrazine	Barricade	Barrier	Casoron	Chipco Ronstar	Dacthal	Dyclomec
KEY TO TABLE 2D ON P. 50.													
<i>Abelia</i> spp.		P,D	D			D							
<i>A. grandiflora</i>		P,D	D	O		D,O						C,F	
<i>Aesculus</i> spp.		P,D	D			D							
<i>Amelanchier alnifolia</i>		P,D	D			D,O					E		
<i>A. laevis</i>		P,D	D			D,O							
<i>Aralia spinosa</i>		P,D	D			D					E		
<i>Aronia melanocarpa</i>		P,D	D			D,O							
<i>Berberis</i> spp.	O	P,D	D			D			F	F	E	C,F	F
<i>B. x Julianae</i>		P,D	D			D			F				
<i>B. mentorensis</i>		P,D	D			D			F				
<i>B. thunbergii</i>		P,D	D			D,O			F				
<i>B. verruculosa</i>		P,D	D			D			F				
<i>Buxus</i> spp.	O	P,D	D	O		D			F	F		C,F	F
<i>B. microphylla</i>		P,D	D,O			D,O			F		E		
<i>B. sempervirens</i>		P,D	D**			D,O					E		
<i>Callistemon citrinus</i>		P,D	D			D							
<i>C. lanceolatus</i>		P,D	D			D,O					E		
<i>C. viminalis</i>		P,D	D			D			F				
<i>Caryopteris clandonensis</i>		P,D	D			D,O							
<i>Ceanothus</i> spp.		P,D	D			D							
<i>C. americanus</i>		P,D	D			D					E		
<i>Chaenomeles japonica</i>		P,D	D			D			F	F			F
<i>C. speciosa</i>		P,D	D			D					E		
<i>Cistus purpureus</i>		P,D	D			D,O					E		
<i>Clethra alnifolia</i>		P,D	D			D							
<i>Cornus</i> spp.		P,D	D			D			F	F		C,F	F
<i>C. alba</i>		P,D	D			D							
<i>C. alternifolia</i>		P,D	D			D,O							
<i>C. amomum</i>		P,D	D			D,O							
<i>C. sericea (stolonifera)</i>		P,D	D**			D,O			F		E		
<i>C. speciosa</i>		P,D	D			D					E		
<i>Corylus</i> spp.		P,D	D			D			F	F			F
<i>Cotinus coggygria</i>		P,D	D			D							
<i>Cotoneaster</i> spp.	O	P,D	D			D			F	F	E	C,F	F
<i>C. acutifolius</i>		P,D	D			D,O							
<i>C. adpressus</i>		P,D	D			D							
<i>C. apiculata</i>		P,D	D**			D,O			F				
<i>C. congestus</i>		P,D	D			D							
<i>C. dammeri</i>		P,D	D**			D,O			F				
<i>C. divaricatus</i>		P,D	D			D							
<i>C. horizontalis</i>		P,D	D			D							
<i>C. microphyllus</i>		P,D	D			D			F				
<i>C. zabelii</i>		P,D	D			D							
<i>Cytisus praecox</i>		P,D	D			D							
<i>C. racemosa</i>		P,D	D			D							
<i>C. scoparius</i>		P,D	D			D					E		

Table 2d. Herbicides Labeled for Use on Shrubs (cont.)

	Postemergence					Preemergence							
	Acclaim	Avail, Roundup Pro, Kleenup	Basagran T/O, Lescogran	Bensumec	Goal T/O	Vantage	Atrazine	Barricade	Barrier	Casoron	Chipco Ronstar	Dacthal	Dyclomec
KEY TO TABLE 2D ON P. 50.													
<i>Daphne odora</i>		P,D	D	O		D					E		
<i>Deutzia</i> spp.		P,D	D			D			F	F		C,F	F
<i>D. gracilis</i>		P,D	D			D					E		
<i>Diervillea lonicera</i>		P,D	D			D,O							
<i>Elaeagnus</i> spp.		P,D	D			D						C,F	
<i>E. pungens</i>		P,D	D			D,O		F					
<i>E. umbellata</i>		P,D	D**			D							
<i>Euonymus</i> spp.	O	P,D	D			D			F	F		C,F	F
<i>E. alata</i>		P,D	D			D,O							
<i>E. kiautshovicus</i>		P,D	D**			D,O		F			E		
<i>Forsythia</i> spp.	O	P,D	D			D			F	F		C,F	F
<i>F. intermedia</i>		P,D	D			D		F			E,T		
<i>F. suspensa</i>		P,D	D			D							
<i>F. viridissima</i>		P,D	D**			D,O		F					
<i>Genista pilosa</i>		P,D	D			D							
<i>Hamamelis virginiana</i>		P,D	D			D					E		
<i>Hibiscus</i> spp.		P,D	D			D					E		
<i>H. rosa-sinensis</i>		P,D	D			D,O							
<i>H. syriacus</i>		P,D	D			D							
<i>Hydrangea</i> spp.	O	P,D	D			D						C,F	
<i>H. macrophylla</i>		P,D	D			D,O							
<i>H. paniculata</i>		P,D	D			D							
<i>H. quercifolia</i>		P,D	D			D							
<i>Hypericum</i> spp.		P,D	D	O		D							
<i>H. frondosum</i>		P,D	D			D					E		
<i>Ilex vomitoria</i>		P,D	D			D,O							
<i>Kalmia</i> spp.		P,D	D			D			F	F		C,F	F
<i>K. latifolia</i>		P,D	D			D							
<i>Kolkwitzia amabilis</i>		P,D	D			D			F	F			F
<i>Leucothoe</i> spp.		P,D	D			D			F	F			F
<i>L. axillaris</i>		P,D	D			D					E		
<i>L. fontanesiana</i>		P,D	D			D					E		
<i>Ligustrum</i> spp.	O	P,D	D	O		D			F	F	E,T	C,F	F
<i>L. amurense</i>		P,D	D			D		F					
<i>L. japonicum</i>		P,D	D			D,O							
<i>L. ovalifolium</i>		P,D	D			D							
<i>L. vicaryi</i>		P,D	D			D							
<i>Lonicera</i> spp.		P,D	D			D			F	F	E	C,F	F
<i>L. fragrantissima</i>		P,D	D			D							
<i>L. japonica</i>		P,D	D**			D,O		F					
<i>L. maackii</i>		P,D	D**			D,O							
<i>L. x morrowii</i>		P,D	D			D,O							
<i>L. tartarica</i>		P,D	D**			D,O		F					
<i>L. xylosteum</i>		P,D	D**			D,O							
<i>Magnolia stellata</i>		P,D	D			D							
<i>Mahonia</i> spp.		P,D	D			D							

Table 2d. Herbicides Labeled for Use on Shrubs (cont.)

	Postemergence					Preemergence							
	Acclaim	Avail, Roundup Pro, Kleenup	Basagran T/O, Lescogran	Bensumec	Goal T/O	Vantage	Atrazine	Barricade	Barrier	Casoron	Chipco Ronstar	Dacthal	Dyclomec
KEY TO TABLE 2D ON P. 50.													
<i>M. aquifolium</i>		P,D	D			D,O					E		
<i>M. bealei</i>		P,D	D			D							
<i>M. repens</i>		P,D	D			D							
<i>Myrica</i>		P,D	D			D							
<i>Nandina domestica</i>	O	P,D	D**			D,O					E		
<i>Osmanthus</i> spp.		P,D	D			D			F	F			F
<i>O. heterophyllus</i>		P,D	D			D,O					E		
<i>Philadelphus</i> spp.		P,D	D			D						C,F	
<i>P. coronarius</i>		P,D	D			D							
<i>Physiocarpus opulifolius</i>		P,D	D**			D,O							
<i>Pieris</i> spp.		P,D	D			D					E	C,F	
<i>P. japonica</i>		P,D	D			D,O		F				C,F	
<i>Potentilla</i> spp.		P,D	D			D						C,F	
<i>P. cistena</i>		P,D	D**			D,O							
<i>P. fructicosa</i>		P,D	D			D					E		
<i>P. glandulosa</i>		P,D	D			D							
<i>P. laurocerasus</i>		P,D	D			D		F			E		
<i>P. tomentosa</i>		P,D	D			D,O							
<i>Prunus triloba</i>		P,D	D			D			F	F			F
<i>P. virginiana</i>		P,D	D			D							
<i>Pyracantha</i> spp.	O	P,D	D	O		D			F	F			F
<i>P. coccinea</i>		P,D	D			D		F			E		
<i>Rhamnus frangula</i>		P,D	D			D,O							
<i>Rhododendron</i> (azalea)	O	P,D	D**	O		D		F	F	F		C,F	F**
<i>R. spp.</i> (rhododendron)	O	P,D	D	O		D,O		F	F	F	E,T	C,F	F
<i>R. catawbiense</i>		P,D	D			D							
<i>R. indica</i>		P,D	D			D							
<i>R. maximum</i>		P,D	D			D							
<i>R. molle</i>		P,D	D			D							
<i>R. mucronulatum</i>		P,D	D			D							
<i>R. obtusum</i>		P,D	D			D							
<i>R. x P.J.M.</i>		P,D	D			D							
<i>R. yedoense</i>		P,D	D			D							
<i>Rhus aromatica</i>		P,D	D			D							
<i>R. typhina</i>		P,D	D			D					E		
<i>Ribes alpinum</i>		P,D	D**			D,O							
<i>Rosa</i> spp.	O	P,D	D			D			F	F	E	C,F	F
<i>R. banksiae</i>		P,D	D			D,O		F					
<i>R. rugosa</i>		P,D	D			D							
<i>Salix matsudana</i> 'Tortuosa'		P,D	D			D,O							
<i>Skimmia japonica</i>		P,D	D			D							
<i>Spiraea</i> spp.		P,D	D			D			F	F		C,F	F
<i>S. x bumalda</i>		P,D	D**			D,O							
<i>S. japonica</i>		P,D	D			D							
<i>S. nipponica</i>		P,D	D			D,O							
<i>S. thunbergii</i>		P,D	D			D							

Table 2d. Herbicides Labeled for Use on Shrubs (cont.)

	Postemergence						Preemergence						
	Acclaim	Avail, Roundup Pro, Kleenup	Basagran T/O, Lescogran	Bensumec	Goal T/O	Vantage	Atrazine	Barricade	Barrier	Casoron	Chipco Ronstar	Dacthal	Dyclomec
<i>S. Vanhouttei</i>		P,D	D			D,O							
<i>Symphoricarpa</i> spp.		P,D	D			D							
<i>Syringa</i> spp.		P,D	D			D,O			F	F	E	C,F	F
<i>S. meyeri</i>		P,D	D			D							
<i>S. patula</i>		P,D	D			D,O							
<i>S. persica</i>		P,D	D			D							
<i>S. villosa</i>		P,D	D			D							
<i>S. vulgaris</i>		P,D	D			D,O							
<i>Vaccinium</i> spp.		P,D	D			D,O							
<i>Viburnum</i> spp.	O	P,D	D			D				E		C,F	
<i>V. carlesii</i>		P,D	D			D							
<i>V. dentatum</i>		P,D	D**			D,O							
<i>V. lantana</i>		P,D	D**			D							
<i>V. lentago</i>		P,D	D**			D,O							
<i>V. opulus</i>		P,D	D**			D,O							
<i>V. plicatum</i>		P,D	D			D			F				
<i>V. suspensum</i>		P,D	D			D,O							
<i>V. trilobum</i>		P,D	D**			D,O			F				
<i>V. wrightii</i>		P,D	D			D			F				
<i>Weigela</i> spp.	O	P,D	D			D			F	F		C,F	F
<i>W. florida</i>		P,D	D			D			F				
<i>Wisteria</i> spp.		P,D	D			D							
<i>W. florida</i>		P,D	D			D							
<i>W. sinensis</i>		P,D	D			D,O							

^aCheck the label for differences in formulations.

C = Container-grown plants.

D = Directed spray.

D** = Directed spray with Lescogran.

E = Established plants.

F = Established field-grown plants.

F = Field-grown plants.

O = Over-the-top spray.

P = Preplant.

T = Transplants.

Table 2e. Herbicides Labeled for Use on Trees

	Postemergence					Preemergence							
	Acclaim	Avail, Roundup Pro, Kleenup	Basagran T/O, Lescogran	Bensumec	Goal T/O	Vantage	Atrazine	Barricade	Barrier	Casoron	Chipco Ronstar	Dacthal	Dyclomec
KEY TO TABLE 2E ON P. 56.													
<i>Acer</i> spp.		P,D	D			D					E	C,F	
<i>A. ginnala</i>		P,D	D			D							
<i>A. negundo</i>		P,D	D			D		F	F				F
<i>A. palmatum</i>	O	P,D	D			D,O		F					
<i>A. platanoides</i>		P,D	D			D		F					
<i>A. rubrum</i>	O	P,D	D**			D,O							
<i>A. saccharinum</i>		P,D	D**			D,O							
<i>A. saccharum</i>		P,D	D			D							
<i>Aesculus</i> spp.		P,D	D			D							
<i>A. glabra</i>		P,D	D			D							
<i>A. pavia</i>		P,D	D			D							
<i>Albizia julibrissin</i>		P,D	D			D,O							
<i>Alnus glutinosa</i>		P,D	D			D							
<i>Betula</i> spp.		P,D	D			D,O		F	F		C,F	F	
<i>B. nigra</i>		P,D	D			D,O							
<i>B. papyrifera</i>		P,D	D**			D,O				E			
<i>B. pendula</i>		P,D	D			D,O							
<i>B. platyphylla</i>		P,D				D,O							
<i>Carya</i> spp. (Hickory)		P,D	D			D							
<i>C. illinoensis</i>		P,D	D			D,O		F	F				F
<i>Castanea</i> spp.		P,D	D			D					C,F		
<i>C. mollissima</i>		P,D	D			D							
<i>Catalpa bignonioides</i>		P,D	D			D,O							
<i>Celtis occidentalis</i>		P,D	D			D,O		F	F	E,T			F
<i>Cercis canadensis</i>		P,D	D			D					C,F		
<i>Cladrastis lutea</i>		P,D	D			D							
<i>Cornus</i> spp.		P,D	D			D		F	F		C,F	F	
<i>C. florida</i>	O	P,D	D**			D,O		F		E,T			
<i>C. kousa</i>		P,D	D			D				E			
<i>C. mas</i>		P,D	D			D							
<i>Crataegus</i> spp.	O	P,D	D			D		F			C,F		
<i>C. viridis</i>		P,D	D			D							
<i>Elaeagnus</i> spp.		P,D	D			D					C,F		
<i>E. angustifolia</i>		P,D	D**			D		F	F	E,T	C,F	F	
<i>Fagus grandifolia</i>		P,D	D			D							
<i>F. sylvatica</i>		P,D	D			D				E			
<i>Fraxinus</i> spp.		P,D	D			D		F	F		C,F	F	
<i>F. americana</i>		P,D	D			D,O							
<i>F. pennsylvanica</i>		P,D	D**			D,O				E			
<i>Ginkgo biloba</i>		P,D	D			D				E			
<i>Gleditsia triacanthos</i>		P,D	D**			D,O		F	F		C,F	F	
<i>Gymnocladus dioicus</i>		P,D	D			D,O							
<i>Juglans</i> spp.		P,D	D			D		F			C,F		
<i>J. nigra</i>		P,D	D			D,O							
<i>J. regia</i>		P,D	D			D		F	F				F
<i>Koeleruteria paniculata</i>		P,D	D			D,O		F	F				F

Table 2e. Herbicides Labeled for Use on Trees (cont.)

	Postemergence					Preemergence							
	Acclaim	Avail, Roundup Pro, Kleenup	Basagran T/O, Lescogran	Bensumec	Goal T/O	Vantage	Atrazine	Barricade	Barrier	Casoron	Chipco Ronstar	Dacthal	Dyclomec
KEY TO TABLE 2E ON P. 56.													
<i>Lagerstroemia indica</i>		P,D	D			D,O		F			E		
<i>Larix decidua</i>		P,D	D			D					E		
<i>L. europa</i>		P,D	D			D,O							
<i>L. kaempferi</i>		P,D	D			D							
<i>Liquidambar styraciflua</i>		P,D	D**			D,O						C,F	
<i>Liriodendron tulipifera</i>		P,D	D			D,O						C,F	
<i>Maclura pomifera</i>		P,D	D			D,O			F	F			F
<i>Magnolia</i> spp.	O	P,D	D			D			F	F	E	C,F	F
<i>M. grandiflora</i>		P,D	D**			D,O							
<i>M. soulangiana</i>		P,D	D			D							
<i>Malus</i> spp.		P,D	D			D,O		F	F	F	E	C,F	F
<i>M. floribunda</i>		P,D	D			D							
<i>M. pumila</i>		P,D	D			D							
<i>Metasequoia glyptostoboides</i>		P,D	D			D					E		
<i>Morus alba</i>		P,D	D			D							
<i>Nyssa sylvatica</i>		P,D	D			D						C,F	
<i>Oxydendrum arboreum</i>		P,D	D			D		F					
<i>Paulownia tomentosa</i>		P,D	D			D,O							
<i>Phellodendron amurense</i>		P,D	D			D			F	F			F
<i>Platanus</i> spp.		P,D	D			D						C,F	
<i>P. acerifolia</i>		P,D	D			D							
<i>P. occidentalis</i>		P,D	D**			D,O						C,F	
<i>Populus</i> spp.		P,D	D			D			F	F	E,T	C,F	F
<i>P. alba</i>		P,D	D**			D,O							
<i>P. deltoides</i>		P,D	D			D			F	F			F
<i>P. nigra</i>		P,D	D			D							
<i>P. tremuloides</i>		P,D	D			D							
<i>Prunus</i> spp. (peach & cherry)		P,D	D			D		F					
<i>Prunus</i> spp. (plum)		P,D	D			D,O		F					
<i>P. caroliniana</i>		P,D	D			D,O							
<i>P. cerasifera</i>		P,D	D			D							
<i>P. mahaleb</i>		P,D	D			D,O							
<i>P. persica</i>		P,D	D			D							
<i>P. sargentii</i>		P,D	D			D							
<i>P. serotina</i>		P,D	D			D							
<i>P. serrulata</i>		P,D	D			D							
<i>P. subhirtella pendula</i>		P,D	D			D							
<i>P. yedoensis</i>		P,D	D			D							
<i>Pyrus</i> spp. (pear)		P,D	D			D,O		F					
<i>P. calleryana</i>		P,D	D			D							
<i>Quercus</i> spp.		P,D	D			D,O			F	F	E,T	C,F	F
<i>Q. alba</i>		P,D	D			D							
<i>Q. coccinea</i>		P,D	D			D							
<i>Q. muehlenbergii</i>		P,D	D			D							
<i>Q. palustris</i>		P,D	D			D							
<i>Q. phellos</i>		P,D	D**			D,O							

Preemergence																			
Endurance	Factor	Gallery	Goal T/O	Image	Kerb	Norosac	Ornamental Herbicide II	Ornamental Herbicide 5G	Pendulum, Pre-M ^a	Predict	Pennant	Preen (Treflan)	Princep	Regal O-O	Regalstar II	Rout	Snapshot 2.5 TG	Surflan	XL
E	C,F	C,F		E					C,F	F	F,T						C,F	C,F	C,F
								F											
												C,F,T							
	F				O				C,F		F,T	C,F,T					F	C,F	C,F
					O				C,F	F	F,T	C,F,T							
						F													
	C,F	C,F			O	F	C,F				F,T			C,F					
									C,F	F							C,F	F	F
E	C,F	F			O	F			C,F	F	F,T	C,F,T					F	F	F
								F											
									C,F								F	F	F
E	C,F	C,F							C,F								C,F		
						F	F												
					O							C,F,T		C,F					
	F				O					F		C,F,T					F	F	F
					O	F					F,T								
	F					F	F		C,F								F	F	F
									C,F										
									C,F										
E	C,F						C,F					C,F,T					F	F	F
E	C,F						C,F				F,T	C,F,T					F	F	F
								F			F,T						F	F	F
								F	C,F										
																		F	F
	F								C,F										
									C,F										
					O				C,F										
					O				C,F										
		F			O												F	F	F
E	C,F	F					C,F		F	F,T							F	F	F
					O				C,F										
	C,F				O	F	C,F	F			F,T	C,F,T	C,F	C,F				F	C,F
									C,F										
									C,F										
	F								C,F	F				C,F			F	C,F	
	C,F								C,F	F	C						C,F	C,F	

Table 2e. Herbicides Labeled for Use on Trees (cont.)

	Postemergence						Preemergence						
	Acclaim	Avail, Roundup Pro, Kleenup	Basagran T/O, Lescogran	Bensumec	Goal T/O	Vantage	Atrazine	Barricade	Barrier	Casoron	Chipco Ronstar	Dacthal	Dyclomec
<i>Q. rubra</i>		P,D	D,O			D		F					
<i>Robinia pseudoaccacia</i>		P,D	D			D,O							
<i>Salix</i> spp.	O	P,D	D			D			F	F		C,F	F
<i>S. babylonica</i>		P,D	D			D							
<i>Sorbus</i> spp.		P,D	D			D			F	F			F
<i>S. americana</i>		P,D	D			D,O							
<i>S. aucuparia</i>		P,D	D			D,O							
<i>Taxodium distichum</i>		P,D	D			D							
<i>Tilia</i> spp.		P,D	D			D			F	F			F
<i>T. americana</i>		P,D	D			D,O							
<i>T. cordata</i>		P,D	D			D,O							
<i>Ulmus</i> spp.		P,D	D			D			F	F	E,T	C,F	F
<i>U. americana</i>		P,D	D			D							
<i>U. parviflora</i>		P,D	D			D,O							
<i>U. pumila</i>		P,D	D			D							

^aCheck the label for differences in formulations.

C = Container-grown plants.

D = Directed spray.

D** = Directed spray with Lescogran.

E = Established plants.

F = Field-grown plants.

O = Over-the-top spray.

P = Preplant.

T = Transplants.

Preemergence																			
Endurance	Factor	Gallery	Goal T/O	Image	Kerb	Norosac	Ornamental Herbicide II	Ornamental Herbicide 5G	Pendulum, Pre-M ^a	Predict	Pennant	Preen (Treflan)	Princep	Regal O-O	Regalstar II	Rout	Snapshot 2.5 TG	Surflan	XL
F	C,F	C,F						F	C,F				F	C,F	C,F		C,F	F	
					O	F					F,T	C,F,T							
	F							C,F		F,T	C,F,T						F	F	F
					O	F													
								C,F	F	F,T	C,F,T								
					O	F		C,F											
																		C,F	C,F
					O	F													
													F						
	F																F	F	F
													F						

Table 3. Common and Trade Names of Fumigants for Preplant Bed Preparation

Common name	Trade name
dazomet	Basamid
methyl bromide*	Brom-O-Gas, Brom-O-Sol
metam-sodium*	Vapam Soil Fumigant, Secagon
chloropicrin*	Pic-lor, Tric-lor
methyl bromide + chloropicrin*	Terr-O-Gas (various formulations)

*Restricted use pesticide (RUP). Only certified pesticide applicators or operators may use RUPs.

Author

David Williams

*Department of Natural Resources and
Environmental Sciences*