

# SECTION T.

## PROFESSIONAL LANDSCAPE MAINTENANCE

### Introduction

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This section is primarily a reference for commercial enterprises that manage landscapes or garden areas, often with the use of herbicides. Please refer to other University and Extension guides that cover homeowner uses <https://catalog.extension.oregonstate.edu/em8742>. The herbicides listed in this section are intended for commercial use unless noted otherwise.

Weed management in professionally managed landscapes requires a thorough knowledge of the weeds, weed control practices, application options, plant tolerances, and management strategies. Success with any method depends on planning, properly selecting control methods, and effective timing. When selecting chemicals for weed control, you must understand the subtle differences in application techniques, residual activities, susceptibilities, and timing for control of target species, tolerance of desirable plants, potential for weed shifts, and long-term effects of integrating site objectives and year-round weed management strategies. Often, treatments must be repeated or combined with other practices for maximum control.

**Weed shifts** Weed infestations are dynamic and change depending on previous cultural and weed control practices. For example, routine use of the same or similar herbicides will result in a shift to weed species that tolerate the treatment. Repeated use of simazine in nurseries was first demonstrated to cause a shift within a natural population of common groundsel. Since then, more than 72 species represented in 40 genera have been reported to tolerate triazine herbicides. Globally, there are currently 413 unique cases of herbicide resistance (species x site of action), found in 222 species.

**Preventing weed shifts** Weeds that survive repeated use of the same or similar herbicides must be eliminated before the tolerant species or biotypes become established. Spot-treat or hand pull weeds and combine these methods with other weed management practices to minimize the occurrence of resistant biotypes.

**Managing weedy vegetation** Successful weed control in landscapes requires a comprehensive or year-round approach whereby a combination of weed control practices is employed and alternated over several years. Development of these strategies requires knowledge of each weed and weed control practice. Weeds must be identified and information gathered about the effectiveness of each weed control practice. Consider costs and select herbicide combinations that can be applied together or in split applications that control the weeds present in the landscape. Note the action of each herbicide or how the chemical works in the plant. Then tank mix, and alternately use these products to reduce the chance of developing resistant species or biotypes. Often a combination of mechanical, herbicidal, and sometimes hand removal or spot treatment with herbicide sprays or wipers will provide the most effective year-round control.

**Soil-active herbicides** Persistent, soil-applied herbicides can be applied to weed-free soil during winter when rain will activate the chemical. Some compounds may be applied throughout the year if irrigation is available. Apply lower rates on sandy soils having lower clay or organic matter, or cation exchange capacities. Existing vegetation can be controlled by mixing the soil-active herbicide with a post-emergence contact or translocated herbicide, provided such a mix is not prohibited by either label. Consult labels for listed species and duration of expected control. Avoid disturbing the soil when applying.

**Postemergence herbicides** In landscape plantings, postemergence weed control requires precision since few options exist. Postemergence treatments either selectively control susceptible weeds or are applied with selective equipment. Frequent scouting aimed at identifying susceptible weeds and the correct stage of weed growth must be combined with appropriate weather conditions and labeled spray additives to maximize control. Consult each label for numerous precautions or information about crop or cultivar tolerances. Always test new products on selected plants before adopting their use throughout your operation.

**Caution!** Information provided in this handbook is not intended to be a complete guide to herbicide use. Before using any chemical, read the recommendations on the label. Before a chemical can be recommended for a specific use, it must be thoroughly tested. The recommendation on the manufacturer's label, when followed, can prevent many problems from arising from the wrong use of a chemical.

**Note** Herbicides must be applied at the correct rate and time to selectively control weed growth with minimal chance for injury to land-

scape plants. Obtain more consistent results by reading the herbicide label and other information about the proper application and timing of each herbicide. Suggested rates listed in this guide are stated as pounds active ingredient per acre (lb ai/A) or pounds acid equivalent per acre (lb ae/A). Calibrate your equipment precisely and verify exact application rates, especially to irregular landscape sites.

# Established Tree, Shrub, Rose, and Ground Cover Landscapes

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*Multiply rate by 0.023 for amount per 1,000 sq ft*

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## geo-textiles

*Available at agricultural and garden supply stores*

**Spun-bonded fabrics** (non-woven) lightweight, extruded polypropylene fibers; requires mulch cover due to moderate UV light sensitivity; weed roots and rhizomes can penetrate fabric unless removed before establishment; cheapest option.

**Woven fabrics** moderate-weight polypropylene fibers woven into a mat; can be used without mulch cover due to UV light stability; weed roots and rhizomes can penetrate fabric although tightness of weave can prevent some weeds; moderate cost.

**Laminates** highly porous, dense poly film bonded to capillary fibers with a pressed, non-woven bottom layer. Surface is slick and causes rapid wetting and drying to prevent weed establishment except for perennial rhizomes that can penetrate the laminate; most expensive geo-fabric.

## Soil-applied

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### dichlobenil (Casoron 4G)

**Rate** 4 to 6 lb ai/A (100 to 150 lb/A granular product)

**Time** Apply midwinter immediately before a cold rain to reduce volatility and enhance weed suppression.

**Remarks** Weigh and distribute uniformly and exactly over precisely measured areas to ensure accurate applications. Oregon results over 9 years suggest perennial weeds can be suppressed with 4-, 3-, and 2-lb ai/A rates applied in 3 consecutive years. Grazing livestock is prohibited. Inhibits cellulose and cell wall formation. Products containing dichlobenil approved for homeowner use.

**Caution** Some groundcovers may not be tolerant; consult label. Pine species are sensitive to injury from Casoron 4G if applied within two years after transplanting. Do not use on trees that have been established for less than 6 months. Do not allow granules to stick to foliage or to accumulate at the soil line around the base of the tree.

**Site of action** Group 29: cellulose synthesis inhibitor

**Chemical family** Nitrile

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### dimethenamid-p (Tower 6.0)

**Rate** 0.98 to 1.5 lb ai/A (21 to 32 oz Tower/A)

**Time** Apply to established plantings prior to weed emergence.

**Remarks** Does not control emerged weeds. Wait 2 to 4 weeks after planting for soil to settle before application. Irrigation or rainfall is needed to activate herbicide.

**Caution** Do not apply to seedbeds. Do not apply to sensitive ornamental plants listed on the label such as purple coneflower or ornamental grasses. Do not apply to newly transplanted ornamentals until plants have been watered and soil has been thoroughly packed and settled around roots. Use the low-labeled rate and repeat applications for extended landscape weed control. Do not apply at bud break.

**Site of action** Group 15: very long chain fatty acid synthesis inhibitor

**Chemical family** Chloroacetamide

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### **dithiopyr (Dimension 2EW, EC or Ultra 40WP and several others)**

**Rate** 0.5 lb ai/A (2 pints/A Dimension 2EW)

**Time** Apply before weeds emerge around bases of ornamental plants in landscape.

**Remarks** For best results, prepare a weed-free surface with minimal clods and leaf debris. In the spring when buds are rapidly growing and expanding, over the top application of Dimension 2EW may temporarily injure new growth of desirable plants.

**Caution** Do not exceed 1.5 fl oz/1,000 sq ft every 3 to 4 months (2 pints/A), or 4.5 fl oz/1,000 sq ft per year (6 pints/A). Do not apply to plant roots or weakened ornamental plants, or when drift potential is moderate to high. Do not use in enclosed structures. Dithiopyr is toxic to fish and highly toxic to oysters, shrimp, and other aquatic organisms.

**Site of action** Group 3: microtubule assembly inhibitor

**Chemical family** Pyridine

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### **EPTC (Eptam 7E)**

*Not for use in roses*

**Rate** 5 to 14.9 lb ai/A (5.75 to 17 pints/A) depending on target species

**Time** Apply and immediately incorporate 2 to 3 inches deep with a rototiller 2 weeks before transplanting balled or canned stock; or, spray postplant and incorporate with tillage. In spring, apply around established plants after growth and incorporate.

**Remarks** Use higher rates for perennial weed control and incorporate to a depth of 6 inches with a rototiller. Note sensitive flowers listed on label. Primarily for grass control including quackgrass suppression.

**Site of action** Group 15: very long chain fatty acid synthesis inhibitor

**Chemical family** Thiocarbamate

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### **flumioxazin (SureGuard SC 51%, BroadStar G 0.25%, and others)**

**Rate** 8 to 12 oz (0.25 to 0.38 lb ai/A) of SureGuard; 0.375 lb ai/A (150 lb/A BroadStar)

**Time** Apply to weed-free surface. Flumioxazin should only be applied by commercial licensed applicators. SureGuard application near ornamental plants is limited to directed sprays around well-established woody shrubs and trees. BroadStar may be applied over the top of listed species; foliage of desirable crops must be dry at the time of application. Wet foliage will trap granules on the leaf surface or channel granules to the base of growing plants and burn the foliage

**Caution** Avoid sensitive crops such as buddleia (butterfly bush) and hydrangea. Do not apply to herbaceous bedding plants or areas where bedding plants will be planted or transplanted within three months following application.

**Site of action** Group 14: protoporphyrinogen oxidase inhibitor

**Chemical family** N-phenylphthalimide

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### **halosulfuron-methyl (Sedgehammer)**

*Nutsedge control around established woody ornamentals in landscapes; not for use on roses or ground covers*

**Rate** 0.031 to 0.062 lb ai/A (2/3 to 1 1/3 oz product/A)

**Time** After nutsedge has reached the 3- to 8-leaf stage of growth.

**Remarks** Wait 3 months after transplanting ornamentals, before application, and allow soil to settle around plant. A second treatment may be required 6 to 10 weeks later. Do not exceed 0.25 lb ai/A total or four applications per season. Use 0.5% nonionic surfactant concentration for broadcast applications.

**Caution** Do not apply as an over-the-top spray to desirable flowers, ornamentals, vegetables, shrubs or trees. Avoid contact of this product to leaves of desirable plants since foliar injury, discoloration or death may result. Apply to actively growing nutsedge that is not stressed.

**Site of action** Group 2: acetolactate synthase (ALS) inhibitor

**Chemical family** Sulfonylurea

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### **indaziflam (Marengo and Specticle, granular or sprayable)**

**Rate** 0.031 to 0.062 lb ai/A (2.5 to 5 oz/A Specticle)

**Time** Apply in fall to early spring, prior to weed seed germination, to firmed soil that does not have cracks.

**Remarks** Existing vegetation must be controlled with glyphosate or burndown herbicides such as glufosinate or paraquat. Controls annual broadleaf and grass weeds, and perennial weeds from seed only. Existing perennial/biennial weeds growing from roots will not be controlled. Rainfall or irrigation of 0.25 inch or more within 3 weeks of application is required for maximum efficacy.

**Caution** Read label thoroughly to understand situations that should be avoided. This product has a long residual and may injure grasses 2 to 3 years after application. Avoid direct contact with foliage, green bark, or roots of desired species. Clean spray tanks thoroughly after use. Do not apply around bedding plants. Do not apply around bearing fruit trees, unless beyond the tree drip line. Applications over heavily mulched areas may not control weeds adequately. It is best to apply the product before the mulch is applied. Avoid applications to newly seeded grasses.

**Site of action** Group 29: cellulose synthesis inhibitor

**Chemical family** Alkylazine

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### **isoxaben (Gallery 75 DF)**

**Rate** 0.495 to 0.998 lb ai/A (0.66 to 1.33 lb/A)

**Time** Apply late summer to early fall, in early spring, or immediately after cultivation. Apply to debris-free soil surface.

**Remarks** Identify weeds; adjust rates according to charts on label. Activate with 0.5 inch water or shallow cultivation before weeds emerge. Chemical stability remains adequate when left on soil surface for 21 days. Primarily controls broadleaf weeds. Products containing isoxaben also approved for home owner use.

**Caution** Do not apply to newly transplanted crops until soil settles. See label for 14 sensitive ornamental species for which isoxaben is not recommended, including hydrangea, purple coneflower, and yucca. Use untreated soil to fill around transplants if isoxaben has been applied within 1 year. Many approved species are listed on the label, ornamental roses are not mentioned.

**Site of action** Group 29: cellulose synthesis inhibitor

**Chemical family** Benzamide

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### **napropamide (Devrinol DF-XT, 2-XT, or 50DF)**

**Rate** 4 to 6 lb ai/A (200 to 300 lb/A 2G)

**Time** Apply any time to weed-free soil, then sprinkler irrigate to wet soil 1 to 2 inches deep, or apply during midwinter rains in western Oregon for annual weed control.

**Remarks** Use higher rates with severe weed populations, or when broadleaf weeds are present. Primarily grass control including crabgrass and annual bluegrass. Inhibits root growth. Supplemental label in Oregon for Devrinol 2-XT includes roses.

**Site of action** Group 15: very long chain fatty acid synthesis inhibitor

**Chemical family** Acetamide

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### **oryzalin (Surflan AS and several others)**

**Rate** 2 to 4 lb ai/A (2 to 4 quarts/A) depending on length of control

**Time** Apply any time to weed-free soil, then sprinkler irrigate with 0.5 inch if no rain falls within 1 week, or cultivate 1 inch deep to activate herbicide for annual weed control.

**Remarks** Consult label for tolerant ornamental species. Both grass and broadleaf control. Suppresses but will not control mustards, prickly lettuce, horseweed, and mallow. Inhibits mitosis, primarily in roots. Available products containing oryzalin are approved for homeowner use.

**Caution** Applications of Surflan AS over the top of plants with newly forming buds may cause injury. Use is not recommended on slender deutzia, Douglas-fir, 'Techny' arborvitae, eastern hemlock, begonia, or coleus.

**Site of action** Group 3: microtubule assembly inhibitor

**Chemical family** Dinitroaniline

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### **oxadiazon (Ronstar 2G, Ronstar Flo, and others)**

**Rate** 2 to 4 lb ai/A (100 to 200 lb/A) depending on target weed species

**Time** Apply any time to weed-free soil and irrigate with 0.25 to 0.33 inch water immediately after applying for annual weed control.

**Remarks** Do not cover with soil or mulch, or incorporate, because weed control will desist. Weeds in the pink family (chickweed, mouseear chickweed, and pearlwort) are resistant. Controls a wide range of broadleaves and some grasses. Apply anytime during the year, prior to weed seed germination. Can be applied to both newly transplanted and established ornamentals. Application can be made to actively growing or dormant ornamentals. Rainfall or overhead irrigation after application will improve weed control activity.

**Caution** Applications of RONSTAR G must be made by a professional applicator only. Do not apply to wet foliage or under conditions in which granules will collect on leaves. For residential properties, do not allow unprotected persons or pets to enter the treated areas until the RONSTAR G Herbicide is watered-in. See label for sensitive ornamentals, including some varieties of rhododendron, spruce, hemlock, azalea, viburnum, and cotoneaster. Avoid contaminating water intended for irrigation. Do not use on plants that will produce fruit within 1 year.

**Site of action** Group 14: protoporphyrinogen oxidase inhibitor

**Chemical family** Oxadiazole

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### **pendimethalin (Pendulum 2G and 3.3EC, and others)**

**Rate** 2 to 4 lb ai/A (100 to 200 lb/A Pendulum 2G) depending on desired length of weed control

**Time** Apply at time of planting or before weed seed germinates.

**Remarks** Directed or over the top sprays. Controls most annual grasses and some broadleaves. Soil should be loose and free of all established weeds. Water within a few days to activate herbicide before weeds emerge.

**Caution** Granules may stain stone, wood, or other porous surfaces. Do not apply to newly transplanted ornamentals until plants have been watered and soils has been thoroughly packed and settled around roots.

**Site of action** Group 3: microtubule assembly inhibitor

**Chemical family** Dinitroaniline

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### **prodiamine (Barricade 65WG or 4L and 63 others)**

**Rate** 0.65 to 1.5 lb ai/A (1 to 2.3 lb/A 65WG) depending on desired length of weed control

**Time** Apply any time to weed-free soil, and incorporate with 0.5 inch water or rain within 14 days.

**Remarks** May be applied to newly transplanted and established ornamentals as a broadcast, over-the-top spray or directed-spray. Activate with 0.5 inch of rain or irrigation water, or with shallow incorporation.

**Caution** Do not exceed 2.3 lb/A in any 12-month period. Labels may have slight differences for approved uses.

**Site of action** Group 3: microtubule inhibitor

**Chemical family** Dinitroaniline

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### **pronamide (Kerb SC T&O and 50 W or WP)**

*Not for use in roses or groundcovers*

**Rate** 1 to 2 lb ai/A (2.5 to 5 pints/A)

**Time** Apply in fall before soil freezes.

**Remarks** Fall applications to woody ornamentals before leaf fall. Preemergence and postemergence control of susceptible winter annual and perennial grasses and chickweed. Requires soil moisture from rain or irrigation to activate; do not incorporate mechanically. Use lower rates for annual grasses and light-texture soils; higher rates for perennial grasses and heavier soils. Control of established grasses is slow. Degraded by microorganisms in warmer weather. Absorbed primarily through roots.

**Caution** A restricted-use pesticide for non-residential use only.

**Site of action** Group 3: microtubule assembly inhibitor

**Chemical family** Benzamide

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### **S-metolachlor (Pennant Magnum)**

**Rate** 1.24 to 2.48 lb ai/A (1.3 to 2.6 pints/A)

**Time** Apply as direct spray toward base of desired plant, either to established ornamentals or 5 days after transplanting.

**Remarks** Existing weeds must be removed. Primarily controls grasses, but also some broadleaf weeds, and suppresses nutsedge. 12 month PHI if applying to fruit trees.

**Caution** Do not apply more than twice per year. Consult label for tolerant ornamentals.

**Site of action** Group 15: very long chain fatty acid synthesis inhibitor

**Chemical family** Chloroacetamide

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### **trifluralin (Trifluralin 10G)**

**Rate** 0.4 lb ai/A

**Time** Apply before weeds emerge.

**Remarks** Trifluralin must be activated by a single rain or overhead sprinkler irrigation of at least 0.5 inch. If not activated within 3 days, mechanically incorporate trifluralin with equipment that won't damage. Apply before weed seeds germinate; trifluralin will not control established weeds.

**Caution** Do not apply to ground covers until they are established and well rooted. Do not apply Trifluralin to newly transplanted ornamentals, ground covers, flowers, and non-bearing fruit and nut crops and non-bearing vineyards until soil or potting media has been settled by packing and irrigation or rainfall and no cracks are present or injury may occur.

**Site of action** Group 3: microtubule assembly inhibitor

**Chemical family** Dinitroaniline

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## **Convenient Soil-applied Premixes for Broad-spectrum Control of Grasses and Broadleaf Weeds**

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### **benefin + oryzalin (XL 2G)**

**Rate** 200 lb/A per application

**Time** Apply before target weeds germinate.

**Remarks** Precisely calibrate application equipment, preferably at half rates, to enable two perpendicular passes for increased accuracy. Inhibits cell division or mitosis, primarily in roots. At least 2 months between applications; do not exceed 600 lb/A per year.

**Caution** Sensitive species include Douglas-fir, eastern hemlock, and begonia.

**Site of action** (both) Group 3: microtubule assembly inhibitor

**Chemical family** (both) Dinitroaniline

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### **isoxaben + trifluralin (Snapshot 2.5 TG)**

**Rate** 200 lb/A

**Time** Apply to soil that is free from weeds and debris. Soil must be settled with water and free of cracks after transplanting.

**Remarks** Activate within 31 days using 0.5 inch of water or shallow cultivation before weeds begin to emerge. Follow label instructions for repeat treatments.

**Caution** Do not apply to unrooted liners or cuttings, bedding plants, or new-planted ground covers.

**Site of action** (isoxaben) Group 29: cellulose synthesis inhibitor; (trifluralin) Group 3: microtubule assembly inhibitor

**Chemical family** (isoxaben) benzamide; (trifluralin) dinitroaniline

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## Postemergence or Foliar Applied

### bentazon (Basagran T&O)

**Rate** 0.5 lbs ai/A (1 pt/A Basagran)

**Time** Spring to early summer, depending on growth stage of weeds.

**Remarks** Use handheld pump-up back pack or knapsack sprayers. For control of Canada thistle and suppression of sedges and nutsedge where other options such as clopyralid are not possible. For Canada thistle, apply 2 pints/A when plants are between 8 inches tall and bud stage. Apply a second application 2 weeks later if needed. For nutsedge, apply 1.5 to 2 pints/A when plants are 6-8 inches tall, and make a second application 7 to 10 days later if needed. Always add a crop oil concentrate. Use no more than 2 lb ai/A per year. Irrigate to make sure plants are actively growing before applying bentazon. Not as effective if temperatures drop below 50°F at night and in daytime does not exceed 70°F. Efficacy will be poor on drought stressed weeds.

**Caution** Apply as a directed spray, away from the crop. May apply over the top of some species if crop oil concentrate is not added and application is tested on a few plants to verify crop safety.

**Site of action** Group 6: photosystem II inhibitor

**Chemical family** Benzothiadiazole

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### clethodim (Envoy Plus and several others)

**Rate** 0.09 to 0.18 lb ai/A (12 to 32 oz/A)

**Time** Apply postemergence to actively growing annual or perennial grasses as listed on label.

**Remarks** **For grass control in ornamental plantings.** Controls annual bluegrass. Applications made to grass plants stressed by insufficient moisture, hot or cold temperatures, or to grass plants exceeding recommended growth stages may result in unsatisfactory control.

**Caution** Do not exceed 68 fl oz/A per season. Test for crop safety before applying to landscape species not listed on the label.

**Site of action** Group 1: acetyl CoA carboxylase (ACCase) inhibitor

**Chemical family** Cyclohexanedione

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### clopyralid (CleanSlate)

*Conifers, non-leguminous woody species, and ornamental grasses in landscapes*

**Rate** 0.094 to 0.65 lb ae/A (0.25 to 1.5 pints/A depending on weed species present)

**Time** Apply to actively growing broadleaf weeds. For perennials such as Canada thistle, apply after most basal leaves have emerged and before bud stage.

**Remarks** Spot and directed applications are permissible; do not make broadcast applications. Surfactants or crop oils are generally not needed

**Caution** Do not allow sprays of this product to contact exposed suckers and/or roots of susceptible trees or shrubs or injury may occur. Do not apply to turf, except golf courses.

**Site of action** Group 4: synthetic auxin

**Chemical family** 6-Chloropicolinate

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### fenoxaprop ethyl (Acclaim Extra)

**Rate** 0.015 to 0.173 lb ai/A (3.5 to 39 fl oz/A) depending on weed species and growth stage

**Remarks** For grass control in many deciduous and evergreen trees, and in shrubs and herbaceous and flowering plants. Adjust rates depending on number of grass tillers (see label). Ensure thorough coverage to actively growing, susceptible grasses. Repeat after grass begins active growth, but do not exceed 120 fl oz/A per season. Inhibits fatty acid production, cell membranes, and new growth.

**Caution** Salvia and philodendron are not tolerant. Determine crop tolerance before extensive use.

**Site of action** Group 1: acetyl CoA carboxylase (ACCase) inhibitor

**Chemical family** Aryloxyphenoxy propionate

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### **fluazifop (Fusilade II Turf and Ornamental, Ornamec 170)**

**Rate** 0.25 to 0.375 lb ai/A (16 to 24 fl oz/A Fusilade II; 6 to 9 oz/1,000 sq ft Ornamec)

**Time** Apply to actively growing grasses, or within 7 days after irrigation, as a broadcast or directed spray with 0.25% nonionic surfactant when susceptible grasses are in the labeled growth stage.

**Remarks** Identify grasses, and adjust rates depending on susceptibility and stage of weed growth as label instructs. Results often are erratic if grasses are stressed from lack of vigor, drought, high temperature, or low fertility. More mature grasses and quackgrass can be controlled but may require two applications. Annual bluegrass and all fine fescues resist treatment.

**Caution** Do not tank mix with other pesticides. Do not apply within 5 days of other pesticide treatments. Not for use on tulips.

**Site of action** Group 1: acetyl CoA carboxylase (ACCase) inhibitor

**Chemical family** Aryloxyphenoxy propionate

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### **glufosinate ammonium (Finale)**

*Spot or directed spray only*

**Rate** 2 to 4 fl oz/gal of water

**Time** Apply to thoroughly cover actively growing weeds.

**Remarks** May be used to trim or edge landscape plantings.

**Caution** Do not apply as an over-the-top broadcast spray in ornamentals or shade trees. Avoid all contact with desirable foliage and green bark. REI 12 hr.

**Site of action** Group 10: glutamine synthase inhibitor

**Chemical family** Phosphinic acid

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### **glyphosate (numerous product names)**

*Not for ground covers*

**Rate** Spray: 1.5 to 5 lb ai/A or 1 to 2% solution for high-volume sprayers

**Time** Apply as directed spray toward base of bush, when weeds are actively growing or moving sugars to roots.

**Remarks** Use lower rates for annual weeds; consult label for higher rates and time of application for perennial weeds. Expedite Application Equipment contains a special formulation using small-droplet technology.

**Caution** Do not spray green foliage or green (undeveloped) bark. If applications are repeated, do not exceed a total of 10.6 lb ai/A (10.6 quarts/A) per year. Repeated use in Australian orchards for several years has resulted in resistant biotypes. To avoid developing weed resistance, rotate chemicals and weed control practices.

**Site of action** Group 9: inhibits EPSP synthase

**Chemical family** None generally accepted

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### **glyphosate (several products)**

*Not for ground covers*

**Rate** Wiper: use 33% solution.

**Time** Apply 1 gal product to 2 gal water and wipe weeds. Avoid contact with desirable vegetation.

**Remarks** In severe infestations, reduce equipment ground speed or apply in two directions to ensure contact with wiper. (See remarks above.)

**Site of action** Group 9: inhibits EPSP synthase

**Chemical family** None generally accepted

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### halosulfuron-methyl (Sedgehammer)

*Nutsedge control around established woody ornamentals in landscapes; not for use on roses or ground covers; directed spray only*

**Rate** 0.031 to 0.062 lb ai/A (0.66 to 1.33 oz/A) to three- to eight-leaf nutsedge

**Time** Directed spray on established woody ornamentals.

**Remarks** For control of nutsedge. Use lower rate on light infestations and high rate on heavy infestations. Do not exceed 5.33 oz/A per year. Add a nonionic surfactant at 0.25 to 0.5% v/v. May tank mix with glyphosate. Not recommended on roses or ground covers.

**Caution** Do not apply over the top of desirable flowers, ornamentals, vegetables, trees, or shrubs. Avoid contact of this product to leaves of desirable plants since foliar injury, discoloration or death may result.

**Site of action** Group 2: acetolactate synthase (ALS) inhibitor

**Chemical family** Sulfonylurea

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### pelargonic acid (Scythe)

*For ornamental trees and shrubs only*

**Rate** Broadcast: use 3 to 10 gal product per 100 gal water depending on species to be controlled. Spot spray: use 5 to 10% solution (6.67 to 13 fl oz/gal) to cover 400 sq ft.

**Time** For burndown of vegetation with directed and shield sprays, and sucker control. Apply to thoroughly wet foliage, either broadcast to non-crop area or preemergence to ornamental crop; or spot treat and trim around ornamentals, trees, flower beds, paths, and drives.

**Remarks** Controls small, actively growing weeds and weakens established weeds by removing susceptible vegetation. Disrupts cell membranes, causing leakage and symptoms of leaf burn.

**Site of action** Group 0: unknown

**Chemical family** Carboxylic acid

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### sethoxydim (Segment)

**Rate** 0.28 to 0.47 lb ai/A (36 to 60 fl oz/A)

**Time** Apply at optimum growth stage of grasses listed on the label.

**Remarks** Labeled for over the top or directed spray on many landscape ornamentals. Identify susceptible grasses. Control often is erratic on grasses stunted or stressed from drought, high temperatures, or low fertility. Resistant grasses include annual bluegrass and all fine fescues. Quackgrass can be suppressed. Inhibits fatty acid production, cell, membranes, and new growth.

**Site of action** Group 1: acetyl CoA carboxylase (ACCase) inhibitor

**Chemical family** Cyclohexanedione

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## Root Growth Control

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### spunbonded polypropylene + trifluralin (Typar Biobarrier)

**Remarks** A geo-textile fabric containing permanently attached nodules of time-release herbicide. Prevents root encroachment when placed vertically, horizontally, or surrounding structures such as sidewalks, roads, building foundations, curbs, tennis courts, swimming pools, septic fields, or underground pipes or cables in the soil. Extend edge of fabric 18 inches beyond structure to prevent root growth around edges of protected structure. Maintain at least 4 inches of soil overlay. Physical and mitotic inhibition of roots.

**Site of action** (trifluralin) Group 3: microtubule assembly inhibitor

**Chemical family** (trifluralin) dinitroaniline

# Bulb, Flower Beds, and Native Wildflowers

Aaron Becerra-Alvarez

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Multiply rate by 0.023 for amount per 1,000 sq ft

## Preemergence, Soil-applied Treatments

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### isoxaben (Gallery 75DF, SC, 2.5DG and several others)

*Perennial groundcovers and bulbs*

**Rate** 0.495 lb ai/A (0.66 lb/A Gallery 75DF)

**Time** Late winter and early spring. 2 to 4 weeks after planting, before bulbs and annual weeds emerge. Also may apply after bulbs emerge but before they flower.

**Remarks** Activate with 0.5 inch water or shallow cultivation before weeds emerge. Chemical stability remains adequate when left on soil surface for 21 days. Primarily for broadleaf control.

**Caution** Not for commercial production sites. Not recommended on tulips taller than 0.75 inch, or on gladiolus before emergence, or if corms were less than 1 inch in diameter, or on bulbs while they are flowering.

**Site of action** Group 29: cellulose synthesis inhibitor

**Chemical family** Benzamide

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### oryzalin (Surflan AS)

*Bulbous iris, daffodil, hyacinth, narcissus, tulip and others*

**Rate** 0.75 lb to 1.5 lb ai/A (0.75 to 1.5 quarts/A) depending on target species and time of year applied.

**Time** Apply 2 to 4 weeks after planting ornamental bulbs but before annual weeds emerge.

**Remarks** For fall-planted bulbs, apply in late winter to weed-free soil.

**Caution** Do not apply to emerged tulips taller than 0.75 inch. Do not apply to gladioli corms prior to emergence or less than one (1) inch in diameter.

**Site of action** Group 3: microtubule assembly inhibitor

**Chemical family** Dinitroaniline

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### oryzalin + benefin (XL 2G)

*Including bulbous iris, daffodil, hyacinth, and tulip*

**Rate** Bulbs: use 75 to 150 lb/A depending on soil texture and time of year. Flowers: use 200 lb/A per application with at least 2 months between applications, not to exceed 600 lb/A per year.

**Time** Apply before target weeds germinate or immediately after cultivation. For bulbs, apply 2 to 4 weeks after planting but before weeds emerge.

**Remarks** Consult label for tolerant flowers and bulbs. (Inhibits cell division or mitosis, primarily in roots.)

**Caution** Do not apply to tulips emerged to 0.75 inch high or more, or to gladiolus before it emerges, or to plants less than 1 inch in diameter. Sensitive species include Douglas-fir, eastern hemlock, and begonia.

**Site of action** (both) Group 3: microtubule assembly inhibitor

**Chemical family** (both) dinitroaniline

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### **oxadiazon (Ronstar 50 WSP)**

*Gladiolus bulbs only, and a few ground covers*

**Rate** 2 to 4 lb ai/A (4 to 8 lb/A WSP) depending on target weed species.

**Time** Apply any time to weed-free soil and irrigate with 0.25 to 0.33 inch water immediately after applying for annual weed control.

**Remarks** Over the top or directed sprays. Apply anytime during the year, prior to weed seed germination. Rainfall or overhead irrigation after application will improve weed control activity.

**Caution Applications of RONSTAR G must be made by a professional applicator only.** Irrigate within 2 hr if applied over the top to wash herbicide from leaves. Weeds in the pink family (chickweed, mouse ear chickweed, and pearlwort) are resistant. Primarily broadleaf control.

**Site of action** Group 14: protoporphyrinogen oxidase inhibitor

**Chemical family** Oxadiazole

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### **pendimethalin (Pendulum 2G, AquaCap 3.8ME, or several others)**

**Rate** 2 to 4 lb ai/A (100 to 200 lb/A 2G) depending on desired length of weed control. For wildflowers up to 2.1 quarts/A Pendulum AquaCap

**Time** Apply before, during, or after planting bulbs. Apply to seeded wildflowers after flower seedlings have emerged but before weed seeds germinate.

**Remarks** May be applied to control susceptible weeds (primarily grasses) in bulbs (including crocus, daffodil, gladiolus, and tulip) and established wildflowers (including black-eyed Susan, California poppy, coreopsis, and oxeye daisy) listed on the label. Primarily for grass control.

**Caution** Granules may stain stone, wood, or other porous surfaces.

**Site of action** Group 3: microtubule assembly inhibitor

**Chemical family** Dinitroaniline

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### **prodiamine (Barricade 65WG/4FL and several others)**

*See label for listed bulbs and wildflowers*

**Rate** 0.65 to 1.5 lb ai/A (1 to 2.3 lb/A 65WG or 21-48 oz/A 4FL) depending on length of control desired, and number of applications per year.

**Time** In fall or spring before weeds germinate or after weeds are removed.

**Remarks** Irrigate soon after treatment to wash herbicide onto the soil surface and to activate it within the top layer of soil. Do not exceed 2.3 lb/A.

**Site of action** Group 3: microtubule assembly inhibitor

**Chemical family** Dinitroaniline

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### **S-metolachlor (Pennant Magnum)**

*Many bulbs and flowers, except daffodil*

**Rate** 1.24 to 2.48 lb ai/A (1.3 to 2.6 pints/A) depending on soil type and organic matter.

**Time** After transplanting

**Remarks** Apply when soil has firmed around plant. Irrigate shortly after planting to wash the herbicide from foliage and to activate the herbicide in the soil. Will not control emerged weeds. Existing weeds must be removed. Primarily targets grasses but controls some broadleaves and suppresses nutsedge. Inhibits seedling roots and/or shoots.

**Caution** Consult label for tolerant and approved species. Do not apply more than twice per year.

**Site of action** Group 15: very long chain fatty acid synthesis inhibitor

**Chemical family** Chloroacetamide

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### **trifluralin (Treflan 10G)**

**Rate** 0.4 lb ai/A (40 lb/A)

**Time** Apply Trifluralin 10G to the soil surface 2 to 4 weeks after planting, but prior to the emergence of annual weeds. Trifluralin 10G may also be applied following bulb emergence. For fall planted bulbs, apply Trifluralin 10G again in late winter or early spring to weed-free soil surfaces.

**Remarks** Trifluralin must be activated by a single rain or overhead sprinkler irrigation of at least 0.5 inch. If not activated within 3 days, mechanically incorporate trifluralin with equipment that won't damage bulbs. Apply before weed seeds germinate; trifluralin will not control established weeds.

**Caution** Do not make preplant applications of Trifluralin 10G to areas where gladioli corms less than one inch in diameter will be planted or injury may occur.

**Site of action** Group 3: microtubule assembly inhibitor

**Chemical family** Dinitroaniline

## **Postemergence or Foliar-applied Treatments**

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### **bentazon (Basagran T&O, Broadloom)**

**Rate** 0.5 lb ai/A (1 pint/A Basagran)

**Time** Spring to early summer, depending on growth stage of weeds.

**Remarks** Use handheld pump-up backpack or knapsack sprayers to direct spray around bulbs, bedding plants and flowers. For control of Canada thistle and suppression of sedges and nutsedge where other options such as clopyralid or S-metolachlor are not possible. For Canada thistle, apply 2 pints/A when plants are between 8 inches tall and bud stage. Apply a second application 2 weeks later if needed. For nutsedge, apply 1.5 to 2 pints/A when plants are 6-8 inches tall, and make a second application 7 to 10 days later if needed. Always add a crop oil concentrate. Use no more than 2 lb ai/A per year. Irrigate to make sure plants are actively growing before applying bentazon. Not as effective if temperatures drop below 50°F at night and in daytime does not exceed 70°F. Efficacy will be poor on drought stressed weeds.

**Caution** Apply as a directed spray, away from the crop. May apply over the top of some species if crop oil concentrate is not added and application is tested on a few plants to verify crop safety.

**Site of action** Group 6: photosystem II inhibitor

**Chemical family** Benzothiadiazole

### **clethodim (Envoy Plus and several others)**

*Many bulbs, and flower beds*

**Rate** 0.09 to 0.18 lb ai/A (9 to 32 oz/A) depending on weed species

**Time** Apply postemergence to actively growing annual or perennial grasses as listed on label.

**Remarks** For grass control in ornamental plantings. Controls annual bluegrass. Applications made to grass plants stressed by insufficient moisture, hot or cold temperatures, or to grass plants exceeding recommended growth stages may result in unsatisfactory control. NIS required at 0.25%.

**Caution** Do not exceed 68 fl oz/A per season. Test for crop safety before applying to landscape species not listed on the label.

**Site of action** Group 1: acetyl CoA carboxylase (ACCase) inhibitor

**Chemical family** Cyclohexanedione

### **fenoxaprop ethyl (Acclaim Extra)**

*Daylily, iris and others*

**Rate** 13 to 39 fl oz/A

**Remarks** Adjust rates depending on number of grass tillers (see label). Ensure thorough coverage to actively growing, susceptible grasses. Repeat after grass begins active growth but do not exceed 120 fl oz/A per season. Inhibits fatty acid production, cell membranes, and new growth.

**Caution** Determine crop tolerance before extensive use.

**Site of action** Group 1: acetyl CoA carboxylase (ACCase) inhibitor

**Chemical family** Aryloxyphenoxy propionate

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### **fluazifop (Fusilade II)**

*Alyssum, marigold, petunia, geranium, iris, zinnia, and many others; not for tulips*

**Rate** 0.25 to 0.375 lb ai/A (16 to 24 fl oz/A)

**Time** Apply to actively growing grasses or within 7 days after irrigation with 0.25% nonionic surfactant when susceptible grasses are in the labeled growth stage.

**Remarks** Check label for crops that can be injured by over-the-top applications. Identify grasses and adjust rates depending on susceptibility and stage of weed growth as label instructs. Results often are erratic on grasses stressed from lack of vigor, drought, high temperature, or low fertility. More mature grasses and quackgrass can be controlled but may require two applications. Annual bluegrass and all fine fescues resist treatment. Inhibits fatty acid production, cell membranes, and new growth.

**Caution** Do not tank mix with other pesticides. Do not apply within 5 days of other pesticide treatments.

**Site of action** Group 1: acetyl CoA carboxylase (ACCase) inhibitor

**Chemical family** Aryloxyphenoxy propionate

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### **sethoxydim (Segment II)**

**Rate** 0.28 to 0.47 lb ai/A (1.5 to 2.5 pints/A)

**Time** Apply at optimum growth stage listed on the label.

**Remarks** Identify susceptible grasses. Control often is erratic on grasses stunted or stressed from drought, high temperatures, or low fertility. Resistant grasses include annual bluegrass and all fine fescues, but quackgrass can be suppressed. Inhibits fatty acid production, cell membranes, and new growth. Many species of bedding plants, ground covers and wildflowers are listed as tolerant on the label, but some have been injured in limited testing such as snow-in-summer (*Cerastium tomentosum*). Best to test plant tolerance on a small area if tolerance is in question.

**Site of action** Group 1: acetyl CoA carboxylase (ACCase) inhibitor

**Chemical family** Cyclohexanedione

# General Maintenance around Ornamental Plantings

Aaron Becerra-Alvarez

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## **diquat (Reglone)**

**Rate** 0.5 lb ai/A

**Time** Apply any time when weeds are small and actively growing.

**Remarks** Avoid spray contact with desirable ornamental plants. Acts as a contact; absorbs electrons after photosynthesis and recycles herbicide.

**Caution** A moderately toxic herbicide; protective gear required for handling and application. Do not ingest or inhale spray mist. Wear protective face shields, respirators, and clothing.

**Site of action** Group 22: photosystem I electron diversion

**Chemical family** Bipyridilium

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## **glyphosate (numerous product names)**

**Rate** Spray: use 1.5 to 5 lb ai/A, or 1 to 2% solution for high-volume sprayers.

**Time** Apply as directed spray toward base of ornamental plant when weeds are actively growing or moving sugars to roots.

**Remarks** Use lower rates for annual weeds; see label for higher rates and timing for perennial weeds. Expedite Application Equipment contains a special formulation using small-droplet technology.

**Caution** Do not spray green foliage or green bark. If repeating applications, do not exceed a total of 10.6 lb ai/A (10.6 quarts) per year. Inhibits production of three amino acids and protein synthesis.

**Site of action** Group 9: inhibits EPSP synthase

**Chemical family** None generally accepted

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## **glyphosate**

**Rate** Wiper: use 33% solution.

**Time** Apply 1 gal product to 2 gal water and wipe weeds, avoiding contact with desirable vegetation. In severe infestations, reduce equipment ground speed or apply in two directions to ensure contact with wiper. (See remarks above.)

**Site of action** Group 9: inhibits EPSP synthase

**Chemical family** None generally accepted