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Chemical Weed Control in Commercial Nursery & Landscape Plantings  
Michigan State University Extension Service  
Elton M. Smith, Landscape Horticulture, The Ohio State University  
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# CHEMICAL WEED CONTROL

## In Commercial Nursery & Landscape Plantings



Ohio Cooperative Extension Service  
The Ohio State University

1990



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# 1990 Chemical Weed Control In Commercial Nursery And Landscape Plantings

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## FACTORS AFFECTING HERBICIDE PERFORMANCE

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The effectiveness of a weed control program is only as successful as the person responsible for selection, calculation, calibration and application of herbicides. All herbicides will control weeds as specified on the label; therefore, it's up to us to create the proper conditions necessary to achieve the desired results.

Acceptable weed control can be achieved in the nursery or landscape throughout the year with two or three applications of the appropriate herbicides. A late fall or winter pre-emergence herbicide treatment should be followed by a late spring or early summer application after the initial cultivation. The combination of autumn and spring treatments usually results in the most effective weed control program.

Depending on the herbicide applied in summer, more than one application may be needed. If oats or cover crops are to be grown in autumn, use a short residual herbicide such as Dacthal, Lasso or Pennant rather than Ronstar or Princep combinations, which may inhibit seed germination.

Supplemental post-emergence treatments may be necessary to control perennial weeds and annuals not controlled with the pre-emergence herbicides.

A number of factors are important in making decisions on the selection of pre-emergence herbicides for maximum effectiveness.

### Plant Tolerance

Always consult the herbicide label to determine the safety of the herbicide on a particular landscape species. Use herbicides **only** when recommended for a given genera or species (see pages 15-18).

### Weed-Free Soil

Most effective weed control with pre-emergence herbicides is obtained when the soil has been tilled and all weeds eliminated. Most pre-emergence chemicals will not kill seedlings or estab-

lished weeds. Tilled soil allows for better herbicide penetration and distribution.

### Soil Moisture

When ½ inch of rainfall or irrigation follows within a few days after application of pre-emergence herbicides, most effective weed control is obtained. Application to moist soils is usually preferred to that of dry soils. Excessive moisture may reduce effectiveness of certain herbicides such as Treflan.

### Soil Temperature

Certain pre-emergence herbicides are affected by temperature. Products such as Casoron, Eptam and Treflan must be soil incorporated at higher temperatures or volatilization can occur and effectiveness lost.

### Soil Type and Organic Matter

Studies have shown that considerable variation exists in effectiveness of pre-emergence herbicides with different soil types. Casoron, for example, is more effective in heavy clay type soils than in light sandy soils, while Treflan controls weeds more efficiently in light or sandy soils. Organic matter in soil reacts with and absorbs herbicides. In general, the more organic matter, the higher the herbicide rate required to control weeds.

### Weed Species

A knowledge of the most prevalent weed species is paramount to selecting the proper herbicide. If ragweed is a problem, Ronstar, Treflan and Dacthal should not be selected; however, if annual grasses such as foxtail and crabgrass are the principal weeds, these herbicides would be excellent choices.

### Cultivation

Herbicides such as Dacthal are reduced in effectiveness by cultivation following treatment. Casoron, Devrinol, Pennant, Kerb, Princep, Ronstar, Surflan and Treflan treated soil can be disturbed with shallow (1-1½ inch) cultivation without reducing weed control. Cultivating deeper than 2 inches will reduce effectiveness of all the herbicides.

## PRE-EMERGENCE HERBICIDES FOR NURSERY-LANDSCAPE USE

**Betasan, Lescosan** *Bensulide* 10-12 lbs aia

Formulations—	12.5% G	80-100 lbs/A
	7.0% G	107-180 lbs/A
	3.6% G	209-348 lbs/A
	4 E	1 $\frac{1}{8}$ -3 $\frac{1}{8}$ gals/A in 80-100 gals water

Weeds controlled—Annual grasses, especially crabgrass and annual bluegrass.  
 Additional notes—Irrigate after application. Used primarily in flower and bulb plantings.

**Casoron, Dyclomec, Norosac, Barrier** *Dichlobenil* 5-6 lbs aia

Formulations—	4% G	125-150 lbs/A
	2% G	250-300 lbs/A

Weeds controlled—Annuals and perennials, especially mugwort, thistle, nutsedge, quackgrass and bindweed. Avoid use on fir, spruce, hemlock, certain Japanese holly and viburnum.  
 Additional notes—Not as effective in fine, sandy soil. Apply in autumn or early winter. Incorporate 2-3 inches if soil temperature is above 45°F.

**Dacthal** *DCPA* 10.5-12.0 lbs aia

Formulations—	75% WP	14-16 lbs/A
	5% G	210-240 lbs/A

Weeds controlled—Annual grasses and some broadleaf weeds, including dodder.  
 Additional notes—Irrigate following application to improve effectiveness. Safe to use with most woody species and many herbaceous species.

**Devrinol** *Napropamide* 4-6 lbs aia

Formulations—	10% G	40-60 lbs/A
	50% WP	8-12 lbs/A in 50 gals water

Weeds controlled—Annual grasses and broadleaf weeds, including chickweed, groundsel, lamb's-quarters and redroot pigweed.  
 Additional notes—Registered for field-grown and container trees, shrubs and ground covers. Improve effectiveness with incorporation by tillage or water.

**Pennant** *Metolachlor* 2-4 lbs aia

Formulations—	5% G	40-80 lbs/A
	7.8% E	2-4 pts/A

Weeds controlled—Most annual grasses and yellow nutsedge.  
 Additional Notes—Registered for field grown and container trees, shrubs and ground covers. Improve effectiveness with incorporation by tillage or water. Do not use on seedbeds, unrooted cuttings or on foliage that is wet or under covered polyhouses.

Combinations with Dual + Princep —

Pennant 7.8 E — 2-4 pts/A + Princep 80W — 1.25 lbs/A  
 Pennant 7.8 E — 2-4 pts/A + Princep Caliper 90-1.1 lbs/A  
 Pennant 7.8 E — 2-4 pts/A + Princep 4 L — 1.6-2.0 pts/A

**Eptam** *EPTC* 3-6 lbs aia

Formulations— 10% G 30-60 lbs/A  
7 E 5¼-7 pts/A in 10-50 gals water

Weeds controlled—Annual weeds plus nutsedge, quackgrass and mugwort.

Additional notes—Eptam must be incorporated 2-3 inches for annual weed control and 6 inches by cross disking for perennial weed control. For mugwort control, use 17 pints of 7 E in 10-50 gals of water.

**Gallery** *Isoxaben* 0.5-1.0 aia

Formulations— DF 0.66 0.66-1.33 lbs/A

Weeds controlled—Broadleaf weeds such as bittercress, common groundsel, spurge, chickweed and oxalis. More effective against broadleaf weeds but will also control barnyard grass, annual bluegrass, crabgrass and foxtail.

Additional notes—Can be used in containers, field stock, ground covers and in the landscape. Do not use on bedding plants.

**Goal** *Oxyfluorfen* 1-2 lbs aia

Formulation— 2 E 4-8 pts/A

Weeds controlled—Barnyardgrass, crabgrass, pigweed, lesser bittercress, lamb's-quarters, groundsel, chickweed and purslane.

Use **only** for conifer seedbeds, transplants and container stock.

**Goal Combinations**—Granular formulations

**OH-2** — Goal + Prowl 100 lbs/A

**Rout** — Goal + Surflan 100 lbs/A

Weeds controlled—Lesser bittercress, chickweed, dandelion, groundsel, oxalis and spurge, among others.

Additional notes—Do not apply in greenhouses or polyhouses or for 3-4 weeks following removal of poly. Apply when foliage is dry. Avoid treatment during a growth flush.

**Kerb** *Pronamide* 2.0 lbs aia

Formulation— 50% WP 4.0 lbs/A

Weeds controlled—Annual and perennial grasses and chickweed, winter annuals and curly dock.

Additional notes—Apply **only** in autumn or winter for control primarily of established perennial grasses such as quackgrass. Kerb is a restricted use pesticide.

**Lasso** *Alachlor* 4.0 lbs aia

Formulations— 15% G 27 lbs/A  
4 E 4 qts/A in 20 or more gals water

Weeds controlled—Most annual grasses plus carpetweed, pigweed and purslane. Reduces competition from seedling johnsongrass, yellow nutsedge, lamb's-quarters, nightshade, ragweed and smartweed.

Additional notes—The 4E formulation is registered for juniper and taxus only, while the 15G is labeled for cotoneaster, crabapple, dogwood, euonymus, holly, juniper and taxus. Irrigate after treatment to avoid crop injury. Do not apply in polyhouses, on seed beds or on unrooted cuttings. Alachlor is a restricted use herbicide.

**Princep** *Simazine* 1-3 lbs aia

Formulations— 4% G 25-75 lbs/A  
4 L 1-3 qts/A  
80 W 1.3-3.8 lbs/A  
Caliber 90 2.2-3.4 lbs/A in 25 gals water

Weeds controlled—Annual grasses and broadleaf weeds for up to 3 months during the growing season.

Additional notes—Autumn or early winter applications at 2-3 lbs aia are suggested. A rate of 1-1.5 lbs aia is recommended for summer use alone or in combination with Dacthal, Devrinol, Pennant, Lasso or Surflan. Princep may injure birch, euonymus, deutzia, lilac, linden, privet and spirea.

**Ronstar** *Oxadiazon* 2.0-4.0 lbs aia

Formulations— 2% G 100-200 lbs/A  
50% WP 4-8 lbs/A

Weeds controlled—Many annual grasses and broadleaf weeds, including lesser bittercress, common groundsel, galinsoga, Pennsylvania smartweed, yellow woodsorrel and barnyardgrass.

Additional notes—Effective results can be expected for 2-3 months. Avoid application of 2G to wet foliage to prevent phytotoxicity. Ronstar 50WP registered for use only in arborvitae, false cypress, juniper, euonymus, pine, boxwood and holly. Ronstar 50WP can be tank mixed with Roundup. Use Ronstar WP at 4-8 lbs/A or 1.5-3.0 oz/1000 sq ft.

**Surflan** *Oryzalin* 2-4 lbs aia

Formulation— A.S. 2-4 qts/A

Weeds controlled—Annual grasses, chickweed, purslane, lamb's-quarters and pigweed.

Additional notes—Labeled for trees, shrubs, evergreens, ground covers and annual flowers. Apply ½ inch of water to activate herbicide following application. Tank mixes of Surflan and Roundup are registered as a combination product to undesirable vegetation. Surflan can also be mixed with Fusilade and Poast.

**XL** *Oryzalin + Benefin* 4-6 lbs aia

Formulations— 2 G 200-300 lbs/A

Weeds controlled—Barnyard grass, crabgrass, foxtails, goosegrass, johnsongrass (from seed), annual ryegrass and annual bluegrass. Also, carpetweed, prostrate knotweed, common purslane, common chickweed and henbit.

Additional notes—Labeled for container grown stock, plants in the landscape and ground covers. Use on blue fescue, firethorn, gazania, English Ivy, juniper, photinia and St. Johnswort. Also, bulbous iris, narcissus and tulip.

**Treflan** *Trifluralin* 1-4 lbs aia

Formulations— 5% G 20-80 lbs/A  
4 E 1-4 gals

Weeds controlled—Annual grasses and some broadleaf weeds.

Additional notes—Treflan should be incorporated 2-3 inches into the soil. Treflan is safe on nearly all landscape plants and is highly recommended during the first growing season of woody plants, in new ground cover and in flower garden plantings. Do not apply Treflan 5G when the foliage is wet.



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## POST-EMERGENCE HERBICIDES FOR NURSERY-LANDSCAPE USE

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Post-emergence herbicides are used for general weed cleanup around buildings, waterways, fencerows, etc. Used with extreme caution, these materials may be used in tree plantings. Avoid herbicide contact with foliage, trunks or stems with green tissue of desired crops as damage will result from each of these materials.

### **Amitrole (*Amino triazole*)**

Applied to the foliage of perennial broadleaf weeds and absorbed and translocated to the stems and roots. It is more effective against poison ivy than Roundup and very effective against Mugwort. Commercial formulations of amino triazole are restricted use pesticides. If it should contact foliage of desired plants, leaves turn yellow, white and then brown. Use only as a spot treatment for perennial weeds in or near nursery crops.

### **Amizine (*Amino triazole* and *Simazine*)**

A mixture of 15% Amitrole and 45% Simazine used at the rate of 7 lbs/A of commercial product to control perennial weeds and prevent the growth of seedlings. Apply when weeds are small and thoroughly cover the foliage and soil surface. Most effective in non-crop areas.

### **Asulox (*Asulam*)**

Controls annual grasses when applied as an over-the-top spray on juniper and taxus only. Apply to actively growing grasses between seedling and early seedhead formation for most effective control. Apply at 1 gal/A without surfactant to control crabgrass, barnyardgrass, fall panicum, foxtail, goosegrass and horseweed. Apply with a minimum of 20 gals of water/A. Asulox is a systemic herbicide that requires 4-6 weeks for effective control. It is safe to replant in treated soil one month after treatment.

### **2,4-D and Related Compounds**

The non-volatile forms of 2,4-D can be used among trees to control broadleaf weeds when there is no air movement. If grasses are also a problem, 2,4-D should not be used.

### **Fusilade 4E, Ornamec or Fusilade 1E (*Fluazifop butyl*)**

A systemic herbicide that controls a wide range of annual and perennial grasses. Use 13 oz. Fusilade 1E (2000) or 1 pt Fusilade 4E or Ornamec with 3 ozs/10 gals of nonionic surfactant in 5-40 gals water at 40-60 psi to treat 1 acre. For best control, treat grasses before they reach 8-10 inches in height. Over-the-top applications may be made to about 140 species of landscape plants grown in Ohio, including annual and perennial flowers, ground covers, evergreens, shrubs and trees. Approximately 40 species are labeled for directed spray applications. Read label for complete listing of tolerant plants.

### **Gramoxone Extra (*Paraquat*)**

Used at the rate of .63-.94 lb aia or 2.0-3.0 pts of the commercial formulation per sprayed acre for control of annual weeds and grasses and for top kill of perennial weeds and grasses around the base of trees. Avoid use on green-barked trees, including littleleaf linden. Repeat applications as necessary to control newly germinated seedlings and to control regrowth of perennials. A surfactant should be used. There is no soil residue. Use protective gloves while handling the concentrate to avoid contact with skin. Gramoxone Extra is a restricted use pesticide and replaces Gramoxone Super.

### **Poast (*Sethoxydim*)**

Controls annual and perennial grasses but not sedges or broadleaf weeds when applied as an over-the-top spray. Apply at the rate of 1-2½ pts/A when grasses are no taller than 6-8 inches in height. Combine 2 pts oil concentrate in 20 gals water/A, and apply at 40-60 psi to penetrate the grass foliage. For spot treatment prepare a 1% solution of Poast and oil by mixing 1¼ fl oz (2 tbs) of each material per gallon of water. The following plants are tolerant: trees—arborvitae, ash, birch, dogwood, fir, hemlock, honeylocust, Southern magnolia, maple, oak, Russian olive, pine, poplar, spruce, sweetgum and sycamore. Shrubs—alpine currant, boxwood, cotoneaster, elaeagnus, euonymus, forsythia, holly, honeysuckle, juniper, lilac, ninebark, rhododendron, sandcherry, spirea, viburnum and yew. Ground covers—ivy, myrtle and pachysandra. Flowers—begonia, chrysanthemum, coleus, geranium, gladiolus, impatiens, iris, marigold, petunia, pinks, snapdragon, sweet william and zinnia. Foliage discoloration can be expected with some juniper selections.

### **RAD-E-GATE 25 or Phytar 560 (*Cacodylic Acid*)**

Used to control annual and perennial weeds around trees, for lawn renovation and for general weed control in non-crop areas. A surfactant is not needed; it's inactivated on contact with the soil. If regrowth occurs, re-apply as required. Apply at the rate of 3 gals/A. Do not spray on basal suckers.

### **Roundup (*Glyphosate*)**

Controls annual and perennial weeds when used before planting and in established ornamentals. Registered as a directed spray toward the base of arborvitae, azalea, boxwood, crabapple, euonymus, fir, Douglas fir, holly, lilac, magnolia, maple, oak, privet, pine, spruce and yew. To control weeds, apply to actively growing grasses and broadleaf weeds. Use 1 qt/A in 10-40 gals water if weeds are less than 6 inches tall. Apply 2-3 qts/A to control Canada thistle and 3-4 qts for field bindweed and trumpet creeper control. Non-ionic surfactants such as Improve may be used to assist in wetting of foliage. Most effective control of perennial weeds is obtained when weeds are in the flower bud or bloom stage at treatment. There is no soil residue; however, a waiting period of 3-7 days is necessary after treatment and before tillage to obtain maximum weed control. Highly recommended for use with rope wick applicators on labeled crops.



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## WEED CONTROL

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### Combinations of Post-Emergence With Pre-Emergence Herbicides

Combinations of post-emergence with pre-emergence herbicides are used to kill existing weeds and prevent emergence of others. The combinations below have been used extensively in trees with excellent success.

**Gramoxone Extra** at 2.0-3.0 pts/A plus **Princep 80 W** 1-2 lbs aia (1.3-2.5 lbs)

Use as a directed spray and treat regrowth as needed with Gramoxone Super only. Avoid contact with foliage and green, yellow or immature bark.

**RAD-E-CATE** or **Phytar 560** at 3 gal/A plus **Princep 80 W** 1-2 lbs aia (1.3-2.5 lbs)

May be used in the same way as Gramoxone Super and Princep with the same precautions.

**Roundup** at 1-3 qts/A plus **Surflan 75 W** at 2 $\frac{2}{3}$ -5 $\frac{1}{2}$  lbs

**Roundup** at 1-3 qts/A plus **Princep 80 W** at 1.5-3.5 lbs

**Roundup** at 1-3 qts/A plus **Princep 4 L** at 1.0-3.0 qts

**Roundup** at 1-3 qts/A plus **Princep Caliper 90** at 2.2-3.4 lbs

Weeds can be significantly reduced in the field the year prior to planting by: 1) growing one or more cover crops and 2) repeated disking or tilling of plowed ground. More effective is use of a combination of herbicides and repeated disking.

### Post-Emergence Herbicides

Most broadleaf weeds can be controlled with Roundup, Amitrole or 2,4-D the season before growing a crop. Weeds somewhat resistant to these herbicides can be reduced with repeated use of directed sprays of Gramoxone Extra or similar type compounds. Gramoxone Extra will kill most all green plants; therefore, care must be exercised in avoiding spray drift. Several applications will be necessary to eliminate perennial weeds. Roundup at 1-2 lbs will control quackgrass. Apply when the grass is 4 to 6 inches tall and retreat in two weeks if needed.

### Pre-Emergence Herbicides

Casoron at 6-8 lbs aia will reduce quackgrass, mugwort, dandelion, bindweed, thistle and other perennials. Disk every 6-8 weeks during the season. Planting should be delayed one planting season if the 8 lb rate is used.

Eptam incorporated into the soil at a rate of 5-15 lbs aia controls quackgrass, nutgrass and mugwort.

### Weed Control in Liner Beds



### Pasteurization

Heating the soil to 160°F with steam for one-half hour will kill most weed seeds and stolons. Steaming at 180°F eliminates most other harmful organisms such as insects, diseases and nematodes. Steam pasteurization of the soil is economical when high dollar-value plants are grown in a limited area. Portable steam generators can be used for bed pasteurization.

### Fumigation

The soil temperature should be at least 50°F (60°F for chloropicrin), moist and well worked for effective weed control with fumigants. Some of the most commonly used chemicals are (1) CHLORO-O-PIC (chloropicrin), (2) TERR-O-GAS, BROM-O-GAS (methyl bromide with chloropicrin), (3) METH-O-GAS, BROM-O-SOL (methyl bromide), (4) Vapam, VPM (metham-sodium), (5) Vorlex (methyl isothiocyanate plus dichloropropene-dichloropropane), and (6) Mylone, Basamid-Granular (dazomet). There are specific instructions for use with respect to covering or sealing with each of the fumigants plus a specific waiting period before planting. Methyl bromide is a restricted use fumigant.

### Herbicides

**Dacthal** — Use at 10 lbs aia for annual grasses and some broadleaf weeds. Reapplication is necessary every 4-6 weeks during spring and summer.

**Pennant** — Apply at 2-3 lbs aia for annual grass control in deciduous shrubs and evergreens. Can be combined with Princep for use in yew, juniper, arborvitae, etc.

**Kerb** — Effective against winter annual grasses and selected broadleaf weeds at 2 lbs aia. Apply over plants established at least one full growing season.



**Princep** — Use alone at 1 lb aia or in combination with Dacthal at 5 lbs aia or Surflan at 2 lbs aia in conifer beds.

**Treflan** — Preplant treatment at 1-4 lbs aia for all woody plants. Not effective in high organic soils such as those containing large amounts of peat moss.

### Weed Control at Planting And During the First Growing Season



Just before planting a field to young nursery stock, Treflan can be applied at the rate of 1-4 lbs aia. Incorporating immediately to a depth of 2 inches with a rotovator or tiller is more effective than using a disk type harrow. Treflan effectively controls annual grasses and most broadleaf weeds except ragweed, smartweed and velvetleaf. The effectiveness of Treflan is increased if shallow cultivation (1½-2 inches follows application by 2-3 weeks).

After Treflan is no longer effective, other herbicides can be used during the first growing season, depending on the nursery crops grown. On crops tolerant of Princep, the combination of Princep at 1 lb aia with Dacthal, Pennant, or Surflan can be used during the first growing season. Granular Princep applied after June 1 may affect cover crop germination. Dacthal at 10.5 to 12 lbs aia or Surflan at 2-4 lbs aia can also be used on first year plantings. Devrinol at 4 lbs aia, Pennant at 2-3 lbs aia and Ronstar at 3 lbs aia are also used during the first growing season. Irrigate following application for most effective results.



### Controlling Weeds in Established Plantings in the Nursery or Landscape

#### Annual Weeds

To control weeds throughout the year, herbicides should be applied in the autumn or early winter and again in the spring and/or summer as necessary. Princep applied in autumn at 3 lbs aia will normally remain effective until late spring or early summer at which time the nursery should be cleaned of weeds. Another application of a pre-emergence herbicide should be applied.

Ronstar, Dacthal, Devrinol, Pennant, Lasso or Surflan could follow a 3 lbs fall or winter application of Princep. More than one application of Dacthal, Pennant, and Surflan will be needed throughout the summer. If oats or fall cover crops are to be planted, avoid an application of a herbicide that will remain effective past mid-August.

Soil treated the previous fall or winter with Princep at 1-3 lbs aia can be retreated with Princep at 1 lb aia in combination with Dacthal, Devrinol, Pennant or Surflan. The advantage to combining these herbicides with Princep is to increase the length of time the treatments remain effective and to control a wider spectrum of weeds, especially grasses. Princep at 2-3 lbs aia in spring or summer should not follow Princep at 3 lbs. aia in the fall. Princep at 3 lbs aia could be applied in spring or summer if not used the previous autumn. Princep should not be used at rates greater than 4 lbs aia in any one year.

#### Post-Emergence

Post-emergence herbicides can be used in the nursery and landscape in certain situations. Some of these herbicides will injure

desired ornamentals if the spray contacts the foliage; therefore, extreme caution must be exercised in application.

Post-emergence sprays are most effectively used in tree areas and in plantings of large shrubs where the foliage is not likely to be sprayed. Most post-emergence sprays have limited application in evergreen blocks because the foliage often extends to or close to the soil. The exceptions to this use are Asulox on juniper and taxus, Fusilade and Poast, which are safe to use as oversprays on selected species.

To control annual grasses and broadleaf weeds, apply Gramoxone Extra, RAD-E-CATE 25, Roundup or comparable compounds.

To kill existing weeds and prevent emergence of others, apply a pre- and post-emergence herbicide in combination. Gramoxone Extra or RAD-E-CATE 25 plus Princep, which must be mixed, has been effective in controlling existing weeds within days with excellent pre-emergence control for two to three months for most annual weeds. Retreatment of the post-emergence herbicide is usually necessary 2-3 times during the season.

**PRE-EMERGENCE** (Herbicides listed by lbs active ingredient/acre.)

Season	Evergreens	Deciduous Trees	Deciduous Shrubs
Autumn	PRINCEP (2-3 lbs) CASORON (6 lbs)	PRINCEP (1-3 lbs) CASORON (6 lbs)	CASORON (6 lbs) PRINCEP (2-3 lbs)
or	KERB (2 lbs) DEVINOL (5 lbs)	DEVINOL (5 lbs) GALLERY (0.5-1.0 lbs)	KERB (2 lbs) DEVINOL (5 lbs)
Winter	GALLERY (0.5-1.0 lbs)		GALLERY (0.5-1.0 lbs)
Spring	PRINCEP (1-3 lbs) PRINCEP (1 lb) plus DEVINOL (5 lbs) OR DACTHAL (5.25 lbs) OR SURFLAN (2 lbs) OR DUAL (2 lbs)	PRINCEP (1-3 lbs) PRINCEP (1 lb) plus DEVINOL (5 lbs) OR DACTHAL (5.25 lbs) OR SURFLAN (2 lbs) OR DUAL (2 lbs)	PRINCEP (1-3 lbs) RONSTAR (2-4 lbs) DEVINOL (5 lbs) DACTHAL (10.5-12.0 lbs) OR SURFLAN (2-4 lbs) LASSO (4 lbs)
or	RONSTAR (2-4 lbs) DEVINOL (5 lbs) SURFLAN (2-4 lbs)	RONSTAR (2-4 lbs) SURFLAN (2-4 lbs) DEVINOL (5 lbs)	PENNANT (2-4 lbs) PRINCEP (1 lb) plus DEVINOL (5 lbs) OR DACTHAL (5.25 lbs) OR SURFLAN (2 lbs) OR PENNANT (2 lbs)
Summer	LASSO (4 lbs) DACTHAL (10.5-12.0 lbs) PENNANT (2-4 lbs) OH 2 (2 + 1 lbs) ROUT (2 + 1 lbs) GALLERY (0.5-1.0 lbs)	LASSO (4 lbs) PENNANT (2-4 lbs) DACTHAL (10.5-12.0 lbs) OH 2 (2 + 1 lbs) GALLERY (0.5-1.0 lbs)	ROUT (2 + 1 lbs) XL (4-6 lbs.) GALLERY (0.5-1.0 lbs)

**Pre-Emergence**

<b>Casoron</b> (6 lbs)	Apply in fall, winter, or spring before April 1. Cultivate frequently. Expect some control of quackgrass, mugwort, bindweed, dandelion and thistle.
<b>Eptam</b> (5-15 lbs)	Incorporate after application to control nutsedge, quackgrass and mugwort.
<b>Kerb</b> (2 lbs)	Apply in fall or early winter to control quackgrass, orchardgrass, perennial ryegrass, perennial bluegrass, dock and sheep sorrel. This pre-emergence herbicide provides post-emergence control of numerous perennial grasses.

**Post-Emergence**

<b>Amitrole</b>	Apply when growth of weeds is most active to control quackgrass, mugwort, bindweed, dandelion and thistle. Retreat in 10-14 days.
<b>Asulox</b>	Spray annual grasses in active growth in juniper and taxus only.
<b>Fusilade</b>	Apply to grasses in active growth.
<b>Poast</b>	Spray annual and perennial grasses 6-8 inches in height.
<b>Roundup</b>	Spray quackgrass and other perennial grasses in active growth. Most broadleaf perennials are controlled more effectively in late summer or early autumn.



## Controlling Weeds in Annual and Perennial Flowers



## Controlling Weeds in Ground Cover Plantings



### Pre-Emergence

<b>Betasan, Lescosan</b> (10-12 lbs aia)	Registered for many herbaceous plants and 7 bulbous crops. Use granular form; incorporate and irrigate after application. It is most effective against annual grasses.
<b>Dacthal</b> (9 lbs aia)	Recommended for 52 established flowers. Apply after planting. Avoid use on carnation, geum, pansy, phlox and sweet william.
<b>Eptam</b> (3 lbs aia)	Incorporate before planting young plants. Safe with alyssum, ageratum, amaranthus, aster, balsam, begonia, mums, dahlia, daylily, dianthus, nasturtium, marigold, pansy, petunia and zinnia.
<b>Goal &amp; Surflan</b> (2 + 1 lbs aia)	Registered only for candytuft, salvia and verbena.
<b>Surflan</b> (2-4 lbs aia)	Limited to use on begonia, chrysanthemum, gazania, geranium, impatiens, marigold, pansy, periwinkle, petunia, stock and zinnia.
<b>Treflan</b> (1-4 lbs aia)	Apply before setting the plants and incorporate 2-3 inches in soil. Labeled for more than 40 flowers.

The ground covers listed are those labeled for each herbicide at recommended rates.

<b>Betasan, Lescosan</b> (10-12 lbs aia)	Ajuga, English ivy, juniper, myrtle, pachysandra, sedum
<b>Dacthal</b> (12.0 lbs aia)	Cotoneaster, euonymus, juniper, pachistima, Boston ivy, English ivy, honeysuckle
<b>Devrinol</b> (4.0-6.0 lbs aia)	Ajuga, English ivy, hypericum, liriopie, myrtle, pachysandra
<b>Pennant</b> (2-4 lbs aia)	English ivy, euonymus, honeysuckle, juniper, pachysandra
<b>Dual + Princep</b> (2 + 1½ aia)	Liriopie
<b>Eptam</b> (5-15 lbs aia)	Ajuga, English ivy, myrtle, pachysandra, sedum
<b>Gallery</b> (0.5-1.0 lbs aia)	Cotoneaster, English ivy, juniper, liriopie and pachysandra
<b>Goal + Prowl</b> (2 + 1 lbs aia)	Pachysandra, potentilla
<b>Goal + Surflan</b> (2 + 1 lbs aia)	Euonymus
<b>Princep</b> (1-3 lbs aia)	Cotoneaster, juniper
<b>Ronstar</b> (2-4 lbs aia)	Cotoneaster, English ivy, euonymus, juniper, myrtle
<b>Surflan</b> (2-4 lbs aia)	Cotoneaster, euonymus, juniper, myrtle, stonecrop
<b>Treflan</b> (1-4 lbs aia)	Cotoneaster, euonymus, honeysuckle, juniper, potentilla
<b>XL</b> (4-6 lbs aia)	Blue fescue, English Ivy, juniper and St. John's Wort



## Controlling Weeds in Container Grown Plants



Pasteurization (See Weed Control in Liner Beds)  
 Fumigation (See Weed Control in Liner Beds. Treat soil in bulk before filling containers.)

### Herbicides

**Dacthal**  
(12.0 lbs aia) Effective against crabgrass, purslane and lamb's-quarters but not ragweed or galinsoga.

**Devrinol**  
(5 lbs aia) Most effective against annual grasses and nutsedge. Irrigate immediately following application.

**Gallery**  
(0.5-1.0 lbs aia) Controls difficult weeds such as bittercress, groundsel, spurge and yellow woodsorrel

**Goal**  
(1-2 lbs aia) Registered for conifers only to control lesser bittercress, groundsel, common chickweed, etc.

**OH 2**  
(2 + 1 lbs aia) Effective in the control of chickweed, groundsel, bittercress, spurge and oxalis.

**Rout**  
(2 + 1 lbs aia) Controls similar weeds as above. Effective for 3 months from spring application.

**Lasso II**  
(4 lbs aia) For use with juniper and holly only. Most effective for annual grass control.

**Princep**  
(1 lb aia) Used with conifers in container production. Combine with Dacthal, Devrinol, or Lasso for broadleaf weed and grass control.

**Ronstar**  
(2-4 lbs aia) Effective in control of annual broad-leaf weeds such as groundsel, galinsoga and oxalis.

**Surflan**  
(2-4 lbs aia) Controls annual grasses and broad-leaf weeds, including chickweed.

**Treflan**  
(1-4 lbs aia) Used to control annual grasses. Irrigate immediately after application.

**XL**  
(4-6 lbs aia) Controls annual grasses and knotweed, purslane, chickweed and henbit.

Walkways and borders — Post-emergence herbicides — Gramoxone Extra, RAD-E-CATE 25 or Roundup. Use low pressure to avoid drift; direct spray to avoid foliage contact with ornamentals.

Soil under containers — gravel over plastic — use 5-6 inches of gravel over plastic.

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## MIXING HERBICIDES

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The following instructions for mixing herbicides for sprayer application should be followed carefully:

- The manufacturer's label usually lists the number of **pounds** of active ingredient contained in each gallon of herbicidal concentrate. The percentage of active material is listed for wettable powders and granular materials. Aia refers to the amount of active ingredient to be applied per acre. The active ingredient is the amount of pure herbicide material in a compound or formulation. To compute the pounds of wettable powder or granular product needed per acre, divide the desired aia by the percent product formulation. A recommendation of 3 pounds aia of Princep can be computed as follows:

$$\begin{array}{l} 4\% \text{ Granular Formulation} \\ 3.0 \div .04 = 75 \text{ lbs Princep 4-G} \end{array}$$

$$\begin{array}{l} 80\% \text{ Wettable Powder} \\ 3.0 \div .80 = 3.75 \text{ lbs Princep 80 W} \end{array}$$

Thus, either 75 pounds of G-4 or 3.75 pounds of 80 W Princep will equal 3.0 pounds aia. Formulas for calculating amounts of herbicides appear on pages 11-12.

- Instructions on the manufacturer's labels pertaining to personal hazards in handling should be read and strictly observed.

3. Concentrated herbicides should never be poured directly into an empty spray tank.
  - a. First, fill the tank ½ full with water
  - b. Add the herbicidal concentrate
  - c. Finish filling the tank with water
4. To ensure thorough mixing, operate the spray rig with the control valve in the closed position for a few minutes. This bypasses the liquid into the spray tank.
5. Never allow a sprayer with mixed chemicals to stand without agitation. Heavy wettable powders may clog nozzles and settle into the corners of the spray tank, becoming very difficult to remove.
6. Always be sure the herbicide sprayer has been calibrated properly to ensure application of the herbicide at the recommended rates.

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## STORING SPRAYERS

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Most herbicides can be easily cleaned from spray equipment. Do not leave herbicide solutions in sprayers for any extended period of time. Always flush the system with detergent water as soon as possible. All spray lines and pumps should be drained of water. The tank should be drained of water. The pump should

be filled with oil or some other suitable lubricant to eliminate rust damage and pump freezing. Store large sprayers in a dry barn or shed until needed again. Nozzles, caps, screens, etc. should be removed from the spray rig, cleaned and placed in clean cloth bags until ready to use again.

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## PREVENTING PLANT DAMAGE FROM HERBICIDE SOIL RESIDUES

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Planting into soils previously treated with herbicides occasionally causes some concern. If a cover crop has not been grown and replanting is necessary, the following procedures can be followed to prevent injury if a high level of herbicide is suspected. (High levels can be confirmed by germinating oats in the soil. If after 2-3 weeks the oats are green and growing, there is little residue remaining.)

Dip the moist roots of the transplantings into dry activated carbon or into a slurry of 1 lb/gal of water before setting. Use Aqua Nuchar A or equivalent grade available from industrial chemical or drug supply companies or Gro-Safe available from nursery suppliers.

When an overdose of herbicides is applied the plants may or may not be injured depending on the species involved, herbicide and rate it was applied. Activated carbon, which neutralizes Princep and Casoron, among others, can be distributed around the base of the plants involved to protect from injury or death. Use the carbon at the rate of 150 lbs times the suspected aia of herbicide applied. For example, if Princep was broadcast applied to cover 1 acre at the rate of 6 lbs aia, then  $6 \times 250$  or 900 lbs activated carbon should be applied per acre. Apply the carbon only as a band under the plants rather than broadcast, and incorporate into the soil for more immediate results. Therefore, only ¼ to ⅓ of the 900 lbs would be needed to row-treat the area treated with herbicide.

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## FORMULAS AND EXAMPLES FOR CALCULATING AMOUNTS OF HERBICIDES

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The percent formulation of a given herbicide and the pounds aia recommended can be obtained from the section "Pre-emergence Herbicides for Nursery-Landscape Use" or from the herbicide label.

### Granular Materials

Example — A landscaper needs to treat 4,000 sq ft of Arborvitae with 2% Ronstar granules at 4 lbs aia. How much Ronstar is required?

#### Formula

$$\text{lbs aia} \times \frac{\text{sq ft to be treated}}{44,000 \text{ sq ft/acre}} \times \frac{100}{\% \text{ granular}} = \text{lbs required to treat area}$$

#### Calculation

$$4 \text{ lbs aia} \times \frac{4,000}{44,000} \times \frac{100}{2} = 18.2 \text{ lbs } 2\% \text{ granular Ronstar}$$



## Wettable Powder

Example — A nurseryman needs to treat 3 acres with 50% Kerb wettable powder at the rate of 10 lbs aia.

### Formula

$$\text{lbs aia} \times \frac{\text{sq ft to be treated}}{44,000 \text{ sq ft/acre}} \times \frac{100}{\text{powder}} = \text{lbs required to treat area}$$

### Calculation

$$10 \text{ lbs aia} \times \frac{132,000}{44,000} \times \frac{100}{50} = 60 \text{ lbs 50\% Kerb WP to be mixed in enough water to cover 3 acres}$$

## Liquid Concentrate

Example — The recommendation is to apply trifluralin at 2 lbs aia. Because Treflan contains 4 lbs active ingredient/gal, how many gallons should a grower apply on ½ acre?

### Formula

$$\text{lbs aia} \times \frac{\text{sq ft to be treated}}{44,000} \times \frac{1}{\text{lbs active ingredient/gal}} = \text{gals treated to treat area}$$

### Calculation

$$2 \text{ lbs aia} \times \frac{22,000}{44,000} \times \frac{1}{4} = .25 \text{ or } \frac{1}{4} \text{ gal Treflan to be mixed in enough water to cover } \frac{1}{2} \text{ acre}$$

## Band Treatment

Less total herbicide is used and, therefore, costs are reduced with band treatment. With band treatment, the soil surface in the row is treated but the area between the rows is not and must be cultivated or mowed. The actual amount of herbicide is calculated on total in-row and not total acreage. The formula to calculate amounts of herbicide to apply in band treatment follows:

## Granular or Wettable Powder

Example — How much 4% granular Casoron is required to treat 10,000 sq ft at 6 lbs aia with a 1-ft band? The rows are 4 ft apart.

### Formula

$$\text{lbs aia} \times \frac{\text{Total area in nursery planting}}{44,000} \times \frac{\text{Fraction of total area contained in 1 ft of area to be treated}}{44,000} \times \frac{100}{\% \text{ active ingredient}} = \text{lbs herbicide required to treat area}$$

### Calculation

$$6 \text{ lbs aia} \times \frac{10,000 \times \frac{1}{4}}{44,000} \times \frac{100}{4} = 8.52 \text{ lbs Casoron to treat in row area}$$

## Liquid

### Formula

$$\text{lbs aia} \times \frac{\text{Total area in planting}}{44,000} \times \frac{\text{Fraction of total area contained in 1 ft of area to be treated}}{44,000} \times \frac{1}{\% \text{ active ingredient}} = \text{lbs herbicide required to treat area}$$

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## CLEANING HERBICIDE SPRAYERS

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It is difficult to remove some herbicides after they have been used in the sprayer. The following suggestions are made on cleaning the spray equipment after the use of certain herbicides.

### 1. 2,4-D

It is difficult to remove 2,4-D compounds from sprayers. It is advised that sprayers used for applying these materials not be used for any purpose other than applying herbicides.

The 2,4-D type materials can be removed if the following recommendations are followed immediately after use (as soon as spraying is completed).

- a. Flush out the entire system with a water detergent solution immediately after the spraying is completed. Fill the tank and prime the spray system with ammonia solution (1 gal household ammonia in 10 gals water) and let stand for 12-24 hours. Disassemble the nozzles and soak the caps, screens, etc., in the ammonia solution.
- b. Rinse thoroughly with water and let circulate through the sprayer.
- c. Test spray a few plants you know to be susceptible 4-5 days before using sprayer on larger areas.

### 2. Princep

Rinse thoroughly with a detergent immediately after use. Check screens for clogging and if present, soak in ammonia solution for 12-24 hours.

### 3. Other Herbicides

Any sprayer used to apply herbicides should be cleaned immediately after use. Special instructions for particularly troublesome herbicides have been outlined. If the procedures for cleaning out other herbicides are not specifically outlined:

- a. Flush the sprayer system with clean water.
- b. Rinse thoroughly with a detergent solution.
- c. Rinse again with clear water.

The herbicide label may carry cleaning instructions. If so, follow the manufacturer's recommendation.

#### Table of Useful Equivalents

##### Liquid

1 gal	=	4 qts	=	128 ounces
1 qt	=	2 pts	=	32 ounces
1 pt	=	2 cups	=	16 ounces
1 tbsp	=	3 tsp		
16 tbsp	=	1 cup		
1 oz	=	29.5 ml or CC		
1 tbsp	=	15 ml	=	½ ounce

##### Dry

1 lb	=	16 ozs	=	454 grms
1 oz	=	28.25 grms		

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## CAUTION—HERBICIDES CAN BE DANGEROUS

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**All herbicides should be considered poisonous to humans.**

Read the entire label on the container.

All directions and safety precautions should be followed.

Store herbicides in closed, clearly-labeled, original containers, in dry places, out of the reach of children and irresponsible persons and pets.

Bury empty cartons and punch holes in cans and drums.

If herbicides are spilled on the skin, wash thoroughly with soap. If herbicides are swallowed, come in contact with eyes or are absorbed to the point of showing symptoms, call a doctor immediately.

Emergency first aid directions and the telephone number of the nearest poison control center should be posted in a conspicuous place!

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## GLOSSARY

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### Herbicidal Selectivity

Weed killing chemicals are called herbicides and are generally classified into one of three types depending on their effects on plants.

**Contact** — Contact herbicides kill all plant parts covered by the chemical. Generally the plant dies soon after treatment with such materials. Contact herbicides may be further classified as selective, i.e., kills some plants with little or no damage to others, and non-selective, or toxic to all plants.

**Growth Regulators** — Also known as growth modifiers, growth substances, translocated herbicides or systemic herbicides. These herbicides can be absorbed by either the roots or above ground parts and are translocated throughout the plant system.

**Soil Sterilants** — Any chemical that prevents the growth of green plants when present in the soil. Soil sterilants may be applied post-emergent on existing weeds or as pre-emergent treatment on bare ground.

### Classification of Herbicides

Herbicides may be divided into three groups based on the time of application with respect to either the crop or weed species.

**Pre-plant** — Generally regarded as any treatment made before the crop is planted.

**Pre-emergence** — Application of an herbicide to the soil before the emergence of weeds through the soil surface.

**Post-emergence** — Application of an herbicide to existing weeds.

### Methods of Application

Application method depends on weed species and population, equipment available, herbicide formulation and economics.

**Broadcast Treatment** — Refers to a uniform application to an entire area.

**Band Treatment** — Refers to the application of a narrow strip over or in the crop row but not between rows.

**Directed Sprays** — Refers to the application of herbicide to a particular plant part. Usually the lower stem or trunk of the plant. Such treatments are usually directed at or just above the ground line.

**Spot Treatment** — Spot treatment is the treatment of a restricted area, usually to contact an infestation of a particular weed species. Soil sterilants are often used to remove small areas of particularly troublesome perennial weeds to prevent their spread.

### Surfactants

Includes wetting agents, emulsifiers, detergents, spreaders, sticking agents and dispersing agents. These materials are added for easier mixing of the herbicides and water. In addition, they cause spray droplets to spread or stick better, allowing easier penetration of the leaf surface. Such agents usually intensify the herbicidal action of applied herbicides and may even have specific toxic effects to plants when applied alone.

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## REMEMBER

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1. The proper selection of herbicides should be based on the nursery crops grown, weed species, soil type (sand, clay) and equipment available.
2. Always establish trial plots before using herbicides for the first time.
3. Read the entire label on the container and follow all directions.
4. If there are any uncertainties regarding weed species controlled, crop tolerances, application, etc., contact the county agricultural agent of the cooperative Extension service.
5. The applicator should be thoroughly familiar with all areas of application such as figuring areas, calculating rates, proper distribution and any follow-up measures that may be necessary.
6. As a result of variations in environment or other conditions, herbicides do not always result in the same degree of control each year.
7. Pre-emergence herbicides are most effective if the soil is moist and application is followed by rainfall or irrigation.
8. Emergency first aid directions should be conspicuously posted.
9. According to the federal insecticide, fungicide and rotocide act (fifra), all "commercial" and "private" users of herbicides should be certified. Check with the Ohio Department of Agriculture or your county cooperative Extension service agent regarding certification.



**WOODY PLANTS TOLERANT TO PRE-EMERGENCE HERBICIDES**

The following Ohio landscape plants are tolerant to listed pre-emergence herbicides. An (X) in the column indicates the herbicide can be used safely for that plant. The list includes only those plants with company label registrations.

	BETASAN	CASORON	DACTHAL	DEVINOL	PENNANT	PENNANT + PRINCEP	EPTAM	GALLERY	GOAL	OH-2	ROUT	KERB	LASSO	PRINCEP	RONSTAR	SURFLAN	TREFLAN	XL
<b>Narrowleaf Evergreens</b>																		
Arborvitae.....		X	X	X	X	X		X	X	X	X	X		X	X	X	X	
Chamaecyparis.....							X	X		X	X			X	X	X	X	
Eastern Red Cedar.....		X		X										X	X	X	X	
Fir.....			X	X			X	X	X				X					
Fir, Balsam.....								X						X				
Fir, Douglas.....				X	X				X			X		X	X	X	X	
Fir, Fraser.....					X									X		X	X	
Fir, White.....					X									X		X	X	
Hemlock.....				X	X		X	X	X					X	X	X	X	
Juniper.....	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Microbiota.....											X							X
Pine.....			X	X			X	X	X	X		X			X			
Pine, Austrian.....					X				X					X	X	X	X	
Pine, Japanese Black.....									X		X			X	X	X	X	
Pine, Mugo.....					X				X		X			X	X	X	X	
Pine, Red.....									X					X			X	
Pine, Scotch.....					X				X					X	X	X	X	
Pine, White.....					X				X		X			X	X	X	X	
Spruce.....			X	X			X	X	X	X	X	X		X	X	X	X	
Spruce, Blue.....					X				X		X			X		X	X	
Spruce, Norway.....									X		X			X	X	X	X	
Spruce, White.....									X		X			X	X	X	X	
Yew.....		X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	
<b>Broadleaf Evergreens</b>																		
Boxwood.....	X	X	X	X	X		X	X		X	X	X			X	X	X	X
Cherry Laurel.....																X	X	X
Euonymus.....					X	X				X	X	X	X		X	X	X	X
Firethorn.....	X		X		X	X		X		X	X	X			X	X	X	X
Holly.....	X	X	X	X	X		X	X		X	X	X		X	X	X	X	X
Holly, Japanese.....					X	X	X			X	X	X			X	X	X	X
Japanese Pieris.....			X		X	X	X		X	X				X	X	X	X	X
Leucothoe.....		X		X	X	X	X								X	X	X	X
Magnolia grandiflora.....															X	X	X	X
Mahonia.....									X	X				X	X	X	X	X
Mountain Laurel.....		X	X		X			X				X		X	X	X	X	X
Rhododendron.....		X	X	X	X	X	X		X			X		X	X	X	X	X
<b>Deciduous Trees</b>																		
Ash.....		X	X	X	X			X				X			X			
Ash, White.....																	X	X
Bald Cypress.....																		
Beech.....												X			X			
Birch.....		X	X	X	X			X		X		X			X			
Birch, European.....										X							X	
Buckeye, Ohio.....												X						
Cherry, Flowering.....												X						
Chinese Chestnut.....			X									X					X	
Corktree, Amur.....		X																
Crabapple.....		X	X	X	X	X		X				X	X		X		X	
Dawn Redwood.....															X	X		
Dogwood.....		X	X	X	X		X	X		X	X		X	X	X		X	X
Dogwood, Kousa.....																	X	
Elm.....		X	X									X			X			
Elm, American.....														X				
Elm, Siberian.....														X				
Ginkgo.....												X			X	X		
Goldenchaintree.....		X		X														
Goldenraintree.....		X														X		
Hackberry.....		X													X	X		
Hawthorn.....			X	X								X						
Honeylocust.....				X								X	X	X		X	X	

**WOODY PLANTS TOLERANT TO PRE-EMERGENCE HERBICIDES**

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	BETASAN	CASORON	DACTHAL	DEVIRINOL	PENNANT	PENNANT + PRINCEP	EPTAM	GALLERY	GOAL	OH-2	ROUT	KERB	LASSO	PRINCEP	RONSTAR	SURFLAN	TREFLAN	XL
<b>Deciduous Trees—continued</b>																		
Larch, Japanese.....				X														X
Linden.....	X						X	X				X						
London Planetree.....											X					X	X	
Magnolia.....	X	X	X				X	X	X			X			X	X		
Maple.....	X	X	X	X	X	X	X	X	X			X		X	X	X		
Maple, Amur.....														X	X			
Maple, Norway.....															X			X
Maple, Red.....																		X
Maple, Silver.....																		X
Maple, Sugar.....																		X
Mountain Ash.....	X																	
Oak.....	X	X					X	X	X			X			X			
Oak, Pin.....				X														X
Oak, Red.....					X	X								X	X			X
Oak, Scarlet.....																		X
Pear, Bradford.....												X						
Poplar.....	X	X	X	X								X			X			
Redbud.....			X						X	X		X						X
Russian Olive.....	X		X											X	X			
Sweetgum.....			X					X				X				X		X
Sycamore.....			X									X						X
Tuliptree.....			X									X						X
Tupelo.....												X						X
Walnut.....	X	X	X	X								X						X
Willow.....	X	X	X					X				X						X
<b>Deciduous Shrubs</b>																		
Abelia.....	X		X	X				X		X	X					X		
Azalea.....	X	X	X	X	X		X	X			X	X			X	X		X
Azalea, Mollis.....		X																
Barberry.....		X	X		X		X	X	X	X			X	X	X	X		X
Beautybush.....		X																
Buddleia.....															X			
Cinquefoil.....			X		X					X					X			X
Cotoneaster.....	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X		X
Currant.....																		
Deutzia.....	X	X													X			X
Dogwood, Red Osier.....					X										X			
Euonymus, Winged.....	X	X	X	X	X		X				X				X	X		X
Flowering Almond.....	X																	
Flowering Quince.....	X											X			X			
Forsythia.....	X	X	X	X	X				X	X	X				X	X		X
Hibiscus.....				X				X		X					X	X		
Honeysuckle.....	X	X	X	X	X				X	X			X	X	X	X		X
Hydrangea.....			X						X		X							
Hypericum.....				X							X					X		X
Lilac.....	X	X	X		X		X	X	X			X			X	X		X
Mockorange.....	X	X										X				X		X
Mockorange, Lemoine.....																X		X
Nandina.....	X			X	X			X			X			X	X	X		
Peashrub.....	X													X				
Photinia.....	X			X	X		X			X					X	X		
Privet.....	X	X	X	X	X				X	X	X				X	X		X
Rose.....	X	X	X	X	X							X			X	X		X
Rose-of-Sharon.....																X		
Spiraea.....	X	X			X				X	X	X							
Spiraea, Vanhoutte.....																		X
Sumac.....															X			
Viburnum.....			X	X	X		X	X	X						X			X
Viburnum, Doublefile.....										X								X
Weigela.....	X	X			X	X		X	X							X		X
Witchhazel.....															X			

**GROUND COVERS AND FLOWERS TOLERANT TO PRE-EMERGENCE HERBICIDES**

	BETASAN	CASORON	DACTHAL	DEVINOL	PENNANT	PENNANT + PRINCEP	EFTAM	GALLERY	OH-2	ROUT	PRINCEP	RONSTAR	SURFLAN	TREFLAN	XL
<b>Ground Covers</b>															
Ajuga .....	X			X			X					X			
Boston Ivy .....			X											X	
Cotoneaster .....			X					X			X		X	X	
Crown Vetch .....														X	
English Ivy .....	X	X	X	X	X		X	X				X	X	X	X
Euonymus .....			X		X					X		X	X	X	
Honeysuckle .....			X		X									X	
Juniper .....	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Liriope .....				X	X	X		X			X		X	X	
Myrtle .....	X			X			X	X			X		X	X	
Pachistima .....		X	X												
Pachysandra .....	X		X	X	X		X	X	X	X		X			
Potentilla .....									X	X				X	
Sedum .....	X			X			X					X		X	
Stonecrop .....													X		
St. John's Wort .....	X			X			X			X		X		X	X
<b>Flowers</b>															
Achillea .....														X	
Ageratum .....			X				X							X	
Alyssum .....	X		X				X								
Amaranthus .....							X								
Aster .....	X		X	X			X							X	
Astilbe .....															
Baby's Breath .....			X												
Bachelor's Button .....	X														
Balsam .....							X							X	
Begonia .....							X						X	X	
Bell Flower .....			X												X
Blackeyed Susan .....														X	
Bleeding Heart .....			X												
Bugloss .....			X												
Calendula .....	X													X	
California Poppy .....														X	
Calliopsis .....														X	
Campanula .....	X														
Candle Larkspur .....			X												
Candytuft .....	X		X							X					
Carnation .....															
Centaurea .....														X	
Chrysanthemum .....			X	X			X					X	X	X	
Coleus .....			X												
Columbine .....			X												
Coral Bells .....	X		X												
Coreopsis .....			X							X				X	
Cosmos .....			X											X	
Daffodil .....	X			X											X
Dahlia .....	X		X	X			X							X	
Daisy .....	X			X											
Daylily .....							X								
Delphinium .....			X												
Dianthus .....							X					X		X	
Dusty Miller .....													X	X	
Evening Primrose .....			X												
Fernleaf Yarrow .....			X												
Feverfew .....			X												
Forget-Me-Not .....			X											X	
Four-O-Clock .....			X											X	



GROUND COVERS AND FLOWERS TOLERANT TO PRE-EMERGENCE HERBICIDES

	BETASAN	CASORON	DACHTAL	DEVRIKOL	PENNANT	PENNANT + PRINCEP	EPTAM	GALLERY	OH-2	ROUT	PRINCEP	RONSTAR	SURFLAN	TREFLAN	XL
<b>Flowers—continued</b>															
Foxglove.....			X												
Gaillardia.....			X											X	
Gazania.....	X												X	X	X
Geranium.....			X	X									X		
Germander.....														X	
Gladiolus.....	X		X	X									X	X	
Gold Dust.....			X												
Golden Marguerite.....			X												
Golden Tuft.....			X												
Hosta.....				X				X							
Impatiens.....													X	X	
Iris.....			X												X
Ixora.....														X	
Lantana.....			X												
Larkspur.....															
Lavendercotton.....			X												
Lily.....			X												
Lobelia.....														X	
Lupine.....			X											X	
Marigold.....	X		X		— NOT REGISTERED FOR FLOWERS —	— NOT REGISTERED FOR FLOWERS —	X						X	X	
Morning Glory.....			X											X	
Mother-of-Thyme.....			X											X	
Nasturtium.....			X				X							X	
Nicotiana.....														X	
Ornamental Grasses.....								X							
Pansy.....	X						X						X		
Peony.....			X									X			
Periwinkle.....												X			
Petunia.....			X	X			X				X		X	X	
Phlox.....														X	
Pincushion Flower.....														X	
Pink Heath.....			X												
Poker Plant.....			X												
Portulaca.....					— NOT REGISTERED FOR FLOWERS —	— NOT REGISTERED FOR FLOWERS —									
Primrose.....	X														
Purple Cone Flower.....			X												
Ranunculus.....	X														
Rudbeckia.....														X	
Salvia.....										X				X	
Scabiosa.....														X	
Scarlet Sage.....			X												
Shasta Daisy.....														X	
Snapdragon.....			X											X	
Snow-in-Summer.....														X	
Snow on the Mountain.....														X	
Stock.....	X													X	
Stone Crop.....			X										X		
Strawflower.....			X												
Sundrops.....			X												
Sunflower.....			X												
Sweet Alyssum.....														X	
Sweet Pea.....	X		X											X	
Sweet William.....														X	
Tulip.....	X													X	
Verbena.....			X							X					
Violet.....			X												
Virginia Spiderwort.....			X												
Wall Flower.....	X														
Wormwood.....			X												
Zinnia.....			X	X			X						X	X	

**WEEDS CONTROLLED BY PRE-EMERGENCE HERBICIDES**

The following list of grasses and broadleaf weeds are labelled as being controlled by the pre-emergence herbicides. An (X) in the column indicates the weed is controlled for the herbicide listed.

	BETASAN	CASORON	DACTHAL	DEVINOL	PENNANT	PENNANT + PRINCEP	EPTAM	GALLERY	GOAL	OH-2	ROUT	KERB	LASSO	PRINCEP	RONSTAR	SURFLAN	TREFLAN	XL
<b>Grasses</b>																		
Barnyardgrass.....	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Bermudagrass.....							X											
Bluegrass, Annual.....	X	X	X	X			X	X		X	X	X		X	X	X	X	X
Bluegrass, Kentucky.....		X										X						
Cheat (Chess).....				X								X					X	
Crabgrass.....	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Downy Bromegrass.....				X								X		X		X	X	
Fall Panicum.....	X			X	X	X	X				X	X		X	X	X	X	
Foxtail.....	X	X						X						X		X	X	X
Bristly Foxtail.....				X												X	X	
Giant Foxtail.....				X	X	X	X		X				X			X	X	
Green Foxtail.....			X	X	X	X	X		X				X			X	X	
Yellow Foxtail.....			X	X	X	X	X			X	X	X			X	X	X	
Goosegrass.....	X		X	X	X	X	X	X	X		X	X	X	X	X	X	X	X
Johnsongrass (from seed).....			X	X	X	X	X					X				X	X	X
Nutsedge.....					X	X	X						X					
Orchardgrass.....												X						
Quackgrass.....		X					X					X						
Ryegrass (annual).....				X			X	X				X		X				X
Ryegrass (perennial).....												X						
Sandbur.....			X	X			X						X		X	X	X	
Stinkgrass (lovegrass).....			X	X			X					X					X	
Tall Fescue.....												X						
Witchgrass.....		X	X		X		X		X				X	X		X		
<b>Broadleaf Weeds</b>																		
Annual Morningglory.....							X		X			X		X				
Carpetweed.....		X	X	X	X	X	X		X			X	X	X	X	X	X	X
Chickweed.....		X	X	X			X			X	X	X		X		X	X	X
Clover, white.....								X										
Common Groundsel.....		X		X				X	X	X				X	X	X		
Dandelion.....		X						X	X	X								
Deadnettle (Henbit).....	X	X					X					X		X		X	X	X
Dodder.....			X									X						
Dogfennel.....		X																
Evening Primrose.....		X													X			
Fleabane.....								X		X								
Galinsoga.....					X	X		X				X		X				
Henbit.....								X										
Horsetail.....		X																
Knotweed.....		X		X				X				X				X	X	X
Lamb's-quarters.....	X	X	X	X		X	X	X		X	X	X	X	X	X	X	X	
Lesser Bittercress.....								X		X					X	X		
Liverwort.....															X			
Mallow.....				X		X		X				X						
Marestail.....								X			X							
Mugwort (Chrysanthemum Weed).....		X					X											
Mustards.....		X						X				X		X				
Nettle, Burning.....												X					X	
Nightshades.....				X	X		X	X				X	X	X				
Peppergrass.....		X							X				X	X				
Pigweed.....							X			X		X	X	X	X	X	X	X
Prostrate Pigweed.....							X		X							X	X	X
Redroot Pigweed.....	X	X	X	X	X	X	X		X		X				X	X	X	X
Tumble Pigweed.....							X									X		
Plantain.....		X						X										
Prickly Lettuce.....				X				X						X				
Prickly Sida.....							X	X										
Purslane.....		X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
Ragweed.....		X		X		X	X	X				X	X	X		X	X	
Red Sorrel.....								X				X						
Shepherdspurse.....	X	X					X	X	X	X	X	X		X		X		

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	BETASAN	CASORON	DACTHAL	DEVINOL	PENNANT	PENNANT + PRINCEP	EPTAM	GALLERY	GOAL	OH-2	ROUT	KERB	LASSO	PRINCEP	RONSTAR	SURFLAN	TREFLAN	XL
<b>Broadleaf Weeds—continued</b>																		
Smartweed (Pennsylvania).....		X				X		X	X			X	X	X	X			
Sow Thistle.....				X				X	X	X	X			X	X	X		
Speedwell.....			X					X						X	X			
Spurge, Leafy.....		X																
Spurge, Petty.....		X	X												X			
Spurge, Prostrate.....								X		X	X				X			
Spruce, Spotted.....								X		X	X							
Thistle, Bull.....		X						X										
Thistle, Canada.....		X																
Timothy.....		X																
Velvetleaf.....								X										
Wild Aster.....		X																
Wild Carrot.....		X																
Yellow Rocket.....		X															X	
Yellow Woodsorrel (Oxalis).....		X						X	X	X	X				X	X		



## FORMULATIONS FOR SMALL AREAS

Trade Name	Common Name Active Ingredient/Acre	Formulation Product/Acre	Formulation Product/1,000 sq ft
<b>Pre-Emergence</b>			
Betasan or Lescosan 4E	bensulide 10-12	3 gals	8.7 ozs
Betasan or Lescosan 3.6G	bensulide 10-12	278-333 lbs	6.3-7.6 lbs
Betasan or Lescosan 7G	bensulide 10-12	143-171 lbs	3.3-3.9 lbs
Betasan or Lescosan 12.5G	bensulide 10-12	80-96 lbs	1.8-2.2 lbs
Casoron 4G	diclobenil 6	150 lbs	3-4 lbs
Dacthal 75W	DCPA 10.5-12	14-16 lbs	5-6 ozs
Dacthal 5G	DCPA 10.5-12	210-240 lbs	4.8-5.4 lbs
Devrinol 50W	napropamide 4-6	8-12 lbs	3-4.4 ozs
Devrinol 10G	napropamide 4-6	40-60 lbs	15-22 ozs
Eptam 7EC	EPTC 3-6	5¾-7 pts	2.1-2.6 ozs
Eptam 10G	EPTC 3-6	30-60 lbs	.7-1.4 lbs
Gallery	isoxaben 0.5-1.0	.66-1.33 lbs	.25-.50 ozs
Goal 2E	oxyfluorfen 1-2	4-8 pts	1.4-2.9 ozs
OH-2	oxyfluorfen & pendimethalin 2 + 1	100 lbs	2.3 lbs
Rout	oxyfluorfen & oryzalin 2 + 1	100 lbs	2.3 lbs
Kerb 50W	pronamide 2	4 lbs	1.5 ozs
Lasso 4E	alachlor 4	4 qts	3 ozs
Lasso II 15G	alachlor 4	27 lbs	9.8 ozs
Pennant 5G	metolachlor 2-4	40-80 lbs	1-2 lbs
Princep 80W	simazine	33.8 lbs	1.5 ozs
Princep 4G	simazine	375 lbs	1.7 lbs
Ronstar 2G	oxadiazon	100-200 lbs	4.6 lbs
Surflan A.S.	oryzalin 2-4	2-4 qts	1.5-3 ozs
Treflan 5G	trifluralin 1-4	20-80 lbs	2.0 lbs
Treflan 4E	trifluralin 1-4	1-4 gals	9-12 ozs
XL 2G	benefin + oryzalin 4-6	200-300 lbs	4.5-7.0 lbs
<b>Post-Emergence</b>			
Amitrol	amino triazole	1-2 gals	3-6 ozs
Amizine	amino triazole + simazine	7 lbs	2.6 ozs
Asulox	asulam	1 gal	3 ozs
Fusilade 1E	fluazifop butyl	13 oz	.30 oz
Fusilade 4E	fluazifop butyl	1 pt	.36 oz (10 ml)
Gramoxone Extra	paraquat	2.0-3.0 pts	¾-¾ ozs (11-20 ml)
Roundup	glyphosate	1-4 qts	1½-2¾ oz/Gal



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