



This Journal of Environmental Horticulture article is reproduced with the consent of the Horticultural Research Institute (HRI – [www.hriresearch.org](http://www.hriresearch.org)), which was established in 1962 as the research and development affiliate of the American Nursery & Landscape Association (ANLA – <http://www.anla.org>).

#### HRI's Mission:

To direct, fund, promote and communicate horticultural research, which increases the quality and value of ornamental plants, improves the productivity and profitability of the nursery and landscape industry, and protects and enhances the environment.

The use of any trade name in this article does not imply an endorsement of the equipment, product or process named, nor any criticism of any similar products that are not mentioned.

# Pretransplant Application of Goal (Oxyfluorfen) for Weed Control in Container-grown Nursery Crops<sup>1</sup>

Jeffrey F. Derr<sup>2</sup>

Department of Plant Pathology, Physiology and Weed Science  
Virginia Polytechnic Institute and State University  
Hampton Roads Agricultural Experiment Station  
1444 Diamond Springs Road  
Virginia Beach, VA 23455

## Abstract

No injury was observed to 'Hershey Red', 'Pleasant White' and 'Scarlet Rose' azalea (*Rhododendron obtusum* Planch.), 'Prince of Wales' juniper (*Juniperus horizontalis* Moench), 'Helleri' holly (*Ilex crenata* Thunb.) or 'Green beauty' boxwood (*Buxus microphylla* Siebold & Zucc.) following pretransplant applications of Goal (oxyfluorfen) at rates ranging from 0.6 to 4.5 kg ai/ha (0.5 to 4.0 lb/A). Acceptable control of common groundsel (*Senecio vulgaris* L.) (less than one weed per pot) lasted approximately 1 month at 0.6 kg/ha (0.5 lb/A), 2 to 3 months at 1.1 kg/ha (1.0 lb/A), 3 to 4 months at 2.2 kg/ha (2.0 lb/A) and 4 months at 4.5 kg/ha (4.0 lb/A) with sprayed applications of Goal. Sprayed applications of Goal at 1.1 kg/ha (1.0 lb/A) gave equivalent weed control to a post-transplant application of Ornamental Herbicide 2, a granular formulation containing 2% oxyfluorfen and 1% pendimethalin, at 3.3 kg ai/ha (3.0 lb ai/A).

**Index words:** nursery crops, herbicides, common groundsel, weed control.

**Species used in this study:** azalea (*Rhododendron obtusum* Planch.); Prince of Wales juniper (*Juniperus horizontalis* Moench); Helleri holly (*Ilex crenata* Thunb. 'Helleri'); Green beauty boxwood (*Buxus microphylla* Siebold & Zucc.)

**Herbicides used in this study:** Ornamental Herbicide 2 (oxyfluorfen) 2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene plus (pendimethalin) N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzenamine; Goal (oxyfluorfen) 2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene

**Weed species used in this study:** common lambsquarters (*Chenopodium album* L.); common groundsel (*Senecio vulgaris* L.); large crabgrass (*Digitaria sanguinalis* (L.) Scop.); yellow woodsorrel (*Oxalis stricta* L.)

## Introduction

Annual grasses can be managed in nurseries using preemergence or postemergence herbicides (6). Annual broadleaf weeds are generally the predominant weed species found in container production. Granular herbicides such as Rout (oxyfluorfen plus oryzalin), Ornamental Herbicide 2 (oxyfluorfen plus pendimethalin) and Ronstar (oxadiazon) provide control of a wide range of annual broadleaf weeds in container-grown nursery crops, but there are no sprayable formulations of herbicides available that will control broadleaf weeds like common groundsel in species such as azalea (6). Uniform coverage can be difficult with granular herbicides and granular herbicides tend to be more expensive than sprayable formulations. Sprayable formulations could also be applied through irrigation systems, allowing nurserymen greater labor efficiency.

The formulation of an herbicide may effect the crop tolerance to a given herbicide. Increased injury was observed to aucuba (*Aucuba japonica* Thunb.), 'Formosa' and 'Fashionaire' azalea and red tip photinia (*Photinia* × *fraseri*), when Ronstar was applied as an emulsifiable concentrate than as a granular formulation (7). Both azalea cultivars in this study exhibited no injury from application of granular Ronstar at 2.2 to 17.9 kg ai/ha (2 to 16 lb ai/A) 2 months after application, but injury, ranging from 5 to 12 percent, was observed with the same application rates of an emulsifiable concentrate formulation.

Goal is being developed as a pretransplant herbicide for broadleaf weed control in cabbage (*Brassica oleracea* L. var. *capitata* L. f. *alba* DC.) and other crucifers. A pretransplant application of Goal at 1.1 kg/ha (1.0 lb/A) resulted in 100% control of redroot pigweed (*Amaranthus retroflexus* L.) and common lambsquarters with 85% control of large crabgrass and 83% control of fall panicum (*Panicum dichotomiflorum* Michx.) (3). Addition of Poast increased the control of large crabgrass and fall panicum. Application of a granular formulation of Goal was less toxic to cabbage plants than the emulsifiable concentrate applied broadcast at 0.6 kg/ha (0.5 lb/a) (8).

Granular formulations of Goal have been evaluated in nursery crops. No injury was reported to several field grown nursery crops including low-fast cotoneaster (*Cotoneaster dammerii* Schneid), 'Hinocrimson' azalea and Andorra juniper following applications of a granular formulation of Goal at 4.5 kg/ha (4.0 lb/A) (4). Application of granular Goal at 4.5 kg/ha (4.0 lb/A) provided good control of a range of broadleaf weeds with no injury to eight woody ornamental species (5). Application of Poast at 0.6 or 1.1 kg/ha (0.5 or 1.0 lb/A) after the Goal treatment increased the control of annual grasses, with up to 86% reduction in total weed cover. A granular formulation of Goal at 4.5 kg/ha provided 87% control of common groundsel, 76% control of large crabgrass and 67% control of yellow woodsorrel (2). No difference in growth of newly planted 'Hershey Red' azalea liners was detected between the untreated and the Goal treated plants. Application of Ornamental Herbicide 2 completely controlled southern yellow woodsorrel (*Oxalis dilenii* Jacq.) 8 weeks after application in container studies using a pine bark plus sand media (1). Approximately 1.5

<sup>1</sup>Received for publication September 27, 1988; in revised form November 8, 1988.

<sup>2</sup>Assistant Professor of Weed Science.

plants per pot of southern yellow woodsorrel were observed 12 and 18 weeks after treatment at that rate, compared to approximately 9 plants per pot in the control pots. At 4 and 8 weeks after treatment, 1.4 weeds per pot were observed in containers treated with 3.3 kg ai/ha (3.0 lb ai/A) of Ornamental Herbicide 2 compared with 25 weeds per pot in control pots.

Experiments were conducted to determine if pretransplant, sprayed applications of Goal would be safe to several container-grown nursery crops. Length of control for individual weed species was also investigated.

## Materials and Methods

Black plastic (#1) pots were filled with a mix containing pine bark and sand (9:1 equal parts, by vol). Goal treatments were applied using a CO<sub>2</sub>-pressurized backpack sprayer delivering 230 l/ha (25 gal/A) using 8003 flat fan nozzles. The emulsifiable concentrate formulation of Goal was applied at 0.60, 1.1, 2.2 and 4.5 kg ai/ha (0.5, 1.0, 2.0 and 4.0 lb ai/A). Immediately after treatment, one liner of a nursery species was transplanted per container. In the first 1986 study, 10 cm (4 in) tall liners of 'Hershey Red' azalea were used. In the second 1986 study, 10 cm (4 in) tall liners of 'Hershey Red' and 'Pleasant White' azaleas were used. This second study was repeated, with the reported results an average of the two trials. In the first 1987 study, 8 cm (3 in) tall 'Helleri' holly was planted while in the second 1987 study, 10 cm (4 in) tall 'Prince of Wales' junipers, 17 cm (7 in) tall 'Green Beauty' boxwoods and 20 cm (8 in) tall 'Scarlet Rose' azaleas were used. Both of these studies were repeated, with the reported results an average of the two trials.

After transplanting, one set of pots received Ornamental Herbicide 2 at 3.3 kg ai/ha (3.0 lb ai/A), a standard granular herbicide treatment in container-grown nursery crops. A slow release, 18N-2.6P-9.9K (18-6-12) fertilizer containing micronutrients was applied to each pot. A weed seed mixture containing large crabgrass, common groundsel and either yellow woodsorrel or common lambsquarters was applied to each pot. Pots were irrigated after seeding and maintained on a gravel pad in an outdoor lathhouse. The experimental design for all studies was a randomized complete block with 4 replications, with one pot being a replication. At monthly intervals, all weeds were removed and counted by species. The weed seed mixture was then reapplied to all pots. In 1986 studies, ornamental vigor was evaluated visually. In

1987 studies, ornamental shoot and root fresh and dry weight were recorded three months after herbicide application, in addition to visual evaluations.

## Results and Discussion

**1986 studies.** No weeds were found in pots treated with 1.1 kg/ha (1.0 lb/A) or higher of Goal one month after application in the first study (Table 1). Small amounts of large crabgrass and common groundsel were detected in the 0.6 kg/ha (0.5 lb/A) treated pots and in the Ornamental Herbicide 2 treated containers. Common groundsel control in the 0.6 kg/ha (0.5 lb/A) treated pots decreased over time, with weed numbers not different from the untreated pots by 4 months after treatment. Excellent common groundsel control was observed at rates of 1.1 kg/ha (1.0 lb/A) or higher at 2, 3 and 4 months after application, with control appearing to decrease by 5 months after treatment. Weed control with 1.1 kg/ha (1.0 lb/A) of Goal was comparable to that observed with the Ornamental Herbicide 2 treatment. No reduction in plant quality was observed to 'Hershey Red' azalea from any treatment (Data not shown).

In the second study, overall length of weed control appeared to be less than that observed in the first study. No control of common groundsel was detected with Goal at 0.6 kg/ha (0.5 lb/A) 3 months after treatment (Table 2). By 4 months, only Goal at 4.5 kg/ha (4.0 lb/A) provided acceptable weed control. Although common groundsel plants were detected at lower rates, the weeds were often quite stunted and easy to hand weed. Results observed with 1.1 kg/ha (1.0 lb/A) Goal were similar to those seen with the granular treatment, Ornamental Herbicide 2. The greater control observed with the sprayed Goal treatment at 2.2 kg/ha (2.0 lb/A) over that seen with granular Ornamental Herbicide 2 containing oxyfluorfen at the same rate could be due to more uniform coverage in the sprayed treatments. No injury to either 'Hershey Red' or 'Pleasant White' azaleas was observed with any treatment (Data not shown).

**1987 Studies.** Weed control with Goal at 0.6 kg/ha (1.0 lb/A) was unacceptable by 2 months after treatment (Table 3). Control of large crabgrass with oxyfluorfen decreased faster than that for yellow woodsorrel or common groundsel. This is consistent with the fact that Goal generally provides greater control of annual broadleaf weeds than annual grasses (5, 6). Broadleaf weed control was acceptable with Goal at 2.2 kg/ha (2.0 lb/A) 3 months after treatment but had decreased in the 1.1 kg/ha (1.0 lb/A) rate by this time. Excellent

**Table 1.** Numbers of large crabgrass, common lambsquarters and common groundsel during the growing season as affected by preemergence herbicide applications in the first 1986 study.

		Month after treatment						
Treatment	Rate (Kg ai/ha)	1			2	3	4	5
		Common lambsquarters	Large crabgrass	Common groundsel	Common groundsel	Common groundsel	Common groundsel	Common groundsel
		Number per pot						
Untreated		2.8	51.5	11.2	16.3	12.5	4.5	9.0
Orn. Herb 2	3.3	0.0	0.8	0.3	0.5	0.0	1.5	2.2
Goal	0.6	0.2	1.0	0.3	3.7	1.7	3.0	7.0
Goal	1.1	0.0	0.0	0.0	0.2	0.0	0.8	2.0
Goal	2.2	0.0	0.0	0.0	0.7	0.2	0.0	1.3
Goal	4.5	0.0	0.0	0.0	0.0	0.0	0.3	1.7
LSD (0.05)		1.1	3.5	2.7	5.9	5.1	3.2	4.6

control of all three weed species was observed with the 4.5 kg/ha (4.0 lb/A) application rate 3 months after treatment. As in 1986 studies, weed control appeared to be greater in pots treated with sprayed applications of Goal at 2.2 kg/ha (2.0 lb/A) compared to the granular treatment.

In the second study, weed control 2 months after treatment was unacceptable with Goal at 0.6 kg/ha (0.5 lb/A) (Table 4). Excellent control of large crabgrass, yellow woodsorrel and common groundsel was observed with 2.2 and 4.5 kg/ha (2.0 and 4.0 lb/A) of Goal.

No reduction in shoot or root fresh or dry weight from any treatment was observed for the cultivars of juniper,

azalea, boxwood and holly used in this study (Data not shown).

### Significance to the Nursery Industry

Pretransplant applications of Goal were shown to be safe to four nursery species and effectively controlled annual weeds for up to 4 months, depending on application rate. This innovative method of Goal application provides a way to control broadleaf weeds at planting time, when weed control is most important. Weed control was equal to or greater for sprayed applications of Goal than with Orna-

**Table 2.** Numbers of large crabgrass and common groundsel during the growing season as affected by preemergence herbicide applications in the second 1986 study.

		Month after treatment				
Treatment	Rate (kg ai/ha)	1		2	3	4
		Large crabgrass	Common groundsel	Common groundsel	Common groundsel	Common groundsel
		Number per pot				
Untreated		3.4	6.6	6.6	4.5	7.9
Orn. Herb 2	3.3	0.4	0.6	1.1	1.7	2.2
Goal	0.6	0.0	1.2	2.7	6.1	5.6
Goal	1.1	0.1	0.1	0.8	1.1	3.3
Goal	2.2	0.0	0.0	0.5	0.4	1.5
Goal	4.5	0.0	0.1	0.2	0.1	0.3
LSD (0.05)		0.5	1.0	0.9	1.0	2.0

**Table 3.** Numbers of large crabgrass, yellow woodsorrel and common groundsel during the growing season as affected by preemergence herbicide applications in the first 1987 study.

		Month after treatment							
		1		2			3		
Treatment	Rate (Kg ai/ha)	Large crabgrass	Yellow woodsorrel	Large crabgrass	Yellow woodsorrel	Common groundsel	Large crabgrass	Yellow woodsorrel	Common groundsel
		Number per pot							
Untreated		15.6	7.2	16.3	2.1	5.1	16.9	6.1	23.3
Orn. Herb 2	3.3	2.1	0.9	10.0	0.6	3.0	5.0	1.5	2.0
Goal	0.6	4.2	0.4	15.3	1.0	3.2	10.9	5.0	2.7
Goal	1.1	1.5	0.5	7.2	0.8	1.2	6.2	2.3	1.7
Goal	2.2	0.3	0.1	2.4	0.3	0.9	1.8	0.6	0.6
Goal	4.5	0.0	0.3	0.1	0.0	0.0	0.2	0.0	0.2
LSD (0.05)		1.2	6.0	3.9	0.7	1.3	2.8	3.9	11.1

**Table 4.** Numbers of large crabgrass, yellow woodsorrel and common groundsel during the growing season as affected by preemergence herbicide applications in the second 1987 study.

Treatment	Rate (Kg ai/ha)	Month after treatment			Common groundsel
		1	2		
		Large crabgrass	Large crabgrass	Yellow woodsorrel	
		Number per pot			
Untreated		13.9	12.4	5.5	3.3
Orn. Herb 2	3.3	2.3	0.2	0.1	0.0
Goal	0.6	1.0	5.0	1.3	1.0
Goal	1.1	0.7	1.2	0.1	0.1
Goal	2.2	0.1	0.2	0.0	0.0
Goal	4.5	0.0	0.0	0.0	0.0
LSD (0.05)		2.8	4.9	1.4	1.0

mental Herbicide 2, a granular herbicide which contains Goal, at the same application rate. With sprayed applications of Goal, residual control of common groundsel lasted approximately 1 month at 0.6 kg/ha (0.5 lb/A), 2 to 3 months at 1.1 kg/ha (1.0 lb/A), 3 to 4 months at 2.2 kg/ha (2.0 lb/A) and 4 months at 4.5 kg/ha (4.0 lb/A).

(*Ed. note:* This paper reports the results of research only, and does not imply registration of a pesticide under amended FIFRA. Before using any of the products mentioned in this research paper, be certain of their registration by appropriate state and/or federal authorities.)

## Literature Cited

1. Berchielli, D.L., C.H. Gilliam and D.C. Fare. 1988. Evaluation of preemergence herbicides for control of *Oxalis dillenii* Jacq. in a pinebark-amended media. *HortScience* 23:170-172.

2. Beste, C.E. and J.R. Frank. 1985. Weed control in newly planted azalea. *J. Environ. Hort.* 3:12-14.

3. Bhowmik, P.C. and E.N. McGlew. 1986. Effects of oxyfluorfen as a pretransplant treatment on weed control and cabbage yield. *J. Amer. Soc. Hort. Sci.* 111:686-689.

4. Coffman, C.B. and J.R. Frank. 1987. Weed management with fluazifop (Fusilade), haloxyfop (Verdict), sethoxydim (Poast) and oxyfluorfen (Goal) in groundcovers and woody landscape plants. *J. Environ. Hort.* 5:85-88.

5. Coffman, C.B., J.R. Frank and W.A. Gentner. 1984. Sethoxydim (Poast) and oxyfluorfen (Goal) efficacy and tolerance by landscape plants. *J. Environ. Hort.* 2:120-122.

6. Derr, J.F. 1988. Weed control in ornamentals. p. 27-36 *In:* Pest Management Guide for Nursery Ornamentals, Publication 456-007, VA Cooperative Extension Service, Blacksburg, Va.

7. Glaze, N.C., M. Singh and S.C. Phatak. 1987. Ornamental response to two methods of oxadiazon application. *HortScience* 22:265-268.

8. Grabowski, J.M. and H.J. Hopen. 1984. Evaluation of oxyfluorfen formulations for cabbage weed control. *J. Amer. Soc. Hort. Sci.* 109:539-543.

# Effects of Preemergence Herbicides on Hosta and Daylily<sup>1</sup>

Ted Whitwell and John Kelly<sup>2</sup>

Department of Horticulture  
Clemson University  
Clemson, SC 29634

## Abstract

Thirteen preemergence herbicides were evaluated for phytotoxicity to container grown hosta (*Hosta spp.* Tratt. 'Hyacinthina') and daylily (*Heemerocallis spp.* L. 'Sammy Russell'). Severe injury (28 to 55%) was observed from Ronstar (oxadiazon) and Goal (oxyfluorfen) for both species. The other herbicides did not cause visual injury. Three herbicides, Surflan (oryzalin), Endurance (proflam) and Pennant (metolachlor), were selected to investigate plant tolerance in field plantings at 1.1, 2.2, and 4.5 kg/ha (1, 2, and 4 lb/A). None of these herbicides caused visual injury or reduced shoot or root weight for 60 or 90 days after treatment. Daylily flower number was not affected by any of the herbicide treatments.

**Index words:** phytotoxicity, herbicides, weed control

**Herbicides used in this study:** Cinch (cinmethylin) *exo*-1-methyl-4-(1-methylethyl)-2-[(2-methylphenyl)methoxy-7-oxabicyclo[2.2.1]heptane; Devrinol (napropamide) 2-(*n*-naphthoxy)-N,N-diethylpropionamide; Endurance (proflam) 2,4-dinitro-N<sup>3</sup>,N<sup>3</sup>-dipropyl-6-(trifluoromethyl)-1,3, benzenediamine; Eptam (EPTC) S-ethyl dipropylthiocarbamate; Goal (oxyfluorfen) 2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene; Pennant (metolachlor) 2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide; Premier (flumetralin) 2-chloro-N-[2,6-dinitro-4-(trifluoro-methyl) phenyl-n-ethyl-6-fluoro-benzene-methanamine; Prowl (pendimethalin) N-(1-ethoxypropyl)-3,4-dimethyl-2,6-dinitrobenzene-amine; Ronstar (oxadiazon) 3-[2,4-dichloro-5-(1-methylethoxy)phenyl-5-(1,1-dimethylethyl)-1,3,4-oxadiazole; Surflan (oryzalin) 4-(dipropylamino)-3,5-dinitrobenzenesulfonamide; Trellan (trifluralin) 2,3-dinitro-N-N-dipropyl-4-(trifluoromethyl)benzenamine; XL (oryzalin + benfen) N-butyl-N-ethyl-2,6-dinitro-4-(trifluoromethyl)benenamine

## Introduction

Weed control in herbaceous perennial landscape plantings is limited because of the lack of labeled herbicides. Effective preemergence herbicides are available to control a broad spectrum of weeds in woody plantings, however most of these are not labeled for herbaceous perennials. Bing (1) reported considerable variation in the response of perennials

to preemergence herbicides. Goal (oxyfluorfen) injured field grown hosta and daylilies and neither species recovered. Surflan (oryzalin) caused early injury to both species, but they recovered. Currently, the only herbicides labeled for use in daylily are Ornamental Weeder (chloramben), Eptam (EPTC), and Fusilade (fluazifop-P). Devrinol (napropamide) and Fusilade (fluazifop-P) are labeled for use in hosta.

Several other herbicides have labels for use in landscape plants, and if these labels could be expanded it would greatly assist weed management efforts for herbaceous perennials. Surflan (oryzalin) controlled Pennsylvania bittercress (*Cardamine pensylvanica* Muhl. ex. Willd.), large crabgrass (*Digitaria sanguinalis* (L.) Scop.), yellow woodsorrel (*Oxalis stricta* L.), common purslane (*Portulaca oleracea* L.),

<sup>1</sup>Received for publication September 2, 1988; in revised form November 16, 1988. Technical contribution no. 2896 of the South Carolina Agricultural Experiment Station. The authors are grateful to The Horticulture Research Institute, Inc., 1250 I Street, N.W., Suite 500, Washington, DC, 20005, for a grant to partially support this research.

<sup>2</sup>Associate Professors of Horticulture.