



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.

# Spotted Spurge Control and Phytotoxicity to Daylily from Preemergence Herbicides<sup>1</sup>

Jeffrey G. Norcini<sup>2</sup> and James H. Aldrich<sup>3</sup>

University of Florida-IFAS  
Agricultural Research and Education Center  
Rural Route 4, Box 4092  
Monticello, FL 32344-9302

## Abstract

The granular preemergent herbicides Snapshot TG (isoxaben + trifluralin) and Stakeout (dithiopyr) were evaluated as an alternative to Snapshot DF (isoxaben + oryzalin) for control of spotted spurge (*Chamaesyce maculata* [formerly *Euphorbia maculata*]) in container-grown daylily (*Hemerocallis* × 'Aztec Gold'). Stakeout (dithiopyr) at 1.1, 1.7, or 2.2 kg ai/ha (1.0, 1.5, 2.0 lb ai/A) and Snapshot TG (isoxaben + trifluralin) at 5.6 kg ai/ha (5.0 lb ai/A) were as effective as Rout (oxyfluorfen + oryzalin) at 3.4 kg ai/ha (3.0 lb ai/A), Snapshot DF (isoxaben + oryzalin) at 4.5 kg ai/ha (4.0 lb ai/A), or Gallery (isoxaben) at 1.1 kg ai/ha (1.0 lb ai/A) in controlling spotted spurge. Rout (oxyfluorfen + oryzalin) and Ronstar G (oxadiazon) caused significant injury (bleached spots that became necrotic) while the other herbicides caused little to no damage.

**Index words:** *Chamaesyce maculata*, phytotoxicity, weed control, *Hemerocallis*

**Species used in this study:** Aztec Gold daylily, *Hemerocallis* × 'Aztec Gold'.

**Herbicides used in this study:** Gallery DF (isoxaben), N-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl]-2,6-dimethoxybenzamide; Ronstar G (oxadiazon), 3-[2,4-dichloro-5-(1-methylethoxy)phenyl]-5-(1,1-dimethyl)-1,3,4-oxadiazol-2-(3H)-one; Rout (oxyfluorfen + oryzalin), 2-chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluoromethyl)benzene + 4-(dipropylamino)-3,5-dinitrobenzenesulfonamide; Snapshot DF (isoxaben + oryzalin), N-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl]-2,6-dimethoxybenzamide + 4-(dipropylamino)-3,5-dinitrobenzenesulfonamide; Snapshot TG (isoxaben + trifluralin), N-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl]-2,6-dimethoxybenzamide + 2,6-dinitro-N,N-dipropyl-4-(trifluoromethyl)benzenamine; Stakeout (dithiopyr), S,S-dimethyl 2-(difluoromethyl)-4-(2-methylpropyl)-6-(trifluoromethyl)-3,5-pyridinedicarbothioate.

## Significance to the Nursery Industry

Stakeout (dithiopyr) and Snapshot TG (isoxaben + trifluralin) provide potential granular alternatives to Snapshot DF (isoxaben + oryzalin) for safe control of spotted spurge in containerized daylily when weed pressure is moderate. Furthermore, Stakeout (dithiopyr) was effective at only 1.1 kg ai/ha (1.0 lb ai/A), lower than the recommended rate for either Rout (oxyfluorfen + oryzalin) or Snapshot DF (isoxaben + oryzalin). Gallery (isoxaben), a dry flowable formulation, also provided safe and acceptable control but it is not yet registered for use on daylily. Rout (oxyfluorfen + oryzalin), which is labelled for control of spotted spurge, caused moderate damage to daylilies.

## Introduction

Spotted spurge (*Chamaesyce maculata*; formerly *Euphorbia maculata*) is a major warm weather weed problem in container nurseries of the southeastern U.S. according to growers and extension personnel. There are no granular preemergent herbicides currently registered for spotted spurge control on a wide range of herbaceous perennials including daylilies. Growers are increasing their production of perennials like daylilies because of their rising popularity and profitability. Granular herbicides are generally preferred because of their ease of application. However, commonly used granular herbicides such as Rout (oxyfluorfen + oryzalin),

Ronstar G (oxadiazon), and OH-2 (oxyfluorfen + pendimethalin) are phytotoxic to daylilies as well as herbaceous perennials like lirioppe and mondo grass (3, 4, 5, 6) because the granules become trapped in the crown of the plant.

Southern Weedgrass Control (pendimethalin), a granular preemergent herbicide, is registered for use on daylily for control of prostrate spurge but not spotted spurge. The only herbicide labelled for spotted spurge control that can be applied over-the-top (OT) of daylilies is Snapshot DF (isoxaben + oryzalin). Gallery (isoxaben), also applied as an OT spray, is registered for control of spotted spurge in a few perennials but not daylily. Snapshot TG, a granular combination of Gallery (isoxaben) and Treflan (trifluralin), is soon to be released. It safely controls broadleaf weeds and grasses on a variety of ornamentals (2), including daylily (5). An experimental granular herbicide that appears relatively safe and effective for control of grasses and small-seeded broadleaf weeds is Stakeout (dithiopyr) (2; unpublished data).

Given the need for preemergent control of spotted spurge with granular herbicides in daylily and perennials with similar growth habits, the objectives of this 2-year study were to evaluate Snapshot TG (isoxaben + trifluralin) and Stakeout (dithiopyr) for efficacy in spotted spurge control and phytotoxicity to daylily.

## Materials and Methods

Experiments were conducted in 1989 and 1990 to separately evaluate efficacy and phytotoxicity. Efficacy of pre-emergent herbicides was evaluated using 3.8 l (1 gal) containers filled with a medium consisting of pine bark, Canadian sphagnum peat, and sand (5:1:1 by vol); initial

<sup>1</sup>Received for publication June 24, 1991; in revised form October 15, 1991. Florida Agricultural Experiment Station Journal Series No. R-01672. Special thanks to Dr. Gary W. Knox for his assistance in this project.

<sup>2</sup>Assistant Professor.

<sup>3</sup>Senior Biological Scientist.

medium pH was 5.6. A similar soilless medium was used in 1990 except the ratio was 3:1:1 to account for changes in porosity. One cubic meter (1.3 yd<sup>3</sup>) of medium was amended with 6.1 kg (13.5 lb) dolomite, 3.1 kg (6.8 lb) superphosphate, 0.9 kg (2.1 lb) Micromax (12S-0.1B-0.5Cu-12Fe-2.5Mn-0.05Mo-12Zn), and 6.1 kg (13.5 lb) Osmocote 18N-2.6P-1.0K (18-6-12). A top dressing of 14 g (0.5 oz) per pot Osmocote 18-6-12 was applied in mid-August of each year. Phytotoxicity was evaluated using 2-month-old divisions of *Hemerocallis* × 'Aztec Gold' (ave. height = 46 cm [18 in]) growing in 3.8 l (1 gal) containers in the soilless medium described above.

On June 23 and September 4, 1989, or June 15 and August 29, 1990, herbicide treatments were applied OT to weed-free containers of daylilies and soilless medium. Different containers of soilless media and daylilies were used each year. The dry flowable herbicides were applied as a broadcast spray using a compressed-air backpack sprayer which delivered 468 liter/ha (50 gpa) through two 8002 Teejet flat fan tips. Individual aliquots of the granular herbicides were applied uniformly to each container (OT application to daylilies). Stakeout (dithiopyr) was applied at 1.1, 1.7, or 2.2 kg ai/ha (1.0, 1.5, or 2 lb ai/A) and Snapshot TG (isoxaben + trifluralin) at 5.6 kg ai/ha (5 lb ai/A). Treatments included for comparison were an untreated control, Ronstar G (oxadiazon) at 4.5 kg ai/ha (4 lb ai/A), Rout (oxyfluorfen + oryzalin) at 3.4 kg ai/ha (3 lb ai/A), Snapshot DF (isoxaben + oryzalin) at 4.5 kg ai/ha (4 lb ai/A) and Gallery (isoxaben) at 1.1 kg ai/ha (1 lb ai/A). Immediately after application, all containers were overhead irrigated with 1.25 cm (0.5 in) water. The efficacy and phytotoxicity experiments were set up in randomized complete block designs with four containers per replication and four replications per treatment.

Hanging baskets (20.3 cm [8 in] in diameter) of mature spotted spurge were suspended about 1 m (3.25 ft) above the containers of soilless media to provide a source of seeds. In 1989, there were 16 pots of spurge equally distributed over a 72-m<sup>2</sup> (775 ft<sup>2</sup>) experimental plot (i.e., one pot of spotted spurge per four replications). In 1990, weed pressure was substantially increased. Thirty-six pots of mature spotted spurge were equally distributed over a 39 m<sup>2</sup> (420 ft<sup>2</sup>) experimental plot (i.e., one pot of spotted spurge per rep-

lication) for 10 weeks after the June 15 application. The hanging baskets of spotted spurge were removed before the second application in 1990 because the spotted spurge had declined and were producing few seed. Instead, each pot was directly overseeded with an average of 140 spotted spurge seeds per pot 1 day after the herbicides were applied. The experiment was conducted under 31% shade. All containers were overhead irrigated daily with 0.53 cm (0.21 in) of water.

Spotted spurge was counted 6 and 10 weeks after treatment (WAT), and harvested 10 WAT for dry weight determination. Foliar phytotoxicity on daylily was visually evaluated at 2.5, 6, and 10 WAT (11 weeks after the September 1989 application) by two observers to obtain a consensus rating. The rating scale was from 0 (no injury) to 5 (dead), with a rating of ≤1 being considered economically insignificant to growers. Data was subjected to analysis of variance with means separated by Duncan's new multiple range test.

## Results and Discussion

All herbicide treatments provided acceptable control of spotted spurge (≥70% reduction in number of spotted spurge) after the initial application in 1989 except for Ronstar G (oxadiazon), which controlled spotted spurge for 6 weeks (Table 1). Knox (1) reported similar results for efficacy of Ronstar G (oxadiazon). The dry weight of spotted spurge per pot was reduced at least 80% by all herbicide treatments (Table 1). Efficacies of the herbicides applied September 4, 1989 are not reported because unusually cool wet weather hampered germination and reduced growth. Hence, there were insufficient numbers of spotted spurge to accurately assess treatment differences after the second application.

Under the more intense weed pressure in 1990, two applications of all herbicides were required to achieve acceptable control as evidenced by reductions in number and dry weight of spotted spurge per pot 6 and 10 WAT after the second application (Table 2). After the first application, control of spotted spurge was apparent for only 2 WAT, with Ronstar G (oxadiazon), Rout (oxyfluorfen + oryzalin), and Snapshot TG (isoxaben + trifluralin) being the most

Table 1. Preemergent control of spotted spurge (*Chamaesyce maculata*) following herbicide application on June 23, 1989.

Herbicide	Rate kg ai/ha	Weeks after application <sup>2</sup>		
		6	10	
		Mean no. of spurge/pot <sup>3</sup>	Mean no. of spurge/pot	Mean dry wt of spurge/pot (g)
Control	—	8.6 a <sup>x</sup>	5.6 a	7.4 a
Ronstar G	4.48	1.7 b	2.5 b	1.5 b
Rout	3.36	0.3 bc	0.3 cd	0.4 b
Gallery	1.12	0.6 bc	0.9 cd	0.5 b
Snapshot DF	4.48	0.1 c	0.1 d	0.3 b
Snapshot TG	5.60	1.1 bc	1.7 bc	0.4 b
Stakeout	1.12	1.6 bc	1.2 bc	0.4 b
Stakeout	1.68	1.2 bc	0.8 cd	0.5 b
Stakeout	2.24	0.3 bc	0.9 cd	0.2 b

<sup>2</sup>The containers were overseeded by hanging 16 pots of mature spotted spurge in equal distribution about 1 m above the 72 m<sup>2</sup> plot for 10 weeks after treatment.

<sup>3</sup>Statistical analysis performed after square root transformations of spurge counts; nontransformed results are presented.

<sup>x</sup>Means with the same letter within a column are not significantly different at the 5% level using Duncan's multiple range test.

**Table 2. Preemergent control of spotted spurge (*Chamaesyce maculata*) following herbicide applications on June 15 and August 23, 1990.**

Herbicide	Rate kg ai/ha	Weeks after 1st application <sup>z</sup>		Weeks after 2nd application <sup>y</sup>		
		6	10 <sup>x</sup>	6	10	
		Mean no. of spurge/pot <sup>w</sup>	Mean no. of spurge/pot	Mean no. of spurge/pot	Mean no. of spurge/pot	Mean dry wt of spurge/pot (g)
Control	—	46.9 a <sup>y</sup>	46.6 a	16.6 a	22.4 a	2.1 a
Ronstar G	4.48	21.0 b	23.1 b	2.1 b	2.1 b	0.3 b
Rout	3.36	22.1 b	19.6 b	0.5 b	0.6 b	<0.1 b
Gallery	1.12	34.7 ab	35.7 ab	2.4 b	3.4 b	0.1 b
Snapshot DF	4.48	46.6 a	47.8 a	0.4 b	1.4 b	<0.1 b
Snapshot TG	5.60	31.5 ab	27.3 b	0.3 b	0.9 b	0.2 b
Stakeout	1.12	29.6 ab	25.3 b	2.1 b	3.1 b	0.1 b
Stakeout	1.68	28.9 ab	20.8 b	1.5 b	1.6 b	<0.1 b
Stakeout	2.24	39.0 ab	21.7 b	0.3 b	0.2 b	<0.1 b

<sup>z</sup>The containers were overseeded by hanging 36 pots of mature spotted spurge in equal distribution about 1 m above the 39 m<sup>2</sup> plot for 10 weeks after treatment.

<sup>y</sup>Each container was directly overseeded with an average of 140 seeds 1 day after treatment.

<sup>x</sup>Dry wt of spurge/pot means are not reported since they were not significantly different at the 5% level.

<sup>w</sup>Statistical analysis performed after square root transformation of spurge counts; nontransformed results are presented.

<sup>y</sup>Means with the same letter within a column are not significantly different at the 5% level using Duncan's multiple range test.

effective (results not shown). After the second application, Stakeout (dithiopyr) tended to be the least effective at suppressing the seedling population 2 WAT, however it did kill the majority of the spotted spurge in the following weeks. A similar effect of Stakeout (dithiopyr) has been noted on other weed species as well (unpublished data).

Economically significant phytotoxicity on daylily, caused only by Rout (oxyfluorfen + oryzalin) and Ronstar G (oxadiazon) (Table 3), concurs with previous reports of injury to daylily caused by these two herbicides (4, 5, 6). Injury occurred as bleached areas on the leaves that eventually became necrotic. It was noted 7 to 14 days after application. Injured daylilies rapidly improve so that by 6 WAT injury was no longer considered economically significant. By 10 WAT daylilies treated with Rout (oxyfluorfen + oryzalin) or Ronstar G (oxadiazon) had few injury symptoms and were only slightly smaller than untreated plants (pers. obs.). The other herbicides caused little to no injury and no visible reduction in growth. Similar results were obtained in 1990 (results not shown).

In conclusion, Stakeout (dithiopyr) and Snapshot TG (isoxaben + trifluralin) were as effective as the dry flowable

herbicides Snapshot DF (isoxaben + oryzalin) and Gallery (isoxaben) in controlling spotted spurge regardless of weed pressure. Under intense weed pressure used in part of this study, two applications of all herbicides were required for adequate control. Also, Stakeout (dithiopyr), Snapshot TG (isoxaben + trifluralin), and Gallery (isoxaben) provided control of spotted spurge equal to Rout (oxyfluorfen + oryzalin) without phytotoxicity to daylily.

(*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. Knox, G.W. 1986. Efficacy of a wettable powder formulation of the preemergent herbicide, oxadiazon, and phytotoxicity to ornamentals. Proc. Fla. State Hort. Soc. 99:270-272.
2. McNiel, R.E. and L.A. Weston. 1990. Split application of herbicides for weed control in woody nursery plants. Proc. South. Nurserymen's Assoc. Res. Conf. Ann. Rpt. 35:255-257.

**Table 3. Phytotoxicity of herbicide treatments after over-the-top application to *Hemerocallis* × 'Aztec Gold' on June 23 and September 4, 1989.**

Herbicide	Rate kg ai/ha	Injury rating <sup>z,y</sup>					
		Weeks after 1st application			Weeks after 2nd application		
		2.5	6	10	2.5	6	11
Control	—	0 b	0 b	0 a	0 b	0 b	0 b
Ronstar G	4.48	1.4 a	0.9 a	0.2 a	1.7 a	1.4 a	0.2 ab
Rout	3.36	1.4 a	0.8 a	0.1 a	1.7 a	1.4 a	0.5 a
Gallery	1.12	0.1 b	0.1 b	0 a	0 b	0 b	0 b
Snapshot DF	4.48	0.1 b	0.1 b	0 a	0 b	0.1 b	0 b
Snapshot TG	5.60	0.1 b	0.2 b	0 a	0.2 b	0.3 b	0 b
Stakeout	1.12	0.1 b	0.2 b	0 a	0.1 b	0 b	0 b
Stakeout	1.68	0.2 b	0 b	0 a	0 b	0.1 b	0 b
Stakeout	2.24	0.1 b	0 b	0 a	0 b	0 b	0 b

<sup>z</sup>Rating scale, 0-5: 0=No injury, 5=Dead; a rating of ≤ 1.0 was not considered economically significant injury for a grower.

<sup>y</sup>Means with the same letter within a column are not significantly different using Duncan's multiple range test.

3. Skroch, W.A., C.J. Catanzaro, and M.H. Yonce. 1990. Response of nine herbaceous flowering perennials to selected herbicides. *J. Environ. Hort.* 8:26–28.

4. Stamps, R.H. and C.A. Neal. 1990. Evaluation of dinitroaniline herbicides for weed control in container landscape plant production. *J. Environ. Hort.* 8:52–57.

5. Wells, D.W. and R.J. Constantin. 1989. Tolerance of daylilies to selected herbicides. *Proc. South. Nurserymen's Assoc. Res. Conf. Ann. Rpt.* 34:234–235.

6. Whitwell, T. and J. Kelly. 1989. Effects of preemergence herbicides on hosta and daylily. *J. Environ. Hort.* 7:29–31.

---

---

# Influence of Herbicides on Shipping Quality of Landscape Plants<sup>1</sup>

Joanna Hubbard, Ted Whitwell and John Kelly<sup>2</sup>

*Department of Horticulture  
Clemson University  
Clemson, SC 29634*

## Abstract

Japanese barberry 'Crimson Pygmy', Crape myrtle 'Byers Hardy Lavender' and azalea 'Girard Scarlet' were treated with either Southern weedgrass control (pendimethalin) at 3.4 kg a.i./ha (3.3 a.i. lb/A) or Ornamental Herbicide-2 (oxyfluorfen + pendimethalin) at 3.4 kg a.i./ha (3.3 lb a.i./A) or 6.7 kg a.i./ha (6.6 lb a.i./A) prior to simulated shipping in an enclosed environment. No injury was observed on any plants as a result of herbicide treatments.

**Index words:** container production, nursery production, oryzalin, oxyfluorfen, pendimethalin, post harvest storage

**Species used in this study:** Japanese Barberry (*Berberis thunbergii* DC var. *atropurpurea* 'Crimson Pygmy'); Crape Myrtle (*Lagerstroemia indica* L. 'Byers Hardy Lavender'); Azalea (*Rhododendron* × 'Girard Scarlet')

**Herbicides used in this study:** Ornamental Herbicide-2 (oxyfluorfen + pendimethalin), 2-chloro-1-(3-ethoxy-4-nitrophenoxy)4-(trifluoromethyl)benzene + N-(1-ethylpropyl)-3,4-dimethyl-2,6-dinitrobenzeneamine; Southern weedgrass control (pendimethalin).

## Significance to the Nursery Industry

Problems encountered with shipments of containerized landscape plants include symptoms such as flower or fruit drop, distorted leaves and yellowing or browning of the foliage. Such injury may cause serious economic losses as well as damaging customer-grower relationships. Cross-country shipments of nursery stock may require up to 4 days with plants being held in the dark. It is possible that the use of volatile herbicides during production is responsible for this injury. Therefore, it is important for growers to know which plants are most susceptible to injury and how long shipping should be delayed after herbicide application to avoid injury. Two commercially important herbicides, Southern weedgrass control and Ornamental Herbicide-2 were applied to three landscape plant species immediately prior to shipping. No injury symptoms due to herbicides were observed after removal from simulated shipping conditions.

## Introduction

Garden center retailers and landscapers have occasionally noticed unexplained problems with shipments of containerized landscape plants. Postharvest losses are often associated with high temperatures or ethylene in the shipping environment, however the symptoms reported by many nurserymen are more indicative of herbicide injury. These symptoms include flower or fruit drop, distorted foliage and foliar chlorosis and necrosis which can be economically damaging to the grower and/or retailer/landscape contractor. No research has been conducted on postharvest shipping and storage problems specifically involving herbicide-treated nursery stock. Many of the herbicides used by nurserymen are volatile including the dinitroanilines (3) and the diphenylethers (4) and their vapors have been shown to cause phytotoxicity (1, 5). Ornamental Herbicide-2 [(OH-2) oxyfluorfen (2%) + pendimethalin (1%)] and Southern weedgrass control (pendimethalin 2.7%) are preemergence herbicides commonly used in container nurseries for control of annual grass and small-seeded broadleaf weeds. Oxyfluorfen is a diphenylether and pendimethalin a dinitroaniline so both herbicides have potential for damaging nursery stock through volatilization during shipment. Potential injury from herbicide volatility is enhanced when the herbicides are used in enclosed structures and as a result these herbicides are not labeled for use in greenhouses or over-

<sup>1</sup>Received for publication September 12, 1991, in revised form October 28, 1991 as technical contribution from South Carolina Agricultural Experiment Station. This research was partially supported by a grant from the Horticulture Research Institute, Inc., 1250 I Street NW., Suite 500, Washington, DC.

<sup>2</sup>Former Graduate Research Assistant and Professors, resp.