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Isoxaben and Isoxaben Combinations for Weed Control in Container-Grown Herbaceous Flowering Perennials[1]

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Abstract

Gallery DF (isoxaben), Snapshot DF (isoxaben + oryzalin), and Snapshot TG (isoxaben + trifluralin) were applied to four species in 1991 and to nine species in 1992 of container-grown herbaceous flowering perennials to evaluate efficacy, phytotoxicity, and effect on plant growth. Surflan AS (oryzalin) and Treflan 5G (trifluralin) were used as standard herbicide checks. Gallery was applied at 0.56, 0.84, and 1.12 kg ai/ha (0.5, 0.75, and 1.0 lb ai/A). Snapshot DF and Snapshot TG were applied at 2.8, 4.2, and 5.6 kg ai/A (2.5, 3.75, and 5.0 lb ai/A). Coreopsis was not affected by any herbicide treatment either year. Painted daisy was injured by all treatments except Snapshot TG at 2.5 lb ai/A and Treflan. Gallery at 1.12 kg ai/ha (1.0 lb ai/A) and Snapshot DF at 5.6 kg ai/ha (5.0 lb ai/A), injured all species except coreopsis and hibiscus. Surflan injured gloriosa daisy (1991 only), chrysanthemumhollyhock, hibiscus, and painted daisy. Snapshot TG applied at 5.6 kg ai/A (5.0 lb ai/A) injured hollyhock. Height of coreopsis, shasta daisy, gloriosa daisy, and columbine was not affected or only slightly reduced by any treatment. Hollyhock, hibiscus, painted daisy, and chrysanthemum were generally shorter in containers treated with Snapshot DF at 4.2 kg/ha or higher rates.

Index words: flowering perennials, herbicides, phytotoxicity, weed control.

Species used in this study: 'Alaska' shasta daisy (*Chrysanthemum maximum* Ramond); 'Autumn Glory' chrysanthemum (*Chrysanthemum sp.*); 'McKana Giant' columbine (*Aquilegia spp.*); 'Early Sunrise' coreopsis (*Coreopsis grandiflora* L.); gloriosa daisy (*Rudbeckia hirta* L.); 'Southern Belle' hibiscus (*Hibiscus moscheutos* L.); 'Summer Carnival' hollyhock (*Althaea rosea* L.); 'Giant Mixed' painted daisy (*Chrysanthemum coccineum* Wild.) ; 'Summer Pastels' yarrow (*Achillea millifolium* L.).

Herbicides used in this study: Gallery (isoxaben), *N*-[3-(1-ethyl-1-methylpropyl)-5-isoxazolyl]-2,6-dimethoxybenzamide; 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)benezenamine; Surflan (oryzalin), 4-(dipropylamino)-3,5-dinitrobenzenesulfonamide; Treflan (trifluralin), 2,6-dinitro-*N*,*N*-dipropyl-4-(trifluoromethyl)benezenamine.

Significance to the Nursery Industry

Certain herbaceous flowering perennials were found to be sensitive to Gallery and Snapshot DF. Snapshot TG was found to be less injurious to all species tested. Before large-scale use of Gallery or Snapshot DF on herbaceous flowering perennials, careful consideration must be given to the species to which these herbicides might be applied. Independent trials of unlabeled species need to be conducted. Snapshot TG did not injure any of the species tested and therefore might be a more appropriate choice.

Introduction

Herbicide formulations containing isoxaben (Gallery DF, Snapshot DF, and Snapshot TG) have been found to provide good weed control with acceptable crop tolerance in many container- and field-grown landscape plants. Gilliam et al. (4) found that Gallery generally provided inferior grass control compared with Surflan but noted no visual crop injury in field-grown plants. Neal and Senesac (5) found no injury to container-grown landscape plants by Gallery alone or in combination with Treflan or Surflan. However, field-grown Douglas fir and barberry were injured by Snapshot DF and Surflan alone. Fuller (3) reported that some species were injured when multiple applications of Gallery DF, Snapshot DF, and Snapshot TG were made. Of the isoxaben-containing formulations, Snapshot DF caused the most injury to the sensitive plant species.

Limited research has been conducted on the response of herbaceous perennials to application of herbicides. Schuett and Klett (7) reported that container-grown herbaceous perennials were not affected by preemergence herbicides applied at typical use rates. However, carpet bugle (*Ajuga repens atropurpurea*) was injured by Surflan at 4.5 or 6.2 kg ai/A (4.0 or 6.0 lb ai/A). Skroch et al. (8) reported several species of herbaceous flowering perennials were moderately injured by Ornamental Herbicide-2 (oryzalin + oxyfluorfen, *N*-(1-ethylpropyl)3,4-dimethyl-2,6-dinitrobenzeneamine), but observed little or no injury from other herbicides tested. Skroch et al. (9) also reported that preemergence herbicices used in spring flowering bulbs did not cause flower injury. Smith et al. (10) reported field-grown shasta daisy to be slightly injured by Surflan 75W at 1.8 kg ai/A (2.0 lb ai/A). Staats and Klett (11) reported Surflan stunted *Stachys byzantina* and *Phlox paniculata* and reduced the dry weight of *Gypsophilia pacifica*. They also found that Gallery stunted *Stachys*. Derr (1, 2) reported that treatments containing isoxaben caused unacceptable injury in field-grown and container-grown lanceleaf coreopsis, ox-eye daisy, blanket flower, and purple coneflower.

Materials and Methods

This research was conducted during the 1991 and 1992 growing seasons. In 1991, all perennials were seed-grown. In 1992, coreopsis and shasta daisy were propagated by division, while the remaining species were seed-grown. Growing media consisted of pine bark and sand (7:1 by vol). The

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Table 1. Injury (4 weeks after treatment) to and height (80 days after treatment) of container-grown herbaceous flowering perennials due to treatment with isoxaben (Gallery) or isoxaben combinations (Snapshot DF and Snapshot TG), 1991.

Treatment	Rate kg ai/ha	Injury[z]				Height			
		COR[y]	SHA	GLO	COL	COR	SHA	GLO	COL
		%				cm			
Check, weed-free	—	1	1	5	0	30	31	25	13
Check, weedy	—	0	1	0	4	44	33	39	14
Gallery 75DF	0.56	9	46	13	12	32	32	32	7
Gallery 75DF	0.84	6	41	9	19	32	32	34	10
Gallery 75DF	1.12	4	35	12	31	28	30	36	11
Snapshot 80DF	2.8	5	35	18	37	31	35	38	10
Snapshot 80DF	4.2	9	37	28	34	34	39	31	7
Snapshot 80DF	5.6	8	66	69	29	24	12	14	0
Snapshot 2.5TG	2.8	6	8	0	3	3	42	37	19
Snapshot 2.5TG	4.2	4	5	4	10	30	41	39	17
Snapshot 2.5TG	5.6	3	3	10	8	33	36	29	14
Surflan 4AS	3.36	0	24	25	19	37	21	26	5
Treflan 5G	3.36	1	5	1	8	39	35	37	12
LSD (0.05)		NS	29	15	NS	NS	14	12	6

[z]Injury rated: 0 = no injury, 100 = crop dead.

[y]COR = coreopsis, SHA = Shasta daisy, GLO = gloriosa daisy, COL = columbine.

[NS]Not significant.

media was amended with 8 lb/yd^3 slow release fertilizer 18N–2.6P–9.9K (18–6–12), 1.5 lb/yd^3 micronutrients, 10 lb/yd^3 dolomitic lime, and 2 lb/yd^3 13N–9.9P–10.8K (13–13–13). After transplanting, approximately 1.3 cm (0.5 in) of water was applied to settle the media around the roots. All herbicide treatment were applied the next day. Sprayable treatments were applied with a CO_2 backpack sprayer delivering 121 liters/ha (13 GPA) at 207 kPa (30 psi). Granular treatments were applied with a paperbag shaker. After treatments were applied, water was applied to rinse the herbicides from the leaves. Plants were watered as needed throughout the season by overhead sprinklers.

Experimental design was a randomized complete block with 4 replications. Four plants of each species were in each replication. Visual rating of plant injury and weed control were conducted 4 weeks after treatment. Both years plant height was measured at the time of flowering.

Results and Discussion

In both years of the study, weed populations were too low and erratic to make accurate evaluations.

1991 results. Gallery caused slight to moderate injury to all species except coreopsis (Table 1). Snapshot DF and

Table 2. Injury to container-grown herbaceous flowering perennials due to treatment with isoxaben (Gallery) and isoxaben combinations (Snapshot DF and Snapshot TG) at 4 weeks after treatment, 1992.

Treatment	Rate kg ai/ha	Injury[z]							
		COR[y]	SHA	GLO	YAR	MUM	HOL	HIB	PD
		%							
Check, weed-free	—	0	0	3	0	0	8	0	0
Check, weedy	—	0	3	0	0	5	5	0	0
Gallery	0.56	6	6	5	18	40	18	3	65
Gallery	0.84	11	11	4	35	80	20	3	95
Gallery	1.12	8	13	9	58	78	25	3	85
Snapshot DF	2.8	0	4	16	5	39	50	5	85
Snapshot DF	4.2	0	8	16	31	59	66	10	90
Snapshot DF	5.6	5	26	39	53	100	74	6	94
Snapshot TG	2.8	5	3	0	8	1	21	1	29
Snapshot TG	4.2	8	3	0	5	5	14	1	65
Snapshot TG	5.6	5	1	1	10	18	21	6	66
Surflan 4AS	3.36	3	3	14	3	30	66	25	66
Treflan 5G	3.36	13	1	5	5	0	10	0	20
LSD (0.05)		NS	NS	19	25	22	20	6	29

[z]Injury rated: 0 = no injury, 100 = crop dead.

[y]COR = coreopsis, SHA = Shasta daisy, GLO = gloriosa daisy, YAR = yarrow, MUM = chrysanthemum, HOL = hollyhock, HIB = hibiscus, PD = painted daisy.

[NS]Not significant.

Table 3. Height of container-grown herbaceous flowering perennials 75 days after treatment as influenced by isoxaben (Gallery) or isoxaben combinations (Snapshot DF, and Snapshot TG), 1992.

Treatment	Rate lb ai/A	Plant height (cm)							
		COR[z]	SHA	GLO	YAR	MUM	HOL	HIB	PD
Check, weed-free	—	73	29	45	31	24	67	72	19
Check, weedy	—	81	36	54	41	25	93	70	19
Gallery	0.56	75	43	55	33	16	86	69	10
Gallery	0.84	73	46	49	21	8	69	64	2
Gallery	1.12	69	36	37	22	8	62	66	5
Snapshot DF	2.8	69	47	52	33	18	62	67	4
Snapshot DF	4.2	78	55	46	27	3	34	59	2
Snapshot DF	5.6	63	44	48	25	0[y]	23	65	2
Snapshot TG	2.8	79	40	55	32	20	87	82	15
Snapshot TG	4.2	76	51	52	40	24	91	70	10
Snapshot TG	5.6	69	46	43	35	19	85	68	10
Surflan 4AS	3.36	71	49	48	36	17	34	54	8
Treflan 5G	3.36	63	52	48	31	22	85	68	14
LSD (0.05)		9	NS	10	12	8	34	10	7

[z]COR = coreopsis, SHA = Shasta daisy, GLO = gloriosa daisy, YAR = yarrow, MUM = chrysanthemum, HOL = hollyhock, HIB = hibiscus, PD = painted daisy.
[y]All plants dead.
[NS]Not significant.

Surflan caused moderate to severe injury to gloriosa daisy (18 to 69%), shasta daisy (24 to 66%), and columbine (19 to 37%). Snapshot TG and Treflan 5G did not injure any species.

Height of coreopsis was not affected by any herbicide treatment (Table 1). Height of shasta daisy, gloriosa daisy, and columbine was reduced by Snapshot DF at 5.6 kg ai/ha (5.0 lb ai/A). Plant height of columbine was also reduced in containers treated with Surflan.

1992 results. Coreopsis was not injured by any herbicide (Table 2). Injury to shasta daisy ranged from 1 to 26% but there was no difference among treatments. Less injury to shasta daisy in 1992 might have been due to the larger size of the plants at the time of treatment compared to the size of plants in 1991. Gloriosa daisy was significantly injured by Snapshot DF at 5.6 kg ai/ha (5.0 lb ai/A). Gallery at 0.56 kg ai/ha (0.5 lb ai/A), Snapshot DF at 4.2 and 5.6 kg ai/ha (3.7 and 5.0 lb ai/A),and Snapshot TG at 5.6 kg ai/A (5.0 lb ai/A) caused slight (13–20%) but significant injury when compared with the weed-free check. Yarrow suffered moderate (31–58%) injury from Snapshot DF or TG at 4.2 and 5.6 kg ai/ha (3.7 and 5.0 lb ai/A). Injury to chrysanthemum ranged from moderate (39–59%) to severe (59–100%) with Gallery and Snapshot DF. Surflan also caused 30% injury to chrysanthemum. Of the herbicides tested, Snapshot DF and Surflan caused the greatest injury to hollyhock. Hibiscus exhibited slight injury from Snapshot DF and Surflan. Painted daisy was injured by all herbicides except Snapshot TG at 2.8 kg ai/ha (2.5 lb ai/A), and Treflan.

Reduction in plant height was not always considered a negative effect. Snapshot DF at 5.6 kg ai/A (5.0 lb ai/A), and Treflan reduced the height of coreopsis, but the result was a more compact and desirable plant (Table 3). Height of shasta daisy was not adversely affected by any herbicide treatment. Gallery at 0.84 kg ai/ha (0.75 lb ai/A) or higher and Snapshot DF at 4.2 kg ai/ha (3.7 lb ai/A) or higher reduced the height of yarrow and chrysanthemum compared with the weedy check plots. The chrysanthemum plants were severely stunted or killed outright at these rates. Hollyhock height was reduced by Snapshot DF at 4.2 kg ai/ha (3.7 lb ai/A) or higher rates and by Surflan. Hibiscus growth was reduced only in containers treated with and Surflan. Plant height of painted daisy was reduced by all herbicides except Snapshot TG at 2.8 kg ai/ha (2.5 lb ai/A) and Treflan.

These studies indicate the diversity of crop response to different herbicide treatments. Coreopsis grown in containers were not injured as were the field-grown plants as reported by Derr (1). Injury to shasta daisy by Surflan was similar to the injury reported by Smith et al. (11), but only in 1991. Comparisons of response of container-grown and field-grown herbaceous perennials to isoxaben or other herbicides can not be made directly. Recommendations of use can only be made after appropriate research has been conducted.

(*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.)

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Gas Exchange Rates for Selected Red Maple Cultivars Grown in Alabama[1]

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Abstract

The objective of this study was to develop a rapid screening technique to characterize selected red maple (*Acer rubrum* L.) cultivars based on their gas exchange capacities. Evaluations were conducted in Alabama under ambient conditions on an established,irrigated field trial. In preliminary evaluations 9 red maple cultivars ('Autumn Flame', 'Fairview Flame', 'Franksred', 'Karpick', 'Northwood', 'October Glory', 'Redskin', 'Schlesingeri', and 'Tilford') and 3 Freeman maple (*Acer* x *freemanii* E. Murray) selections ('Autumn Blaze', 'Morgan', and 'Scarsen') were observed for differences in net photosynthesis (Pn), transpiration (E), and stomatal conductance (Cs). Based on these results, 4 cultivars of *A. rubrum* were selected and evaluated intensively over 2 years. Throughout the study, growth rates for the 4 selections failed to correspond with gas exchange observations.

Index words: tissue culture, growth, photosynthesis, CO_2 assimilation, transpiration, stomatal conductance, respiration, water use efficiency.

Species used in this study: Red maple (*Acer rubrum* L.) and Freeman maple (*Acer* x *freemanii* E. Murray).

Significance to the Nursery Industry

The gas exchange capacities of 12 red maple (*Acer rubrum* L.) cultivars were measured. Evaluations were conducted under ambient conditions on an established field trial equipped with drip irrigation. Preliminary evaluations indicated that 9 red maple cultivars and 3 Freeman maple (*Acer* x *freemanii* E. Murray) selections differed in net photosynthesis (Pn), transpiration (E), and stomatal conductance (Cs). Based on these results, 4 cultivars of *A. rubrum* were selected for further evaluation. Throughout the study, growth rates for these 4 selections failed to correspond with gas exchange rates.

Our work determined that differences in performance of the red maple cultivars in this study could not be determined by their gas exchange capacities. Continuing studies in various components of gas exchange and environmental conditions affecting these components may reveal factors limiting growth for individual cultivars. However, cultivar evaluations by field performance with conventional methods remain essential.

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Introduction

Several studies have been conducted in an effort to link gas exchange and growth in *Acer* species (2, 5, 7). Studies have shown great variability among red maple seedlings collected from 49 locations across their native range, extending throughout the eastern United States and Canada (10). However, limited work has been reported on the relationship of growth and gas exchange capacities of red maple cultivars grown in a similar environment in the Southeastern United States. Differences in performance (1, 9) and gas exchange capacities (8) of red maple cultivars in the Southeastern United States have been reported. Correlation of gas exchange capacities to field performance might identify climatic zones or microclimates in which a new selection would perform best without lengthy field evaluations. Our objective was to develop a rapid screening technique to characterize selected red maple cultivars based on their gas exchange capacities.

Materials and Methods

Microplantlets of 9 red maples (*Acer rubrum*) and 3 Freeman red maples (*A.* x *freemanii*) along with a group of seedling red maples (cultivars listed in Table 1) were obtained from a commercial nursery (Microplant, Fairview, OR) in March 1988. Trees were transplanted into 2.8 liter (#1) pots in an amended 6:1 (by vol) pinebark:sand medium and grown in a double layered polyhouse for 3 months, then outdoors