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Crop Efficacy and Weed Control Evaluation of a New Herbicide for Herbaceous Ornamentals

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Abstract

There is a need for preemergence herbicides in the container nursery industry due to the high cost of hand weeding, but few preemergence herbicides are labeled for sensitive herbaceous ornamental crops. Currently, Snapshot (isoxaben + trifluralin) is the only granular formulated preemergence herbicide labeled for many sensitive herbaceous ornamental crops. Fortress (isoxaben + dithiopyr) is a new granular preemergence herbicide made by OHP, Inc. for use on sensitive herbaceous ornamental plants. In this experiment, four species of ornamental herbaceous crops in #1 containers were treated with Fortress at 150, 300, and 600 lbs/A, a spray combination of Gallery (isoxaben) plus Dimension (dithiopyr) at 0.75+0.38 lbs ai/A, and Snapshot (isoxaben + trifluralin) at 150 lbs/A. Also, #1 containers filled with amended 6 pine bark : 1 sand substrate were treated with Fortress at 100, 150, and 200 lbs/A, Gallery (isoxaben) plus Dimension (dithiopyr) at 0.75+0.38 lbs ai/A, and Snapshot (isoxaben + trifluralin) at 150 lbs/A and then overseeded with 25 seeds of either oxalis, bittercress, eclipta, phyllanthus, spurge, or crabgrass. Fortress had no effect on size index and caused no significant phytotoxicity of crops tested. Fortress had excellent control of bittercress and oxalis 30 and 60 DAT, and significantly better control than other treatments 90 DAT. Fortress controlled eclipta well 30 and 60 DAT. It provided good control of spurge 30 DAT, but almost none 90 DAT. Fortress provided poor phyllanthus control 60 DAT while Snapshot provided excellent control. All herbicide treatments provided excellent crabgrass control 90 DAT. Fortress had no effect on size index and caused no significant phytotoxicity of crops tested.

INTRODUCTION

A major challenge for container nurseries is the high cost of labor for hand weeding (Gilliam et al., 1990). Labor costs can be reduced drastically when pre-emergence herbicides are used to control weeds compared to hand weeding. In addition to cost, another problem for container nurseries is that there are limited management strategies for specific ornamental plants (Fausey, 2003). Weed management in herbaceous ornamental crops is difficult because there are few herbicides that can be tolerated by these plants (Case et al., 2005). Injuries from preemergence herbicides to herbaceous ornamental crops can include leaf burning and stunted growth (Derr, 1994).

Snapshot TG (isoxaben + trifluralin) has been shown to be one of the safest preemergence herbicides on a variety of herbaceous ornamental crops that controls a broad spectrum of grass and broadleaf weeds (Fain et al., 2006; Mervosh and Ahrens, 1998; Porter, 1996; Thetford et al., 1995). OHP, Inc. has developed a new broad spectrum granular preemergence herbicide, Fortress, for sensitive herbaceous ornamental crops in the nursery industry. Fortress contains the active ingredients isoxaben and dithiopyr. These active ingredients have been available separately in liquid sprays, but they have not been previously available in a combined granular product. The objective of this research is to evaluate Fortress for crop safety on several herbaceous ornamental crops for over-the-top application and efficacy on six common nursery weeds.

MATERIALS AND METHODS

On 30 March 2017, #1 containers were filled with a 6 pine bark : 1 sand (by volume) substrate amended with 4 lbs 4 oz dolomitic lime/yd^3, 14 lbs 7 oz/yd^3 15-9-12 with 12 to 14-month Osmocote controlled release fertilizer, and 1 lb 5 oz/yd^3 MicroMax micro-nutrient package. On 12 April 2017, 20 pots each were treated with Fortress at 100 lbs/A, 150 lbs/A, and 200 lbs/A, Gallery (isoxaben, DOW Chemical, Midland, MI) plus Dimension (dithiopyr, DOW Chemical, Midland, MI) spray at 0.75 + 0.38 lbs ai/A, Snapshot 2.5TG (isoxaben + trifluralin, DOW Chemical, Midland, MI) at 150 lbs/A, or left untreated (control). On 13 April 2017, ten pots of each treatment were seeded with 25 oxalis (*Oxalis stricta*), and ten pots of each treatment were seeded with bittercress (*Cardamine hirsuta*). Pots were placed by weed species in a randomized complete block design with ten blocks and one pot per block under a retractable roof greenhouse with open sides and closed roof and under overhead irrigation. Percent coverage ratings were recorded 30, 60, and 90 days after treatment (DAT).

On 13 June 2017, #1 containers were filled with a 6 pine bark : 1 sand (by volume) substrate amended with 4 lbs 4 oz dolomitic lime/yd^3, 14 lbs 7 oz/yd^3 15-9-12 with 12 to 14-month Osmocote controlled release fertilizer, and 1 lb 5 oz/yd^3 MicroMax micro-nutrient package. On 14 June 2017, pots were treated with the same herbicide treatments as those treated on 13 April 2017. On 15 June 2017, ten pots of each treatment were seeded with 25 seeds of eclipta (*Eclipta prostrata*), longstalk phyllanthus (*Phyllanthus tenellus*), spurge (*Euphorbia maculata*), or crabgrass (*Digitaria ciliaris*) per pot. Pots were placed by weed species in a randomized complete block design with ten blocks and one pot per block in full sun under overhead irrigation. Percent coverage ratings were recorded 30, 60, and 90 DAT.

On 11 April 2017, #1 containers were filled with a 6 pine bark : 1 sand (by volume) substrate amended with 4 lbs 4 oz dolomitic lime/yd^3, 14 lbs 7 oz/yd^3 15-9-12 12 to 14-

month Osmocote controlled release fertilizer, and 1 lb 5 oz/yd^3 MicroMax micro-nutrient package. Liners of tickseed (*Coreopsis grandiflora* 'Baby Sun'), purple coneflower (*Echinacea purpurea*), switchgrass (*Panicum virgatum*), and black-eyed Susan (*Rudbeckia fulgida* var. *sullivantii* 'Goldsturm') were transplanted one per container into 48 containers per species. On 12 April 2017, ten plants each plants were treated with Fortress at 150 lbs/A, 300 lbs/A, and 600 lbs/A, Gallery (isoxaben, DOW Chemical, Midland, MI) plus Dimension (dithiopyr, DOW Chemical, Midland, MI) spray at 0.75 + 0.38 lbs ai/A, Snapshot 2.5TG (isoxaben + trifluralin, DOW Chemical, Midland, MI) at 150 lbs/A, or left untreated (control). Plants were placed in a completely randomized block design by species with ten blocks and one plant per block under overhead irrigation. Plants were placed in full sun. Plants were evaluated for phytotoxicity 30, 60, and 90 DAT. Size indices and flower counts were recorded 90 DAT.

The treatment design for all experiments was a 2-way factorial of herbicide treatment and DAT. Differences among herbicide treatment means were determined using the simulated method. Linear and quadratic trends over DAT were tested using model regression.

RESULTS AND DISCUSSION

For all weed species, the herbicide treatment by DAT interaction was significant. All herbicide treatments provided excellent oxalis control 30 and 60 DAT, but by 90 DAT Fortress at 100 and 200 lbs/A provided significantly better control than Gallery plus Dimension or Snapshot (Table 1).

Table 1. Herbicide efficacy on oxalis percent coverage 30, 60, and 90 DAT.[z]

Treatment	Rate	30 DAT	60 DAT	90 DAT	Sign.[y]
Fortress	100 lbs/A	0.0b[x]	0.0	8.2d	NS
Fortress	150 lbs/A	0.0b	0.0b	13.7cd	NS
Fortress	200 lbs/A	0.0b	0.0b	3.6d	NS
Gallery + Dimension	0.75+0.38 lbs ai/A	0.0b	0.0b	36.0b	Q***
Snapshot 2.5TG	150 lbs/A	0.0b	0.5b	26.6bc	Q**
Control		62.0a	83.1a	97.5a	L***

[z]The treatment by days after treatment interaction was significant for percent coverage at $P < 0.05$.
[y]Not significant (NS) or significant linear (L) or quadratic (Q) trends of percent coverage across DAT using qualitative-quantitative model regression at $P < 0.01$ (**) or $P < 0.001$ (***).
[x]Least squares means comparisons among treatments (lower case in columns) using the simulated method at $P < 0.05$.

Bittercress control among all herbicide treatments was also excellent 30 and 60 DAT (Table 2). By 90 DAT, Fortress at 150 lbs/A and 200 lbs/A provided significantly better control than Gallery plus Dimension or Snapshot.

All herbicide treatments provided good eclipta control 30 DAT, but control 60

DAT was moderate (Table 3). The only treatment with significantly better control than the control 90 DAT was Fortress at 200 lbs/A.

All herbicide treatments provided good spurge control 30 DAT and moderate control 60 DAT (Table 4). However, percent coverage in pots of all herbicide treatments was similar to the control 90 DAT.

Table 2. Herbicide efficacy on bittercress percent coverage 30, 60, and 90 DAT.[z]

Treatment	Rate	30 DAT	60 DAT	90 DAT	Sign.[y]
Fortress	100 lbs/A	0.0ns[x]	0.0b	46.5ab	Q**
Fortress	150 lbs/A	0.0	0.0b	35.1b	Q**
Fortress	200 lbs/A	0.0	0.0b	12.4c	Q*
Gallery + Dimension	0.75+0.38 lbs ai/A	0.0	0.0b	69.5a	Q***
Snapshot 2.5TG	150 lbs/A	0.0	0.0b	69.5a	Q***
Control		30.5	50.5b	81.5a	L**

[z]The treatment by days after treatment interaction was significant for percent coverage at $P < 0.05$.

[y]Linear (L) or quadratic (Q) trends of percent coverage across DAT using qualitative-quantitative model regression at $P < 0.05$ (*), $P < 0.01$ (**) or 0.001 (***).

[x]Least squares means comparisons among treatments (lower case in columns) using the simulated method at $P < 0.05$.

Table 3. Herbicide efficacy on eclipta percent coverage 30, 60, and 90 DAT.[z]

Treatment	Rate	30 DAT	60 DAT	90 DAT	Sign.[y]
Fortress	100 lbs/A	4.3ns[x]	49.1ab	60.5ab	L**
Fortress	150 lbs/A	2.0	29.1b	81.0ab	L***
Fortress	200 lbs/A	0.1	6.3b	46.1b	L***
Gallery + Dimension	0.75+0.38 lbs ai/A	0.3	11.0b	67.0ab	L***
Snapshot 2.5TG	150 lbs/A	1.2	39.0b	68.5ab	L***
Control		26.6	91.0a	91.5a	Q**

[z]The treatment by days after treatment interaction was significant for percent coverage at $P < 0.05$.

[y]Linear (L) or quadratic (Q) trends of percent coverage across DAT using qualitative-quantitative model regression at $P < 0.01$ (**) or 0.001 (***).

[x]Least squares means comparisons among treatments (lower case in columns) using the simulated method at $P < 0.05$.

Phyllanthus control by herbicide treatments was good 30 DAT, although percent coverage of pots treated with herbicide, which ranged from 0.4% to 1.4%, was similar to the non-treated control pots at 15.6% coverage (Table 5). Percent coverage among pots treated with herbicides ranged from 9.6% to 25% 60 DAT and was lower than percent coverage in the control pots. Percent coverage increased significantly in pots treated with herbicide by 90 DAT but were all significantly lower than percent coverage in the control pots.

Table 4. Herbicide efficacy on spurge percent coverage 30, 60, and 90 DAT.[z]

Treatment	Rate	30 DAT	60 DAT	90 DAT	Sign.[y]
Fortress	100 lbs/A	1.6b[x]	37.5b	97.0ns	L***
Fortress	150 lbs/A	2.5b	44.5b	97.0	L***
Fortress	200 lbs/A	0.6b	12.1b	85.6	Q**
Gallery + Dimension	0.75+0.38 lbs ai/A	0.0b	18.0b	97.5	Q**
Snapshot 2.5TG	150 lbs/A	1.1b	25.5b	97.0	Q*
Control		75.5a	99.5a	100.0	L***

[z]The treatment by days after treatment interaction was significant for percent coverage at $P < 0.05$.

[y]Linear (L) or quadratic (Q) trends of percent coverage across DAT using qualitative-quantitative model regression at $P < 0.05$ (*), $P < 0.01$ (**) or 0.001 (***).

[x]Least squares means comparisons among treatments (lower case in columns) using the simulated method at $P < 0.05$.

All herbicide treatments provided excellent control of crabgrass 30, 60, and 90 DAT, but it is important to note that all Fortress treatments had some amount of weed germination while the others did not (Table 6).

Table 6. Herbicide efficacy on crabgrass percent coverage 30, 60, and 90 DAT.[z]

Treatment	Rate	30 DAT	60 DAT	90 DAT	Sign.[y]
Fortress	100 lbs/A	0.1b[x]	9.1b	9.5b	NS
Fortress	150 lbs/A	0.0b	0.0b	0.5b	NS
Fortress	200 lbs/A	0.0b	0.0b	7.5b	NS
Gallery + Dimension	0.75+0.38 lbs ai/A	0.0b	0.0b	0.0b	NS
Snapshot 2.5TG	150 lbs/A	0.0b	0.0b	0.0b	NS
Control		68.5a	99a	100.0a	Q**

[z]The treatment by days after treatment interaction was significant for percent coverage at $P < 0.05$.

[y]Not significant (NS) or quadratic (Q) trends of percent coverage across DAT using qualitative-quantitative model regression at $P < 0.01$ (**).

[x]Least squares means comparisons among treatments (lower case in columns) using the simulated method at $P < 0.05$.

No phytotoxicity occurred on any of the herbaceous crops tested. Tickseed was the only herbaceous crop species that that was affected by herbicide treatments (Table 7). Fortress 100 and 150 lbs/A had significantly greater size index 90 DAT, while the plants in the Gallery plus Dimension treatment produced the largest number of flowers 90 DAT.

Overall, Fortress treatments provided equal or better weed control than Snapshot or Gallery plus Dimension. Fortress particularly provided longer residual control of oxalis compared to Snapshot or Gallery plus Dimension.

Table 7. Size index and flower count of tickseed 90 DAT.

Treatment	Rate	Size Index	Flower Count
Fortress	100 lbs/A	58.2a[z]	5.9b
Fortress	150 lbs/A	61.4a	5.4bc
Fortress	200 lbs/A	53.3ab	5.0bc
Gallery + Dimension	0.75+0.38 lbs ai/A	56.1ab	10.9a
Snapshot 2.5TG	150 lbs/A	46.6ab	2.8c
Control		51.2b	3.4bc

[z]Least squares means comparisons among treatments (lower case in column) using the simulated method at $P < 0.05$.

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