Weed Control

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Section Editor

Growth of three containerized tree species as affected by FreeHand™ 1.75G herbicide

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Index Words: *Quercus virginiana*, *Quercus shumardii*, *Ulmus americana*, pendimethalin, dimethenamid-P, BAS 659 G, live oak, Shumard oak, American elm

Significance to Industry: Freehand™ herbicide could be a useful tool in controlling weeds of containerized live oak, Shumard oak and American elm as there was minimal affect on shoot growth. However, the affect on root growth of these species should be further investigated especially at 300 and 600 lbs/A.

Nature of Work: Weed control in container production of oaks and elms is essential. Weed control can be problematic with the development of resistance to repeated use of a limited number of herbicides as well as the introduction of new weed species from various sources (2). Knowledge regarding the mode of action (MOA) or chemical class of herbicides has become a key to aid in weed resistance management. As new herbicides are introduced, their chemical class(es) are emphasized to support weed control management. Seemingly, herbicides with multiple modes of action are being developed for release, aiding weed control.

One of these newer herbicides is FreeHand™ from BASF (Florham Park, NJ) with 1% pendimethalin, a MOA group 3 herbicide and 0.75% dimethenamid-P, a MOA group 15 herbicide. FreeHand™ (formerly BAS 659 G) has been evaluated for over-the-top use on numerous ornamental species through the IR-4 Project (1). However, no phytotoxicity studies with live oak, Shumard oak and elms are currently listed. This project evaluated effects on growth resulting from two applications of three concentrations of FreeHand™ 1.75G applied over-the-top to container-grown *Quercus shumardii* (Shumard oak), *Quercus virginiana* (live oak) and *Ulmus americana* (American elm).

Actively growing seedlings of American elm, live oak and Shumard oak were transplanted and treated as indicated in Table 1. For each plant, the upper half of the original container substrate was discarded to remove weeds and weed seed and the remaining root ball was repotted with fresh substrate [80:10:10 (pine bark:peat:sand) with sludge; Graco Fertilizer Company, Cairo, GA]. Fertilizer [Osmocote 15-9-12; 8-9 month Southern formulation (#903246), Scotts Horticultural Products, Marysville, OH; Table 1] was placed within the substrate in a layer located at about 2/3 the height of the container. After watering, plant height (top of substrate to tallest terminal) and widest width (terminal to terminal) were measured. Plants were grown on a conventional nursery production bed under full sun. Overhead irrigation via impact sprinklers was twice a day with 0.4 in (1 cm) delivered per event.

The five treatment groups were: 1) Non-weeded control, 2) Periodic hand-weeded control, 3) 150 lbs FreeHand/A, 4) 300 lbs FreeHand/A, and 5) 600 lbs FreeHand/A. Each treatment group had four replications of three plants. Each container was labeled with species, herbicide treatment, replication and plant number. Prior to herbicide application, plants were grouped by treatment such that the container arrangement resulted in an area appropriate for treating each species (Table 1). With live oak and Shumard oak, in order to ensure herbicide application to dry foliage, the plants were placed inside overnight and moved to the production bed the next morning. Table 1 indicates dates and subsequent irrigation applications for the initial and second applications of FreeHand™ 1.75G. Each herbicide treatment-species combination had a specified aliquot of herbicide that was applied over-the-top to dry foliage using an Acme Spred-rite G gravity flow granule spreader (Hummert International, Earth City, MO). The following day the plants were placed in a completely randomized design by 3-plant replications. Six weeks after the second application, plant height and two widths were recorded.

Xanthomonas campestris was isolated from American elm leafspot on 18 June but the NFREC Plant Diagnostic Clinic did not recommend remedial treatment.

Results: There was minor foliar phytotoxicity (primarily necrosis) to three of 12 and eight of 12 Shumard oak plants, one and two weeks after the initial application of 300 lbs/A and 600 lbs/A, respectively. Elm and live oak treated with two applications of 600 lb/A FreeHand™ 1.75G showed a reduction in growth of plant width (Tables 2 and 4). Shumard oak had no adverse effect from the FreeHand™ applications compared to the non-weeded control (Table 3). However, the weeded control plants were significantly taller and somewhat wider.

Although no evaluation of root growth was performed, inspection of the root systems of all three species showed a noticeable negative treatment effect about five months after the initial FreeHand™ application. The two control treatments had more extensive root systems than all FreeHand™-treated plants except possibly the 150 lb/A treatment on Shumard oak and elm. Comparison of live oak root growth by treatment found: the two controls ≥ 150 lb/A > 300 lbs/A and 600 lbs/A. This reduction in root growth could interrupt the normal timing of repotting.

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Table 1. Experimental parameters and procedures associated with treatment of American elm (*Ulmus americana*), live oak (*Quercus virginiana*) and Shumard oak (*Quercus shumardii*) with FreeHand 1.75G herbicide.

Parameter	American elm	Live oak and Shumard oak
Initial/transplanted container type	Classic 300-S / NS C400	RMII-32 cell / Lerio O1O
Initial/transplanted container size (l)	2.5/3.8	0.2/2.7
Transplant date	18 May	8 June
Fertilizer per plant (g) at transplanting	15	10
Herbicide treatment arrangement	3 ft x 4ft (0.9m x 1.2m)	2.5 ft x 3ft (0.8m x 0.9m)
Date of first herbicide treatment	19 May	9 June
Irrigation (cm) 2.5 h after treatment	0.3	0.8
Date of second herbicide treatment	30 June	21 July
Irrigation (cm) 2.5 h after treatment	1.0	1.0

Table 2. Effect of FreeHand 1.75G on vegetative growth of containerized elm (*Ulmus americana*), 11 weeks after the initial application at the University of Florida/IFAS/North Florida Research and Education Center – Quincy in 2009.

Treatment	∆ Height (cm)^z	∆ Width (cm)^y
Non-weeded control	36.2a^x	34.3a
Weeded control	35.4a	32.1ab
FreeHand 150 lbs/A	24.5a	31.5ab
FreeHand 300 lbs/A	37.4a	24.8ab
FreeHand 600 lbs/A	23.8a	20.8b

^{z}Final height minus initial height.
^{y}Final width minus initial height.
^{x}Mean separation by Duncan's Multiple Range Test, P≤0.05.

Table 3. Effect of FreeHand 1.75G on vegetative growth of containerized Shumard oak (*Quercus shumardii*), 11 weeks after the initial application at the University of Florida/IFAS/North Florida Research and Education Center – Quincy in 2009.

Treatment	Δ Height (cm)^z	Δ Width (cm)^y
Non-weeded control	9.0b^x	7.9ab
Weeded control	27.4a	9.1a
FreeHand 150 lbs/A	14.8b	3.4b
FreeHand 300 lbs/A	10.8b	4.8ab
FreeHand 600 lbs/A	15.0b	6.7ab

^{Z}Final height minus initial height.
^{y}Final width minus initial height.
^{x}Mean separation by Duncan's Multiple Range Test, $P \leq 0.05$.

Table 4. Effect of FreeHand 1.75G on vegetative growth of containerized live oak (*Quercus virginiana*), 11 weeks after the initial application at the University of Florida/IFAS/North Florida Research and Education Center – Quincy in 2009.

Treatment	Δ Height (cm)^z	Δ Width (cm)^y
Non-weeded control	33.6ab^x	24.2a
Weeded control	35.1ab	19.0ab
FreeHand 150 lbs/A	39.7a	21.3ab
FreeHand 300 lbs/A	31.5ab	17.0ab
FreeHand 600 lbs/A	28.2b	14.0b

^{Z}Final height minus initial height.
^{y}Final width minus initial height.
^{x}Mean separation by Duncan's Multiple Range Test, $P \leq 0.05$.

Effect of PRE and POST Moisture Levels and Formulation on Preemergence Control of Hairy Bittercress (*Cardamine hirsuta L.*) with Flumioxazin

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Index Words: Flumioxazin, Formulation, Hairy bittercress, Preemergence control, Moisture

Significance to Industry: Moisture is important for preemergence weed control to dissolve granular herbicides and enhance the contact between herbicide and substrate. More nurseries are moving to spray herbicides. In this research, experiments were conducted to evaluate PRE and POST moisture levels effect on preemergence control of hairy bittercress (*Cardamine hirsuta L.*) with flumioxazin in two different formulations: granular-BroadStar 0.25G and spray-SureGuard 51WDG.

Nature of Work: Preemergence herbicides have to be activated by water. For most herbicides labels, 0.25-0.5 inch of irrigation is needed after treatment. From the earlier literature, moisture is one factor affecting the absorption of herbicides by germinating weeds (Menges, 1963). Kempen et al. (1963) indicated herbicides performance was markedly influenced by soil incorporation, depth of incorporation, crop seed placement, soil type and rainfall. Previous research in 1960's showed that irrigation volume affects effectiveness of preemergence herbicides (Knake et al., 1967). As pointed out by Audus (1964), the relationship between soil moisture and absorption of herbicides into the soil exchange complex affects the availability of herbicides for uptake by the plant. In a study on Foxtail control with 25, 31 and 37% moisture (Stickler et al., 1969), the effectiveness of atrazine and EPTC increased with increasing soil moisture. In reviewing the literature, little or no research has been conducted in nursery industry since citied research from the 1960s. Nursery production had changed dramatically since the 1960s. Media in 1960s was based on high soil content; today most media are completely soilless. Growers need solid information about how to best manage moisture levels for the best weed control. Therefore, the objective of this research is to evaluate the influence of pre application moisture levels and post application irrigation levels in the preemergence control of hairy bittercress (*Cardamine harisuta L.*) with flumioxazin.

On 25 February 2011, trade gallon pots were filled with pine bark and sand (6:1, volume/volume) substrate previously mixed with 15 lb/yd^3 (9.3 kg/m^3) of Polyon® (17-5-11) control-released (7-8 months) fertilizer, 5 lb/yd^3 (3.1 kg/m^3) of dolomitic limestone and 1.5 lb/yd^3 (0.9 kg/m^3) Micromax. Pots were separated into three moisture levels and container weights and container metric water contents for each moisture level were measured with 10 samples for each moisture level before herbicides were applied. A Decagon® Soil Moisture Sensor was used to measure volumetric water content. For low moisture, no water was applied 4 days before treatment. The average weight of whole pot was 1.58 kg, and water content was 17%. For medium moisture, no water was applied 1 day before treatment. The average weight of whole pot was 1.73 kg, and water content was 20%. For high moisture, all pots were watered to saturation immediately before treatment. The average weight of the whole pot was 1.88 kg, and water content was 27%. On 1 March 2011, herbicides were applied to the pot surface. Treatments included BroadStar 0.25G at 0.250 and 0.375 lb ai/A and SureGuard 51WDG at 0.250 and 0.375 lb ai/A. Both herbicides have the same active ingredient: flumioxazin. BroadStar was applied with a hand-shaker, and SureGuard was applied by an enclosed-cabinet sprayer which had been calibrated to deliver at 30 GPA (gallon per acre) with a Teejet 8002 flat fan nozzle. After treatment, 4 overhead irrigation volumes were applied, including 0.25, 0.50, 1.00 and 2.00 inches. This experiment consisted of a factorial arrangement of: 2 pre-application levels, 2 flumioxazin formulations (granular and spray), 2 flumioxazin rates (0.25 and 0.375 lb ai/A) and 4 post-application irrigation levels. With additional non-treated control, there were 49 treatments. Six replications for each treatment were included. All pots were completely randomized and maintained overhead irrigation as needed. Hairy bittercress was overseeded with 25 seeds/pot 1 week after treatment (7 March 2011). Weed number was counted weekly and fresh weight was collected at 10 weeks after seeding (10 May 2011). Pairwise comparisons were performed for each growth stage using a generalized linear model using Duncan's Multiple Range Test at $P \geq 0.05$.

Result and Discussion

For weed count, formulation was always a highly significant main effect (Table 1). Irrigation was slightly significant in weed count at 2 and 10 weeks after seeding. The main effects of both rate and pre-application moisture were not significant. Only the two-way interaction of formulation x moisture was significant on hairy bittercress germination. For all response variables (Table 2), the spray formulation was more effective than the granular formulation. Post-application irrigation levels had no effect on efficacy of the spray formulation. All spray formulation treatments achieved about 100% control of bittercress with four post-irrigation levels. Conversely, with the granular formulation at 2 weeks after seeding, irrigation at 0.25 inch was less effective than the higher irrigation levels. These results indicate the importance of adequate irrigation to active BroadStar; however, at 6 and 10 weeks, the weed counts in different irrigation volumes were not significantly different. For the fresh weight, irrigation at 0.25 inch provided 92% control of bittercress, which was similar to irrigation at 2.00 inch (91%). Irrigation at 0.50 and 1.00 inch both provided 97% control. Therefore, the irrigation treatments at 0.25 and 2.00 inch were less effective than irrigation at 0.50 and 1.00 inch.

In summary, formulation was always the most highly significant main effect in hairy bittercress control, while pre-moisture substrate levels were not significant. Spray formulation of flumioxazin always provided excellent control at all irrigation levels and rates. Post-irrigation volume did affect bittercress emergence with the granular formulation in March application. Irrigation volume at 0.50 inch and 1.00 inch provided better control than irrigation at 0.25 inch and 2.00 inch. When preemergence herbicide flumioxazin is applied, the media moisture before treatment does not affect the herbicide effectiveness for hairy bittercress control.

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Table 1. ANOVA of hairy bittercress data (March 2011)

	Weed counts /pot (WAS[z])			
Source of variation	2	6	10	F.W.[y]
Main effects	---Probability---			
Formulation (form.)	<0.0001[x]	<0.0001	<0.0001	<0.0001
Rate	0.58	0.34	0.34	0.08
Pre-moisture (moist.)	1.00	0.76	0.87	0.29
Post-irrigation (irrig.)	0.06	0.09	0.06	0.43
Two-way interactions				
form. x rate	0.58	0.47	0.46	0.12
form. x moist.	0.52	0.58	0.81	0.24
form. x irrig.	0.05	0.06	0.04	0.33
rate x moist.	0.63	0.58	0.90	0.26
rate x irrig.	1.00	0.73	0.62	0.44

[z] WAS=weeks after seeding.
[y] F.W.=fresh weight of hairy bittercress at 10 WAS.
[x] P-value from general linear model of the weekly data.

Table 2. Formulation x post-irrigation level means. Data pooled over pre-moisture levels. (March 2011)

Experimental variable		Weed counts (WAS[z])			F.W.[y] (g/pot)
Formulation	Irrigation (inch)	2	6	10	(% control[v])
spray[x]	0.25	0.00a[w]	0.00a	0.00a	0.00 (100)a
spray	0.50	0.00a	0.00a	0.00a	0.00 (100)a
spray	1.00	0.00a	0.03a	0.03a	0.59 (99)a
spray	2.00	0.00a	0.00a	0.00a	0.00 (100)a
Mean		0.00A	<0.01A	<0.01A	0.15 (100)A
gran.	0.25	0.78a	0.36a	0.47a	8.63 (92)b
gran.	0.50	0.17b	0.11a	0.11a	3.84 (97)a
gran.	1.00	0.25b	0.06a	0.11a	3.64 (97)a
gran.	2.00	0.22b	0.39a	0.47a	9.80 (91)b
Mean		0.35B	0.23B	0.29B	6.47 (94)B
Non-treated control		11.17	15.67	16.50	113.22 (0)

[z] WAS= weeks after seeding.
[y] F.W.= fresh weight of bittercress at 10 WAS.
[x] Spray= SureGuard; gran.= granular= BroadStar.
[w] Means separated using Duncan's Multiple Range Test at P≥ 0.05; lower cases within formulation; upper cases mean comparison between formulation.
[v] % control = 100- (weed fresh weight/ control fresh weight) x 100.

Tolerance of Four Florida Native Plants to Preemergence Herbicides

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Index words: Barricade®, Biathlon®, Dimension, FreeHand™, Gallery®, growth, Hamelia, Illicium, Magnolia, Rout®, Snapshot®, Viburnum

Significance to Industry: As demand and production of native plants increases and labor costs increase, there is a growing need to find preemergence herbicides that are safe to use on these crops. Seven preemergence herbicides were tested on recently potted liners in containerized production and all were found to be safe on *Illicium parviflorum, Magnolia grandiflora,* and *Viburnum obovatum*. In addition, only those herbicides that contained isoxaben (Gallery, Snapshot) reduced the growth of *Hamelia patens*.

Nature of Work: Interest in using native plants in landscapes continues to grow (2) and many municipalities have passed Landscape Ordinances requiring the use of native plants (1). Research has shown that people are willing to pay more for landscapes that include native plants as compared to lawns (6). One of the constraints on the expanded use of native plants is the lack of availability (3). Effective, safe and economical weed control is a major challenge for producers of native plants, just as it is for all growers. Although producers of containerized nursery plants have more weed control options available than in the past, herbicides continue to be the most cost effective method for controlling weeds (5). While the efficacy of most preemergence herbicides available for containerized nursery use has been evaluated, the safety for using them on many native plants has not been tested.

In mid-July, liners of four increasingly popular native plants — *Hamelia patens* Jacq., firebush (105-cell pack); *Illicium parviflorum* Michx. ex Vent, yellow anise, star anise (a Florida endemic, 40-cell pack); *Magnolia grandiflora* L., southern magnolia (60-cell pack); *Viburnum obovatum* Walter ‘Walter’s Whorled Class’, Walter's Whorled Class viburnum (60-cell pack)— were potted up into round nursery containers 6" in diameter (Dillen standard T/W, Middlefield, Ohio). The container growing medium was composed of pine bark:new peat:sand (6:4:1 by vol) with a micronutrient + magnesium supplement (SunTrace, Florikan E.S.A., Sarasota, Fla.) and amended to a pH of 5.5–6.5 using dolomite. Two containers of each plant were placed in the middle of each 4' × 4' full sun plot. The ground in the plots was covered with woven black polypropylene fabric. For some treatments, liners were potted up one week before and for others two weeks prior to treatment application (Table 1).

Prior to treatment application and again at 90 days after treatment (DAT), each plant was measured—height (h), width at widest point (wd1) and perpendicular width (wd2). Plant top growth indexes (PTGI) were calculated as PTGI = $\pi r^2 h$, where r = ((wd1 + wd2)÷2)÷2. Phytotoxicity was rated periodically using a visual scale from 0–10, where 0 = no damage, 3.5 = commercially unacceptable damage and 10 = dead. These damage ratings were made periodically from 7 to 90 DAT.

Treatments were applied on 28 July and replicated six times in a randomized complete block design. Granular herbicide treatments were preweighed and applied using hand-held shaker jars, one for each plot. A compressed air PET bottle sprayer (KKI-S 28mm Inverted Spot Shot, Weed Systems, Inc., Hawthorne, Fla.) pressurized to 25 psi and fitted with a 110° flat fan air injection nozzle (110-02 AirMix®Agrotop Spray Technology, Obertraubling, Germany) was used to apply the liquid treatments. After treatments were applied, the plots were irrigated with ½" [1.3 cm] of water. On 8 August, plants were topdressed with 0.5 oz [14 grams] of a controlled-release fertilizer that included minors and that had a nominal release rating of 5–6 months at 70°F (Osmocote® Plus15-9-12, Scotts). Throughout the experiment, plots were irrigated daily with ½" of water using overhead impact sprinklers.

Table 1. Treatments used in phytotoxicity test.

Product(s) and formulation	Active ingredient(s) (a.i.)	Rate (lbs a.i./A)
†Untreated	—	—
†Barricade 65WG	prodiamine	0.85
‡Biathlon 2.75G	oxyfluorfen + prodiamine	2 + 0.75
‡Biathlon 2.75G	oxyfluorfen + prodiamine	4 + 1.5
†Dimension 2EW	dithiopyr	0.5
†Dimension 2EW + Gallery 75DF	dithiopyr + isoxaben	0.5 + 1
†Dimension Ultra 40WP	dithiopyr	0.5
†Gallery 75 DF	isoxaben	1
† Gallery 75DF + Barricade 65WG	isoxaben + prodiamine	1 + 0.85
‡Rout 3G	oxyfluorfen + oryzalin	2 + 1
‡Snapshot 2.5G	trifluralin + isoxaben	4 + 1

†Liners potted up for these treatments two weeks prior to treatment application.
‡Liners potted up for these treatments one week prior to treatment application.

Statistical analysis consisted of ANOVA and means separation using Duncan's new multiple range test at $P \leq 0.05$ (PROC GLM, SAS Institute Inc., Cary, N.C.).

Results and Discussion:

Acute phytotoxicity. No visible injury was detected on *Viburnum obovatum* at any rating (data not shown). The highest injury ratings for *Illicium parviflorum* and *Magnolia grandiflora* were 0.8 and 0.7, respectively, at 7 days after treatment (DAT) and by 14 DAT essentially no damage was still visible (data not shown). All three of these natives are woody plants. These results are consistent with previous research and recommendations regarding the use of the same or similar active ingredients around woody plants (4, 7, 8, 9, 10). For the less woody *Hamelia patens,* herbicide injury did occur due to some of the herbicide treatments (Table 2). Plants treated with Barricade and the combination of Barricade + Gallery had unacceptable damage at 28 DAT but recovered by 42 DAT. Interestingly, the damage from Gallery applied alone was significantly greater at 28 and 42 DAT than from the Barricade + Gallery combination suggesting that the Barricade might be having a slight safening effect. Further research is needed to test this idea. The injury to the *Hamelia patens* plants treated with Gallery declined to an acceptable level by 90 DAT. Damage from the combination of Dimension + Gallery was similar to Gallery applied alone.

Plant growth**.** The Dimension + Gallery, Gallery, Gallery + Barricade, and Snapshot treatments all reduced the growth of *Hamelia patens* compared to the untreated control (Table 3). All four of these treatments contain one pound of isoxaben per acre. Since Barricade and Dimension applied alone at the same rates did not reduce growth, this suggests that *Hamelia patens* is not tolerant of isoxaben at the tested rate. This plant was the least woody and the fastest growing plant in the evaluation. Herbicide treatments did not reduce the growth of *Illicium parviflorum* but this plant was the slowest growing plant evaluated. Its larger top growth indices than *Viburnum obovatum* was due to larger initial liners sizes. Since *Illicium parviflorum* grew very little during this 90-day trial, longer term evaluations need to be done in the future. It is important to find safe herbicides to use when producing this plant since it is endemic to only a handful of locations in central Florida (11). The only treatment that reduced *Magnolia* growth compared to the untreated control was Biathlon (low rate). However, the growth index using the high rate of Biathlon was not different from the control index suggesting that the observed reduction in growth may have just been due to experimental variability. *Viburnum obovatum* was the second fastest growing plant tested and none of the herbicides reduced growth compared to using no herbicide.

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Table 2. Visual phytotoxicity (injury) ratings for containerized *Hamelia patens* plants started from liners.

Treatment	Application rate (lbs a.i. /A)	Phytotoxicity ratings[z]						
		7 DAT[y]	14 DAT	28 DAT	42 DAT	56 DAT	70 DAT	90 DAT
Untreated control	—	0.0 a[x]	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a	0.0 a
Barricade 65WG	0.85	0.7 a	2.3 abcd	4.8 de	1.1 ab	0.0 a	0.0 a	0.0 a
Biathlon 2.75G	2.75	0.0 a	0.3 ab	0.8 ab	0.0 a	0.0 a	0.0 a	0.0 a
Biathlon 2.75G	5.5	0.2 a	2.7 bcd	2.5 bcd	0.2 ab	0.5 a	0.5 ab	0.6 ab
Dimension 2EW	0.5	0.3 a	3.0 cd	4.8 de	3.2 bc	2.0 ab	1.2 abc	0.6 ab
Dimension 2EW + Gallery 75DF	0.5 + 1	0.2 a	4.0 d	7.4 f	6.6 d	5.4 c	3.8 c	3.5 b
Dimension Ultra 40WP	0.5	0.0 a	0.9 abc	3.3 bcd	1.9 ab	1.7 ab	1.7 abc	1.8 ab
Gallery 75DF	1	0.5 a	2.3 abcd	6.2 ef	5.3 cd	4.3 bc	3.4 bc	2.7 ab
Gallery 75DF + Barricade 65WG	1 + 0.85	0.8 a	2.5 abcd	3.6 cd	2.1 ab	1.9 ab	2.2 abc	2.0 ab
Rout 3G	3.0	0.4 a	1.3 abc	1.4 abc	0.6 ab	0.1 a	0.0 a	0.0 a
Snapshot 2.5G	5	0.0 a	1.0 abc	1.6 abc	1.4 ab	1.5 ab	0.8 abc	1.0 ab

[z] Phytotoxicity rated on a scale of 0–10, where 0 = no visible damage, 3.0 = slight damage but commercially acceptable, 3.5 = commercially unacceptable damage and 10= dead.
[y] DAT = days after treatments applied.
[x] Means separation within columns by Duncan's new multiple range test at $P \leq 0.05$.

Table 3. Plant top growth indices for four Florida native plants 90 days after herbicide treatments.

Treatment	Application rate (lbs a.i. /A)	Growth index (cm^3)[z]			
		Hamelia patens	*Illicium parviflorum*	*Magnolia grandiflora*	*Viburnum obovatum*
Untreated control	—	27,775 a[x]	3,528 a	4,787 abc	713 a
Barricade 65WG	0.85	17,626 abc	3,164 a	4,445 abcd	676 a
Biathlon 2.75G	2.75	19,588 ab	2,424 a	2,611 d	957 a
Biathlon 2.75G	5.5	19,458 ab	3,482 a	3,139 bcd	735 a
Dimension 2EW	0.5	18,650 abc	2,614 a	5,036 ab	759 a
Dimension 2EW + Gallery 75DF	0.5 + 1	9,377 bc	3,331 a	3,546 bcd	674 a
Dimension Ultra 40WP	0.5	18,753 abc	4,125 a	4,718 abc	726 a
Gallery 75DF	1	15,716 bc	3,137 a	5,563 a	958 a
Gallery 75DF + Barricade 65WG	1 + 0.85	7,993 c	2,148 a	5,713 a	665 a
Rout 3G	3.0	18,495 abc	2,720 a	3,573 bcd	911 a
Snapshot 2.5G	5	13,181 bc	2,954 a	3,015 cd	728 a

[z] Growth index = 3.14 × Plant height (cm) × (((width 1 + width 2)÷2) ÷ 2)^2. Note: 1 ft^3 = 8,320 cm^3.
[x] Means separation within columns by Duncan's new multiple range test at $P \leq 0.05$.