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Selecting Preemergent Herbicides for Use In Container-grown Amaryllis

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A two-part study was conducted at the nursery of Sweet Dream Amaryllis, in Valrico, Florida, to identify potential preemergent herbicides for use in the container production of landscape amaryllis (*Hippeastrum* spp.) bulbs. An initial trial of preemergent herbicides with labels allowing general use was first conducted and evaluated for visual plant toxicity and damage. Herbicides used in this study were: Corral® 2.68G (pendimethalin), Freehand® 1.75G (dimethenamid-P and pendimethalin), Snapshot® 2.5TG (trifluralin and isoxaben), Tower® (dimethenamid-P), Surflan® (oryzalin) OH2® (oxyfluorfen and pendimethalin), O-O Herbicide® (oxyfluorfen and oxidiazon), Jewel™ (oxadiazon and pendimethalin), and Rout® (oxyfluorfen and oryzalin), and an untreated control. Two additional secondary studies were conducted over six-month time to evaluate herbicides that were deemed "safe for use" on the reproductive potential of propagative bulbil or "pup" formation numbers. These herbicides were: Corral® 2.68G, Freehand® 1.75G, Snapshot® 2.5TG, Tower® and compared to an untreated check. Bulbil counts were made at six months after the treatments were applied.

Amaryllis (*Hippeastrum* spp.) are an evergreen, tropical to subtropical (USDA Zone 8-11) plant, indigenous to South America, primarily from Brazil and the Andes mountains in Peru, Argentina, and Bolivia but some species extend to the West Indies and Mexico. They were exported to Europe and the first crosses were produced in England in 1799. In the US, there is limited production, mainly in California, Texas, and Florida, which was once a major producer of bulbs (Bell, 1973). Hobbyists, enthusiasts, and collectors dominate the niche trade currently in Florida. The University of Florida also had a breeding program and released three varieties named 'Rio', 'Sampa', and 'Bahia' (Meerow, 2000). Amaryllis are primarily sold as a potted bulbs for forcing, however, they make a good addition to the Florida landscape with minimal horticultural effort. In the opinion of the authors, we are somewhat disappointed that they are not more commonplace within the landscape. The main pests are a few chewing insects (eg. grasshoppers, caterpillars), a weevil (amaryllis weevil), mites, a fungus (red scorch (*Stagonospora curtisii*)), and virus.

Propagation can be accomplished by dividing the base of the bulb. Another way is to split daughter plants or bulbils. The bulbils are then grown in either nursery containers or in common beds and may be further increased in numbers as they age and form bulbils or "pups" of their own. Usually one to three bulbils may form per year.

One of the largest problems for container production may be controlling weeds. With bulbs growing for multiple years in a container it can quickly develop a crop of weeds that will compete and choke out the growing bulbs. Hand labor is used to remove weeds but if there are a large number of containers in production the problem can quickly become economically costly.

Ornamental container growers typically use preemergent herbicides along with hand weeding to remove and reduce the number of germinating weeds on the surface of containers. With minor crops such as amaryllis there is minimal information on compatible preemergent herbicides that can be safely used to prevent weeds. In order to economically and effectively control weeds in amaryllis and educate growers and landscapers with this information, a preemergent herbicide trial was conducted.

Materials and Methods

Herbicide Visual Damage Trial. An initial trial of preemergent herbicides with labels allowing general use on ornamental plants was first conducted. The highest labeled rates were doubled to prevent over-application injury for growers. One-year old bulbs of the variety 'Susan Slade' were potted at three plants per #3 nursery container (10 inches in diameter) in 75% soil filled pots. Potting soil contained 50% compost and 50% shredded tree fines and slow release fertilizer added to the containers. Irrigation was provided by overhead sprinklers. The experiment was started in late March 2017. There were eight herbicide treatments and rates were: Corral® 2.68G (pendimethalin, 228 lbs/ac), Freehand® 1.75G (dimethenamid-P and pendimethalin, 400 lbs/acre), Snapshot® 2.5TG (trifluralin and isoxaben, 400 lbs/acre), Tower® (dimethenamid-P, 64 oz/acre), OH2® (oxyfluorfen and pendimethalin, 200 lbs/acre), Regal O-O Herbicide® (oxyfluorfen and oxadiazon, 200 lbs/ac), Jewel™ (oxadiazon and pendimethalin, 200 lbs/ac), and Rout® (oxyfluorfen and oryzalin, 200 lbs/ac), and an untreated control. Treatments were replicated three times with a nursery container being the treatment unit. Liquid herbicides were applied with a spray bottle and granular herbicides

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delivered with a shaker can. All herbicides were applied over the top of three pots and replicated under the canopy of three pots for each treatment to determine if there was a difference. Plant leaves were evaluated for visual herbicide toxicity and damage four weeks after treatment. Herbicide injury could show up in slower growth rates, longer term growth, and root damage but these were not evaluated.

Bulbil Formation Trial. A second experiment was undertaken to test if herbicides considered safe from the initial experiment would reduce future propagative potential or offset bulbil (pup) formation. Plants were grown in a similar manner as in the first experiment. The experiment was a complete randomized design with six treatments using the cultivar 'Susan Slade'. Six replications of #3 nursery containers containing three bulbs each were treated on 22 Feb. 2018. All treatments were watered in for 10 min with overhead irrigation. Treatments and rates were 1) Corral 2.68G (pendimethalin) 114 lbs/ac; 2) Freehand 1.75G (dimethenamid-P and pendimethalin) 200 lbs/ac; 3) Snapshot 2.5TG (trifluralin and isoxaben) 200 lbs/ac; 4) Tower (dimethenamid-P) 21 mL/1000 ft2; 5) Surflan (orazalyin) 3 oz/1000 ft2 and 6), and an untreated control. Surflan was added to this trial although it had not been included in the first experiment. Herbicides were applied in a similar manner as in the first experiment. Bulbil counts were taken four months after herbicide treatment (MAT) and compared to the control.

An additional experiment was conducted with three additional varieties of amaryllis: 'Sitting Bull', 'Queen of the Nile', and 'Denise'. This experiment was initiated in Apr. 2019 and finished six months later.

Results and Discussion

Herbicide Visual Damage Trial. Three weeks after treatment, herbicides that appeared to look relatively safe were Corral, FreeHand, Tower, Snapshot. Herbicides that caused phytotoxic injury were OH2, O-O Herbicide, Jewel, and Rout. Almost all damage was in the axils of the leaves right at the top of the bulb (Fig.1). There was less injury when herbicides were applied under the canopy, but no treatment was 100% injury free if it caused damage when applied overhead. It would be extremely difficult to apply these herbicides under the leaf canopy if there were any number of containers to be treated and there would be no way to guarantee the application would be only to the soil.

Bulbil Formation Experiment 1. There were no statistically significant differences between herbicide treatments and the untreated control with the cultivar 'Susan Slade'(Fig. 1). The mean values ranged from lowest, Tower with 0.22 new bulbils formed to the highest, Surflan treatment of 0.78 new bulbils. The entire experiment had a mean value of 0.5 new bulbils formed for all treatments. Due to the short, 4 month, duration of the experiment and the application to only one cultivar, an additional experiment was conducted to determine if other cultivars would respond similarly and if differences would emerge over a longer time period.

Bulbil Formation Experiment 2. The results for experiment 2 indicated that herbicides did not influence number of bulbils formed. However, there was a significant difference attributable to cultivar, in that a very small number of bulbils formed in the 'Sitting Bull' cultivar during this experiment (Table 1). Mean values of bulbils formed ranged from 0.22 with the Corral treatment to 0.88 with both the Tower and the Snapshot treatments. The authors feel that a six-month time period after herbicide treatment would be sufficient to determine if the herbicide applications would be detrimental to bulbil formation. Most preemergent herbicides loose efficacy in about 30 days in typical outdoor Florida production areas, especially with overhead irrigation. However, not all cultivars may have the same reaction and caution may be warranted before applying herbicide across different cultivars.

We did observe that 'Sitting Bull' did not form many bulbils in this experiment. We believe that this might be due to environmental factors and not herbicide interactions. Typically, 'Sitting Bull' is a strong bulbil producer.

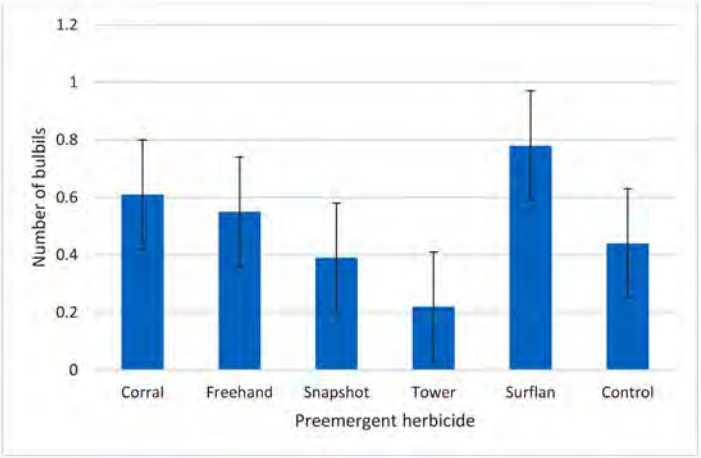

Fig. 1. Mean number of bulbils from *Hippeastrum* spp. 'Susan Slade' amaryllis grown in #3 nursery containers produced four months after treatment as affected by different preemergence herbicides. Error bars represent pooled standard deviation for experiment.

Table 1. Mean number of bulbils produced from *Hippeastrum* spp. 'Denise', 'Queen of the Nile', and 'Sitting Bull' amaryllis grown in #3 nursery containers six months after treatment as affected by different preemergence herbicides.

Preemergent	Mean number of bulbils formed per container		
herbicide	'Denise'	'Queen of the Nile'	'Sitting Bull'
Corral	0.33	0.33	0
Freehand	1.33	1.17	0
Snapshot	1.0	1.33	0.16
Tower	0.5	1.33	0
Control	0.67	0.83	0
Mean[z]	0.76 A	1.00 A	0 B
TRT	NS		
Variety	***		
TRT × Variety	NS		

[z]Mean values with the same letters within a row are not significantly different at the $P = 0.05$ level (Tukey's honest significant difference test). NS, *, **, *** Nonsignificant, or significant F test at $P \leq 0.05, 0.01, 0.001$ level, respectively.

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