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Phytotoxicity and Yellow Nutsedge Control in Azalea and Liriope with Basagran (bentazon)¹

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Abstract

Tolerance of eight azalea cultivars and three liriope cultivars to two broadcast applications of Basagran at 1.1 and 2.2 kg/ha (1.0 and 2.0 lb/A) was determined in container studies. No injury was observed on azalea cultivars 'Rosebud', 'Tradition', 'Delaware Valley White' or 'Elsie Lee' 40 days after the second application of Basagran at 2.2 kg ai/ha (2.0 lb/A) plus crop oil. This treatment injured 'Hershey's Red' and 'Girard's Rose', but two applications of Basagran at 2.2 kg/ha applied alone or at 1.1 kg/ha (1.0 lb/A) with or without crop oil did not injure these two varieties. Slight injury (16%) was observed on 'Corsage' 20 days after the second application of Basagran at 1.1 kg/ha (1.0 lb/A), although no injury was seen with other treatments. Greater injury (22 to 35%) occurred to 'Pleasant White' 20 days after treatment when Basagran was applied twice at 1.1 or 2.2 kg/ha (1.0 or 2.0 lb/A) with or without crop oil. Injury to all azalea cultivars decreased with time, with no injury apparent 70 days after treatment. Greater injury (22 to 27%) was observed in variegated than green liriope or *Liriope spicata* (8 to 13%) 20 days after the second application of Basagran at 1.1 or 2.2 kg/ha (1.0 or 2.0 lb/A) with or without crop oil. Addition of crop oil improved the control of yellow nutsedge with Basagran at 1.1 or 2.2 kg/ha (1.0 or 2.0 lb/A).

Index words: nursery crops, weed control, postemergence herbicides, yellow nutsedge (*Cyperus esculentus* L.)

Species used in this study: azalea (*Rhododendron* x 'Corsage'), (*Rhododendron* x 'Delaware Valley White'), (*Rhododendron* x 'Elsie Lee'), (*Rhododendron* x 'Girard's Rose'), (*Rhododendron* x 'Hershey's Red'), (*Rhododendron* x 'Pleasant White'), (*Rhododendron* x 'Rosebud'), and (*Rhododendron* x 'Tradition'); green liriope (*Liriope muscari* L.); variegated liriope (*Liriope muscari* L. 'Variegata'); *Liriope spicata* Lour.

Herbicides used in this study: Basagran (bentazon), 3-(1-methylethyl)-(1H)-2,1,3-benzothiadiazin-4(3H)-one, 2,2-dioxide

Introduction

Yellow nutsedge is a major weed problem in field nursery production and landscape maintenance situations, and can occasionally be a contaminant in pine bark used for container nursery production (2, 3, 5). There are several preemergence herbicides that will suppress this perennial weed but there are no selective chemicals for postemergence control of yellow nutsedge (1, 2, 5). Nonselective postemergence herbicides can be used to control yellow nutsedge but pose a risk to established crops. There is a need for a selective postemergence herbicide to control yellow nutsedge in nursery crops.

Basagran (bentazon) is a selective herbicide used to control yellow nutsedge in certain agronomic crops and turf (4, 6). Optimum yellow nutsedge control occurs with Basagran applied in split treatments 7 to 10 days apart with a non-phytotoxic oil to young plants with 4 to 6 leaves (6). There has been only limited research conducted on the safety of Basagran to nursery crops. Basagran at 1.1 kg ai/ha (1 lb ai/A) applied with a surfactant in combination with Surflan (oryzalin) (4-(dipropylamino)-3,5-dinitrobenzenesulfonamide) at 3.4 kg/ha (3 lb/A) caused unacceptable injury to forsythia (*Forsythia intermedia* Zabel 'Lynwood Gold') and rhododendron (*Rhododendron catawbiense* Michx. 'Roseum Elegans') (1). No injury was seen in this study to

white pine (*Pinus strobus* L.), yew (*Taxus cuspidata* Sieb. & Zucc. 'Densiformis') or juniper (*Juniperus horizontalis* Rehd. 'Plumosa') from Basagran. Basagran at 0.84 kg/ha (0.75 lb/A) caused excessive injury to Andorra juniper, red osier dogwood (*Cornus sericea* Michx.) and cotoneaster (*Cotoneaster dammeri* Schneid. 'Royal Beauty') (3).

The objective of this research was to determine if azalea and liriope cultivars differ in their sensitivity to broadcast applications of Basagran. The effect of a crop oil concentrate on azalea and liriope tolerance to Basagran and the resulting control of yellow nutsedge was also investigated.

Materials and Methods

1987 studies. One azalea liner or 10 yellow nutsedge tubers were planted in each black plastic pot (#1) in March, 1987. The medium contained pine bark and sand (4:1, by vol.). Pots were fertilized with a slow-release, 18N-2.6P-9.9K (18-6-12) analysis fertilizer, and a complete micro-nutrient fertilizer. Plants were maintained on an outdoor black plastic bed with overhead irrigation, and were watered daily. For all studies, a randomized complete block design with five replications was utilized. The six azalea cultivars utilized in this study were: 'Rosebud', 'Tradition', 'Pleasant White', 'Hershey's Red', 'Delaware Valley White', and 'Elsie Lee'. Plants were treated on May 21, 1987, using a CO₂-pressurized backpack sprayer delivering 230 l/ha using No. 8003 flat fan nozzles. Basagran was applied broadcast at 1.1 or 2.2 kg/ha (1.0 or 2.0 lb/A), with or without crop

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oil³ at 2.3 l/ha (1 qt/A). At treatment time, the azaleas ranged from 13 to 20 cm (5 to 8 in) in height, while yellow nutsedge was 30 cm (12 in) tall. Two weeks later, a second application of Basagran at the same rates were applied. The air temperature was 24°C (73°F), with 10% cloud cover at the first treatment, with 26°C (79°F) air temperature and 5% cloud cover at the second treatment.

This study was repeated with additional plants in June, 1987. In the second study, azalea liners ranged from 13 to 38 cm (5 to 13 in) in height, while yellow nutsedge was 45 cm (18 in) tall. The air temperature was 26°C (79°F) with 5% cloud cover for the first treatment, and 32°C (90°F) air temperature with 10% cloud cover at the second treatment two weeks later. Azalea injury and yellow nutsedge control were rated visually 20, 40 and 60 days after the second application date for each study. The best plant of each cultivar, regardless of treatment, was assigned an injury rating of 0% and all other plants of that cultivar were compared to it. Untreated plants could have lower quality than the plant chosen and thus have an injury rating other than zero. The results from the two studies were combined, with the data subjected to analysis of variance and mean separation using the Least Significant Difference Test (LSD) at the 0.05 level.

1988 studies. The 1988 studies were identical to the 1987 studies, with the addition of two more azalea varieties ('Girard's Rose' and 'Corsage') and three liriopie types (green and variegated liriopie, and *Liriopie spicata*). Plants were maintained on a gravel bed with overhead irrigation. In the first study, azalea liners varied from 17 to 22 cm (7 to 9 in) in height at the first treatment (June 14, 1988), while the liriopie varieties were 25 to 37 cm (10 to 15 in) tall, and yellow nutsedge was 20 cm (8 in) tall. Air temperature was 29°C (85°F) with 0% cloud cover. At the second application, the air temperature was 26°C (79°F) with 10% cloud cover. This study was also repeated. Air temperature was 33°C (92°F) with 5% cloud cover at the first treatment and 26°C (79°F) with 10% cloud cover at the second application. Azalea, liriopie and yellow nutsedge height were similar to the first study. Azalea and liriopie injury, and yellow nutsedge control, were evaluated visually 20, 40 and 60 days after the second treatment. Azalea and liriopie shoot fresh weight were recorded 70 and 80 days, respectively, after the second bentazon application. Results from the two studies were combined.

³Agridex, Helena Chemical Company, Memphis, TN 38137.

Results and Discussion

1987 studies. No injury was observed to the azalea cultivars 'Rosebud', 'Tradition', 'Hershey's Red' or 'Delaware Valley White' 20 days after the second application of Basagran at 2.2 kg/ha (2.0 lb/A) plus crop oil (Table 1). This application rate injured 'Elsie Lee', but lowering the application rate to 1.1 kg/ha (1.0 lb/A) or eliminating the crop oil resulted in no crop damage. Basagran applied twice at 1.1 and 2.2 kg/ha (1.0 and 2.0 lb/A) caused 20 to 80% injury to 'Pleasant White'. Azalea injury was temporary, with all plants outgrowing the damage (data not shown). Injury was observed only in leaves present at application, with leaves emerging after application being unaffected. The injury symptom noted was a leaf burn, with defoliation occurring at higher injury levels.

1988 studies. No injury was noted for the azalea cultivars 'Rosebud', 'Tradition', 'Delaware Valley White' and 'Elsie Lee' 20 days after the second application of Basagran at 2.2 kg/ha (2.0 lb/A) plus crop oil (Table 2). This treatment injured 'Hershey's Red' and 'Girard's Rose', although eliminating the crop oil or reducing the rate to 1.1 kg/ha (1.0 lb/A) did not cause injury. Slight injury was observed to 'Corsage' when Basagran was applied twice at 1.1 kg/ha (1.0 lb/A). All treatments except the 1.1 kg/ha (1.0 lb/A) rate injured 'Pleasant White'.

Slight injury (8 to 13%) was noted to the green and spicata liriopes 20 days after the second application of Basagran (Table 2). Greater injury, ranging from 22 to 27%, was noted in the variegated form.

As in the earlier rating, no reduction in plant quality was observed for the cultivars 'Rosebud', 'Tradition', 'Delaware Valley White' and 'Elsie Lee' 40 days after the second application of Basagran at 2.2 kg/ha (2.0 lb/A) plus crop oil (Table 3). No injury was evident at this time to 'Corsage'. Injury was apparent in 'Hershey's Red' (24%) and 'Girard's Rose' (30%) at the higher rate of Basagran applied with crop oil. Injury ratings decreased for 'Pleasant White'. No injury was apparent in any azalea cultivar 70 days after treatment (data not shown).

Slight injury (7 to 20%) was noted in all three liriopes, although injury had decreased slightly 40 days after treatment (Table 3). New liriopie growth appearing after herbicide application was unaffected. At 80 days after treatment, injury was only evident in the variegated cultivar (data not shown).

No reduction in shoot fresh weight was noted for the azalea cultivars 'Rosebud', 'Tradition', 'Hershey's Red', 'Dela-

Table 1. Injury to six azalea cultivars 20 days after the second application of bentazon in 1987 studies.

Treatment	Rate	Rosebud	Tradition	Pleasant White	Hershey's Red	Del. Valley White	Elsie Lee
				(% injury)			
Check	—	4	2	8	6	11	10
Basagran	1.1 + 1.1	2	6	20	1	27	12
Basagran	2.2 + 2.2	3	8	44	23	17	14
Basagran + crop oil	1.1 + 1.1	5	6	45	9	25	26
Basagran + crop oil	2.2 + 2.2	7	11	80	6	23	41
LSD (0.05)		NS	NS	12	NS	NS	17

Table 2. Injury to eight azalea cultivars and three liriopes 20 days after the second application of bentazon in 1988 studies.

Treatment	Rate	Azalea								Liriope			
		Rosebud	Tradition	Pleasant	Hershey's	Del. Valley	Elsie	Girard's	Corsage	Spicata	Green	Variegated	
				White	Red	White	Lee	Rose					
	(kg/ha)	(% injury)											
Check	—	3	8	4	10	7	2	8	6	3	2	5	
Basagran	1.1 + 1.1	1	14	10	12	11	1	10	16	8	11	23	
Basagran	2.2 + 2.2	2	10	27	11	11	1	10	11	12	11	27	
+ crop oil	1.1 + 1.1	2	12	23	13	17	4	18	14	13	10	22	
Basagran + crop oil	2.2 + 2.2	2	8	35	29	14	2	34	13	13	11	26	
LSD (0.05)		NS	NS	11	14	NS	NS	14	8	4	4	7	

Table 3. Injury to eight azalea cultivars and three liriopes 40 days after the second application of bentazon in 1988 studies.

Treatment	Rate	Azalea								Liriope		
		Rosebud	Tradition	Pleasant	Hershey's	Del. Valley	Elsie	Girard's	Corsage	Spicata	Green	Variegated
				White	Red	White	Lee	Rose				
	(kg/ha)	(% injury)										
Check	—	3	3	2	4	4	0	5	0	4	5	2
Basagran	1.1 + 1.1	0	3	5	5	5	0	6	0	7	11	17
Basagran	2.2 + 2.2	1	3	18	8	7	0	12	2	10	10	20
+ crop oil	1.1 + 1.1	2	4	14	6	7	0	10	1	9	9	19
Basagran + crop oil	2.2 + 2.2	1	3	16	24	6	0	30	2	10	11	19
LSD (0.05)		NS	NS	11	14	NS	NS	16	NS	4	3	3

ware Valley White' or 'Elsie Lee' 70 days after the second Basagran application (Table 4). A reduction in shoot weight was observed for 'Girard's Rose' at the 2.2 kg/ha (2.0 lb/A) rate applied twice with crop oil. All treatments except Basagran at 2.2 kg/ha (2.0 lb/A), reduced shoot weight of 'Corsage'. Basagran at 2.2 kg/ha (2.0 lb/A), applied with or without crop oil, reduced shoot weight of 'Pleasant White', but no reduction was noted for the lower rate.

Only the higher Basagran rate applied with crop oil reduced the shoot weight of *Liriope spicata*. The 1.1 kg/ha (1.0 lb/A) rate, with or without crop oil did not reduce shoot weight of green liriopie. All Basagran treatments reduced shoot weight of the variegated cultivar. Perhaps the reduced amount of chlorophyll in the variegated cultivar makes this

variety more sensitive to Basagran than the non-variegated types.

Poor nutsedge control (<60%) was noted with 2 applications of Basagran at 1.1 kg/ha (1.0 lb/A) (Table 5). Yellow nutsedge control with Basagran applied twice at 1.1 kg/ha (1.0 lb/A) plus crop oil was equivalent to Basagran applied twice at 2.2 kg/ha (2.0 lb/A) without crop oil. The addition of crop oil improved the control observed with bentazon applied twice at 1.1 kg/ha (1.0 lb/A). Only 60 to 67% yellow nutsedge control was observed 40 days after treatment with Basagran applied at 1.1 kg/ha (1.0 lb/A) plus crop oil or at 2.2 kg/ha (2.0 lb/A) without crop oil to 30 cm (12 in) tall nutsedge plants in the 1987 study, while good control (82 to 89%) was observed 20 days after ap-

Table 4. Shoot fresh weight (gm) of eight azalea cultivars 70 days and three liriopes 80 days after the second application of bentazon in 1988 studies.

Treatment	Rate	Azalea								Liriope			
		Rosebud	Tradition	Pleasant	Hershey's	Del. Valley	Elsie	Girard's	Corsage	Spicata	Green	Variegated	
				White	Red	White	Lee	Rose					
	(kg/ha)	(gm)											
Check	—	74	27	61	39	31	71	45	54	45	107	38	
Basagran	1.1 + 1.1	65	26	50	34	34	71	50	34	39	93	20	
Basagran	2.2 + 2.2	80	36	35	40	39	74	35	49	38	75	19	
Basagran + crop oil	1.1 + 1.1	64	26	42	31	29	66	45	31	36	89	20	
Basagran + crop oil	2.2 + 2.2	70	31	33	35	36	72	22	34	34	78	17	
	LSD (0.05)	15	NS	18	NS	NS	NS	16	17	8	19	7	

Table 5. Percent yellow nutsedge control 20, 40 and 60 days after the second application of bentazon in 1987 and 1988 studies.

		Yellow nutsedge control			
Treatment	Rate	1987 studies		1988 studies	
		40 DAT ¹	60 DAT	20 DAT	40 DAT
	(kg/ha)	(%)			
Check	—	8	0	5	4
Basagran	1.1 + 1.1	30	24	58	13
Basagran	2.2 + 2.2	67	54	82	62
Basagran					
+ crop oil	1.1 + 1.1	60	34	89	62
Basagran					
+ crop oil	2.2 + 2.2	99	98	83	74
LSD (0.05)		30	26	17	17

¹DAT = Days After Treatment.

plication to 20 cm (8 in) tall plants with these two treatments in the 1988 study. No treatment provided good control when treatments were applied to 45 cm tall plants in the 1987 study (data not shown). Excellent control was noted with two applications of Basagran at 2.2 kg/ha (2.0 lb/A) plus crop oil in the 1987 study, while fair to good control was seen with this rate in 1988 studies. Initial control of nutsedge shoots was good with all treatment. In both years, yellow nutsedge control decreased over time, either due to regrowth from tubers of injured plants, or from germination of tubers that were dormant at the time of application. In other studies, Basagran applied at 0.84 and 1.68 kg/ha (0.75 and 1.5 lb/A) to 12 cm (5 in) tall yellow nutsedge resulted in 85% control 35 days after application (3).

Significance to the Nursery Industry

Yellow nutsedge is a persistent weed problem in nursery production and landscape maintenance. Presently there are

no selective postemergence herbicides to control yellow nutsedge in nursery crops. Results from these studies indicate that certain azalea cultivars, such as 'Rosebud' and 'Tradition', are very tolerant to Basagran at 2.2 kg/ha (2.0 lb/A), a rate sufficient in this study for yellow nutsedge control, though lower rates may be effective if nutsedge plants are smaller when treated. Other azalea cultivars, such as 'Pleasant White' and 'Hershey's Red', and liriopie are temporarily injured by Basagran, with injury generally averaging 10 to 25% 40 days after treatment, but these cultivars will outgrow the damage within two months of application. If temporary injury can be tolerated, Basagran could be a control option for yellow nutsedge infestations in azalea and liriopie plantings.

(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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