

Comparison of Sulfonylurea Herbicides for Spring Transition

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Abstract

In six field experiments that were conducted during the spring of 2004 with seven sulfonylurea herbicides for removing perennial ryegrass from bermudagrass turf, the most rapid response and effective ryegrass removal occurred with the latest applications made in June compared to applications made in April or May. Flazasulfuron, foramsulfuron, rimsulfuron, trifloxysulfuron, and chlorsulfuron were effective in removing most of the ryegrass. Sulfosulfuron and metsulfuron were least effective for removing ryegrass, especially during the cooler April and May timings.

Introduction

Spring transition is when the winter turfgrass is replaced by bermudagrass for the summer turfgrass. Typically, perennial ryegrass should begin to recede when spring-summer temperatures rise and growth of the winter dormant bermudagrass is stimulated. Bermudagrass growth is encouraged by manipulating irrigation and fertility, lowering heights of cut, and cultivation of the spring turf. Ryegrass is stressed by the cultural practices that promote bermudagrass, however, many ryegrass cultivars tend to tolerate and survive the high summer temperatures. Selective herbicides can effectively remove ryegrass while the bermudagrass emerges from dormancy. In recent years, the class of sulfonylurea herbicides have demonstrated efficacy in removing ryegrass in the spring without causing injury to the bermudagrass. Some of the very early sulfonylurea herbicides, metsulfuron (Manor*/Blade*) and chlorsulfuron (Corsair*), were used for weed control in small grains or noncrop situations. More recently registered were rimsulfuron (TranXit*), foramsulfuron (Revolver*), and trifloxysulfuron (Monument*) and still in the development stages are flazasulfuron (Katana* proposed) and sulfosulfuron (Certainty* proposed). These transition-aid herbicides have the potential to offer precise ryegrass removal at a specific time in the spring and/or rid ryegrass from shady areas, golf course roughs, or anywhere it may tend to last longer into the summer. Six field experiments were conducted to evaluate, determine, and compare the efficacy of seven sulfonylurea herbicides for removing perennial ryegrass from bermudagrass turf on golf courses when applied at various timings from mid-April to late June of 2004.

Materials and Methods

Five similar field experiments were conducted at Desert Highlands, Raven, Cottonwood, and Tatum Ranch golf courses in the Phoenix-Scottsdale area during spring 2004. Two identical tests were conducted on a fairway at Desert Highlands golf course in Scottsdale, AZ on 19 April and 03 May and a third experiment was initiated on 24 June. The fairway turf was a hybrid bermudagrass, Tifway 419 overseeded with a perennial ryegrass blend of Charger II*, Brightstar*, and Quick Trans* mowed at less than 0.5 inch. A similar test was established on the driving range at Raven golf course in Phoenix, AZ on 30 April. The driving range had Tifway 419 overseeded with a ryegrass variety Evening Shade* that was mowed once per week at 1.25 inch height of cut. Two more experiments identical to the Desert Highlands tests in April and May were conducted on fairways at Cottonwood

golf course in Sun Lakes, AZ on 19 May and at Tatum Ranch golf course in Cave Creek, AZ on 15 June. At Cottonwood golf course, the Tifway 419 bermudagrass fairway was overseeded with a ryegrass blend, Futura 2500* that was composed of Express*, Seville II*, and Transist 2200*. The fairway was mowed regularly at 0.5 inch. At Tatum Ranch golf course, the Tifgreen 328 bermudagrass fairway was overseeded with a perennial ryegrass blend of Essence*, Tophat*, and Gator II*. Soon after treatments were made, the mowing height was reduced from 0.5 to 0.4 inch and the fairway was mowed four times/week. All of the experiments were designed with each treatment plot measuring 5 ft x 10 ft and each treatment was replicated three times in a randomized complete block design. The herbicides (Table 1) were applied with a backpack CO₂ sprayer equipped with a hand-held boom with three 8002 flat-fan nozzles spaced 20-inches apart. The herbicides were applied in 40 gpa water at a pressure of 30 psi. All of the treatments included a non-ionic surfactant Latron CS-7 at 0.25% v/v.

The first application at Desert Highlands on 19 April had air temperature at 62°F with the sky ranging from overcast to mostly sunny with an occasional breeze at less than 3 mph. The turf was mowed just before applications were made and the soil temperature at 2-in depth was 58°F. At Raven golf course on 30 April, the air temperature was 62°F, clear, and a very light breeze at less than 2 mph. The second application at Desert Highlands on 03 May had air temperature at 85°F with a clear sky and slight breeze at approximately 5 mph with occasional gusts. The soil temperature was 78°F. On 19 May at Cottonwood golf course, the air temperature was 84°F with a clear sky and very slight breeze at less than 3 mph. The turf was mowed prior to sprays being applied and the soil temperature was 70°F. The Tatum Ranch golf course was sprayed on 15 June when the temperature was 85°F, with no wind and clear sky. The soil temperature was 68°F. The final experiment at Desert Highlands was sprayed with only the higher rates of all of the herbicides with the temperature at 92°F, clear sky, occasional slight breeze and the soil was wet at 78°F.

All of the experimental sites were maintained per normal cultural practices with respect to regular mowing, irrigation, fertilization, or other typical management practices. Observations were made at intervals after spraying throughout the transition period in the spring to evaluate ryegrass removal, bermudagrass cover, and overall quality of the turfgrass.

Results and Discussion

The earliest applications of the herbicides on 19 April at Desert Highlands golf course showed that almost all of the treatments demonstrated significant activity with 33 to 63% ryegrass stand remaining at 7 days after treatment (DAT) (Table 2). The untreated check had 96% ryegrass and metsulfuron treatments were least effective with 83 to 85% ryegrass remaining. At 14 DAT, all flazasulfuron and rimsulfuron treated plots had the least ryegrass with 5 to 10%. At 22 DAT, flazasulfuron and rimsulfuron treatments reduced ryegrass to less than 5%. Foramsulfuron, trifloxysulfuron, and chlorsulfuron at the higher rates demonstrated effective ryegrass removal with less than 13% remaining. The lower rates of foramsulfuron, trifloxysulfuron, and chlorsulfuron did not effectively remove the ryegrass at the early application timing. Sulfosulfuron exhibited initial activity in reducing ryegrass but was comparable to the lower rates of foramsulfuron, trifloxysulfuron, and chlorsulfuron in not completely removing ryegrass.

Similar herbicide treatments were applied on 30 April at Raven golf course where ryegrass removal was prolonged and showed that 55 to 85% remained after 18 DAT (Table 3). At 41 DAT, both flazasulfuron treatments and an extremely high rate of trifloxysulfuron nearly completely removed ryegrass. At 56 DAT, both rates of chlorsulfuron and the high rates of rimsulfuron and metsulfuron were effective in removing ryegrass. Foramsulfuron, sulfosulfuron and the low rates of rimsulfuron, trifloxysulfuron, and metsulfuron were less effective and similar to the untreated check.

Applications of the same treatments made at Desert Highlands golf course 2 weeks later on 03 May showed that several treatments effectively reduced ryegrass where less than 8% remained at 21 DAT (Table 4). Flazasulfuron at both rates applied completely removed all ryegrass. Both rates of rimsulfuron removed most ryegrass so that 3 and 8% remained. The higher rates of foramsulfuron, trifloxysulfuron, and chlorsulfuron were very effective in removing ryegrass where less than 8% remained. The lower rates of foramsulfuron, trifloxysulfuron, and chlorsulfuron were slightly less active and approximately 15% ryegrass was observed at subsequent evaluation dates. Metsulfuron and sulfosulfuron were not effective in removing ryegrass but a slight reduction occurred relative to the untreated check.

Another set of the same treatments was applied 2-1/2 weeks later on 19 May at Cottonwood golf course. Both rates of foramsulfuron, rimsulfuron, trifloxysulfuron, and flazasulfuron were effective removing ryegrass where less than 12% was left at 16 DAT (Table 5). Foramsulfuron, rimsulfuron, and flazasulfuron treatments eliminated almost all ryegrass by 29 DAT. Chlorsulfuron at the high rate was comparable to trifloxysulfuron treatments at 29 DAT where 13% ryegrass remained. Metsulfuron and sulfosulfuron were slightly active compared to the untreated check and ryegrass was removed slowly up to 43 DAT.

The last timing of application of the same set of treatments was made on 15 June at Tatum Ranch golf course. At 16 DAT, most of the treatments reduced nearly all of the ryegrass with less than 5% remaining (Table 6). Both sulfosulfuron treatments and the lower rates of rimsulfuron and metsulfuron had 8 to 10% ryegrass remaining compared to 20% in the untreated check. Flazasulfuron treatments and the high rate of chlorsulfuron completely removed all ryegrass.

A very late timing of application of only the high rates of the herbicides were made on 24 June at Desert Highlands golf course and nearly all of the treatments effectively removed ryegrass at 8 DAT (Table 7.). Rimsulfuron and flazasulfuron completely removed all ryegrass. Foramsulfuron, metsulfuron, chlorsulfuron, and sulfosulfuron removed ryegrass so that less than 6% remained. Trifloxysulfuron was not effective and appeared to be comparable to the untreated check.

Ideal spring transition is complete when all winter turfgrass is removed and replaced by full coverage of the summer bermudagrass turf. The rate of bermudagrass reaching full cover in the treatment plots varied from the April application timing to the June application timing of the herbicides. The June application at Tatum Ranch golf course demonstrated consistent 80 to 90% bermudagrass coverage (Table 8). This was the shortest amount of time to approach full coverage at 13 DAT. Very early applications on 19 April at Desert Highlands showed that rimsulfuron and flazasulfuron or the higher rates of foramsulfuron, trifloxysulfuron, and chlorsulfuron removed ryegrass within 2 to 3 weeks after application but that bermudagrass did not fill in until 84 DAT. Where the later applications were made at Desert Highlands, bermudagrass did not adequately fill in through much of the test site where ryegrass was removed. The 30 April application of herbicides at the Raven golf course showed bermudagrass providing 80 to 90% cover at 56 DAT. At Cottonwood golf course where applications were made on 19 May, bermudagrass coverage was 83 to 93 % at 43 DAT.

The air temperatures and soil temperatures in north Phoenix during the spring show that March and April were very similar with maximum air temperatures at 80°F and minimum air temperatures in the mid-50's (Figure 1). During May, the high temperatures averaged 90°F and then began approaching 100°F in June. In May, the nighttime temperatures still averaged in the low 60's then rose to 70°F in June. Soil temperatures at the 4-in depth were in the mid-60's during March and April then climbed to the 70's in May and June. Bermudagrass growth is stimulated by warmer growing conditions and during the spring 2004, temperatures began to appreciably increase in May and June. Optimal transition conditions would be conducive for herbicide activity on ryegrass for removal and selectively safe on bermudagrass as it emerges from dormancy.

The most rapid response and most effective ryegrass removal occurred at 8 DAT at Desert Highlands golf course with the latest applications on 24 June. All herbicides except sulfosulfuron were effective in removing most ryegrass at 16 DAT when applied on 15 June. Applications in May showed that between 16 and 21 DAT, flazasulfuron, foramsulfuron, rimsulfuron, trifloxysulfuron, and chlorsulfuron removed most of the ryegrass. The most extended period for ryegrass removal was at the Raven golf course and the lack of early activity at less than three weeks following applications may be attributed to less frequent mowing at 1.25 inch on the driving range. The other experiments were on regularly mowed and maintained fairways where the height of cut was one-half inch or less.

Flazasulfuron at the two rates tested, 0.024 and 0.047 lb a.i./A was the most consistently active herbicide in removing ryegrass at all sites. Foramsulfuron at 0.026 lb a.i./A, rimsulfuron at 0.032 lb a.i./A, trifloxysulfuron at 0.014 or 0.023 lb a.i./A, and chlorsulfuron at 0.094 lb a.i./A performed effectively at most sites in a comparable manner. The lower rates of application for most of the herbicides were less effective in removing ryegrass during late April and May. Sulfosulfuron and metsulfuron were least effective in the applications made during April and May. Metsulfuron was tested at rates recommended for use on golf course greens that are less than the rates for fairways and roughs that may explain why less ryegrass removal was observed in the early experiments. All of the herbicides were very effective in removing ryegrass when applied in June.

Foramsulfuron (Revolver*), rimsulfuron (TranXit*), trifloxysulfuron (Monument*), and chlorsulfuron (Corsair*) are available products for removing ryegrass in the spring and demonstrated good efficacy when applied during the spring. Higher rates were more effective when applied in the early spring. All rates were highly effective when applied in June when temperatures were higher. Metsulfuron (Manor*/Blade*) was tested at rates that were recommended for use on greens, therefore, it demonstrated less efficacy in removing ryegrass on the fairways or higher cut turf. Sulfosulfuron is not yet available and was comparable to metsulfuron in most of the experiments. Flazasulfuron at the rates tested was extremely active and further research at lower rates is needed before it is registered for use as a transition-aid.

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*Product names mentioned are registered trademarks. Any products, services, or organizations that are mentioned, shown, or indirectly implied in this publication do not imply endorsement by The University of Arizona.

Table 1. Herbicide names and rates used

Common name	Product name	Product rate/A	Active ingredient (a.i.) rate/A
foramsulfuron	Revolver 0.19SC	8.8 fl oz	0.013
		17.4 fl oz	0.026
rimsulfuron	TranXit 25WG	1.0 oz	0.016
		2.0 oz	0.032
trifloxysulfuron	Monument 75WG	0.1 oz	0.0047
		0.3 oz	0.014
		0.5 oz	0.023
metsulfuron	Manor/Blade 60WG	0.125 oz	0.0047
		0.25 oz	0.0094
chlorsulfuron	Corsair 75WG	1.0 oz	0.047
		2.0 oz	0.094
flazasulfuron	Katana 25WG (proposed name)	1.5 oz	0.024
		3.0 oz	0.047
sulfosulfuron	Certainty 75WG (proposed name)	0.75 oz	0.035
		2.0 oz	0.094

Table 2. Ryegrass reduction with sulfonylurea herbicides during spring transition at Desert Highlands Golf Course applied on 19 April 2004.

<u>Treatment</u>	<u>Rate</u> lb a.i./A	<u>% Ryegrass</u>								
		7 DAT	14 DAT	22 DAT	28 DAT	35 DAT	49 DAT	56 DAT	64 DAT	84 DAT
untreated check		96	100	93	93	63	60	53	47	10
foramsulfuron	0.013	53	32	63	80	43	45	43	27	8
foramsulfuron	0.026	40	25	8	15	7	13	15	13	8
rimsulfuron	0.016	45	10	5	8	5	8	18	10	10
rimsulfuron	0.032	35	7	2	3	0	0	7	5	5
trifloxysulfuron	0.0047	50	35	45	70	40	40	33	25	13
trifloxysulfuron	0.014	38	22	8	13	10	15	17	10	7
metsulfuron	0.0047	85	75	73	63	45	50	43	32	10
metsulfuron	0.0094	83	68	70	78	52	47	37	40	8
chlorsulfuron	0.047	63	68	43	60	28	43	32	28	8
chlorsulfuron	0.094	53	17	13	12	3	13	12	12	3
flazasulfuron	0.024	37	7	3	0	0	2	0	0	0
flazasulfuron	0.047	43	5	3	5	0	0	0	0	0
sulfosulfuron	0.035	50	47	53	62	33	37	35	27	12
sulfosulfuron	0.094	33	37	30	42	18	32	32	25	7
LSD (P=0.05)		12.7	11.8	15.1	27.8	14.8	22.3	15.8	13.9	7.0

Table 3. Ryegrass reduction with sulfonylurea herbicides during spring transition at Raven Golf Course applied on 30 April 2004.

<u>Treatment</u>	<u>Rate</u> lb a.i./A	<u>% Ryegrass</u>			
		18 DAT	41 DAT	56 DAT	76 DAT
untreated check		87	40	22	12
foramsulfuron	0.013	85	32	22	8
foramsulfuron	0.026	85	23	13	3
rimsulfuron	0.016	82	32	18	7
rimsulfuron	0.032	83	25	8	3
trifloxysulfuron	0.014	78	25	12	0
trifloxysulfuron	0.023	70	5	3	0
metsulfuron	0.0047	82	22	12	8
metsulfuron	0.0094	68	20	8	5
chlorsulfuron	0.047	73	15	2	3
chlorsulfuron	0.094	70	20	8	3
flazasulfuron	0.024	58	0	0	0
flazasulfuron	0.047	55	2	2	0
sulfosulfuron	0.035	78	35	20	8
sulfosulfuron	0.094	78	27	17	7
LSD (P=0.05)		11.0	18.7	9.9	6.0

Table 4. Ryegrass reduction with sulfonylurea herbicides during spring transition at Desert Highlands Golf Course applied on 03 May 2004.

<u>Treatment</u>	<u>Rate</u> lb a.i./A	<u>% Ryegrass</u>					
		14 DAT	21 DAT	35 DAT	42 DAT	50 DAT	70 DAT
untreated check		72	50	52	48	50	13
foramsulfuron	0.013	37	17	12	12	13	7
foramsulfuron	0.026	20	2	5	3	8	7
rimsulfuron	0.016	30	8	10	10	10	10
rimsulfuron	0.032	28	3	5	8	7	7
trifloxysulfuron	0.0047	27	15	18	23	22	10
trifloxysulfuron	0.014	33	5	8	8	8	10
metsulfuron	0.0047	70	50	40	37	43	15
metsulfuron	0.0094	57	30	20	37	37	12
chlorsulfuron	0.047	40	13	15	15	22	10
chlorsulfuron	0.094	42	8	7	8	7	2
flazasulfuron	0.024	23	0	0	0	0	2
flazasulfuron	0.047	13	0	0	0	0	0
sulfosulfuron	0.035	53	30	17	28	18	8
sulfosulfuron	0.094	47	28	10	22	17	10
LSD (P=0.05)		19.8	16.1	12.9	13.3	14.5	7.4

Table 5. Ryegrass reduction with sulfonyleurea herbicides during spring transition at Cottonwood Golf Course applied on 19 May 2004.

<u>Treatment</u>	<u>Rate</u> lb a.i./A	<u>% Ryegrass</u>			
		16 DAT	29 DAT	43 DAT	57 DAT
untreated check		53	53	20	15
foramsulfuron	0.013	12	3	2	5
foramsulfuron	0.026	5	0	0	0
rimsulfuron	0.016	3	2	2	0
rimsulfuron	0.032	2	0	0	0
trifloxysulfuron	0.0047	8	17	8	5
trifloxysulfuron	0.014	10	13	5	2
metsulfuron	0.0047	47	35	12	8
metsulfuron	0.0094	33	28	10	7
chlorsulfuron	0.047	28	27	5	3
chlorsulfuron	0.094	18	13	3	3
flazasulfuron	0.024	2	0	0	0
flazasulfuron	0.047	2	2	0	0
sulfosulfuron	0.035	32	43	7	10
sulfosulfuron	0.094	45	40	8	7
LSD (P=0.05)		14.7	13.7	4.2	5.1

Table 6. Ryegrass reduction with sulfonyleurea herbicides during spring transition at Tatum Ranch Golf Course applied on 15 June 2004.

<u>Treatment</u>	<u>Rate</u> lb a.i./A	<u>% Ryegrass</u>
		16 DAT
untreated check		20
foramsulfuron	0.013	5
foramsulfuron	0.026	3
rimsulfuron	0.016	8
rimsulfuron	0.032	2
trifloxysulfuron	0.0047	3
trifloxysulfuron	0.014	2
metsulfuron	0.0047	8
metsulfuron	0.0094	5
chlorsulfuron	0.047	3
chlorsulfuron	0.094	0
flazasulfuron	0.024	0
flazasulfuron	0.047	0
sulfosulfuron	0.035	8
sulfosulfuron	0.094	10
LSD (P=0.05)		5.8

Table 7. Ryegrass reduction with sulfonylurea herbicides during spring transition at Desert Highlands Golf Course applied on 24 June 2004.

<u>Treatment</u>	<u>Rate</u> lb a.i./A	<u>% Ryegrass</u>	
		8 DAT	18 DAT
untreated check		29	13
foramsulfuron	0.026	4	0
rimsulfuron	0.032	0	0
trifloxysulfuron	0.014	23	11
metsulfuron	0.0094	6	4
chlorsulfuron	0.094	3	0
flazasulfuron	0.069	0	0
sulfosulfuron	0.094	4	1
LSD (P=0.05)		8.4	6.5

Table 8. Bermudagrass cover during spring transition

<u>Treatment</u>	<u>Rate</u> lb a.i./A	<u>Bermudagrass cover (%)</u>				
		Desert Highlands #1	Desert Highlands #2	Raven	Cottonwood	Tatum Ranch
untreated check		65	47	78	80	80
foramsulfuron	0.013	77	83	78	92	87
foramsulfuron	0.026	87	75	87	93	88
rimsulfuron	0.016	90	77	82	92	85
rimsulfuron	0.032	95	83	90	83	87
trifloxysulfuron	0.0047	85	70	90	85	90
trifloxysulfuron	0.014	95	73	83	88	82
metsulfuron	0.0047	78	53	83	88	87
metsulfuron	0.0094	88	60	82	90	85
chlorsulfuron	0.047	88	70	90	92	83
chlorsulfuron	0.094	97	82	87	90	82
flazasulfuron	0.024	100	85	93	87	80
flazasulfuron	0.047	97	83	90	90	85
sulfosulfuron	0.035	83	70	80	93	83
sulfosulfuron	0.094	90	75	83	92	83
LSD (p=0.05)		12.3	13.0	11.1	6.5	7.2

Desert Highlands #1 applied on 19 April at 84 DAT, Desert Highlands #2 applied on 03 May at 50 DAT, Raven applied on 30 April at 56 DAT, Cottonwood applied on 19 May at 43 DAT, and Tatum Ranch applied 15 June at 13 DAT

Figure 1. Average air and soil temperatures in north Phoenix in spring 2004

