

# Efficacy of Herbicides for Nutsedge Control in Turf

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## Abstract

*The efficacy of six ALS herbicides for controlling purple nutsedge in bermudagrass turf was demonstrated in five field experiments during the summer of 2004. The highest degree of nutsedge control at 95% at the end of the summer was observed after three monthly applications of trifloxysulfuron at 0.026 lb a.i./A.. Three monthly applications of halosulfuron at 0.062 lb a.i./A controlled nutsedge 88 to 90% at the end of September to early October. Imazaquin at 0.5 lb a.i./A plus MSMA at 3.0 lb a.i./A gave 91% control of nutsedge with three applications. The most rapid and efficacious nutsedge control was observed with flazasulfuron giving 91% control at 15 days after a single application. The highest degree of nutsedge control with a single application of sulfosulfuron was 91 to 96% control at 28 days after treatment. In general, ALS herbicides applied as a single application or multiple applications provided one month of effective control following a first application. After one month, the degree of control declined unless repeated applications at monthly intervals or as needed were applied for extended control. Penoxsulam at 0.12 lb a.i./A in one test gave only 70% control. MSMA at 3.0 lb a.i./A was applied four times and nutsedge control at the end of the season was 63 to 66%.*

## Introduction

Purple nutsedge (*Cyperus rotundus*) is the “world’s worst weed” and infests turfgrasses of parks and landscapes to golf course greens that range from low to high maintenance situations. Effective herbicides have become commercially available to offer turf managers means to control nutsedge in turfgrass. Herbicides that inhibit the acetolactate synthase (ALS) enzyme in plants have demonstrated very good efficacy at extremely low rates of application. Single applications can briefly control nutsedge in turf but multiple applications over more than one summer are usually required to achieve significant reduction to acceptable levels. ALS herbicides were introduced in the 1980’s with Image\* (imazaquin), an imidazolinone herbicide, followed by Manage\* (halosulfuron), a sulfonyleurea herbicide. Monument\* (trifloxysulfuron), another sulfonyleurea herbicide, is the most recently introduced product for nutsedge control. Two other sulfonyleurea herbicides being developed are flazasulfuron (Katana\* proposed) and sulfosulfuron (Certainty\* proposed). Another family of herbicides that are ALS inhibitors is the triazolopyrimidines that include penoxsulam that is very early in exploratory development stages for use in turf. Several field experiments were conducted to determine the efficacy of the six ALS inhibiting herbicides on nutsedge in various turfgrass situations with single and multiple applications at various timings of application.

## Materials and Methods

Five experiments were conducted on various turfgrass sites in Maricopa County, AZ during the summer of 2004. At the Riverview golf course in Sun City, the tee area of a driving range was infested with purple nutsedge in common bermudagrass that was mowed regularly at 0.5 inch height. In Sun Lakes, landscaped areas with common bermudagrass mowed once or twice per week at 1.0 to 2.0 inch height were infested with purple nutsedge. Similarly, in north Tempe, a park area with common bermudagrass was mowed once per week at 1.0 to 2.0 inch height. In south Tempe, the area on the perimeter of a baseball field with common bermudagrass was mowed

regularly at 1.0 inch height. All of the experiments were designed with each treatment plot measuring 5 ft wide x 6, 20, or 44 ft long and each treatment was replicated three or four times in a randomized complete block design. The herbicides were applied with a backpack CO<sub>2</sub> sprayer equipped with a hand-held boom with three 8002 flat-fan nozzles spaced 20-inches apart. The herbicides were applied in 30 to 50 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.

At the Riverview golf course, the treatments plots measured 20 ft in length and each treatment was replicated four times. Herbicides were applied either as a single application, three monthly applications, or as needed multiple applications. The first application of all treatments was made on 08 July 2004 with the air temperature at 90°F, clear sky, no wind, and humidity increasing. The nutsedge was 2 to 3 inches tall and the turf was not mowed until the following day. The second application date was 22 July for as needed applications of Manage and Image treatments. The approximate temperature at the time of application was 80°F. The third application date was 04 August when the second monthly treatments were sprayed with temperature at 86°F, calm wind, and slightly cloudy conditions. The fourth application for an MSMA application was on 19 August with temperature at 84°F, 95% overcast, and calm. The fifth application date for treatments that were needed was 24 August when temperature was 82°F and overcast. The sixth application date for the third monthly application was 03 September with temperature at 82°F, clear, and a slight wind.

In Sun Lakes, both experiments had treatment plots measuring 6 ft in length and replicated four times. Herbicides were applied either as a single application or three monthly applications beginning on 06 July 2004. In the second experiment with only one application of each treatment, the weather conditions were the same on 06 July. The temperature was 102°F, clear sky, and very slight breeze during the initial application. The second application date was 03 August when the temperature was 90°F, clear, and no wind. The treatment MSMA alone was sprayed on 17 August with the air temperature at 79°F, clear sky, and no wind. The third application date for all herbicides was on 31 August with temperature at 84°F, clear sky, and no wind.

In south Tempe on the perimeter of the baseball field at Corona del Sol High School, treatment plots measured 44 ft in length and were replicated three times for the comparison of early versus late timings of application. The first applications were made on 02 August 2004 when the temperature was 98°F and clear. The late timings were applied on 27 August when it was clear, calm, and 75°F.

In north Tempe at a park, treatment plots measured 20 ft in length and were replicated three times. On 23 August, the temperature was 76°F, clear, and there was a very slight breeze. For all experiments, nutsedge control was evaluated at periodic intervals after each application of the treatments. Bermudagrass phytotoxicity was also evaluated.

## Results and Discussion

The highest degree of nutsedge control at 95% was observed after three monthly applications of trifloxysulfuron at 0.026 lb a.i./A at 28 days after treatment (DAT) of the last application at the Riverview golf course and 27 DAT of the last application at Sun Lakes (Tables 1 and 2). At 15 DAT and 18 DAT of the second and third applications, trifloxysulfuron gave nearly complete control of 98 and 97% of nutsedge at Riverview. Also at Riverview, two applications at 7 weeks apart were highly effective by giving 94% control at 38 DAT of the second application at the end of the summer. Single applications of trifloxysulfuron gave 90 to 94% control of nutsedge at 17 to 30 DAT (Tables 3, 4, and 5). Nutsedge control with a single application decreased after 30 DAT. At south Tempe, a single application in late August provided longer effective control of 82% at 47 DAT compared to 52% at 42 DAT of an earlier application in August (Table 4). A similar decrease in control to 68% was observed at Riverview at 43 DAT of the first application. The addition of MSMA at 3.0 lb a.i./A to trifloxysulfuron did not improve nutsedge control over trifloxysulfuron applied alone.

Three monthly applications of halosulfuron at 0.062 lb a.i./A controlled nutsedge 88 to 90% at the end of September to early October (Table 1 and 2). When halosulfuron was applied four times through the summer, at 2 to 3 week intervals, nutsedge control was less than acceptable at 71% at 38 DAT of the last application. A single application of halosulfuron in July to early August gave nearly acceptable nutsedge control within 14 to 25 DAT but control

declined after 28 DAT. Late season applications of halosulfuron in late August and into September continued to give acceptable control of better than 82% beyond 30 DAT. The addition of MSMA to halosulfuron did not improve nutsedge control over halosulfuron applied alone.

Imazaquin at 0.5 lb a.i./A plus MSMA at 3.0 lb a.i./A gave 91% control of nutsedge with three applications at Riverview and Sun Lakes (Tables 1 and 2). A late application of the combination gave 96% control at 20 DAT and then marginally acceptable control at 80% was still observed at 47 DAT at Tempe. Imazaquin applied alone was variable and nutsedge control was less at the earlier observation dates following initial applications compared to later season ratings. Single applications of imazaquin alone offered less than acceptable control of nutsedge at less than 78% control.

MSMA at 3.0 lb a.i./A was applied four times at Riverview and Sun Lakes where the nutsedge control at the end of the season was 63 to 66% (Tables 1 and 2). A single application of MSMA late in the season at south Tempe also resulted in 62% control at 47 DAT (Table 4).

Nutsedge control with a single application of sulfosulfuron at 0.094 lb a.i./A was better than 91% at 28 DAT in three tests (Tables 1, 2, and 3). After 37 DAT, the nutsedge control declined to less than acceptable levels at 50 to 79%. Flazasulfuron at 0.047 lb a.i./A applied one time controlled nutsedge 88 to 91% at 28 DAT (Table 1 and 3) and showed 85% control as soon as 14 DAT (Table 2). As the season progressed, nutsedge in flazasulfuron treated plots was controlled only as high as 75%. Penoxsulam at 0.12 lb a.i./A in one test gave only 70% control at 16 DAT and control did not improve through the remainder of the season at only 66% control.

The most rapid and efficacious nutsedge control was observed with flazasulfuron giving 91% control at 15 DAT of the only application at Riverview on 07 July (Table 1). At 14 DAT, flazasulfuron gave 84 and 85% control in the two tests at Sun Lakes. The highest degree of nutsedge control with a single application was observed with sulfosulfuron giving 91 to 96% control at 28 DAT at Riverview and Sun Lakes (Tables 1, 2, and 3).

Nutsedge control was more acceptable at 80 to 82% at 47 DAT when halosulfuron, trifloxysulfuron, and imazaquin plus MSMA were applied late in the summer on 27 August compared to an earlier application on 02 August (Table 4). At 42 DAT of the earlier application, nutsedge control was about 50% and at control was less than acceptable at the end of the summer. In a second test with a very late application, halosulfuron and trifloxysulfuron showed only 70 to 77% nutsedge control at 63 DAT (Table 5). In general, ALS herbicides applied as a single application or multiple applications provided one month of effective control following the first timing of application. After one month, the degree of control declined unless repeated applications at monthly intervals or as needed were applied for extended control.

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Table 1. Nutsedge control with multiple applications and combinations of herbicides at Riverview Golf Course, Sun City

<u>Treatment</u>	<u>Rate</u> (lb a.i./A)	<u>(Total No. applications)</u> <u>Application dates</u>	<u>Nutsedge control (%)</u>				
			22-Jul	4-Aug	19-Aug	21-Sep	1-Oct
untreated check			0	0	0	0	0
halosulfuron	0.062	(4) 07 Jul, 22 Jul, 04 Aug, 24 Aug	85	70	95	74	71
halosulfuron	0.062	(3) 07 Jul, 04 Aug, 03 Sep	90	83	94	97	88
trifloxysulfuron	0.026	(2) 07 Jul, 24 Aug	88	91	68	97	94
trifloxysulfuron	0.026	(3) 07 Jul, 04 Aug, 03 Sep	84	91	98	97	95
imazaquin	0.5	(3) 07 Jul, 22 Jul, 24 Aug	64	92	69	89	90
sulfosulfuron	0.094	(1) 07 Jul	86	96	83	59	74
flazasulfuron	0.047	(1) 07 Jul	91	91	68	73	75
MSMA	3.0	(4) 07 Jul, 22 Jul, 04 Aug, 19 Aug	55	59	69	48	63
MSMA + halosulfuron	3.0 0.062	(4) 07 Jul, 22 Jul, 04 Aug, 24 Aug	88	76	91	71	74
MSMA + trifloxysulfuron	3.0 0.026	(2) 07 Jul, 24 Aug	84	89	69	97	95
MSMA + imazaquin	3.0 0.5	(3) 07 Jul, 22 Jul, 24 Aug	76	99	88	95	91
LSD (p=0.05)			14.4	14.9	11.1	14.9	12.1

6 separate application dates during season: 07, 22 Jul; 04, 19, 24 Aug; 03 Sep 2004

Rating dates at days after treatment (DAT): 22 Jul = 15 DAT-1 (1<sup>st</sup> application);

04 Aug = 28 DAT-1, 13 DAT-2 (2<sup>nd</sup> application);

19 Aug = 43 DAT-1, 28 DAT-2, 15 DAT-3 (3<sup>rd</sup> application);

21 Sep = 76 DAT-1, 61 DAT-2, 48 DAT-3, 33 DAT-4 (4<sup>th</sup> application), 28 DAT-5 (5<sup>th</sup> application), 18 DAT-6;

01 Oct = 86 DAT-1, 71 DAT-2, 58 DAT-3, 43 DAT-4, 38 DAT-5, 28 DAT-6 (6<sup>th</sup> application)

Table 2. Nutsedge control with multiple applications and combinations of herbicides at Sun Lakes.

<u>Treatment</u>	<u>Rate</u> (lb a.i./A)	<u>Nutsedge control (%)</u>				
		20-Jul	3-Aug	12-Aug	16-Sep	27-Sep
untreated check		0	0	0	0	0
halosulfuron	0.062	81	23	76	97	90
trifloxysulfuron	0.026	79	84	80	98	95
imazaquin	0.5	38	13	65	83	80
sulfosulfuron	0.094	76	91	78	50	50
flazasulfuron	0.047	85	54	64	60	60
MSMA	3.0	0	55	80	68	66
MSMA + halosulfuron	3.0 0.062	79	74	80	93	85
MSMA + trifloxysulfuron	3.0 0.026	83	84	86	97	90
MSMA + imazaquin	3.0 0.5	55	3	75	92	91
LSD (p=0.05)		13.7	21.3	10.4	8.1	9.1

Treatments applied on 06 Jul, 03 and 31 Aug 2004. MSMA applied 4<sup>th</sup> time on 17 Aug

Rating dates on 20 Jul = 14 DAT-1, 03 Aug = 28 DAT-1; 12 Aug = 37 DAT-1, 9 DAT-2;

16 Sep = 72 DAT-1, 44 DAT-2, 16 DAT-3; 27 Sep = 83 DAT-1, 55 DAT-2, 27 DAT-3

Table 3. Nutsedge control with a single application of herbicides at Sun Lakes

Treatment	Rate (lb a.i./A)	Nutsedge control (%)			
		14 Dat	28 Dat	72 Dat	84 DAT
untreated check		0	0	0	0
halosulfuron	0.062	79	71	74	63
trifloxysulfuron	0.026	80	94	76	59
imazaquin	0.5	64	39	64	64
sulfosulfuron	0.094	79	95	85	79
flazasulfuron	0.047	84	88	79	66
LSD (p=0.05)		10.3	26.2	11.9	17.3

Application on 06 July 2004

Table 4. Early and late applications of herbicides for nutsedge control in south Tempe

Treatment	Rate (lb a.i./A)	Nutsedge control (%)				
		early			late	
		25 DAT	42 DAT	86 DAT	20 DAT	47 DAT
untreated check		0	0	0	0	0
MSMA	3.0	0	40	32	50	62
imazaquin + MSMA	0.5 + 3.0	90	47	68	96	80
halosulfuron	0.062	90	50	73	91	82
trifloxysulfuron	0.026	94	52	48	94	82
LSD (p=0.05)		5.8	50	36	50	36

Early application on 02 Aug and late application on 27 Aug 2004

Table 5. Nutsedge control with a single late application of herbicides in north Tempe.

Treatment	Rate (lb a.i./A)	Nutsedge control (%)		
		16 DAT	30 DAT	63 DAT
untreated check		0	0	0
halosulfuron	0.062	80	82	70
imazaquin	0.5	78	78	58
trifloxysulfuron	0.035	80	90	77
penoxsulam	0.12	70	63	67
LSD (p=0.05)		2.4	10.0	16.9

Application on 23 Aug 2004