Comparison of Two Rates and Two Formulations of Imazaquin for Control of Purple Nutsedge

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Abstract

Purple nutsedge (Cyperus rotundus) is a major warm season weed in turfgrass, landscape and agricultural settings. It's long term persistence is achieved in part by (1) the production of tubers with numerous growing points (2) the ability to produce multiple plants from basal bulbuls at the soil level and (3) the tolerance to defoliation and/or soil cultivation. In turf, purple nutsedge can tolerate almost any mowing regime, and is competitive (in it's growth habit) with turfgrasses.

Imazaquin (IMAGE) herbicide has been commercially available in the turfgrass market for almost 12 years for use in warm season turfgrasses for the control of purple nutsedge. Research conducted in the late 1980's at the University of Arizona showed that Image (EC formulation) provided adequate control of purple nutsedge when (1) multiple applications were applied 25 days apart (2) at the 0.50 lb. ai./a rate. In this scenario 98% nutsedge control was achieved (on 100 % nutsedge plots, mowed weekly at 2.5 inches). Repeat applications were still necessary after regrowth (presumably from growing points from underground nutlets). These results were achieved using the 1.5 EC (emulsifiable concentrate formulation).

A new test was conducted in 1999, evaluating both the 1.5 EC and 70 DG (dispersible granule) formulations applied at two rates (0.375 lb. ai./a. and 0.50 lb. ai./a).

Mean percent weed control on the three evaluation dates of August 17, August 29 and September 16 ranged from 25% to 32%, 50% to 68% and 55% to 75%, respectively. These dates represent the time intervals of 18 DAT/1, 30 DAT/1 and 17 DAT/2. On all three evaluations dates (where measured), the degree of injury, color and percent nutsedge infestation level was significant for the overall "treatment" effect at P=0.05, or less. (Tables 1,2).

Actual percent weed control (based on the mean of control plots) was significant on August 29 (30 DAT/1) and on September 16 (17 DAT/2:47 DAT/1). Maximum weed control of 75% was achieved by the EC @ 0.50 lbs. ai./a. at 17 days after the second application. Percent weed control for the DG @ 0.50 lbs. ai./a. was greatest (61%) at that time also.

Introduction

Purple nutsedge (Cyperus rotundus) is a major warm season perennial weed in turfgrass, landscape and agricultural settings. Its long term persistence is achieved by the (1) production of underground tubers with numerous growing points, (2) the ability to produce multiple plants from lateral stems of basal bulbuls without further sprouting from nutlets, and (3) tolerance to defoliation. In turf, purple nutsedge can tolerate almost any mowing regime and is quite competitive.

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Imazaquin (IMAGE) in the turfgrass market became commercially available over twelve years ago for the control of purple nutsedge in bermudagrass turf. Research conducted in the late 1980's at the University of Arizona showed that Image provided adequate control of purple nutsedge when multiple treatments were applied 25 days apart at the rate of 0.50 lbs ai/a. In 100% nutsedge plots, 98% surface control was achieved after two applications. Repeat applications were still warranted after regrowth. Those results were achieved using the 1.5 EC formulation.

A new test was conducted in 1999, evaluating both the 1.5 EC formulation and the 70 DG formulation. Both formulations were applied at two rates (0.375 and 0.50 lb. AI/A).

Materials

The test area was located at the University of Arizona Campus Agricultural Center in Tucson, Arizona. A 40' x 150' border with a known history of purple nutsedge was disced in 1998 and flooded and fertilized with 3.0 lbs. -N- per 1000 sq. ft., starting in the spring of 1999 to promote a 100% purple nutsedge cover. The area was mowed weekly at 2.25" using a rotary mower to promote basal bulbul pioneering and plot fill in.

Once the test area achieved 95% or greater infestation levels, treatments were applied. Both the EC and DG formulations were applied at the 0.375 and 0.50 lb AI/A rates on July 30, August 30 and finally on October 12. The fall season of 1999 was extremely warm, with 90EF daytime temperatures occurring well into mid-November. Applications were completed in the morning by 8:00 am using a Co_2 back-pack sprayer with 8006 nozzles applying 90 gpa.

Plot size was 1.8' x 10'. Spray was allowed to dry on the leaf for 8 hours and was then watered in by hand using a hand held spray nozzle operated off a spray tank filled only with water. Plots were irrigated in 3 cycle soak sequences to avoid any runoff.

The mean post application “water in” depth was 0.40 inches of water, +/- 0.05 inches, when calculated by a time/volume calibration on a per plot basis.

Plots were evaluated for the degree of injury to the weed 1-6 (1 = none, 4 = moderate, 6 = dead) and percent plot of “live nutsedge” (0-100%). Nutsedge color scores (when applicable) were assigned to plots to denote loss of chlorophyll or general plant health.

Percent weed control was calculated as the infestation level of the treated area, divided by that of the untreated check.

Each of the five field blocks contained two control plots which were then averaged over all replications for the value used for the “percent weed control” equation.

Data was analyzed using the analysis of variance technique using SAS software. Orthogonal polynomial contrasts were devised to evaluate the effects of herbicide rate, formulation, and the rate * formulation interaction. An LSD value was also calculated as the mean separation statistic for the rate-formulation combinations (when listed as “treatments”). Data was collected twice after the initial application and once during the peak of the second and third applications.

Result and Discussion

Mean percent weed control on the three evaluation dates of August 17, August 29 and September 16 ranged from 25% to 32%, 50% to 68% and 55% to 75%, respectively. These dates represent the time intervals of 18 DAT/1, 30 DAT/1 and 17 DAT/2. (Table 1).

Weed response at intervals after 3 weeks following the third treatment was not sufficient to validate weed control. After this time, purple nutsedge plots had foliage which turned lighter green to yellow in color, but there was no severe foliar injury or necrosis of the foliage. Why this occurred is not understood. Spray containers were rinsed and separate calibrations were made on all three application dates. As explained previously, the water-in procedure was followed in great detail and was applied by the principal investigator. As Imazaquin (EC) is taken up by both the foliage and via

root uptake, a greater response after the third application was expected (based on past experience with the EC formulation). In previous work, a late October application did reduce spring cover and growth of nutsedge. This response is outstanding and will not be known until spring 2000.

On all three evaluations dates (where measured), the degree of injury, color and percent nutsedge infestation level was significant for the overall "treatment" effect at P=0.05, or less. (Tables 1,2).

Actual percent weed control (based on the mean of control plots) was significant on August 29 (30 DAT/1) and on September 16 (17 DAT/2 : 47 DAT/1). Percent weed control was not significant on August 17, eighteen days after the first initial treatments were applied (on July 30). This is typical of purple nutsedge, which responds in a slow necrosis of the foliage by 25 days after initial treatment (with imazaquin). The heightened response from the additional sequential (repeat) applications was realized in this trial, as well (Table 10).

Both the "formulation" and the "rate*formulation" contrasts were statistically significant at the second and third evaluation dates (P = 0.05, or less). The "rate" contrast was never significant for percent weed control (Table 3)..

On August 17 (18 DAT/1), the absolute amount of plot infestation cover was significant, as was the degree of visual injury. However, the percent weed control was not (Table 1).

Percent weed control ranged from 25% to 33% on August 17. The 0.50 lb. AI/A rates ranked slightly above the 0.35 lb. AI/A rates. Actual plot infestation levels ranged from 56% to 62% among treated nutsedge plots. The control had 83% nutsedge cover and caused the treatment effect in the ANOVA to be significant for percent living nutsedge ground cover (Table 1).

The degree of injury score ranged from 1.0 (no injury) to 4.0 (moderate injury). All treatments caused an identical level of visible injury (3.4 - 4.0) to the nutsedge foliage (Table 2).

On August 29, the degree of injury, the percent plot infestation level and percent weed control were significant for the "treatment" effect. Mean visible injury scores ranged from 2.8 to 3.4 (Table 2). Image EC at 0.50 lb. AI/A ranked first for injury (mean = 3.4). The least visible injury occurred for the DG formulation applied as the 0.375 lb. AI/A treatment combination (mean = 2.8). No contrasts were significant for this response variable (Table 3). Percent plot living nutsedge mean treatment values ranged from 23% to 36% among Imazaquin treated plots (Table 1). The control had 72% nutsedge cover. Percent weed control on August 29 ranged from 50% to 68% control. Image EC at 0.50 lb. AI/A had the greatest control of 68%. All three remaining treatments had 50% to 56% weed control (Table 1). The formulation and rate*formulation contrasts were significant (Table 3).

Basically, the superior response of the EC at 0.50 lb. AI/A rate treatment when compared to the other treatments, carried the formulation contrast, as the same EC at 0.375 lb. AI/A ranked last for control. The formulation*rate interaction was also significant (Table 3).

On September 16, the treatment mean affect was significant for the degree of injury (Table 2), color of the foliage (data not shown), percent plot living nutsedge and for percent weed control (Table 1).

Mean degree of injury scores ranged from 2.8 (slight to moderate) to 3.8 (moderate) among Imazaquin treated turf. The EC at 0.50 lb. AI/A treatment combination showed the greatest injury (mean = 3.8), followed closely by the three remaining treatments (Table 1). The formulation contrast was significant (carried only by the EC at 0.50 lb. AI/A response) as was the rate and rate*formulation contrast (Table 3). The rate of 0.50 lb. AI/A produced better results than both of the 0.375 lb. AI/A treatments. Since the EC at 0.375 ranked tied for the least response, the two way interaction was significant.

Nutsedge color scores (a measure of greenness) ranged from 3.2 (yellow) to 6.4 (moderate green) on September 16, 1999. The EC at 0.50 lb. AI/A (combination treatment) had the most discolored nutsedge (3.2). Both DG treatments were the least discolored (1.2 to 2.2). In this case, both the EC treatments produced a greater discoloration than the DG treated nutsedge (data not shown).

Percent plot living sedge cover ranged from 21% to 38% among Imazaquin treated turf on September 16. The control yielded 84% mean nutsedge ground cover. Again, the EC at 0.50 lb. ai/a treatment combination had the least amount of living nutsedge ground cover (21%). Likewise, the EC at 0.375 lb. ai/a had the greatest amount (38%) among treated

plots (Table 1). Since the DG treatments ranked in between the EC treatments, the formulation*rate interaction was significant.

Lastly, percent weed control ranged from 55% to 75% in mid-September (Table 1). The EC at 0.50 lb ai/a clearly produced the greatest amount of weed control (75%), followed by the DG formulation at 0.50 lb. ai/a, which produced 61% weed control (Table 1).

Both formulations applied at 0.375 lb. ai/a had 55% to 56% control. Both the rate and formulation*rate interaction were significant(Tables 1, 3).

Nutsedge plants did not become necrotic and there was little effect from all treatments after the third application made on October 12, 1999. Therefore, no further data collection was possible.

Table 1. Mean percent weed control[1] and percent plot cover[2] of purple nutsedge after application of Imazaquin herbicide at two rates and two product formulations. University of Arizona, 1999.

TREATMENT	FORMULATION[3]	RATE[4]	% CONTROL[5] 17 AUGUST	% CONTROL[5] 29 AUGUST	% CONTROL[5] 16 SEPTEMBER
Imazaquin	EC	0.50	33 (56)[6]	68 (23)[6]	75 (21)[6]
Imazaquin	EC	0.375	25 (62)	50 (36)	55 (38)
Imazaquin	DG	0.50	28 (60)	54 (33)	61 (33)
Imazaquin	DG	0.375	27 (61)	56 (32)	56 (37)
Control	- -	- -	- - (83)	- - (72)	- - (84)
Test Mean[7]			28 (65)	60 (39)	62 (43)
LSD Value[8]			NA (NA)	11 (NA)	11 (NA)

[1]Percent weed control. Values are the average of five replications. 1 - (treated/control) * 100.

[2](Percent plot cover). Amount of living purple nutsedge covering plot surface. Values are the mean of five replications (0-100%).

[3]Formulation. EC = emulsifiable concentrate. DG = dispensable granule.

[4]Rate = lbs. active ingredient per acre

[5]Percent weed control. [17 August = 18 DAT/1]:[29 August = 30 DAT/1]:[16 September = 17 DAT/2 and 47 DAT/1].

[6]Percent plot coverage of living purple nutsedge included (in parenthesis) for background information only.

[7]Test Mean = mean of all plots and treatments.

[8]LSD Value = Mean separation statistic for treatment comparisons. Treatments with numerical differences larger than the LSD value are significantly different from each other.

Table 2. Mean degree of injury[1] scores of purple nutsedge after application of Imazaquin herbicide at two rates and two product formulations. University of Arizona, 1999.

TREATMENT	FORMULATION[2]	RATE[3]	DEGREE INJURY 17 AUGUST	DEGREE INJURY 29 AUGUST	DEGREE INJURY 16 SEPTEMBER
Imazaquin	EC	0.50	4.0	3.4	3.8
Imazaquin	EC	0.375	3.4	3.2	2.8
Imazaquin	DG	0.50	3.4	3.2	3.0
Imazaquin	DG	0.375	3.4	2.8	2.8
Control	- -	- -	1.0	1.0	1.0
Test Mean[4]			3.0	2.7	2.7
LSD Value[5]			0.9	0.8	0.6

[1]Degree of injury 1-6. 1 = none, 4 = moderate, 6 = severe and no green tissue remaining. Values are the average of five replications.

[2]Formulation. EC = emulsifiable concentrate. DG = dispensable granule.

[3]Rate = lbs. active ingredient per acre

[4]Test Mean = mean of all plots and treatments.

[5]LSD Value = Mean separation statistic for treatment comparisons. Treatments with numerical differences larger than the LSD value are significantly different from each other.

Table 3. Significance level[1] of orthogonal polynomial contrasts for rate and formulation effects for percent weed control of purple nutsedge after applications of Imazaquin herbicide, University of Arizona, 1999.

RESPONSE	RATE 0.375 VS.0.50 LB. AI/A	FORMULATION EC VS. DG PRODUCTS	RATE*FORMULATION INTERACTION
Degree Injury 17 AUG[2]	NS	NS	NS
Degree Injury 29 AUG[3]	NS	NS	NS
Degree Injury 16 SEPT[4]	*	XX	*
% Weed Control 17 AUG[5]	NS	NS	NS
% Weed Control 29 AUG[6]	NS	*	**
% Weed Control 16 SEPT[7]	NS	**	*

[1]Contrast significance level. NS = non-significant; X = significant at P = 0.05; XX = significant at P = 0.01.

[2]Degree injury to purple nutsedge. 17 Aug. 18 DAT/1.

[3]Degree injury to purple nutsedge. 29 Aug. 30 DAT/1.

[4]Degree injury to purple nutsedge. 16 Sept. 17 DAT/1:47 DAT/2.

[5]Percent weed control 1 - (TRT/Control) X 100. 18 DAT/1.

[6]Percent weed control 1 - (TRT/Control) X 100. 30 DAT/1.

[7]Percent weed control 1 - (TRT/Control) X 100. 17 DAT/1:47 DAT/2.

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