A Promising Herbicide to Control Annual Bluegrass in Creeping Bentgrass Putting Greens

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Objectives:

1. Comparison of methiozolin to other pre−emergence herbicides for annual bluegrass control on creeping bentgrass putting greens.
2. Weed spectrum of methiozolin on annual weeds, including crabgrass and goosegrass.
3. Evaluation of the safety of methiozolin on bentgrass putting greens following variable rates applied both spring and fall.

Annual bluegrass (Poa annua L.) is a troublesome weed worldwide in creeping bentgrass (Agrostis stolonifera L.) putting greens. The few pre−emergence options labeled for greens either exhibit limited control of annual bluegrass, such as bensulide, or result in phytotoxicity to bentgrass, such as dithiopyr. Recently methiozolin, a plant cell wall biosynthesis inhibitor (CBI), was introduced for use in turf in the United States. Earlier research found that when applied as a post−emergence herbicide methiozolin effectively controlled annual bluegrass with minimal phytotoxicity on creeping bentgrass. The objective of this study was to evaluate the safety and effectiveness of methiozolin as a pre−emergence herbicide for annual bluegrass on creeping bentgrass green with initial application starting in late summer/early fall.

Three field studies with plot size measuring 1.5 X 1.5 m were established on USGA−spec creeping bentgrass putting greens with historic annual bluegrass encroachment in Missouri and Oklahoma over a two−year period. Experimental design was a randomized complete block design with four replications. Treatments (Table 1) included methiozolin at different rates (0.25, 0.5, 0.75 and 1.0 kg ai ha^{-1}) and application intervals (7, 14, or 28 days), in addition to bensulide, bensulide + oxadiazon, and dithiopyr at labeled rates (Table 1). Evaluations included weekly assessment of turf quality, phytotoxicity, percent annual

Figure 1. Representative effectiveness of methiozolin (1.0 kg ai ha−1) for annual bluegrass control on creeping bentgrass green at 26 weeks (March 16th) after initial treatment. Plot on the left is un−treated, and on the right is treated. Note the yellow−colored annual bluegrass on the untreated (left) plot.

bluegrass, and normalized difference vegetation index (NDVI) by using a hand−held sensor (GreenSeeker®). Percent annual bluegrass cover was also used to calculate the area under percent weed curve (AUPWC), which represents the cumulative effect of annual bluegrass infestation throughout the season. To simplify the discussion, only treatment effects on annual bluegrass control from fall applications will be discussed in this report.

In all studies, initial applications were made before annual bluegrass germinated. Following fall applications, methiozolin resulted in 85 to 100% annual bluegrass control by the following spring compared to the untreated control (Table 2). All methiozolin application regimes provided statistically similar annual bluegrass control. Bensulide, dithiopyr, and bensulide plus oxadiazon exhibited erratic control of annual bluegrass at 66% or less. In the three studies, plots that received methiozolin showed up to 91, 94 or 95% AUPWC reductions, respectively, compared to the untreated control (Table 3). No significant differences were found among methiozolin treatments rates or application intervals. Bensulide, bensulide plus oxadiazon, and dithiopyr showed inconsistent control of annual bluegrass compared to the untreated controls in the three studies.

Following herbicide applications, there was no significant reduction in turfgrass quality observed in Missouri or Oklahoma. Minor turfgrass phytotoxicity was only observed following the treatment bensulide + oxadiazon. In Oklahoma, methiozolin caused up to 10% reduction in creeping bentgrass turf quality at 7 weeks after initial treatment (WAIT). Verticutting in November prior to the final application was believed to contribute to the injury.

Summary

- Sequential applications of methiozolin starting in early fall provide effective annual bluegrass control (85% or above) at total rates of 2.0 or 2.25 kg ai ha−1 per season.
- Methiozolin is generally safe and potential injury to creeping bentgrass turf is minimal.
- Methiozolin can be used as a pre−emergence herbicide in late summer/early fall on putting greens to effectively control annual bluegrass, with minimal injury to creeping bentgrass turf.

Table 1. Treatment list and application details for methiozolin and other pre−emergence herbicide applied to creeping bentgrass putting greens.

Treatment	Product	Rate (kg ai/ha)	App. interval* (weeks)	Total apps	Total Rate (kg ai/ha)
Methiozolin	PoaCure® 25EC	0.25	1	8	2.0
Methiozolin	PoaCure® 25EC	0.50	2	4	2.0
Methiozolin	PoaCure® 25EC	0.75	2	3	2.25
Methiozolin	PoaCure® 25EC	1.00	4	2	2.0
Methiozolin	PoaCure® 25EC	0.50 + 0.50 + 1.00	2	3	2.0
Bensulide	Bensumec® 4LF	14.00	−−	1	14
Siduron	Tupersan® 50%	2.24	−−	1	2.24
Bensulide + Oxadiazon	Andersons® Goose−grass/crabgrass control	13.46 + 3.36	−−	1	16.82
Dithiopyr	Dimension® 2EW	0.56	−−	1	0.56
Untreated	−−	−−	−−	−−	−−

*Initial applications were made on September 16th, 2011 and September 13th, 2012 in Missouri, and September 26th, 2012 in Oklahoma.

Table 2. Treatment effect of methiozolin on percent annual bluegrass cover (%) at 11 or 12 weeks after initial application (WAIT, end of fall) and 20, 26, or 28 WAIT (at the beginning of spring) in three studies initiated in 2011 and 2012 in Missouri, and 2012 in Oklahoma.

Treatment	Rate (kg ai/ha)	% Annual bluegrass, WAIT					
		--MO 2011--		--MO 2012--		--OK 2012 --	
		12	20^z	11	26^y	11	28^x
Methiozolin	0.25	0.3	0.0	0.5	0.6	0.3	1.1
Methiozolin	0.50	0.3	0.0	0.5	0.4	0.8	1.3
Methiozolin	0.75	0.0	0.0	0.3	0.4	0.5	0.5
Methiozolin	1.00	0.5	0.0	0.8	1.1	0.8	0.6
Methiozolin	0.50 + 0.50 + 1.00	2.5	0.5	1.3	0.8	1.0	3.0
Bensulide	14.00	6.5	4.3	3.5	8.6	6.3	17.8
Bensulide+Oxadiazon	13.46 + 3.36	--^{w}	--	4.5	3.5	5.3	20.6
Dithiopyr	0.56	5.3	10.8	3.0	15.8	2.5	7.4
Untreated	--	16.0	23.0	10.0	21.5	5.8	19.6
LSD (*P*=0.05)		5.3	5.4	2.4	6.5	3.3	6.2

^{z}Evaluations at 20 weeks after treatment were made on February 2nd, 2012.
^{y}Evaluations at 26 weeks after treatment were made on March 16th, 2013.
^{x}Evaluations at 28 weeks after treatment were made on April 9th, 2013.
^{w}Bensulide + oxadiazon was not included in this study.

Table 3. Area under percent weed curve (AUPWC) of annual bluegrass influenced by treatment in three studies applied at St. Louis, MO in 2011 (Study 1), 2012 (Study 2), and Stillwater, OK in 2012 (Study 3).

Treatment	Rate	Study 1	Study 2	Study 3
	kg a.i .ha^{-1}		--AUPWC^z--	
Methiozolin	0.25^y	431	163	101
Methiozolin	0.50	267	134	184
Methiozolin	0.75	201	110	87
Methiozolin	1.00	276	178	138
Methiozolin	0.50 + 0.50 + 1.00	493	203	267
Bensulide	14.00	726	643	1600
Bensulide + oxadiazon	13.46 + 3.36	--^{x}	695	1643
Dithiopyr	0.56	909	1416	699
Control	--	2144	1810	1682
LSD (*P* = 0.05)		385	788	630
			--Orthogonal contrasts--	
Methiozolin vs. bensulide		**^{w}	NS	***
Methiozolin vs. bensulide + oxadiazon		--	NS	***
Methiozolin vs. dithiopyr		**	***	*
Methiozolin vs. control		***	***	***

^{z}Area under percent weed curve (AUPWC) was calculated by the equation: $AUPWC = \sum \{[(X_{i+1} + X_i)/2](t_{i+1} - t_i)\}$, where X_i = percent annual bluegrass coverage at the ith observation, t_i = days after treatment at the ith observation, and n = number of total observations.
^{y}Methiozolin was applied sequentially at 0.25 kg ha^{-1} weekly for 8 applications, 0.50 kg ha^{-1} biweekly for 4 applications, 0.75 kg ha^{-1} biweekly for 3 applications, 1.00 kg ha^{-1} monthly for 2 applications, and 0.50 kg ha^{-1} followed by bi-weekly 0.50, and 1.00 kg ha^{-1} beginning on 16 Sept. 2011 and 13 Sept. 2012 in Missouri, and 26 Sept. 2012 in Oklahoma.
^{x}Treatment with bensulide + oxadiazon was not applied in the Missouri 2011 study.
^{w}NS,*, **, and *** represent not significant, significant at *P*=0.05, 0.01, or 0.001, respectively.