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Evaluation of goosegrass response to combinations of topramezone and chlorothalonil

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Abstract

Few herbicides are registered for goosegrass control in creeping bentgrass turfgrass. Topramezone controls goosegrass and is labeled for use on creeping bentgrass, but potential injury risks lead many turf managers to frequently apply it at a low-dose. This application practice increases the likelihood that topramezone treatments will be mixed with fungicide treatments. Previous research found that fungicides can reduce the activity of some herbicides, but their effects on topramezone efficacy are unknown. Four studies were established between Blacksburg, VA, and North Brunswick, NJ, in 2021 to determine whether chlorothalonil reduces goosegrass control from topramezone. In controlled environment dose-response studies the amount of topramezone needed to reduce goosegrass biomass by 50% increased from 3.04 g ha^{-1} to 5.27 g ha^{-1} when chlorothalonil (7,400 g ha^{-1}) was added to the mixture. In field experiments, topramezone at 3.7 and 6.1 g ha^{-1} controlled goosegrass by 50% and 63%, respectively, at 42 d after treatment when averaged across herbicide admixtures. The addition of chlorothalonil alone and chlorothalonil plus acibenzolar-S-methyl to topramezone reduced goosegrass control from 73% to 52% and 45%, respectively, when averaged across topramezone rate. From these studies we can conclude that chlorothalonil has the potential to reduce goosegrass control when topramezone is applied at the maximum allowable rate (6 g ae ha^{-1}) or less. This is the first report of fungicides acting to reduce herbicidal weed control efficacy in turfgrass systems.

Introduction

Increasing incidences of goosegrass populations that are resistant to preemergence herbicides (Breeden et al. 2017; McCullough et al. 2013; McElroy et al. 2017) have forced turfgrass managers to rely on postemergence (POST) herbicides to control goosegrass within creeping bentgrass turf. Options for POST control of goosegrass in creeping bentgrass are limited. Fenoxaprop can effectively control goosegrass within creeping bentgrass, but only if it is applied multiple times to 2-leaf-stage goosegrass at the maximum labeled application rate of 18 g ha^{-1}(Leibhart et al. 2014). Speedzone® (PBI-Gordon Corporation, Shawnee, KS) a broadleaf herbicide containing carfentrazone, dicamba, 2,4-D, and methylchlorophenoxypropionic acid (MCPP), can control goosegrass, but label-mandated 4-wk reapplication intervals often lead to variable results (Carroll et al. 2021; Leibhart et al. 2014).

Topramezone is a herbicide that inhibits 4-hydroxphenylpyruvate dioxygenase (HPPD; categorized as a Group 27 herbicide by the Weed Science Society of America) that can control mature goosegrass in cool-season turf (Cox et al. 2017), but it has the potential to injure creeping bentgrass turf at labeled rates (Brewer 2017; Elmore et al. 2015). Due to this potential for injury, turfgrass managers have employed a variety of methods to mitigate creeping bentgrass injury from topramezone, including frequent low-dose applications. Frequent, low-dose applications of topramezone can effectively control goosegrass without unacceptably injuring creeping bentgrass (Brewer and Askew 2021), but frequent topramezone applications increase the likelihood that herbicide treatments will be mixed with other agrochemicals for practicality.

Turf managers often mix multiple agrochemicals in a single tank to reduce application costs and compaction caused by spray equipment. Chemical admixtures can alter herbicide uptake, translocation, or metabolism due to changes in plant biochemistry (Akobundu et al. 1975), and chemical admixtures have been exploited to decrease turf injury by topramezone (Boyd et al., 2021; Brewer et al. 2021). Bermudagrass (*Cynodon dactylon* L. Pers.) phytotoxicity was reduced when chelated iron (Boyd et al. 2021) was mixed with topramezone. An admixture of metribuzin improved bermudagrass response to topramezone by reducing white discoloration and enabling lower topramezone rates to achieve goosegrass control (Brewer et al. 2021). The addition of quinclorac alone, or triclopyr, 2,4-D + dicamba + MCPP + carfentrazone can also reduce bermudagrass bleaching associated with topramezone (Brewer et al. 2016; Carroll et al. 2021; Cox et al. 2017). Creeping bentgrass turf was injured less when topramezone was mixed with the herbicide safener cloquintocet-mexyl (Elmore et al. 2015). Furthermore, iron chelates, paclobutrazol, and turf pigment admixtures improve creeping bentgrass response to topramezone (Goncalves 2019). Although chemical admixtures have been well documented to influence plant responses to topramezone, previous studies have not evaluated the interaction of topramezone with fungicides.

Due to their frequency of use on highly managed turf, fungicides will likely be mixed with or applied within a few days after herbicide applications. Although fungicide effects on topramezone weed control efficacy have not been reported, previous research has evaluated combinations of other herbicides with fungicides in cropping systems. Lancaster et al. (2005a) found that azoxystrobin, boscalid, pyraclostrobin, and chlorothalonil can reduce large crabgrass (*Digitaria sanguinalis* L. Scop.) control when mixed with clethodim or sethoxydim on peanut crops. Lancaster et al. (2007) also discovered that pyraclostrobin and chlorothalonil reduced common ragweed (*Ambrosia artemisiifolia* L.) control when diclosulam was used, but chlorothalonil did not affect tall morningglory (*Ipomoea purpurea* L.) control when 2,4-DB was applied (Lancaster et al. 2005b). In contrast, a variety of fungicides did not influence glyphosate efficacy on several weeds (Gricher and Prostko 2009) or yellow nutsedge (*Cyperus esculentus* L.) control with imazapic (Jordan et al. 2009).

Previous research suggest that fungicides could alter herbicidal performance in turfgrass systems, such as occurs with pinoxaden in St. Augustinegrass [*Stenotaphrum secundatum* (Walter) Kuntze] (Peppers et al. 2020). We hypothesize that the same could be true when mixtures of topramezone and chlorothalonil are applied for goosegrass and disease control. Since chlorothalonil is the most commonly used fungicide on turfgrass (US EPA 2017) and is marketed in multiple formulations, we conducted studies to examine goosegrass control with topramezone when mixed with two commonly used formulations of chlorothalonil in turfgrass systems. These studies are the first to examine how fungicide admixtures influence weed control by topramezone, and also the first to compare the influence of two fungicide formulations on herbicidal efficacy. Our first objective was to determine how chlorothalonil admixtures alter goosegrass control and biomass in response to five topramezone doses. Our second objective was to evaluate goosegrass control in cool-season turf by topramezone alone or mixed with two chlorothalonil formulations.

Materials and Methods

Rate Response of Goosegrass to Topramezone Alone and in Combination with Chlorothalonil

Two greenhouse trials were initiated between February and March 2021 at the Glade Road Research Facility in Blacksburg, VA (37.23° N, 80.44°W) to evaluate goosegrass response to five rates of topramezone (Pylex®; BASF Corporation, Research Triangle Park, NC) applied alone and in conjunction with chlorothalonil (Daconil Weatherstik®; Syngenta Crop Protection LLC). Both trials were arranged in a randomized complete block design with four replications each. Treatments were arranged in a five-by-two factorial arrangement with five levels of topramezone rate and two levels of chlorothalonil (included or not included). The five rates of topramezone examined were 0, 1, 2, 4, and 6 g ae ha^{-1}, and a single rate of chlorothalonil (7,400 g ai ha^{-1}) was examined with all rates of topramezone. Rates examined in this study were relatively low compared with typical label-recommended rates in order to simulate a low-dose, frequent application protocol that is commonly used against creeping bentgrass turf. All treatments were reapplied 3 wk after the initial applications. The goosegrass was between the 5- to 8-tiller growth stage at the time of application. Herbicides were applied with a CO_2-pressurized spray chamber calibrated to deliver 280 L ha^{-1} at 289 kPa and fitted with a single TeeJet 8002 (Spraying Systems, Glendale Heights, IL) even flat-fan nozzle. All topramezone-containing treatments were applied with 0.5% v/v of methylated seed oil (MSO) (Dyne-Amic®; Helena Chemical Company, Collierville, TN). Goosegrass percent visual control was evaluated 3 wk following the second application. Aboveground goosegrass biomass was collected at the same time as control data were collected. Plant material was dried for 1 wk and then weighed.

Data were subjected to ANOVA with the GLM procedure using SAS software (version 9.2; SAS Institute Inc, Cary, NC) with sums of squares partitioned to evaluate main effects and all possible interactions of topramezone dose, chlorothalonil admixture, and trial, and also the effect of replicate on visible goosegrass injury and dry weight. Significant topramezone dose responses were subjected to nonlinear regressions using SigmaPlot (version 14.0; Systat Software, San Jose, CA). Visually estimated goosegrass control data were fitted to a three-parameter sigmoidal model equation (Equation 1):

$$f = a/\{1 + \exp[-(x - x_0)/b]\} \quad [1]$$

where f represents the percent visible injury relative to the nontreated control, x represents the topramezone rate, and a, b, and x_0 represent the regression parameters. This equation was used to calculate the rate at which 50% (C_{50}) goosegrass control was observed with topramezone alone and in combination with chlorothalonil relative to the nontreated check. Dry weight data were fit to a two-parameter exponential decay model (Equation 2):

$$f = a \times \exp(-b \times x) \quad [2]$$

where f represents weight as a percent of the nontreated control, x represents the topramezone rate, and a and b represent the regression parameters. This equation was used to calculate the rate at which 50% (WR_{50}) reduction in dry weight was observed with topramezone alone and in combination with chlorothalonil relative to that of the nontreated check. Resulting C_{50} and WR_{50} values were subjected to ANOVA, and means were separated with Fisher's protected LSD test at $P \leq 0.05$.

Response of Goosegrass to Topramezone Alone and in Combination with Two Formulations of Chlorothalonil

Field trials were initiated in the summer of 2021 at the Virginia Tech Golf Course (VT) in Blacksburg, VA, and at the Rutgers Hort Farm 2 (RU) in North Brunswick, NJ (40.47°N, 74.42°W) to evaluate goosegrass control with two rates of topramezone alone and in combination with two formulations of chlorothalonil. Treatments were arranged in a randomized complete block, factorial design with all combinations of two levels of topramezone and three levels of fungicide admixture. A nontreated control comparison was also included. The two levels of topramezone were

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3.7 and 6.1 g ae ha^{-1}. All topramezone-containing treatments were applied with MSO at 0.5% v/v. The three levels of fungicide were no chlorothalonil admixture, chlorothalonil alone, and chlorothalonil plus acibenzolar-S-methyl (S-methyl 1,2,3-benzothiadiazole-7-carbothioate; Daconil Action; Syngenta Crop Protection LLC). The chlorothalonil rate was 7,400 g ai ha^{-1} for both formulations, and the acibenzolar-S-methyl rate was 14 g ai ha^{-1}. All treatments were reapplied as needed to achieve acceptable (>80%) goosegrass control with topramezone alone applied at 6.1 g ae ha^{-1}. Treatments were reapplied 2 wk after the initial application at VT only because substantial control had been achieved from a single application at RU. The study conducted at VT was established on a fairway that consists of a mixture of creeping bentgrass and perennial ryegrass turf maintained at a 1.5-cm height of cut. At the start of this trial, goosegrass coverage averaged 25% to 35% across plots and had between 3 and 5 tillers at the initial application timing. The study conducted at RU was established on perennial ryegrass maintained at a 4-cm height of cut; goosegrass cover averaged 20% to 30% across plots. The RU trial was initiated on July 20, 2021. The VT trial was initiated on July 21, 2021, and treatments were reapplied on August 6, 2021. Prodiamine (Barricade 4FL; Syngenta Crop Protection LLC) was applied to all plots following the second application to reduce rating error associated with newly germinated plants that were not exposed to the POST applications. Prodiamine was applied at 1,261 g ai ha^{-1} to all plots on August 7, 2021. Goosegrass control was assessed visually at 7, 14, and 21 d after the initial application (DAIT). Control was assessed as a percentage where 0% equaled no control and 100% equaled full goosegrass control. At 42 DAIT, percent goosegrass coverage was evaluated using line-intersect counts that included 70 intersects at 6.35-cm (2.5-inch) increments within the treated portion of each plot. Each intersect was rated as containing goosegrass or not containing goosegrass. Goosegrass control was determined from the line-intersect counts by comparing goosegrass coverage in the nontreated check in each replication versus the coverage in each treated plot. Goosegrass control data were subjected to ANOVA with sums of squares partitioned to evaluate the interactions of trial location, topramezone rate and fungicide admixture.

Results and Discussion

Rate Response of Goosegrass to Topramezone Alone and in Combination with Chlorothalonil

The interaction of topramezone dose and chlorothalonil admixture was significant ($P < 0.05$) for goosegrass C_{50} and WR_{50} and not dependent on trial ($P > 0.05$). The resulting C_{50} and WR_{50} values were significantly influenced by chlorothalonil admixture ($P < 0.05$). Regression analysis indicates that lower rates of topramezone that cause no more than 30% control are minimally influenced by chlorothalonil admixture (Figure 1). Chlorothalonil reductions in goosegrass control were measurable when topramezone was applied at higher dosages (Figure 1), which significantly altered C_{50} values (Table 1). Topramezone applied at 3.68 g ae ha^{-1}alone controlled goosegrass by 50%, and an additional 28% more topramezone was needed to match this control level when chlorothalonil was added. Higher rates of topramezone were required to achieve aboveground biomass reduction when applied in conjunction with chlorothalonil (Figure 2). Goosegrass biomass was reduced by 50% with 3.04 g ae ha^{-1} topramezone alone, but 5.27 g ae ha^{-1} topramezone, or 73% more, was needed to match this biomass reduction level when chlorothalonil was added. These results suggest that chlorothalonil has minimal impact on the short-term visible goosegrass phytotoxicity caused by topramezone, but it reduces the overall impact to growth and subsequent mortality of goosegrass. Findings from the dose-response studies aligned with our initial hypothesis that the addition of chlorothalonil reduces topramezone herbicidal activity on goosegrass and suggested that additional field studies were warranted.

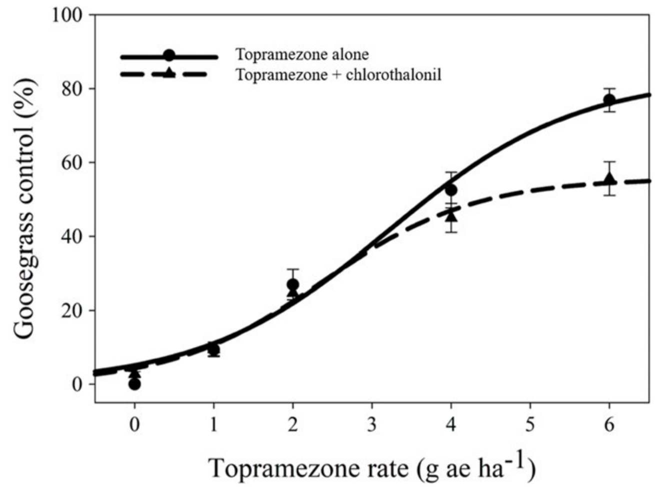

Figure 1. Percent visual control response relative to the nontreated control of goosegrass 28 d after treatment with increasing rates of topramezone alone or in combination with chlorothalonil applied at 7,400 g ai ha^{-1} in a greenhouse experiment conducted in Blacksburg, VA. Responses were modeled using a three-parameter sigmoidal model using the equation: $f = a/\{1+\exp[-(x-x_0)/b]\}$. Means are expressed using differing symbols for topramezone alone versus topramezone plus chlorothalonil, and regression equation models are represented by differing line type for each treatment type. Vertical bars represent standard error ($P = 0.05$).

Response of Goosegrass to Topramezone Alone and in Combination with Two Formulations of Chlorothalonil

The interaction of chlorothalonil admixture and topramezone rate was significant ($P < 0.0001$) and not dependent on trial location ($P > 0.56$) at 14 and 42 DAIT. Therefore, goosegrass-control data were pooled across locations at these rating timings. Goosegrass control from topramezone alone at 6.1 g ae ha^{-1} was 80% and 82% at VT and RU, respectively (data not shown). Thus, the level of goosegrass control was similar between sites despite treatments being applied twice at VT and only once at RU. The need for a second treatment at VT and not RU may be due to an average rainfall of 24 mm wk^{-1} at VT compared with 53 mm wk^{-1} at RU (data not shown) and lack of irrigation at VT. Limited water likely reduced topramezone activity at the VT location based on the results reported by Shekoofa et al. (2020).

At 14 and 42 DAIT, topramezone applied at 6.1 g ae ha^{-1} controlled goosegrass by 13% greater than topramezone applied at 3.7 g ae ha^{-1} when averaged across admixture levels (Table 2). Chlorothalonil and chlorothalonil plus acibenzolar-S-methyl significantly reduced goosegrass control by topramezone regardless of rate or assessment date. Chlorothalonil and chlorothalonil plus acibenzolar-S-methyl significantly reduced goosegrass control by topramezone regardless of rate or assessment date, relative to topramezone applied alone. At 14 DAIT chlorothalonil alone and chlorothalonil plus acibenzolar-S-methyl reduced goosegrass control with topramezone alone from 64% to 48% and 44%,

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Table 1. Predictive model for percent goosegrass visual control and goosegrass biomass, in response to topramezone applied alone or in combination with chlorothalonil.[a]

Response variable	Treatment[b]	Equation	R^2	Parameter estimates and confidence range[c]			50% reduction values[d]	
				a	b	x_0	C_{50}	WR_{50}
Control		$f = a/\{1+\exp[-(x-x_0)/b]\}$						
	Topramezone alone	$f = 83.2/\{1+\exp[-(x-3.21)/1.2]\}$	.90	83.2 (13.7)	1.2 (0.35)	3.2 (0.6)	3.68	–
	Topramezone + chlorothalonil	$f = 55.7/\{1+\exp[-(x-2.4)/1.0]\}$	.86	55.7 (7.2)	1.0 (0.35)	2.4 (0.5)	4.70	–
Biomass		$f = a^*\exp(-b^*x)$						
	Topramezone alone	$f = 102.7^*\exp(-0.19^*x)$	.74	102.7 (9.0)	0.19 (0.45)	–	–	3.04
	Topramezone + chlorothalonil	$f = 102.9^*\exp(-0.12^*x)$	.60	102.9 (8.8)	0.12 (0.35)	–	–	5.27
	LSD (0.05)						**0.91**	**1.17**

[a]Greenhouse experiments were conducted in Blacksburg, VA. Percent goosegrass coverage was modeled using a three-parameter sigmoidal model equation: $f = a/\{1+\exp[-(x-x_0)/b]\}$ in which f represents the percent goosegrass visual control relative to the nontreated control, x represents topramezone rate in g ae ha^{-1} and a, b, and x_0 represent the regression parameters. Goosegrass biomass was modeled using a two-parameter exponential decay model equation: $f = a^*\exp(-b^*x)$ in which f represents goosegrass biomass as a percent of the nontreated, x represents topramezone rate in g ae ha^{-1} and a and b represent the regression parameters.
[b]All treatments included methylated seed oil at 0.5% v/v.
[c]Parameter estimates and parameter estimate 95% confidence intervals (CI) are presented as a means of model comparison. The confidence range is the ± range of the 95% CI and is presented in parentheses.
[d]Estimated rate (g ae ha^{-1}) of topramezone required to control goosegrass 50% (C_{50}) and reduce the dry above-ground biomass of goosegrass 50% (WR_{50}) are presented based on visual control ratings and aboveground biomass collected 28 and 42 d after treatment, respectively. C_{50} and WR_{50} values are expressed as g ae ha^{-1}.

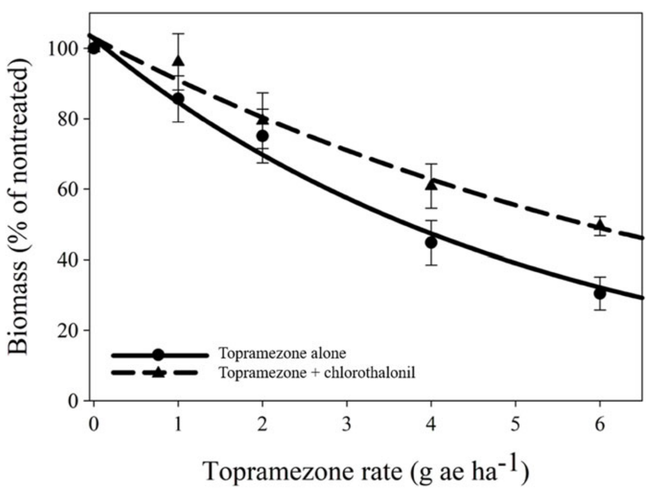

Figure 2. Aboveground biomass, presented as a percent of the nontreated, 42 days after treatment with increasing rates of topramezone alone or in combination with chlorothalonil applied at 7,400 g ai ha^{-1} in a greenhouse experiment conducted in Blacksburg, VA. Responses were modelled using a two-parameter exponential decay model with the equation: $f = a^*\exp(-b^*x)$. Means are expressed using differing symbols for topramezone alone versus topramezone plus chlorothalonil and regression equation models are represented by differing line type for each treatment type. Vertical bars represent standard error (P = 0.05).

respectively. Similarly, at 42 DAIT, both chlorothalonil-containing admixtures reduced goosegrass control by 21% to 28% compared to topramezone applied alone.

These data indicate that the addition of either formulation of chlorothalonil reduces goosegrass control with topramezone. This is the first report of topramezone antagonism in turfgrass systems. However, topramezone antagonism has been observed in production agriculture. For example, glyphosate antagonized topramezone when applied to glyphosate-resistant giant ragweed (*Ambrosia trifida* L.) in Indiana (Harre et al. 2018). The contact herbicides saflufenacil and propanil antagonized topramezone control of barnyardgrass (*Echinochloa crus-galli* L. Beauv.) in rice (*Oryza sativa* L.) production (Moore 2019). Furthermore, HPPD-inhibiting herbicide efficacy is often reduced when applied in conjunction with herbicides that inhibit acetolactate synthase (Kaastra et al. 2008).

Although the mechanism for reduction in topramezone goosegrass control by chlorothalonil-containing products cannot be ascertained through this research, Lancaster et al. (2005a) found that chlorothalonil reduces sethoxydim and clethodim absorption by approximately 14% when applied in mixture. A similar reduction in topramezone absorption would be expected to reduce goosegrass control based on rate responses in other studies (Brewer et al. 2021). However, researchers have not evaluated topramezone absorption when applied with chlorothalonil. Additionally, the inclusion of MSO with chlorothalonil-containing products may slightly injure goosegrass due to cumulative surfactant load from adding formulated fungicides with MSO. The labels for both formulations of chlorothalonil evaluated in these studies discourage surfactant admixtures to reduce turf injury potential (Anonymous 2018, 2022). Robinson et al. (2013) observed transient injury in wheat (*Triticum aestivum* L.) when tebuconazole was applied with herbicides such as 2,4-D and bromoxynil. Transient injury was observed when chlorothalonil was applied with pinoxaden and MSO to St. Augustinegrass (Peppers et al. 2020). The description of this transient injury in both wheat and St. Augustinegrass is consistent with that caused by surfactants; however, data that would support this claim was not collected in either study. In the current study, injury associated with additional surfactant load that accompanied chlorothalonil formulations is plausible but was not observed at the prescribed rating dates.

The results of the greenhouse rate-response screen suggest that when applied in conjunction with chlorothalonil, topramezone will not control goosegrass by >80% unless it is applied at above-labeled rates to creeping bentgrass turf. For sethoxydim and clethodim, increased herbicide rates overcame the reduction in large crabgrass control by combining chlorothalonil with these herbicides (Lancaster et al. 2005a). In this study, the maximum topramezone application rate in creeping bentgrass was evaluated (6.1 g ae ha^{-1}) and was not sufficient to alleviate the antagonistic effects that chlorothalonil has on goosegrass control with topramezone. However, the reduction in goosegrass control may be potentially overcome by increasing the total number of topramezone applications. Previous studies indicate that multiple topramezone applications are typically needed to control goosegrass (Brewer et al. 2021; Cox et al. 2017). When topramezone and chlorothalonil applications coincide, applying additional topramezone to overcome the reduced goosegrass

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Table 2. Influence of herbicide admixture and topramezone rate on goosegrass (*Eleusine indica* L. Gaertn.) control at 14 and 42 d after the initial treatment.[a,b]

Main effect	Treatment	Goosegrass control[c]	
		14 DAIT	42 DAIT
Herbicide admixture[d]		%	
	Topramezone	64	73
	Topramezone + chlorothalonil	48	52
	Topramezone + chlorothalonil + acibenzolar-S-methyl	44	45
	LSD (0.05)	5.2	11.9
Topramezone rate[e]			
	3.7	45	50
	6.1	58	63
	LSD (0.05)	4.3	9.7

[a]Abbreviation: DAIT, days after initial treatment; LSD, least significant difference.
[b]Data are displayed as a percent control where 0% equals no goosegrass control and 100% equals complete goosegrass control.
[c]Control data presented for 14 DAIT are visual control ratings, while control data presented for 42 DAIT are derived from line-intersect goosegrass counts.
[d]All treatments included methylated seed oil at 0.5% v/v.
[e]Topramezone rate is expressed as g ae ha^{-1}.

control caused by mixing the two products may be more economical than the labor and fuel involved with applying topramezone and chlorothalonil separately. The economics involved will be subject to the turf management employed, regional labor and fuel costs, and available time for management inputs. An extensive survey conducted by the Golf Course Superintendents Association of America found that labor, fungicide, and herbicide account for 55%, 4%, and 2%, respectively, of the average golf course annual budget (GCSAA 2018). It would be reasonable to assume that the additional labor cost of applying herbicides and fungicides separately may offset any potential gains in weed control efficacy compared to the mixture. Based on the results from these studies, we can conclude that adding chlorothalonil reduces goosegrass control with topramezone when applied at rates of 6 g ae ha^{-1} or lower. Practitioners who frequently apply topramezone at rates of 6 g ae ha^{-1} should take precautions to apply it alone and not in conjunction with chlorothalonil, or they should be aware of the economic value of mixing the products and how that compares to the number of topramezone treatments needed for acceptable weed control. Since many golf courses regularly apply chlorothalonil, future research should determine whether applying topramezone in sequence with chlorothalonil will control weeds more effectively than the mixture. If so, at what interval should the two be separated? Likewise, assessing how chlorothalonil impacts topramezone absorption and translocation may help design treatment programs to mitigate issues with reduced goosegrass control caused by the admixture.

Practical Implications

Goosegrass control options in creeping bentgrass turfgrass are limited, especially with increasing instances of goosegrass resistance to preemergence herbicides. Topramezone can effectively control goosegrass, but topramezone injures creeping bentgrass when applied at one-third the maximum rate allowed in other cool-season grasses. This has led many end-users to employ a frequent, low-dose topramezone application protocol to control goosegrass throughout the growing season. Increases in application frequency cause more potential overlap between pest control treatments. Chlorothalonil application timings are likely to coincide with frequent applications of topramezone. Previous research has indicated that admixtures of chlorothalonil may reduce herbicidal efficacy of a wide variety of herbicides. Greenhouse and field studies indicate that chlorothalonil reduces goosegrass control when used with topramezone regardless of formulation. These data will serve to inform turfgrass managers and extension specialists about the detrimental effects of these combinations. The topramezone label would be improved by adding a cautionary statement regarding negative interactions caused by chlorothalonil admixtures.

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