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Selective Control of Bentgrass in 'True Putt' Creeping Bluegrass[1]

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Abstract

The ability to selectively control a specific cool-season grass growing in a mixed stand would offer great advantages to turfgrass managers. It is common for monostands of creeping bentgrass (*Agrostis stolonifera*) to become infested with annual bluegrass (*Poa annua*). Conversely, monostands of 'True Putt' creeping bluegrass (*Poa annua* var. *reptans*), a commercially available perennial biotype of *Poa annua*, often develop bentgrass infestations. The objective of this study was to evaluate the efficacy of various herbicides for the selective control of bentgrass with minimal injury to True Putt. Nine herbicide treatments were applied to 248 cm^2 (38.4 in^2) plugs maintained at 1.3 cm (0.51 in) in the greenhouse. The experiment was conducted twice during the winter of 2001–2002. Several ratings were made over the four week period on quality of bentgrass and creeping bluegrass and on reduction of bentgrass cover. Vantage, Image, Assure II, Fusilade II, Finale, and Balance Pro gave a minimum of 65% control with Vantage, Assure II, Fusilade II, and Finale achieving 100% control. However, Vantage was the only herbicide that provided complete control of bentgrass while causing no significant reduction in the quality of True Putt creeping bluegrass. Assure II and Fusilade II also provided complete control of bentgrass, but both had a negative impact on the quality of True Putt.

Index words: turf quality, post emergence herbicides, *Poa annua*.

Chemicals used in this study: Assure II (Quizalofop P-ethyl), Ethyl(R)-2-[4-(6-chloroquinoxalin-2-yloxy)-phenoxy]propionate; Balance Pro (Isoxaflutole), 5-cyclopropyl-4-(2-methylsulfonyl-4-trifluoromethylbenzoyl) isoxazole; Finale (Glufosinate ammonium), Butanoic acid, 2-amino-4-(hydroxymethylphosphinyl)-, monoammonium salt; Fusilade II (Fluazifop-P-butyl), Butyl(R)-2-[4-[[5-(trifluoromethyl)-2-pyridyl]oxy]phenoxy]propanoate; Image (Imazaquin) 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-3-quinolinecarboxylic acid; Kerb (Pronamide), 3,5-dichloro-N-(1,1-dimethyl-2-propynyl)-benzamide; L-tyrosine; Vantage (Sethoxydim), 2-[1-(ethoxyimino)butyl]-5-[2-(ethylthio)propyl]-3-hydroxy-2-cyclohexen-1-one; Roundup Pro (Glyphosate), Isopropylamine salt of N-(phosphonomethyl)glycine.

Significance to the Nursery Industry

Creeping bluegrass is a recently developed cool-season turfgrass for which little management information has been published. It is well adapted to shaded, damp areas, and compacted soils. It has been planted on lawns, golf courses and athletic fields but little is known about weed management in this turfgrass. The ability to selectively eliminate creeping bentgrass growing with creeping bluegrass would aid turf managers in maintaining a uniform turfgrass surface. This study evaluated herbicides for the potential to selectively eliminate bentgrass. Vantage provided excellent bentgrass control with no adverse affect on True Putt creeping bluegrass. Assure II and Fusilade II also gave good control, but caused some phytotoxicity to True Putt. These results indicate that additional studies are needed with the herbicides used in this experiment. These products will kill or severely injure most cool-season grasses and it is important to follow labeled instructions for every chemical.

Introduction

Poa annua L. is a cool-season grass that originated on the European continent (14). It is an opportunistic species that has successfully encircled the earth, expanding its range to all continents of the world and nearly all climatic conditions (6, 12, 15). It is particularly well adapted to extremely low heights of cut (3–4 mm), compacted soil, and shade which are common in highly maintained turf sites. Because of these adaptations, *P. annua* has become a cultivated weed on many fine turf areas comprising a substantial component of the turf sward.

Poa annua is a unique species with biotypes that cover the life cycle continuum from true annual, *Poa annua* var. *annua* Hausskn., to long-lived perennial, *Poa annua* var. *reptans* Hausskn. (13). Recent interest in developing improved cultivars of *P. annua* var. *reptans*, has created the need for a common name (creeping bluegrass) for the perennial types (1) to help alleviate confusion with the annual types, still called annual bluegrass. Creeping bluegrass, unlike its annual counterpart, is perennial, produces stolons, and generally has a limited flowering period, thus often producing a desirable turfgrass surface (10).

The development of improved cultivars of creeping bluegrass has also created the need to investigate the management issues for this new grass. One issue of importance is weed control, especially perennial grass control. The ability to selectively control one cool-season perennial grass growing in a mixed stand has many advantages; however, this kind of selective control is seldom possible.

The most common invader of creeping bentgrass is *P. annua*. Numerous studies have employed herbicides, plant growth regulators, and biological organisms for controlling *P. annua*, but most have shown little long-term effectiveness (9, 16). Similar to the infestations of *P. annua* in monostands of bentgrass, monostands of True Putt creeping bluegrass often develop bentgrass infestations. Large differences in growth habit and appearance, and the propensity for the invading species to form patches, results in unwanted variation in the turf surface. In order to maintain a uniform turfgrass

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Table 1. Herbicides evaluated for selective control of creeping bentgrass in True Putt creeping bluegrass under greenhouse conditions.

Trade name	Common name	Rate	
		kg ai/ha	(lb ai/A)
Vantage	Sethoxydim[y]	0.32	(0.28)
Kerb	Pronamide	1.14	(1.02)
Image	Imazaquin[z]	0.49	(0.438)
Assure II	Quizalofop P-ethyl[y]	0.08	(0.07)
Fusilade II	Fluazifop P-butyl[y]	0.21	(0.19)
Roundup Pro	Glyphosate	0.03	(0.03)
Roundup Pro	Glyphosate	0.03	(0.03)
+ L-tyrosine	+ L-tyrosine	0.31	(0.28)
Finale	Glufosinate-ammonium	0.84	(0.75)
Balance Pro	Isoxaflutole	0.11	(0.09)

[z]Crop oil included at 1% v/v.

[y]Crop oil included at 0.25% v/v.

surface, it would be advantageous to selectively eliminate the bentgrass.

The objective of this study was to evaluate the efficacy of various herbicides for the selective control of bentgrass while minimizing the injury to True Putt creeping bluegrass.

Materials and Methods

In October 2001, 248 cm^2 (38.4 in^2) plugs were collected from a True Putt creeping bluegrass putting green located at the University of Minnesota Agricultural Experiment Station, St. Paul, MN. Approximately half of each plug consisted of wild creeping bentgrass. The plugs were placed in 420 cm^3 (25.6 in^3) pots on a pure sand rootzone in the greenhouse with 16-h days (75 µmol/m^2/s plus ambient sunlight) at 21 ± 2C (70F) and 8 h nights at 18 ± 2C (65F) for 8 wks prior to initiating treatments. The grass was clipped three times a week at 1.3 cm (0.5 in) and clippings were removed. Irrigation was applied daily and liquid fertilizer applied weekly with 400 ppm N, P_2O_5, and K_2O. On November 26, 2001, herbicide treatments (Table 1) were applied in a spray chamber using an air pressurized sprayer calibrated to deliver 191 liters/ha (20 gal/A) at 276 kPa (40 psi). Treatments were arranged in a randomized complete block design with three replications.

The experiment was repeated on January 16, 2002. The turf was evaluated pre-treatment and post-treatment at 3 d, 7 d and then weekly for 4 wks after treatment. Turf was visually rated for turf quality (0–9, 0 = dead or brown, 6 = lowest acceptable, 9 = optimum) and percent living cover (0–100%) for both species.

Data were subjected to analysis of variance using the statistical analysis functions within the Agriculture Research Manager (ARM) version 6.1.8 software package (4). Data from each experiment were evaluated separately and significant treatment effects ($P < 0.05$) were determined through the use of a one-way ANOVA. Treatment means were separated by least significant difference (LSD) procedures.

Results and Discussion

Analysis of variance indicated significant year-by-treatment interaction. Therefore, experiments (Experiment 1, November 2001 and Experiment 2, January 2002) were analyzed and will be discussed separately.

All herbicides, with the exception of Kerb in Experiment 1 (Exp1), significantly reduced bentgrass turf quality ratings within 7 to 14 days after treatment (DAT) with the majority reducing turf quality ratings below the minimum level of acceptability (Table 2). Additionally, all treatments, with the exception of the Roundup-Pro treatments, continued to decrease quality ratings throughout the four week evaluation period and nearly all caused a significant reduction in bentgrass cover by 28 DAT (Table 4).

Nonselective herbicides. Finale, a herbicide that disrupts cell membrane integrity, was used knowing that it should work equally on both species. It significantly reduced turf quality (Tables 2 and 3) and completely eliminated both species by 14 DAT (Table 4). Finale provided complete control of both species in this study.

Roundup-Pro, an amino acid synthesis inhibitor, was applied at a rate significantly reduced from the labeled rate of 1.68 kg a.i./ha (1.5 lb a.i./A). Parups and Cordukes (11) found that this reduced rate resulted in more damage to bentgrass than *P. annua*. They also discovered that the application of the amino acid L-tyrosine one day prior to the glyphosate application reduced the impact of the glyphosate on bentgrass. We applied L-tyrosine in combination with Roundup-Pro and found no beneficial effect in Exp1 and was associated with more damage to both grasses in Experiment 2 (Exp2) than Roundup Pro alone (Tables 2 and 3). The difference between our results and Parups and Cordukes (11) could be related to timing of L-tyrosine application as they applied the amino acid one day before glyphosate, whereas we applied it in combination. Moreover, Parups and Cordukes (11) used a non-formulated glyphosate which did not contain any additives, such as a surfactant. The additives in a formulated glyphosate, such as Roundup-Pro, often aid glyphosate absorption and may negatively affect the stated benefit of an exogenous application of L-tyrosine. Although both grasses completely recovered in Exp1, the potential risk involved with using Roundup Pro for selective control, even at very low rates, was obvious in Exp2 and is not advised.

Selective postemergence grass herbicides. Vantage, Fusilade II, and Assure II are postemergence grass herbicides for which *P. annua* has been reported to possess some resistance (5). They are categorized as grass meristem destroyers and work by inhibiting lipid biosynthesis. All three herbicides negatively impacted bentgrass turf quality within 7 DAT (data not shown) and provided complete control of bentgrass 14 to 21 DAT (Table 4). Although Assure II and Fusilade II gave complete bentgrass control, both caused some phytotoxicity (Table 3) and had a growth regulator effect (data not shown) on True Putt resulting in a slight reduction of turf quality in Exp1 and a more dramatic reduction 21 to 28 DAT in Exp2 (Table 3). The greater reduction in quality in Exp2 was most likely a result of a *Xanthomonas* bacterial wilt infection which was found across all treatments and occurred between 14 and 21 DAT. Creeping bluegrass can usually tolerate the presence of *Xanthomonas* (8, 16), however the additive stress imposed on plants by the application of Assure II and Fusilade II may have contributed to increased damage (Table 3).

True Putt treated with Vantage, in contrast to Assure II and Fusilade II, maintained high quality turf throughout the experiment and showed no indications of adverse effects other

Table 2. Bentgrass turf quality ratings following herbicide applications.

	Turf quality (DAT)[z]					
	Experiment 1			Experiment 2		
Herbicides	7	14	28	7	14	28
	0 to 9					
Vantage	4.0d[y]	0.0d	0.0d	5.3d	0.3d	0.0e
Kerb	6.7ab	7.0a	2.3b	6.7bc	7.0ab	4.7c
Image	5.7bc	3.7c	1.3c	6.0bcd	3.3c	1.3d
Assure II	4.7cd	0.0d	0.0d	5.7cd	0.7d	0.0e
Fusilade II	4.3cd	0.0d	0.0d	5.7cd	0.7d	0.0e
Roundup Pro	5.3bcd	7.0a	7.7a	7.0ab	6.3b	6.3b
Roundup Pro+L-tyrosine	5.3bcd	5.3b	8.0a	5.7cd	4.7c	4.3c
Finale	0.0e	0.0d	0.0d	2.0e	0.0d	0.0e
Blance Pro	5.3bcd	3.0c	1.0c	7.0ab	4.0c	2.0d
Control	7.7a	8.0a	8.0a	8.0a	8.0a	8.0a

[z]Turf quality was rated on a 0 to 9 scale with 0 = dead, 6 = acceptable and 9 = optimum.

[y]Treatment means were separated by LSD procedures. Means followed by the same letter do not significantly differ (p = 0.05).

Table 3. True Putt creeping bluegrass turf quality ratings following herbicide applications.

	Turf quality (DAT)[z]					
	Experiment 1			Experiment 2		
Herbicides	7	14	28	7	14	28
	0 to 9					
Vantage	7.0b[y]	7.7b	8.0a	8.0a	7.7ab	8.0a
Kerb	8.0a	7.3abc	3.7d	8.0a	7.0ab	4.3c
Image	6.7b	5.0d	5.3c	7.3a	6.7ab	6.0b
Assure II	7.3ab	6.3c	7.7a	7.3a	6.7ab	3.0c
Fusilade II	7.3ab	7.7ab	6.3b	7.7a	6.7ab	4.3c
Roundup Pro	7.3ab	7.3abc	8.0a	7.3a	6.3b	6.3b
Roundup Pro+L-tyrosine	7.0b	6.7bc	8.0a	7.0a	4.7c	3.7c
Finale	1.0c	0.0e	0.0e	2.7b	0.0d	0.0d
Blance Pro	7.3ab	7.0ab	8.0a	8.0a	8.0a	8.0a
Control	8.0a	8.0a	8.0a	8.0a	8.0a	8.0a

[z]Turf quality was rated on a 0 to 9 scale with 0 = dead, 6 = acceptable and 9 = optimum.

[y]Treatment means were separated by LSD procedures. Means followed by the same letter do not significantly differ (p = 0.05).

Table 4. Reduction in creeping bentgrass cover following the herbicide applications.

	Bentgrass reduction (DAT)[z]					
	Experiment 1			Experiment 2		
Herbicides	7	14	28	7	14	28
	%					
Vantage	44b	100a	100a	32b	95a	100a
Kerb	18cd	18b	39c	8bc	15de	26d
Image	13d	21b	83b	20bc	38bc	72b
Assure II	40bc	100a	100a	22bc	83a	100a
Fusilade II	44b	100a	100a	25bc	93a	100a
Roundup Pro	36bcd	17b	10d	23bc	27bcd	5e
Roundup Pro+L-tyrosine	26bcd	15b	7d	34b	45b	45c
Finale	100a	100a	100a	70a	100a	100a
Blance Pro	26bcd	31b	91ab	0c	20cde	66b
Control	13d	13b	17d	0b	0e	0e

[z]Treatment means were separated by LSD procedures. Means followed by the same letter do not significantly differ (p = 0.05).

than a subtle dip in turf quality at 7 DAT in Exp1 (Table 3). There was no growth regulator effect observed and no loss of turf quality or reduction in cover due to the *Xanthamonas* infection. The lack of bacterial wilt damage was further indication that Vantage caused no injury that could make True Putt more vulnerable to pathogen attack.

Herbicides used in warm-season grasses. Kerb and Image are generally used in warm-season grasses for cool-season grass control. Both herbicides caused a significant but gradual reduction in turf quality for both species. Image had a greater impact on bentgrass than True Putt but still caused significant turf quality reductions (Tables 2 and 3). We noted the occurrence of swollen nodes present on True Putt treated with Kerb. Bartels and Hilton (2), using wheat seedlings, found that Kerb halted root cell division at metaphase; the cells enlarged radially rather than longitudinally, and the root tips became swollen and club shaped. Since nodal regions also contain actively dividing cells, the swollen nodes we observed were probably the result of an interruption of cell division. Because Kerb inhibits cell division, it provides a slow decline in turf cover (7) rather than a quick kill. This slow decline in turf quality and cover was evident for both grasses (Tables 2 to 4). Kerb and Image were detrimental to both grasses and are not recommended for selective control.

Balance Pro. Balance Pro is a carotenoid biosynthesis inhibitor used as a preemergence herbicide in corn fields. New growth on sensitive plants emerges white because of the lack of pigment production. The bentgrass was sensitive and slowly declined as new leaves emerged void of pigmentation and older leaves senesced (Table 2), whereas True Putt was unaffected and maintained a high quality throughout the experiment (Table 3). Balance Pro provided a slow removal of most of the bentgrass, but lacked complete control. Balance Pro is labeled for very limited use because of ground water contamination concerns (3) and is not currently available for use on turfgrass.

Some herbicides can provide selective bentgrass control while not harming True Putt creeping bluegrass. Vantage and Balance Pro provided excellent control of bentgrass with no reduction in the quality of True Putt. Assure II or Fusilade II may offer the dual benefit of bentgrass control and seedhead suppression, but further investigation is needed to determine optimal rates and application timing for seedhead suppression. Vantage eliminated or nearly eliminated bentgrass within two weeks of application, whereas Balance Pro required more than a month and may require a repeat application for complete control. In addition, bentgrass is likely to be more tolerant of these herbicides in the field and may need multiple applications for complete control.

These products could provide the turfgrass manager two different approaches for controlling bentgrass in True Putt. Balance Pro would allow for a slow transition while Vantage would provide quick eradication. Caution should be taken if attempting to employ any of this research. All of these products will kill or severely injure most cool season grasses and product labels should be followed.

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