CONTROLLING ROUGHSTALK BLUEGRASS IN TURFGRASS WITH BISPYRIBAC-SODIUM AND SULFOSULFURON

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ABSTRACT

Morton, Deborah Elaine, M.S., Purdue University, May, 2008. Controlling roughstalk bluegrass in turfgrass with bispyribac-sodium and sulfosulfuron. Major Professor: Zac Reicher.

Roughstalk bluegrass (*Poa trivialis* L.) is a relatively new and troublesome weed on golf courses, home lawns and athletic fields from the Midwest to the Mid-Atlantic states. Due to poor drought and heat tolerance and susceptibility to disease, roughstalk bluegrass goes dormant or dies in late summer and leaves thin or patchy turf. Cultural controls are ineffective for roughstalk bluegrass and non-selective herbicides are disruptive. Bispyribac-sodium and sulfosulfuron have recently been labeled for selective control of roughstalk bluegrass, but their use needs refined. Our objective was to determine the most effective and efficient selective control methods for roughstalk bluegrass. Studies were conducted in 2005-2007 in Indiana and neighboring states. Initial studies revealed inconsistency in herbicide response, potentially due to different cultivars or phenotypes present at each location. However, variability in herbicide response was not observed across eight cultivars in West Lafayette, IN, potentially eliminating this as a cause of variability. Our work along with others revealed that herbicides became more effective once temperatures exceeded 21° C. Sulfosulfuron at 27 g a.i. ha^{-1} applied three times on a two week interval or bispyribac-sodium at 37, 56, or 74 g a.i. ha^{-1} applied four times on a two week interval most effectively and consistently controlled roughstalk bluegrass among the treatments used in our studies.

These treatments provided adequate control up to 12 weeks after initial treatment, but regrowth occurred from surviving plants or stolons. However, this regrowth can be limited by reseeding with desired turf thereby improving long-term control of roughstalk bluegrass.

CHAPTER ONE

LITERATURE REVIEW

Overview

Roughstalk bluegrass (*Poa trivialis* L.) is a sod-forming grass of European origin (Alderson and Sharp, 1995) is a developing weed problem on golf courses, athletic fields, and home lawns from the Midwest to the Mid-Atlantic states. Roughstalk bluegrass is a shallow rooted, cool-season perennial grass that is usually light green and is adapted to mowing heights of 1.3 to 5.0 cm, and is identified by its folded vernation, membranous ligule, absent collar, boat-shaped leaf tip and fine blades (Christians, 2004). Roughstalk bluegrass has poor drought and heat tolerance, poor to fair wear tolerance, is susceptible to a number of diseases including dollar spot (Christians, 2004) and is moderately sensitive to salt (Carrow and Duncan, 1998). Therefore, roughstalk bluegrass populations thin in the late summer in the Midwestern United States which decreases aesthetic and functional turf quality.

Although roughstalk bluegrass is commonly considered a weed, it is desirable under certain circumstances. Roughstalk bluegrass is one of the few grasses that performs adequately in shade and, therefore may grow where other turf species will not. The main commercial use of roughstalk bluegrass is as an overseed species on golf course greens in the southern United States. Its high cold tolerance but poor heat tolerance makes it an ideal overseeded grass for temporary winter turf for bermudagrass (*Cynodon dactylon* L.) putting greens (Christians, 2004).

Contamination

Roughstalk bluegrass contamination in turf stands likely occurs from preexisting natural infestations or through seed contamination. When Kentucky bluegrass (*Poa pratensis* L.) was brought over from Europe years ago, it was contaminated with roughstalk bluegrass which allowed it to naturalize across the United States (Hurley, 1997). Due to its naturalization, roughstalk bluegrass can be found in many areas including pastures, home lawns, roadside ditches, and stream banks (Hurley, 1997). Therefore, it is possible that some roughstalk bluegrass contamination in golf courses, athletic fields and home lawns could be due to the spread of stolons or seed from these preexisting stands. Conversely, roughstalk bluegrass found in many fairways appears to be newer, improved varieties, which suggests seed contamination as a likely cause (Levy, 1998). In a laboratory study, 90 samples of creeping bentgrass (*Agrostis stolonifera* L.) seed were tested for purity and 30% contained roughstalk bluegrass (Levy, 1998). Although most seed companies test their creeping bentgrass seed for purity (Hurley, 1997), current testing standards may be inadequate (Levy, 1998). This is a significant problem on athletic fields where overseeding is done multiple times per year thus increasing the chances of contamination. Regardless of the source of original contamination, roughstalk bluegrass stolons are likely spread through aerification, mowing, and other cultural practices and populations are established throughout the turf stand.

Herbicide Control

The best current control of roughstalk bluegrass is the non-selective herbicide, glyphosate, followed by reseeding (Liskey, 1999). Reseeding an entire area to control this grass species takes extra time, effort, and money that would be unnecessary with a selective herbicide. However, selective controls of roughstalk bluegrass are still being developed and their use needs refined.

In the late 1980's, an Oregon study was conducted to determine if fenoxaprop could be used to selectively control roughstalk bluegrass seedlings in perennial ryegrass (*Lolium perrene* L.) seed fields. Timing of application affected herbicide performance, where applications from late winter to mid-spring provided greater control than earlier applications (Mueller-Warrant, 1990). Later spring applications enhanced control, but damage to perennial ryegrass was greater (Mueller-Warrant, 1990). However, since roughstalk bluegrass is found in creeping bentgrass stands and creeping bentgrass is extremely sensitive to fenoxaprop, this herbicide is not feasible on golf course turf.

In 1995 and 1996, spring applications of several preemergent herbicides were examined for roughstalk bluegrass control in overseeded bermudagrass greens (Johnson, 1998). Herbicides were applied in March and included trifluralin plus benefin at 2.2 kg ha^{-1}, pendimethalin at 3.4 kg ha^{-1}, dithiopyr at 0.6 kg ha^{-1}, prodiamine at 0.8 kg ha^{-1}, bensulide plus oxadiazon at 8.4 kg ha^{-1} and bensulide at 11.2 kg ha^{-1}. Roughstalk bluegrass survived all of these applications, but was injured up to 71% by oryzalin with or without oxyflouren. However, these two herbicides damage desired cool-season turf and are not practical for northern turf sites.

Bispyribac-sodium

Bispyribac-sodium is labeled for use in turfgrass as Velocity™ (Valent USA Corp., Walnut Creek, CA) herbicide for selective postemergence control of annual bluegrass (*Poa annua*) and roughstalk bluegrass in creeping bentgrass and perennial ryegrass fairways or sod farms (Anonymous, 2004). Bispyribac-sodium is an acetolactate synthase (ALS) inhibiting herbicide and belongs to the pyrimidinyl carboxy herbicide family (Shimizu et al., 2002). ALS inhibitors block formation of branched chain amino acids leucine, isoleucine and valine (Lycan and Hart, 2005a).

Three applications of bispyribac-sodium at 60 g ha^{-1} reduced annual bluegrass from 33% to less than 1% with minimal damage to the creeping bentgrass (Park et al., 2002). A two year study was conducted in two different locations in Virginia to gauge the effects of bispyribac-sodium on roughstalk bluegrass in creeping bentgrass. Damage to both roughstalk bluegrass and creeping bentgrass was monitored. Applications were made in June, August, and September at 37 g ha^{-1}. Ten weeks after initial treatment of bispyribac-sodium, three June applications reduced roughstalk bluegrass by 88%, three August applications reduced roughstalk bluegrass by 48%, and three September applications reduced roughstalk bluegrass by 11% (Askew et al., 2004). Three applications of bispyribac-sodium at 74 g ha^{-1} in June, August, and September resulted in control of 93, 95 and 31%, respectively (Askew et al., 2004). Injury to creeping bentgrass increased with bispyribac-sodium rate, but injury dissipated by eleven weeks after treatment.

Using bispyribac-sodium to control annual bluegrass in other species such as Kentucky bluegrass, tall fescue (*Festuca arundinacea* L.), perennial ryegrass and fine fescue (*Festuca spp.*), causes chlorosis and growth suppression to those grasses (Lycan and Hart, 2005a). Kentucky bluegrass was most severely stunted and chlorotic compared to the other grasses in the study (Lycan and Hart, 2005a). Therefore bispyribac-sodium is not practical to use on Kentucky bluegrass to control roughstalk bluegrass.

Although in the previous study Kentucky bluegrass was the most sensitive to bispyribac-sodium, response of Kentucky bluegrass cultivars to bispyribac-sodium is variable. Responses of 173 Kentucky bluegrass cultivars to bispyribac-sodium ranged from little or no damage to complete kill (Shortell et al., 2006). Variability in Kentucky bluegrass cultivars in response to bispyribac-sodium suggests variability in cultivars of other *Poa* species in response to bispyribac-sodium.

Since bispyribac-sodium is often phytotoxic to desired grasses, iron or nitrogen may be used to reduce phytotoxicity. Phytotoxicity to creeping bentgrass caused by bispyribac-sodium was reduced by adding iron ($FeSO_4$) at 1.1 kg ha^{-1} and nitrogen at 2.2 kg ha^{-1} to the tank mix (McDonald et al., 2006). Adding iron and nitrogen did not affect the amount of control of annual bluegrass when treated with bispyribac-sodium (McDonald et al., 2006).

Reseeding may be necessary following bispyribac-sodium applications to control grassy weeds. In 2002 and 2003, field studies were conducted to determine the length of time needed to safely reseed Kentucky bluegrass and creeping bentgrass after a bispyribac-sodium application (Lycan and Hart, 2006a). Bispyribac-sodium applied two to six weeks before seeding did not reduce Kentucky bluegrass or creeping bentgrass cover compared to the untreated control (Lycan and Hart, 2006a). However, bispyribac-sodium applied one week before seeding did reduce Kentucky bluegrass or creeping bentgrass cover compared to the untreated control (Lycan and Hart, 2006a). Therefore, reseeding should be delayed for two weeks following bispyribac-sodium applications (Lycan and Hart, 2006a).

Efficacy of bispyribac-sodium is temperature related. Field studies show that annual bluegrass has a greater sensitivity to bispyribac-sodium at warmer temperatures (20 and 30 C) than at cooler temperatures (10 C) (McCullough and Hart, 2006a). Conversely, creeping bentgrass has greater sensitivity at cooler temperatures (10 C) than at warmer temperatures (20 and 30 C) (McCullough and Hart, 2006a). Bispyribac-sodium applications made in the summer months were more effective than applications made in the spring or fall in controlling annual bluegrass (Lycan and Hart, 2006b). Summer temperatures ranged between 24 and 30 C whereas spring temperatures ranged between 14 and 21 C (Lycan and Hart, 2006b). Therefore, bispyribac-sodium applied in temperatures > 21 C is safer on creeping bentgrass and more effective on annual bluegrass compared to applications made in cooler temperatures. A 2002 to 2004 study continued these results. Bispyribac-sodium at 74 g ha^{-1} effectively reduced annual bluegrass when applied in the fall or spring providing up to 55% reduction in annual bluegrass (Hart and McCullough, 2007). However, summer applications of bispyribac-sodium at 148 g ha^{-1}

reduced annual bluegrass populations more than fall applications, suggesting that bispyribac-sodium is more effective on annual bluegrass in the summer than the fall (Hart and McCullough, 2007).

Sulfosulfuron

Sulfosulfuron is currently sold under the trade name Certainty™ (Monsanto, St. Louis, MO) and is an acetolactate synthase (ALS) inhibitor which belongs to the sulfonyl-urea family (Anonymous, 2005). Sulfosulfuron is labeled to control roughstalk bluegrass in creeping bentgrass tees and fairways (Anonymous, 2005). Warm-season grasses, such as hybrid bermudagrass, have acceptable tolerance to sulfosulfuron (Lycan and Hart, 2004). However, cool-season turfgrass species tolerance to sulfosulfuron is not well studied (Lycan and Hart, 2004).

In 2001 and 2002, a study was conducted to determine safety of sulfosulfuron on four cool-season grasses. All four grasses showed noticeable chlorosis from sulfosulfuron treatments. Kentucky bluegrass and perennial ryegrass exhibited chlorosis four weeks after initial treatment and recovered from the initial injury by eight weeks after initial treatment (Lycan and Hart, 2004). Tall fescue and fine fescue suffered severe chlorosis and reduced clipping weights with fine fescue displaying a more substantial decrease in clipping weights compared to the other grasses in the study four weeks after initial treatment (Lycan and Hart, 2004). Tall fescue was not able to recover by eight weeks after treatment (Lycan and Hart, 2004). Overall, tall fescue and fine fescue were injured the most by sulfosulfuron and Kentucky bluegrass was least injured by sulfosulfuron (Lycan and Hart, 2004). Therefore, sulfosulfuron would not be a good choice to control roughstalk bluegrass in tall fescue or fine fescue.

Reseeding may also be necessary following sulfosulfuron applications to control grassy weeds. In 2003 and 2004, field studies were conducted to determine the length of time needed to safely reseed Kentucky bluegrass, creeping bentgrass, and perennial ryegrass after a sulfosulfuron application (Lycan and Hart, 2005b). Sulfosulfuron applied two to six weeks before seeding did not reduce Kentucky bluegrass, creeping bentgrass, or perennial ryegrass cover compared to the untreated control by seven weeks after seeding (Lycan and Hart, 2005b). However, sulfosulfuron applied one week before seeding did reduce Kentucky bluegrass or creeping bentgrass cover and the reduction in cover was still noticeable seven months after seeding (Lycan and Hart, 2005b). Sulfosulfuron applied one week before seeding reduced perennial ryegrass cover compared to the untreated control plot, but it recovered by seven months after seeding (Lycan and Hart, 2005b). This study shows that sulfosulfuron applications made one week before seeding Kentucky bluegrass, creeping bentgrass, or perennial ryegrass could reduce ground cover of these species (Lycan and Hart, 2005b).

Efficacy of sulfosulfuron also appears to be temperature dependent. In 2002, 2003, and 2004, a study was conducted in New Jersey to observe efficacy of sulfosulfuron on roughstalk bluegrass, creeping bentgrass, and Kentucky bluegrass at different temperatures. Rates of sulfosulfuron included 0, 5.6, 11.2, 22.4, or 44.8 g a.i. ha^{-1} applied 15, 20, or 25°C. Roughstalk bluegrass was the most sensitive of the three species studied and chlorosis was greater at 15 and 25°C compared to 20°C (McCullough and Hart, 2006b).

Preliminary studies show that sulfosulfuron efficacy may be cultivar dependent (Reicher and Weisenberger, 2005). In 2004, fourteen samples of roughstalk bluegrass were collected from golf courses around the state of Indiana (Reicher and Weisenberger, 2005). These samples were treated with sulfosulfuron at 13 or 27 g a.i. ha^{-1} applied three times on a three week interval once established (Reicher and Weisenberger, 2005). Cultivars responded in one of three ways including decreased cover as rate of sulfosulfuron increased, decreased cover from both rates with little difference in effect between rates, or little to no response to sulfosulfuron (Reicher and Weisenberger, 2005).

Spray Additives

Herbicide efficacy can be increased through the addition of spray additives. A study was conducted to determine which spray additive increased bispyribac-sodium efficacy and rainfastness on barnyardgrass in rice. Applying bispyribac-sodium alone provided no control of barnyardgrass whereas bispyribac-sodium plus organosilicone/nonionic surfactant and urea ammonium nitrate provided the greatest control of barnyardgrass (*Echincloa crusgalli* L.) (Koger et al., 2007). This same treatment also decreased the rainfast period from 8hrs to 1hr after application of bispyribac-sodium (Koger et al., 2007).

Another study was conducted to determine which spray additives increased absorption and translocation of bispyribac-sodium in barnyardgrass. Bispyribac with no additive resulted in 4% absorption whereas the addition of urea ammonium nitrate with either organosilicone/nonionic surfactant or methylated seed oil/organosilicone resuted in 47 to 80% absorption, respectively (Dodds et al., 2007). Bispyribac-sodium applied with methylated seed oil/organosilicone with urea ammonium nitrate or methylated seed oil/organosilicone/urea ammonium nitrate resulted in the highest absorption and translocation compared to the other treatments in the study (Dodds et al., 2007).

The turf and ornamental bispyribac-sodium label does not suggest using a surfactant, but the crop use label states bispyribac-sodium applications must include a surfactant unless otherwise specified (Anonymous 2006). The question is whether or not spray additives would increase the efficacy of bispyribac-sodium on turf and not exacerbate damage to the desired turf species. A study was performed in New Jersey to determine the effects of bispyribac-sodium with the addition of a non-ionic surfactant or methylated seed oil on annual bluegrass in creeping bentgrass (McCullough and Hart, 2007). Annual bluegrass control increased with the addition of a non-ionic surfactant or methylated seed oil to bispyribac-sodium compared to bispyribac-sodium applied without an additive (McCullough and Hart, 2007). Addition of additives increased creeping bentgrass discoloration in one of the two years one week after the second application (McCullough and Hart, 2007). A 2004 and 2005 showed that the addition of iron and nitrogen to bispyribac-sodium did not affect control of annual bluegrass (*Poa annua* L.) (McDonald et al., 2006).

Objectives

Our main objective for this research was to observe the effects of sulfosulfuron and bispyribac-sodium on roughstalk bluegrass. In order to do this, we conducted individual studies focused on four objectives:

1. Determine the most effective herbicide strategy for short-term control of roughstalk bluegrass.
2. Compare the effectiveness of sulfosulfuron and bispyribac-sodium on different cultivars of roughstalk bluegrass at two mowing heights.
3. Determine the most effective strategy for conversion of roughstalk bluegrass infested areas to creeping bentgrass.
4. Evaluate effect of iron and nitrogen on safety of creeping bentgrass and control of roughstalk bluegrass.

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