CHAPTER THREE

CULTIVARS OF ROUGHSTALK BLUEGRASS RESPOND SIMILARLY TO BISPYRIBAC-SODIUM AND SULFOSULFURON

Abstract

Roughstalk bluegrass (*Poa trivialis* L.) is a difficult-to-control weed in cool-season turfgrasses found on golf courses, athletic fields and home lawns. Bispyribac-sodium and sulfosulfuron are labeled for selective control of roughstalk bluegrass. Our objective was to determine whether cultivars of roughstalk bluegrass respond differently to bispyribac-sodium or sulfosulfuron. Studies were conducted in Indiana at two mowing heights in 2006 and 2007. Bispyribac-sodium and sulfosulfuron reduced roughstalk bluegrass cover compared to the untreated control in 2006 at the 1.25 cm mowing height and at both mowing heights in 2007. Though bispyribac-sodium was slightly more effective than sulfosulfuron throughout these studies, all cultivars responded similarly to these herbicides. Therefore, effects of bispyribac-sodium and sulfosulfuron are not cultivar-specific on the grasses used in our study and cultivar differences likely did not cause variability in control reported in previous studies.

Introduction

Roughstalk bluegrass is a difficult-to-control weed in cool-season turfgrasses found on golf courses, athletic fields and home lawns. Due to poor drought and heat tolerance and susceptibility to disease, roughstalk bluegrass goes dormant in late summer and leaves thin or patchy turf (Christians, 2004). However, roughstalk bluegrass recovers quickly from dormancy through stolons and grows aggressively in fall and spring, out-competing desirable grasses. Increasing irrigation and fungicides is often attempted to prevent summer dormancy, but these increase maintenance expense and are not practical for most turf managers.

Roughstalk bluegrass contamination can occur through seed contamination and from natural infestations in preexisting stands. Since roughstalk bluegrass found in many fairways appears to be newer varieties, seed contamination is thought to be a likely cause (Levy, 1998). In a 1996 laboratory study where 90 samples of creeping bentgrass (*Agrostis stolonifera* L.) seed were tested for purity, 30% contained roughstalk bluegrass (Levy, 1998). Roughstalk bluegrass can also be found in pastures, home lawns, roadsides, and along streams, probably as a result of naturalization after it was originally brought to the United States from Europe (Hurley, 1997). Therefore, it is possible that roughstalk bluegrass contamination could also be from spread of pre-existing stands of roughstalk bluegrass. Regardless of the source, turf stands could contain a number of cultivars or phenotypes of roughstalk bluegrass as weeds.

Two herbicides for potential selective control of roughstalk bluegrass are bispyribac-sodium (2,6-bis[(4,6-dimethoxypyrimidin-2-yl)oxy] benzoic acid) and sulfosulfuron (1-(4,6-dimethoxypyrimidin-2-yl)-3-[2-ethanesulfonyl-imidazo[1,2-a]pyridine-3-yl) sulfonyl]urea). Bispyribac-sodium is labeled for use in turfgrass as Velocity™ (Valent U.S.A. Corp., Walnut Creek, CA) for selective postemergent control of annual bluegrass (*Poa annua* L.) and roughstalk bluegrass in creeping bentgrass and perennial ryegrass (*Lolium perenne* L.) golf course fairways or sod farms (Anonymous, 2004). Sulfosulfuron is labeled for use in turfgrass as Certainty™

(Monsanto, St. Louis, MO) and is labeled to control roughstalk bluegrass in creeping bentgrass tees and fairways (Anonymous, 2005).

Our previous research showed that bispyribac-sodium and sulfosulfuron are effective for controlling roughstalk bluegrass, but control can be variable (Morton et al., 2007). Bispyribac-sodium outperformed sulfosulfuron at two locations in this study while sulfosulfuron outperformed bispyribac-sodium at another location (Morton et al., 2007). The cause of variability is unknown, but one possibility could be due to differential herbicide response of the cultivars/phenotypes used. ‘Laser’ roughstalk bluegrass was used in one location while infestations of unknown cultivars/phenotypes were used in the other locations. In another preliminary study, sulfosulfuron effects were variable across fourteen roughstalk bluegrass phenotypes collected from golf courses in Indiana (Reicher and Weisenberger, 2005). Furthermore, effects of bispyribac-sodium are variable across another *Poa* species, Kentucky bluegrass (*Poa pratensis* L.). Responses of 173 Kentucky bluegrass cultivars to bispyribac-sodium ranged from little or no damage to complete kill (Shortell et al., 2006). Therefore, our hypothesis was cultivars of roughstalk bluegrass would respond differently to sulfosulfuron or bispyribac-sodium.

Materials and Methods

This study was conducted in 2006 and 2007 at the W.H. Daniel Turfgrass Research and Diagnostic Center, West Lafayette, IN. Soil types were Mahalasville-Treaty clay loam (fine-silty, mixed, mesic Typic Argiaquolls) with a pH of 7.0 and organic matter content of 7.2% and Starks-Fincastle silt loam (Fine-silty, mixed, mesic Aeric Ochraqualfs) with a pH of 7.3 and organic matter content of 4.9%. Adjacent studies were done under either 1.25 cm or 5.0 cm mowing heights. All experimental areas were seeded on 30 Aug. 2005, at 98 kg/ha. Experimental design was a split-plot design with three replications. Main plots were cultivars of roughstalk bluegrass and subplots were herbicide treatments. Main plots were 5 x 1.5 m and subplots were 1.5 x 1.5 m with 0.5 m untreated alleyways between each subplot. Eight roughstalk bluegrass cultivars were studied in this project and included ‘Sabre II’, ‘Sun-up’, ‘Bariviera’, ‘Winterlinks’, ‘Racehorse’, ‘Pulsar’, ‘Proam’, and ‘Laser’ which were all commercially available in 2005. Cultivars were selected at random and no attempt was made to select cultivars from different parental lines. Herbicide treatments included an untreated control, sulfosulfuron at 13 g a.i. ha^{-1} applied twice on a two week interval, and bispyribac-sodium at 37 g a.i. ha^{-1} applied four times on a two week interval. Sulfosulfuron treatments included MON 0818 (Monsanto, St. Louis, MO) surfactant at 0.25% v/v. Initial applications were made on 13 June 2006, and the study was repeated on adjacent and previously untreated areas beginning with applications on 13 June 2007. All herbicide applications were applied in 814 L ha^{-1} water with a CO_2-pressurized backpack sprayer using a three-nozzle (Tee Jet XR8001.5VS, Spraying Systems Co., Wheaton, IL) boom at 207 kPa. Throughout the experiment, turf received 196 kg N ha^{-1} yr^{-1} and was sufficiently irrigated to ensure optimal growth. Studies maintained at 1.25 cm was mowed three times per week and turf maintained at 5 cm was mowed two times per week. Clippings were returned to the plots at both heights. Experimental areas were on a preventative fungicide program, mainly targeting dollar spot, brown patch, and pythium, with applications made every ten to fourteen days during June, July, and August each year.

In both years and at both mowing heights, percent cover was rated visually every two weeks during the growing season. Data were analyzed using PROC GLM (SAS Institute, Cary, NC). An arcsin transformation was performed on the data. A two tailed F-test was performed on the transformed data to test the homogeneity of errors. Error variances were not homogenous, and thus data were not combined across years. Bispyribac-sodium treatments were removed from 8 WAIT data in the 1.25 cm study in 2006 due to zero variance. Zero variance was due to bispyribac-sodium treatments resulting in 0% cover for all cultivars.

Results and Discussion

1.25 cm mowing height: 'Laser' and 'Winterlinks' were among the best performing cultivars throughout 2006 while 'Pulsar' was the worst performing cultivar (Table 3-1 and Figure 3-1). Averaged over herbicide treatments, 'Winterlinks', 'Proam', and 'Laser' maintained ≥ 86% cover while 'Pulsar' and 'Sun-up' cover was reduced to 64% 4 WAIT in 2006 (Figure 3-1). 'Pulsar' maintained less than 5% cover while 'Laser' had > 20% cover by 12 WAIT (Figure 3-1). Averaged across cultivars in 2006, bispyribac-sodium and sulfosulfuron reduced roughstalk bluegrass cover by > 29% compared to the untreated control by 4 WAIT (Figure 3-2). Bispyribac-sodium was the most effective by 12 WAIT, reducing cover to 0% compared to 4% by sulfosulfuron and 77% in the untreated control plots (Figure 3-2).

Cultivar x herbicide interactions occurred in percent cover of roughstalk bluegrass at 8 and 12 WAIT in 2006 (Table 3-1). Though all cultivars responded similarly to both bispyribac-sodium and sulfosulfuron at 8 WAIT, this interaction was primarily due to variability in the untreated controls. Sulfosulfuron and bispyribac-sodium reduced roughstalk bluegrass cover to ≤ 4% regardless of cultivar at 8 WAIT, while the untreated control cover ranged from 'Pulsar' with 7% cover to 'Bariviera' with 78% cover (Figure 3-3). Cultivar x herbicide interaction at 12 WAIT was due to effective control from bispyribac-sodium regardless of cultivar, but cover in the sulfosulfuron treatments and untreated controls was inconsistent among cultivars. Bispyribac-sodium reduced roughstalk bluegrass cover to ≤ 1% at 12 WAIT regardless of cultivar, while sulfosulfuron treated cultivars ranged from 1% cover ('Pulsar') to 10% cover ('Laser'). Even though there were statistical differences in cultivar response to sulfosulfuron, they were not agronomically important. Cover in the untreated controls at 12 WAIT ranged from Pulsar with 16% cover to Laser with 91% cover suggesting that 'Laser' is less sensitive to summer stresses than 'Pulsar'.

Averaged over herbicide treatments in 2007, ‘Laser’ maintained 46% cover at 4 WAIT which was higher than all other cultivars except ‘Sabre II’ (Figure 3-4). All cultivars performed equivalently at 8 and 12 WAIT (Table 3-1 and Figure 3-4). Initial roughstalk bluegrass cover in 2007 was less than in 2006, primarily due to a *Poa annua* infestation the previous fall. Though the *Poa annua* was effectively removed with mesotrione (2-(4-mesyl-2-nitrobenzoyl)cyclohexane-1,3-dione) at 186 g a.i. ha^{-1} applied three times on a two week interval in fall 2006, the roughstalk bluegrass did not recover to 100% cover before initial applications were made in 2007.

Averaged over cultivars, sulfosulfuron and bispyribac-sodium decreased cover of roughstalk bluegrass to ≤ 16% at 4, 8 and 12 WAIT compared to the untreated control at ≥ 20% cover (Figure 3-5). Bispyribac-sodium was more effective than sulfosulfuron decreasing cover to 8%, 2%, and 2% at 4, 8, and 12 WAIT, respectively, while sulfosulfuron decreased cover to 16%, 11%, and 11%, respectively.

5 cm mowing height: Few significant effects were seen at the 5 cm mowing height in 2006 (Table 3-1). Averaged over herbicide treatments, ‘Bariviera’ maintained 55% cover at 8 WAIT which was less than ‘Racehorse’ and ‘Sun-up’ at 85% and 86% cover, respectively (Figure 3-6). On all three rating dates in 2007, the untreated control maintained the highest cover when averaged over cultivars, followed by sulfosulfuron and bispyribac-sodium, respectively (Figure 3-5). However, only at 8 WAIT were the effects agronomically important where sulfosulfuron decreased cover to 36%, bispyribac-sodium decreased cover to 5%, and cover in the check plots was 73%. At 5.0 cm, all cultivars responded similarly to the herbicide treatments.

Conclusions

We hypothesized that cultivars of roughstalk bluegrass would respond variably to sulfosulfuron or bispyribac-sodium, but this was not the case in our study. Though we found statistical differences among roughstalk bluegrass cultivars in response to sulfosulfuron in 2006 at the 1.25 cm mowing height at 12 WAIT, these differences were not agronomically important.

Results from our study show that sulfosulfuron or bispyribac-sodium should perform consistently on roughstalk bluegrass, regardless of cultivar. However, this statement can only be made for the cultivars used in this study. Since roughstalk bluegrass contamination may take years to develop, likely contaminants are those roughstalk bluegrass cultivars available at the time of seeding and/or those unimproved phenotypes already present on site. These cultivars or phenotypes are likely much older than those used in our study, which were commercially available in 2005. Ensuing research should include older cultivars or unimproved phenotypes of roughstalk bluegrass to determine if these grasses respond variably to these herbicides.

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Table 3-1. ANOVA for percent cover of roughstalk bluegrass in the 1.25 and 5 cm height study in 2006 and 2007. An arcsin transformation was performed on the data. Mean squares are presented.

	2006			2007		
	4 WAIT[z]	8 WAIT	12 WAIT	4 WAIT	8 WAIT	12 WAIT
1.25 cm						
Cultivar (C)	0.163 *	0.139 *	0.113 **	0.303 **	0.057 ns	0.052 ns
Herbicide (H)	1.865 *	6.270 **	7.462 **	0.224 **	0.677 **	0.887 **
C x H	0.047 ns	0.090 **	0.064 **	0.012 ns	0.013 ns	0.031 ns
5 cm						
Cultivar (C)	0.008 ns	0.130 *	0.015 ns	0.013 ns	0.257 ns	0.007 ns
Herbicide (H)	0.009 ns	0.024 ns	0.006 ns	0.063 **	3.896 **	0.156 **
C x H	0.021 ns	0.191 ns	0.018 ns	0.003 ns	0.053 ns	0.004 ns

[z]WAIT = weeks after initial treatment

ns, *, ** Nonsignificant or significant at $P \leq 0.05$ or 0.01, respectively

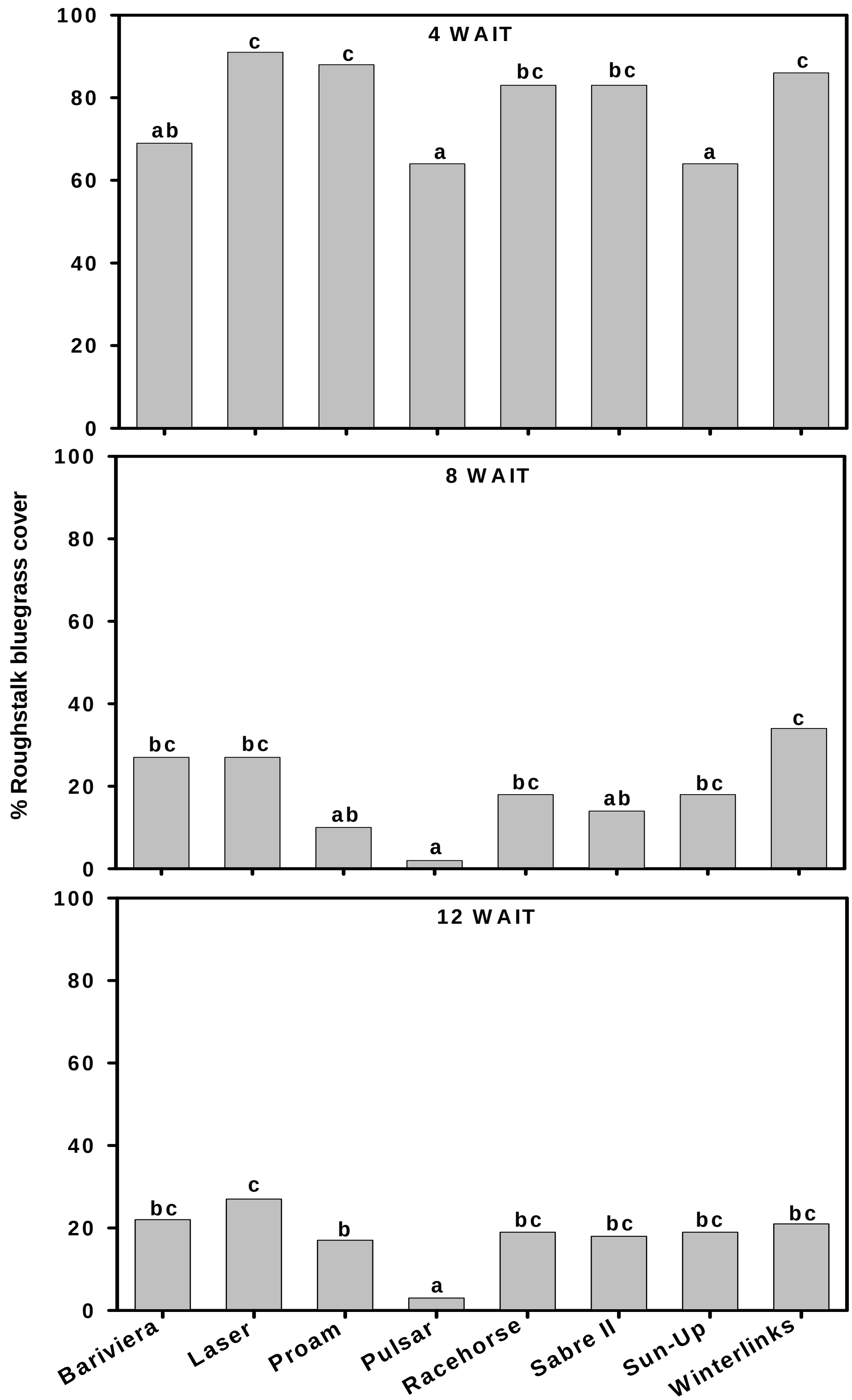

Figure 3-1. Cultivar means of percent cover in the 1.25 cm study in 2006 at 4, 8, and 12 weeks after initial treatment (WAIT). Means are back-transformed and averaged over three replications and three herbicide treatments. Bars with the same letter are not significantly different ($P < 0.05$).

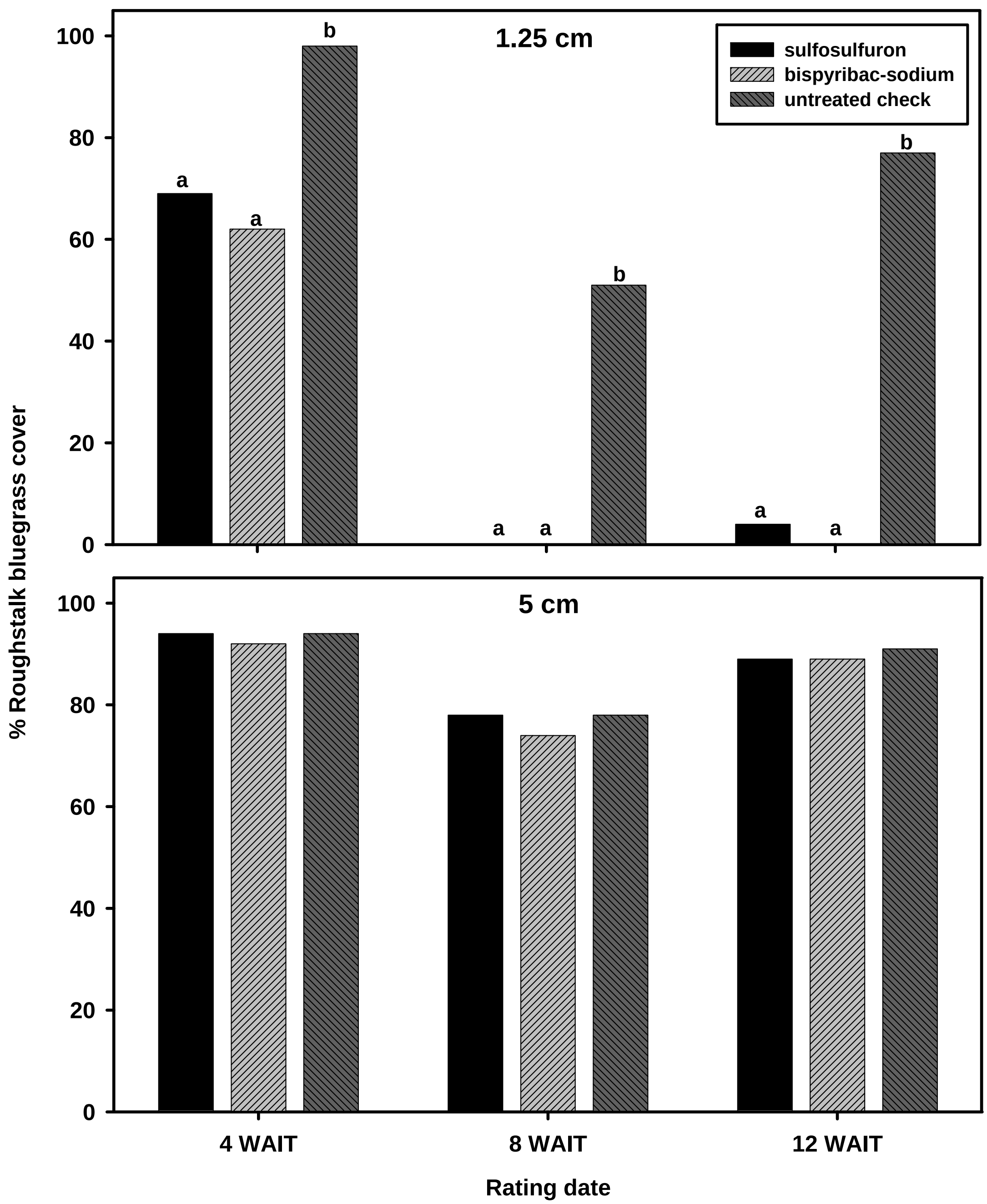

Figure 3-2. Percent cover of roughstalk bluegrass mowed at 1.25 and 5 cm as influenced by sulfosulfuron and bispyribac-sodium at 4, 8, and 12 weeks after initial treatment (WAIT) in 2006. Means are back-transformed and averaged over three replications and eight cultivars. Bars with the same letter are not significantly different within each rating date ($P < 0.05$).

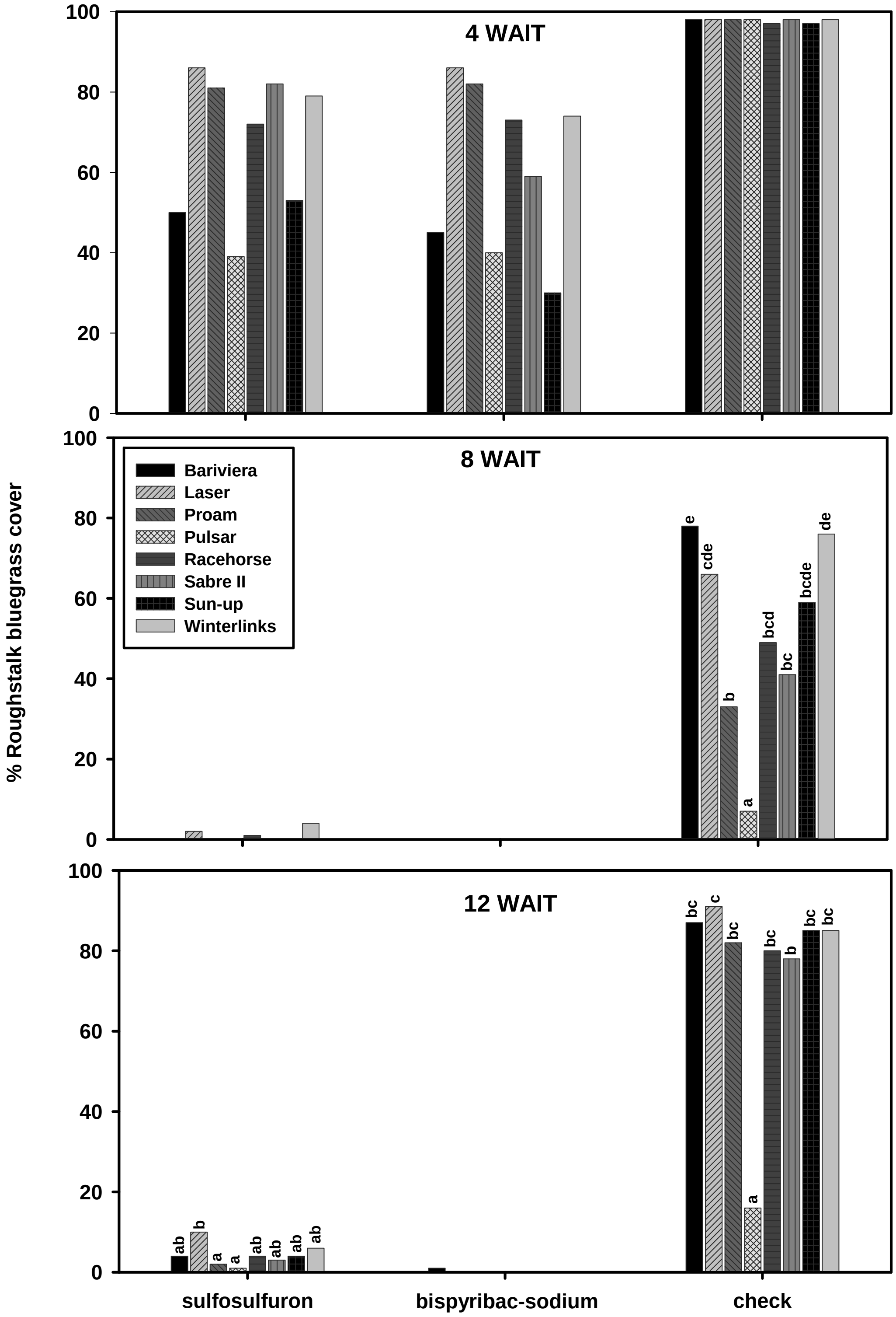

Figure 3-3. Differences among cultivars mowed at 1.25 cm as a result of sulfosulfuron and bispyribac-sodium in 2006 at 4, 8, and 12 weeks after initial treatment (WAIT). Means are back-transformed and averaged over three replications. Means of cultivars within herbicides with the same letter or no letter are not significantly different at ($P < 0.05$).

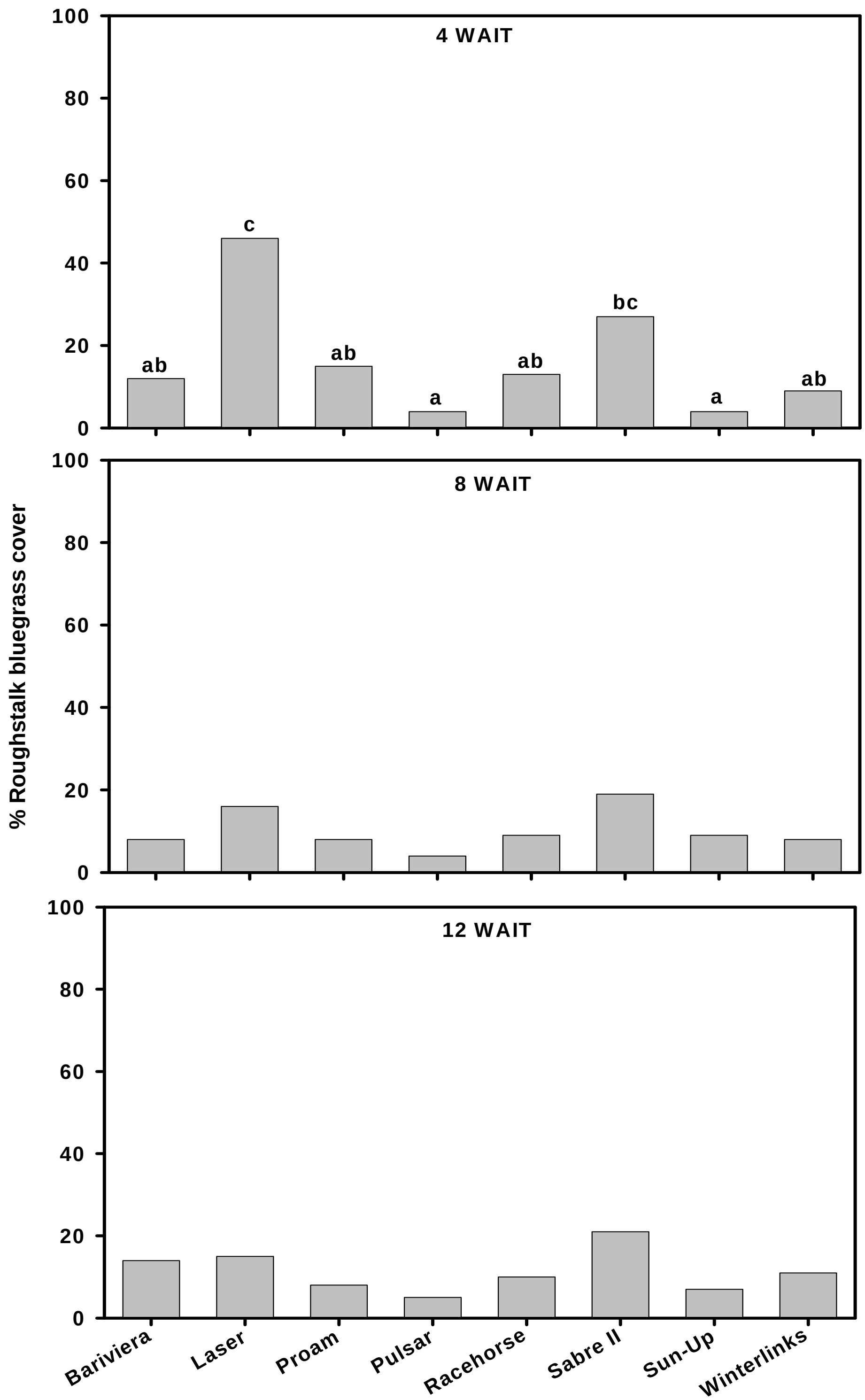

Figure 3-4. Cultivar means of percent cover in the 1.25 cm study in 2007 at 4, 8, and 12 weeks after initial treatment (WAIT). Means are back-transformed and averaged over three replications and three herbicide treatments. Bars with the same letter or no letter are not significantly different (P < 0.05).

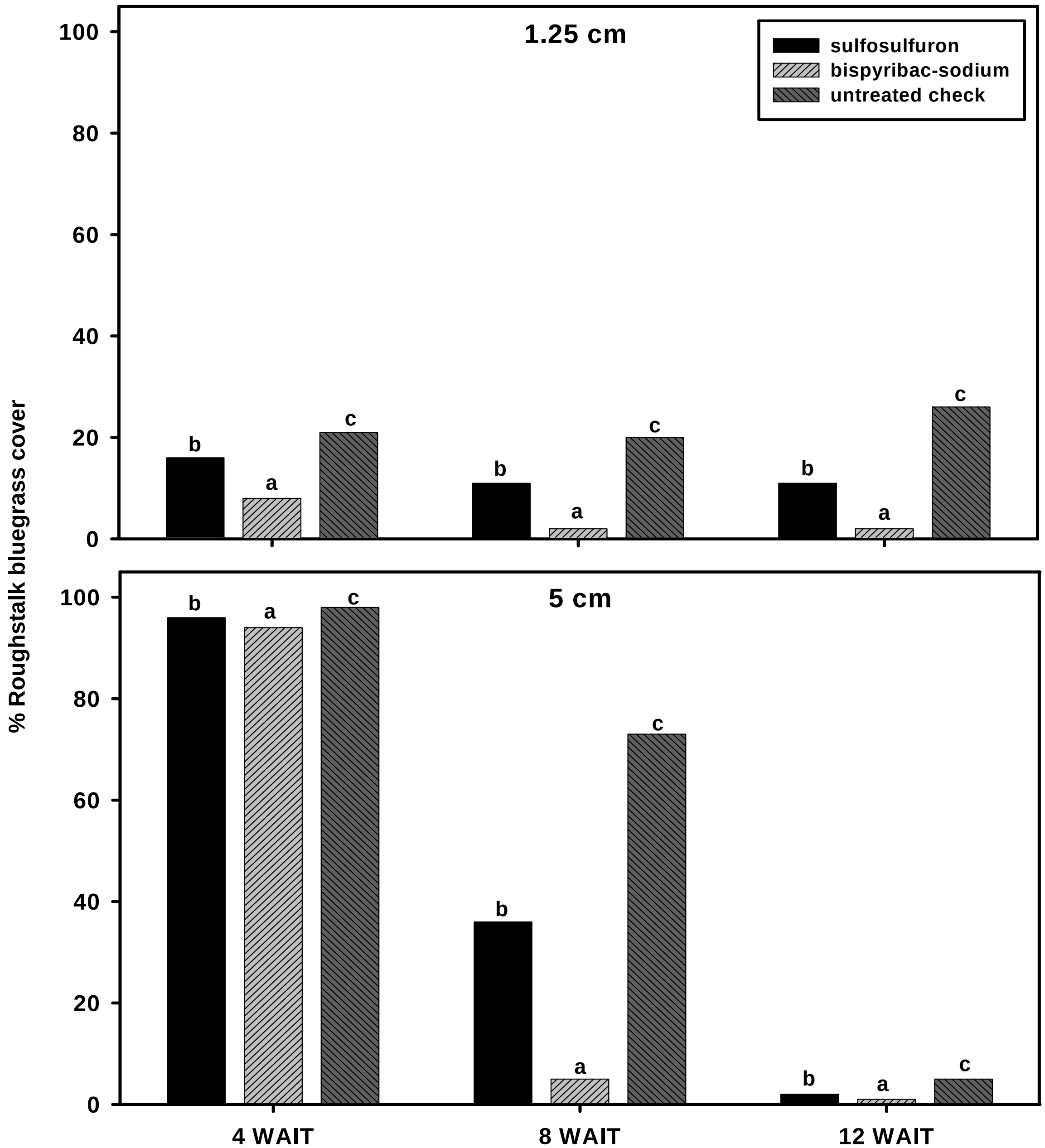

Figure 3-5. Percent cover of roughstalk bluegrass at 1.25 and 5 cm as influenced by sulfosulfuron and bispyribac-sodium at 4, 8, and 12 weeks after initial treatment (WAIT) in 2007. Means are back-transformed and averaged over three replications and eight cultivars. Bars with the same letter are not significantly different within each rating date ($P < 0.05$).

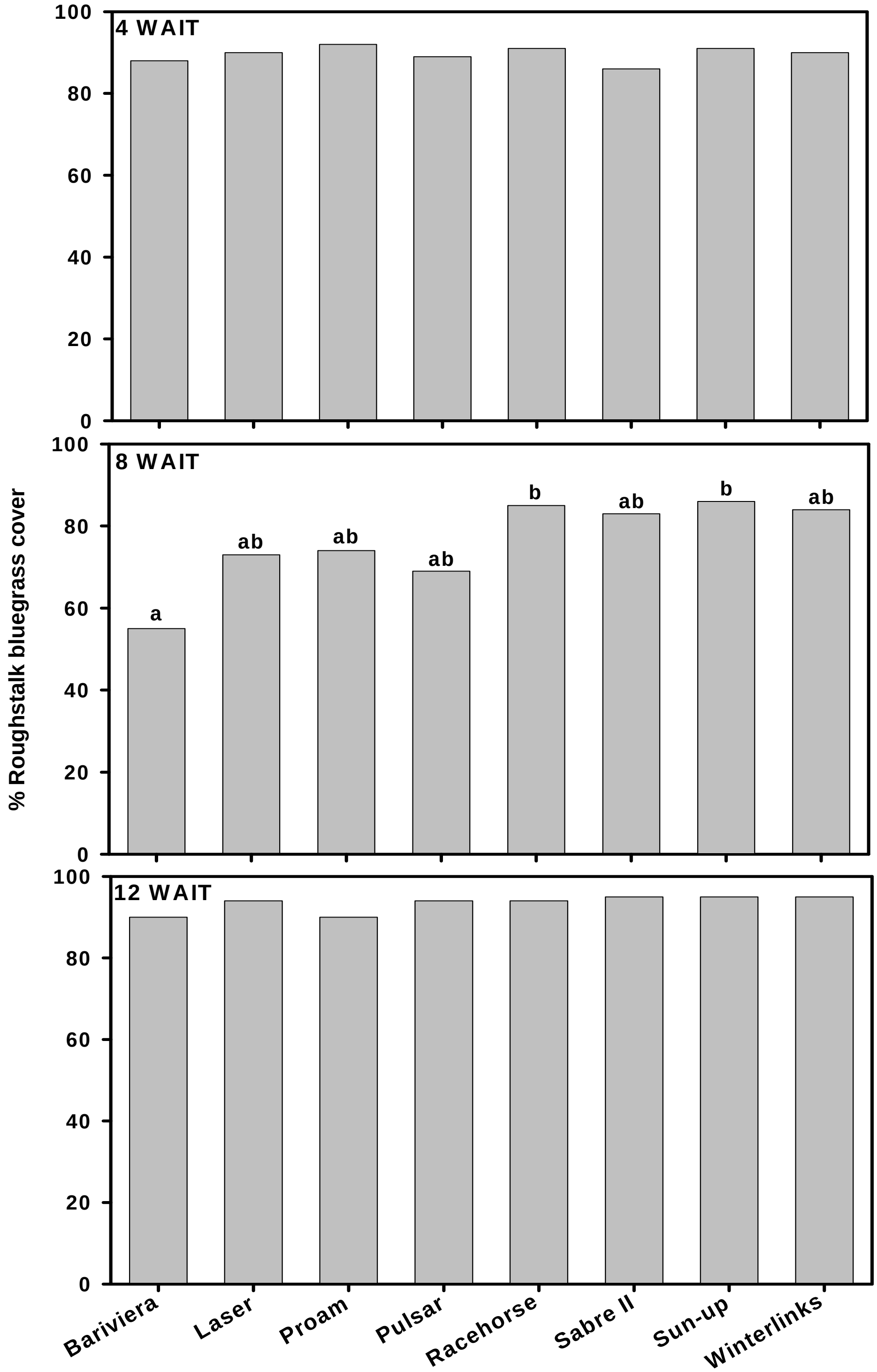

Figure 3-6. Cultivar means of percent cover in the 5 cm study in 2006 at 4, 8, and 12 weeks after initial treatment (WAIT). Means are back-transformed and averaged over three replications and three herbicide treatments. Bars with the same letter or no letter are not significantly different ($P < 0.05$).