CONTROL OF *POA ANNUA* AND *POA TRIVIALIS* IN CARBON-SEEDED TALL FESCUE AND PERENNIAL RYEGRASS GROWN FOR SEED

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Introduction

Diuron applied preemergence to the grass crop and weed species, combined with a 1-inch-wide band of activated carbon over the top of the seeded row, has enabled growers to establish weed-free plantings. Populations of *Poa annua* have now evolved resistance to diuron herbicide, and many herbicides have been evaluated as candidates for diuron replacement. Previous research from Oregon State University has evaluated preemergence herbicides for weed management in carbon-seeded grasses grown for seed (Cole et al., 2003; Curtis et al., 2011, 2012). For example, in 2011, we reported that pyroxasulfone (Zidua), rimsulfuron (Matrix), and indaziflam (Alion) herbicides performed well as replacements for diuron (Curtis et al., 2011).

The potential exists to label a combination of pyroxasulfone premixed with flumioxazin for use in grass seed production. Testing of this premix product has been initiated by the IR-4 project for registration on established grasses grown for seed. Rimsulfuron is also in the IR-4 project for use in carbon seeding. The manufacturer of indaziflam has indicated they would support a label in grasses grown for seed for use with carbon seeding and also in established grass seed stands.

Two studies were conducted at Hyslop Research Farm during the 2014–2015 season to assess the effect of preemergence herbicides on crop injury and on control of roughstalk bluegrass (*Poa trivialis*) and diuron-resistant annual bluegrass (*Poa annua*) in new plantings of both tall fescue and perennial ryegrass. The studies compared the following preemergence herbicide treatments: (1) indaziflam, (2) pyroxasulfone/flumioxazin, (3) rimsulfuron, (4) rimsulfuron plus pronamide, (5) diuron followed by ethofumesate (standard), and (6) diuron plus pronamide (standard).

Study 1—Tall Fescue

Materials and Methods

Plots were 8 feet x 35 feet and were arranged in a randomized complete block design with four replications. Three rows of *Poa trivialis* seed and three rows of diuron-resistant *Poa annua* seed were planted on 12-inch row spacing in the front portion of the plots. Fifteen rows of 'Rebel XLR' turf-type tall fescue were planted in the rear portion of the plots on 18-inch row spacing. The tall fescue was planted 0.25 inch deep with a 1-inch-wide band of activated carbon applied over the rows at 300 lb/acre. Planting was completed on September 16, 2014.

Herbicide application and soil data are presented in Table 1. Herbicide treatments were applied on September 17 and November 24 with a compressed-air pressurized boom mounted on a unicycle frame and calibrated to deliver 20 gpa at 20 psi. The planting was

Table 1. Herbicide application and soil data, tall fescue.

	------------------------- Application date --------------------------	
	Sep.17, 2014	Nov. 24, 2014
Crop growth stage	Preemergence	5 tiller
Poa trivialis growth stage	Preemergence	5 tiller
Poa annua growth stage	Preemergence	5 tiller
Air temperature (°F)	69	53
Relative humidity (%)	70	85
Wind (mph, direction)	1, NE	2, SW
Cloud cover (%)	90	60
First irrigation (inches)	Sep. 17 (0.25)	—
Soil temperature at 2 inches (°F)	70	47
pH	5.3	
OM (%)	2.82	
CEC (meq/100g)	13.3	
Texture	Silty clay loam	

irrigated with 0.25 inch following the preemergence application. Irrigation was continued through crop emergence. Injury to the tall fescue and percent control of the *Poa* species were evaluated visually on April 6, 2015. The tall fescue was swathed on June 25, harvested with a small plot combine on July 7, and seed was cleaned.

Results and Discussion

Competition from a background population of diuron-susceptible *Poa annua* reduced yields in the untreated check treatment (Table 2). This *Poa annua* population was controlled in the herbicide-treated plots, resulting in tall fescue yields that were greater than those in the untreated check plots. Diuron-resistant *Poa annua* control was greater than 97% in the herbicide treatment plots, with the exception of the rimsulfuron alone and the diuron followed by ethofumesate treatments (Table 2). *Poa trivialis* was controlled greater than 95%, with the exception of the rimsulfuron alone and the diuron followed by ethofumesate treatments.

Diuron-resistant *Poa annua* and *Poa trivialis* populations were not controlled by preemergence applications of rimsulfuron, but were controlled by preemergence applications of indaziflam, pyroxasulfone/flumioxazin, and pronamide + diuron. The addition of pronamide to rimsulfuron improved control of both species over rimsulfuron alone.

Study 2—Perennial Ryegrass

Materials and Methods

The second study was established in carbon-seeded perennial ryegrass. Plots were 8 feet x 35 feet and were arranged in a randomized complete block design with four replications. Three rows of *Poa trivialis* seed and three rows of diuron-resistant *Poa annua* seed were planted on 12-inch row spacing in the front portion of the plots. Twenty-four rows of 'APR 2105' perennial ryegrass were planted in the rear portion of the plots on 12-inch row spacing. The perennial ryegrass was planted 0.25 inch deep with a 1-inch-wide band of activated carbon applied over the rows at 300 lb/acre. Planting was completed on October 8, 2014.

Herbicide application and soil data are presented in Table 3. Herbicide treatments were applied on October 8 and November 24 with a compressed-air pressurized boom mounted on a unicycle frame and calibrated to deliver 20 gpa at 20 psi. Rainfall of 0.23 inch occurred on October 10. Injury to the perennial ryegrass and percent control of planted *Poa* species were evaluated visually on April 6, 2015. The perennial ryegrass was swathed on June 29, harvested with a small plot combine on July 8, and seed was cleaned.

Results and Discussion

For most treatments, diuron-resistant *Poa annua* control was greater than 96%; however, the rimsulfuron

Table 2. Control of *Poa* species and crop injury with herbicide treatments in carbon-seeded tall fescue, 2014–2015.

		--------- Control[1]---------			
Treatment	Rate	*Poa annua*	*Poa trivialis*	Crop injury[1]	Clean seed yield
	(lb ai/a)	------------ (%) ------------		(%)	(lb/a)
Untreated check	0	0	0	0	928
Indaziflam	0.02	99	99	19	973
Pyroxasulfone/flumioxazin	0.1	100	95	4	997
Pyroxasulfone/flumioxazin	0.14	100	99	23	1,252
Pyroxasulfone/flumioxazin	0.13	100	100	6	1,049
+ pronamide	—	—	—	—	—
Rimsulfuron	0.05	13	38	0	1,020
Rimsulfuron	0.06	15	63	0	1,033
Rimsulfuron + pronamide	0.05 + 0.13	75	88	0	1,079
Diuron	2.3	13	63	0	1,015
followed by ethofumesate	1.0	—	—	—	—
Pronamide + diuron	0.25 + 1	97	98	0	1,080
LSD (*P* = 0.05)	—	23	25	5	305
CV	—	26	24	68	20

[1]% control and crop injury evaluated April 6, 2015.

Table 3. Herbicide application and soil data, perennial ryegrass.

	Application date	
	Oct. 8, 2014	Nov. 24, 2014
Crop growth stage	Preemergence	1 tiller
Poa trivialis growth stage	Preemergence	1 tiller
Poa annua growth stage	Preemergence	1 tiller
Air temperature (°F)	78	53
Relative humidity (%)	55	85
Wind (mph, direction)	3, E	2, SW
Cloud cover (%)	0	60
First rainfall (inches)	Oct. 10 (0.23)	Dec. 1 (0.61)
Soil temperature at 2 inches (°F)	70	47
pH	5.3	
OM (%)	2.82	
CEC (meq/100g)	13.3	
Texture	Silty clay loam	

treatments and the diuron followed by ethofumesate treatments did not provide adequate control (Table 4). *Poa trivialis* was controlled greater than 95%, with the exception of the rimsulfuron alone and the diuron followed by ethofumesate treatments.

Conclusions

Diuron-resistant *Poa annua* and *Poa trivialis* in perennial ryegrass can be controlled by preemergence applications of indaziflam, pyroxasulfone/flumioxazin, and pronamide + diuron. The addition of pronamide to rimsulfuron improved control of the *Poa* species over rimsulfuron alone. Rimsulfuron with the addition of pronamide provided 75% control of the diuron-resistant *Poa annua* and 88% control of the *Poa trivialis* in the tall fescue study. Rimsulfuron plus pronamide controlled 74% of the *Poa annua* and 95% of the *Poa trivialis* in the perennial ryegrass.

These data indicate that indaziflam and pyroxasulfone/flumioxazin have excellent potential for crop establishment of tall fescue and perennial ryegrass utilizing carbon seeding. Rimsulfuron needs the addition of pronamide to provide control of the *Poa* species in these studies. Based on the injury ratings, tall fescue is more sensitive to the preemergence herbicides than perennial ryegrass. These data suggest that the application rate of pyroxasulfone/flumioxazin should be no more than 0.1 lb ai/acre. Further research is needed to determine if lower rates of both indaziflam and pyroxasulfone/flumioxazin could be used while maintaining satisfactory weed control results.

References

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Table 4. Control of *Poa* species and crop injury with herbicide treatments in carbon-seeded perennial ryegrass, 2014–2015.

Treatment	Rate	--------- Control[1] ---------		Crop injury[1]	Clean seed yield
		Poa annua	*Poa trivialis*		
	(lb ai/a)	------------ (%) ------------		(%)	(lb/a)
Untreated check	0	0	0	0	1,520
Indaziflam	0.02	96	96	9	1,596
Pyroxasulfone/flumioxazin	0.1	100	100	1	1,492
Pyroxasulfone/flumioxazin	0.14	100	100	19	1,535
Pyroxasulfone/flumioxazin	0.13	100	100	9	1,727
+ pronamide	—	—	—	—	—
Rimsulfuron	0.05	60	78	0	1,751
Rimsulfuron	0.06	73	85	0	1,686
Rimsulfuron + pronamide	0.05 + 0.13	74	95	0	1,690
Diuron	2.3	76	80	0	1,719
followed by ethofumesate	1.0	—	—	—	—
Pronamide + diuron	0.25 + 1.0	100	100	0	1,642
LSD ($P = 0.05$)	—	24	10	2	306
CV	—	21	8	37	13

[1]% control and crop injury evaluated April 6, 2015.