FALL PREEMERGENCE HERBICIDE APPLICATIONS TO SPRING PLANTINGS OF COOL-SEASON GRASS SEED CROPS IN WESTERN OREGON

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Introduction

Oregon's grass seed production is dependent on the ability to produce seed free of weed contaminants. Annual bluegrass (*Poa annua*) and roughstalk bluegrass (*Poa trivialis*) represent two major weed seed contamination threats to western Oregon grass seed production. The climate in our growing region allows annual bluegrass to germinate in the fall as rainfall returns to the area and soil temperatures decrease. Germination slows as soil temperatures cool in early winter and then increases as soils warm in the early spring (McElroy et al., 2004). Germination rates slow as soil temperatures rise in late spring. Roughstalk bluegrass germination occurs slightly earlier in the fall if soil moisture is available and continues later in the spring, as it can tolerate warmer soil temperatures.

Two basic planting strategies are utilized to minimize the potential buildup of these two weed species: (1) fall planting with a carbon band protecting the seed row from fall-applied preemergence herbicides, or (2) planting the crop in the spring when warmer soil conditions do not favor weed seed germination. Both planting options are expensive. Fall plantings require the addition of activated carbon slurry plus the application of preemergence herbicides. Alternatively, spring plantings typically need to go through a cold period for vernalization and, thus, need an extra growing season in order to obtain the first seed harvest.

For the production of tall fescue and fine fescue, primarily chewings and creeping red, the industry has found that the spring planting technique is the most cost-effective method for establishment of new stands. The problem growers face, however, is that potential herbicide registrations for preemergence use in spring-planted stands state that they can be applied only following the first harvest.

Materials and Methods

Five studies were conducted with spring-planted grass seed crops from 2010–2016 at Oregon State University's Hyslop Research Farm in Corvallis. The five studies were all planted in the spring, either April or May, and were allowed to go dormant through the low rainfall months of July, August, and September. Studies were arranged in randomized complete block designs with plot size of 8 feet by 35 feet and four replications. Rows of diuron-resistant annual bluegrass (Curtis et al., 2011) and roughstalk bluegrass obtained from screenings provided by local growers were shallowly drilled in the front portions of plots for efficacy evaluations. Applications were made with a unicycle-type small plot sprayer delivering 20 gpa. Study plots were swathed and combined with a modified John Deere plot swather and a Hege 180 combine. Seed was cleaned with a Clipper Cleaner, and yields were quantified. Data were analyzed using ANOVA and means separated by LSD.

Results and Discussion

In 2010–2011, four rates of pyroxasulfone/flumioxazin and a single rate of flufenacet/metribuzin were compared to an untreated check treatment (Table 1). Yields were not affected by herbicide treatments in comparison to the untreated control. All herbicide treatments controlled annual bluegrass at 90% or greater.

A 2012–2013 study compared several herbicide treatments, including flufenacet/metribuzin + diuron, indaziflam, pyroxasulfone, pyroxasulfone/flumioxazin, terbacil + diuron, and metribuzin, with an untreated check treatment for control of roughstalk bluegrass and diuron-resistant annual bluegrass (Table 2). The flufenacet/metribuzin, indaziflam, and pyroxasulfone/flumioxazin controlled roughstalk bluegrass 93% and greater, and these herbicides and pyroxasulfone controlled annual bluegrass 82% or greater with no reductions in yield. No control of the weeds occurred with the terbacil + metribuzin treatment or with metribuzin alone, although no yield reduction occurred.

In 2015, four herbicide treatments were applied to a spring planting of tall fescue at three timings in the fall (Table 3). Flufenacet/metribuzin, pyroxasulfone/flumioxazin, EPTC, and indaziflam were applied 9 days prior to the first major rain event (0.23 inch), 1 day prior to the rain event, and 29 days following the rain event. These treatments were compared to an untreated check. Both roughstalk bluegrass and diuron-resistant annual bluegrass were seeded into the tall fescue plots prior to any herbicide application. With the exception of EPTC, the herbicide treatments provided 93% or better

control of the introduced weeds. None of the treatments, including EPTC, reduced yields in comparison to the untreated control (Table 3).

Two studies investigated fall applications of herbicide treatments to spring plantings of creeping red fescue and chewings fescue (Tables 4 and 5). Treatments in these two studies included flufenacet/metribuzin, indaziflam, pyroxasulfone/flumioxazin, dimethenamid-P, A20540B, and s-metolachlor, compared with an untreated check. In the creeping red fescue study, flufenacet/metribuzin, indaziflam, and pyroxasulfone/flumioxazin controlled both weed species at 94% or greater, and no treatments reduced yields. In the chewings fescue study, flufenacet/metribuzin, indaziflam, pyroxasulfone/flumioxazin, and dimethenamid-P controlled roughstalk bluegrass and diuron-resistant annual bluegrass 90% or greater. All treatments, with the exception of indaziflam, reduced yield in comparison to the untreated check. Yield reductions might be mitigated with rate reductions. In all cases, diuron-resistant annual bluegrass was controlled at levels 90% or greater with flufenacet/metribuzin, pyroxasulfone/flumioxazin, and indaziflam. These herbicides also provided at least 93% control of roughstalk bluegrass in four out of five studies. In general, fall applications of flufenacet/metribuzin, pyroxasulfone/flumioxazin, and indaziflam to spring-planted grass seed crops were effective and safe.

Table 1. Control of diuron-resistant annual bluegrass in spring-planted tall fescue, Corvallis, OR, 2010–2011.[1]

Treatment[2]	Rate	Annual bluegrass[3]	Crop injury[3]	Clean seed yield
	(lb ai/a)	(% control)	(%)	(lb/a)
Untreated	0	90	0	1,110
Pyroxasulfone/flumioxazin	0.1	100	5	1,292
Pyroxasulfone/flumioxazin	0.14	100	18	1,227
Pyroxasulfone/flumioxazin	0.19	100	25	1,364
Pyroxasulfone/flumioxazin	0.29	100	45	1,181
Flufenacet/metribuzin	0.43	100	8	1,419
LSD $P = 0.05$		0	7	NS
CV		0	5	14

[1]Planted April, 23, 2010
[2]Applied October 8, 2010
[3]Evaluated April 22, 2011

Table 2. Control of roughstalk bluegrass and diuron-resistant annual bluegrass with fall herbicide applications in spring-planted tall fescue, Corvallis, OR 2012–2013[1]

Treatment[2]	Rate	Roughstalk bluegrass[3]	Annual bluegrass[3]	Crop injury[3]	Clean seed yield
	(lb ai/a)	--------- (% control) ---------		(%)	(lb/a)
Untreated	0	0	0	0	743
Flufenacet/metribuzin + diuron	0.55 + 2.0	100	100	0	1,132
Indaziflam	0.02	93	92	18	1,008
Pyroxasulfone	0.09	82	100	0	877
Pyroxasulfone/flumioxazin	0.14	98	100	0	925
Terbacil + diuron	0.4 + 2.0	0	0	0	903
Metribuzin	0.38	0	0	0	869
LSD $P = 0.05$		12	2	7	NS
CV		17	2	190	20

[1]Planted May 2, 2012
[2]Applied October 15, 2012
[3]Evaluated May 24, 2013

Table 3. Fall treatment timings for control of roughstalk bluegrass and diuron-resistant annual bluegrass in spring-seeded tall fescue, Corvallis, OR.[1]

Treatment	Rate	Timing (2015)	Roughstalk bluegrass[2]	Annual Bluegrass[2]	Crop injury[2]	Clean seed yield
	(lb ai/a)		------- (% control) -------		(%)	(lb/a)
Untreated	0	Oct. 2	0	0	0	1,246
Flufenacet/metribuzin	0.55	Oct. 2	100	100	1	1,294
Pyroxasulfone/flumioxazin	0.14	Oct. 2	94	100	3	1,360
EPTC	3.0	Oct. 2	8	8	0	1,313
Indaziflam	0.02	Oct. 2	100	99	8	1,229
Flufenacet/metribuzin	0.55	Oct. 9	100	100	3	1,131
Pyroxasulfone/flumioxazin	0.14	Oct. 9	93	100	3	1,208
EPTC	3.0	Oct. 9	10	13	0	1,335
Indaziflam	0.02	Oct. 9	100	100	10	1,246
Flufenacet/metribuzin	0.55	Nov. 9	100	100	3	1,334
Pyroxasulfone/flumioxazin	0.14	Nov. 9	97	99	4	1,184
EPTC	3.0	Nov. 9	0	0	0	1,132
Indaziflam	0.02	Nov. 9	98	97	15	1,167
LSD *P* = 0.05			8	8	4	NS
CV			8	8	82	13

[1]Planted April 8, 2015
[2]Evaluated April 21, 2016

Table 4. Fall treatments for control of roughstalk bluegrass and diuron-resistant annual bluegrass in spring-planted creeping red fescue, Corvallis, OR, 2015–2016.[1]

Treatment[2]	Rate	Roughstalk bluegrass[3]	Annual bluegrass[3]	Clean seed yield
	(lb ai/a)	---------- (% control) ----------		(lb/a)
Untreated	0	0	0	1,065
Flufenacet/metribuzin	0.43	96	99	978
Indaziflam	0.03	97	96	1,095
Pyroxasulfone/flumioxazin	0.14	94	97	1,135
Dimethenamid-P	0.98	86	88	1,054
A20540B[4]	0.82	55	56	1,129
s-metolachlor	0.95	51	53	1,130
LSD *P* = 0.05		14	17	NS
CV		14	16	12

[1]Planted April 10, 2015
[2]Applied November 10, 2015
[3]Evaluated April 21, 2016
[4]A20540B = bicyclopyrone/mesotrione/s-metolachlor

Table 5. Fall treatments for control of roughstalk bluegrass and diuron-resistant annual bluegrass in spring-planted chewings fescue, Corvallis, OR 2015–2016.[1]

Treatment[2]	Rate	Roughstalk bluegrass[3]	Annual bluegrass[3]	Crop injury[3]	Clean seed yield
	(lb ai/a)	--------- (% control) ---------		(%)	(lb/a)
Untreated	0	0	0	0	1,321
Flufenacet/metribuzin	0.43	98	100	14	981
Indaziflam	0.03	99	100	4	1,183
Pyroxasulfone/flumioxazin	0.14	95	97	1	1,080
Dimethenamid-P	0.98	90	94	3	1,000
A20540B[4]	0.82	60	60	0	1,117
s-metolachlor	0.95	61	70	0	1,067
LSD $P = 0.05$		7	9	7	162
CV		7	8	138	10

[1]Planted April 10, 2015
[2]Applied November 11, 2015
[3]Evaluated April 21, 2016
[4]A20540B = bicyclopyrone/mesotrione/s-metolachlor

References

Curtis, D.W., K.C. Roerig, A.G. Hulting, and C.A. Mallory-Smith. 2012. Alternative herbicides to diuron in carbon seeded perennial ryegrass (*Lolium perenne*) grown for seed. In W.C. Young III (ed.). *2011 Seed Production Research Report*. Oregon State University, Ext/CrS 136.

McElroy, J.S., R.H. Walker, G.R. Wehtje, and E. van Santen. 2004. Annual bluegrass (*Poa annua*) populations exhibit variation in germination response to temperature, photoperiod, and fenarimol. Weed Science 52:47–52.

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