AUXIN HERBICIDE SUPPRESSION OF ITALIAN RYEGRASS SEED VIABLITY IN TALL FESCUE SEED PRODUCTION

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Introduction

Grass seed growers in Oregon have questions regarding the control of late-season Italian ryegrass (*Lolium multiflorum* L.) escapes in tall fescue (*Schedonorus arundinaceus* (Schreb.) Dumort.) grown for seed. Once Italian ryegrass populations become established, especially multiple resistant populations, control and management are challenging in seed production cropping systems. Italian ryegrass produces 2,000–6,000 seeds per plant, many of which enter the seed bank, intensifying the problem over time. Weed seed banks are the major source of weed population persistence. Control and management of the seed bank can reduce populations in a field; therefore, preventing seed production on late-season Italian ryegrass escapes could help to reduce the seed bank and manage herbicide resistance.

Previous research on weed species in rangelands showed that applications of synthetic auxin herbicides affected seed viability and could be used as a management tool to reduce seed production of invasive annual grasses such as downy brome (Ball, 2014; Rinella et al., 2010, 2013). In addition, annual grasses were more susceptible than perennial grasses to synthetic auxin herbicides, and sensitivity varied within and among species.

Therefore, we tested the hypothesis that an application of a synthetic auxin herbicide applied late in the growing season could reduce Italian ryegrass seed viability before entering the weed seed bank, while at the same time maintaining tall fescue seed yield and viability.

Materials and Methods

2017 sites

Two studies were conducted at OSU's Hyslop Experimental Farm near Corvallis, OR. One site was planted with Italian ryegrass ('Florida 80'), and the other site was in an established 2-year-old turf-type tall fescue ('Rebel XLR') stand. Average annual precipitation was 43 inches, with an average annual temperature of 54°F. A third study was conducted in a commercial 3-year-old turf-type tall fescue field ('AST 5112') infested with Italian ryegrass located north of Dallas, OR. At this site, average annual precipitation ranged from 40 to 45 inches, with an average temperature of 54°F. Plot size was 10 feet x 34 feet at all three sites.

2018 sites

Two studies were conducted at OSU's Schmidt Experimental Farm near Corvallis, OR. One site was a 3-year-old tall fescue ('Rebel XLR') stand, and the other site was planted with Italian ryegrass ('Florida 80'). The average annual precipitation is 43 inches, with an average annual temperature of 54°. A third study near Gaston, OR, was conducted in a commercial 4-year-old tall fescue ('Penn RK4') field infested with Italian ryegrass. The average annual precipitation was 45 inches, with an average annual temperature of 57°F. Plot size was 6 feet x 12 feet at all three sites.

Six synthetic auxin herbicides were applied to Italian ryegrass and tall fescue at two growth stages, BBCH 49 (boot) and BBCH 59 (anthesis) (Table 1). For the Hyslop and Schmidt Farm trials, a strip split randomized block design was used, with herbicides as the primary treatment and BBCH growth stage as the secondary treatment. For the Gaston and Dallas trials, a complete randomized block design was used. Four

Table 1. Synthetic auxin herbicides applied to Italian ryegrass and tall fescue.

Herbicide[1]	Trade name	Rate
		(lb ae/a)
Dicamba acid	Vision	0.89
2,4-D acid	Unison	0.98
Aminopyralid	Milestone	0.45
Dicamba + 2,4-D	Latigo	0.71 + 0.98
2,4-D + clopyralid	Unison + Stinger	0.98 + 0.27
Dicamba acid[2]	Vision	1.96
2,4-D acid[2]	Unison	1.96
Halauxifen-methyl + florasulam[2]	Quelex	0.36

[1]All treatments sprayed with nonionic surfactant 0.25% v/v.
[2]Applied only on 2018 trials.

replications were used for each treatment combination. Seeds were harvested at recommended moisture levels (Silberstein et al., 2010).

Seed viability and speed of germination were evaluated using standard seed germination tests with four replications for both Italian ryegrass and tall fescue. Viability was considered the sum of seeds that germinated after each count plus the seeds that were viable in the tetrazolium test. Seed weight of 1,000 seeds was measured with two subsamples for each replication for each species. OSU research farm trials and growers' on-farm trials were analyzed separately because of the differences in study design.

Results and Discussion

Aminopyralid was the only herbicide included in the study that reduced seed viability and seed weight (Tables 2 and 3). However, the average effect of aminopyralid on seed viability was greater in tall fescue than in Italian ryegrass (Table 2). Aminopyralid reduced seed viability of Italian ryegrass by 55% when applied at anthesis, while at the boot stage the reduction was 46%. Tall fescue had a greater sensitivity to the treatment when aminopyralid was applied at anthesis, with an average seed viability reduction of 79%, compared to 59% when applied at boot stage.

Table 2. Seed viability (%) after synthetic auxin applications to Italian ryegrass and tall fescue at boot and anthesis stages in field trials.[1]

	OSU research farm trials			
	Italian ryegrass seed viability		Tall fescue seed viability	
	Boot	Anthesis	Boot	Anthesis
	(%)		(%)	
Control	85.9 c	85.6 cd	97.2 de	97.2 e
2,4-D	89.1 cde	86.2 cde	96.5 cde	97.8 e
Dicamba	87.5 cde	85.2 cd	96.2 cde	95.9 cde
Aminopyralid	53.8 b	42.0 b	48.5 b	23.8 a
2,4-D + clopyralid	86.0 cd	87.6 cde	94.9 cde	96.0 cde
Dicamba + 2,4-D	87.5 cde	89.0 cde	95.5 cde	94.6 cde
Dicamba (2x)[2]	89.0 cde	91.5 cde	93.5 cde	94.8 cde
2,4-D (2x)[2]	96.5 e	89.8 cde	94.8 cde	94.5 cde
Halauxifen-methyl + florasulam[2]	94.2 cde	92.8 cde	95.8 cde	97.5 cde
	Grower field trials			
	Italian ryegrass seed viability		Tall fescue seed viability	
	Boot	Anthesis	Boot	Anthesis
	(%)		(%)	
Control	94.5 d	94.5 d	94.8 d	95.4 d
2,4-D	94.6 d	94.6 d	93.9 d	92.8 d
Dicamba	94.1 d	94.0 d	92.0 d	92.8 d
Aminopyralid	43.5 c	38.2 bc	30.0 ab	17.8 a
2,4-D + clopyralid	93.1 c	94.4 d	92.8 d	91.6 d
Dicamba + 2,4-D	95.4 d	95.4 d	92.5 d	93.1 d
Dicamba (2x)[2]	96.0 d	97.2 d	94.5 d	95.0 d
2,4-D (2x)[2]	99.5 d	98.0 d	91.8 d	95.5 d
Halauxifen-methyl + florasulam[2]	99.0 d	97.0 d	96.8 d	96.2 d

[1]Means followed by the same letter within either the OSU research farm trials or within the grower field trials are not different at HSD Tukey ($P < 0.05$).
[2]Applied only on 2018 trials.

Similar results were documented for seed weight reduction with aminopyralid application; however, there were no differences between species (Table 3). The average seed weight reduction in Italian ryegrass after application of aminopyralid was 42% at anthesis and 39% at boot stage. For tall fescue, the average reduction of seed weight was 47% and 46% for anthesis and boot stages, respectively. Aminopyralid affected the speed of germination by 1 or 2 days (data not shown); however, these results were not different among the herbicides, nor were they consistent among the different trials.

Even though Italian ryegrass seed viability was reduced with aminopyralid applications, the reduction in tall fescue seed viability precludes its use for control of late-season Italian ryegrass escapes in tall fescue seed production fields. These results are in contrast to previous research, which reported that perennial grasses

Table 3. Seed weight (g/1,000 seed) after synthetic auxin applications to Italian ryegrass and tall fescue at boot and anthesis stages.[1]

	OSU research farm trials			
	Italian ryegrass seed weight		Tall fescue seed weight	
	Boot	Anthesis	Boot	Anthesis
	(g/1,000 seeds)		(g/1,000 seeds)	
Control	2.1 f	2.2 f	2.3 f	2.4 f
2,4-D	2.1 df	2.1 f	2.3 f	2.3 f
Dicamba	2.1 bdf	2.1 f	2.3 f	2.3 f
Aminopyralid	1.2 ac	1.2 ace	1.3 ace	1.2 ab
2,4-D + clopyralid	2.1 bdf	2.1 f	2.3 f	2.2 ef
Dicamba + 2,4-D	2.1 df	2.1 f	2.2 f	2.3 f
Dicamba (2x)[2]	2.0 bdf	2.0 bdf	2.0 bdf	2.1 cef
2,4-D (2x)[2]	2.0 bdf	2.0 bdf	2.1 bdf	2.0 cef
Halauxifen-methyl + florasulam[2]	2.0 bdf	2.1 bdf	2.1 bdf	2.0 cef
	Grower field trials			
	Italian ryegrass seed viability		Tall fescue seed viability	
	Boot	Anthesis	Boot	Anthesis
	(g/1,000 seeds)		(g/1,000 seeds)	
Control	2.1 c	2.1 c	2.2 c	2.2 c
2,4-D	2.1 c	2.1 c	2.2 c	2.2 c
Dicamba	2.1 c	2.0 c	2.2 c	2.2 c
Aminopyralid	1.4 ab	1.2 a	1.3 a	1.2 a
2,4-D + clopyralid	2.1 c	2.1 c	2.2 c	2.2 c
Dicamba + 2,4-D	2.1 c	2.1 c	2.2 c	2.2 c
Dicamba (2x)[2]	2.0 c	2.0 bc	2.0 c	2.0 bc
2,4-D (2x)[2]	2.0 c	2.0 bc	2.0 c	2.0 bc
Halauxifen-methyl + florasulam[2]	2.0 c	2.0 bc	2.0 c	2.0 bc

[1]Means followed by the same letter within either the OSU research farm trials or within the grower field trials are not different at HSD Tukey ($P < 0.05$).
[2]Applied only on 2018 trials.

were generally less susceptible to synthetic auxin treatments than annual grasses (Rinella et al., 2010, 2013).

Results of the study indicate that aminopyralid applications, when properly timed, can reduce seed size and viability of Italian ryegrass, but tall fescue seed is too sensitive to permit its use during the crop season. Aminopyralid is currently registered for use in rangelands, pastures, and some noncrop areas and was previously shown to reduce the viability of invasive grass species, so it may have some applications to reduce Italian ryegrass seed production on sites other than grass seed production fields.

Because aminopyralid was the only herbicide in this study to reduce seed viability and seed weight, these results raise questions about why some synthetic auxins affect seed development while others do not and why our results do not agree with previous reports that perennial species are more tolerant to these herbicides. Different synthetic auxin molecules may have different auxin receptors involved in the mechanism affecting seed viability. Additional studies should be conducted with synthetic auxin herbicides that were not tested in this study.

References

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