SEQUENTIAL HERBICIDE APPLICATIONS FOR DOWNY BROME (*BROMUS TECTORUM*) CONTROL IN ESTABLISHED KENTUCKY BLUEGRASS FOLLOWING LATE-SEASON PROPANE FLAMING IN THE GRANDE RONDE VALLEY OF NORTHEASTERN OREGON

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Introduction

A study was conducted during the fall of 2016 and spring of 2017 to evaluate downy brome (*Bromus tectorum*, BROTE) control and crop injury potential from sequential applications of preemergent and postemergent herbicides in established Kentucky bluegrass (KBG). Most herbicide products included in this trial are currently registered for use, except as follows:

- Flumioxazin + pyroxasulfon (Fierce), indaziflam (Alion), and topramezone (Impact) are not registered for use in any grass seed crops in the Pacific Northwest.
- Metribuzin products are not registered for use in northeastern Oregon or Columbia Basin grass seed production.
- East of the Cascades, flucarbazone (Everest) is registered only for Kentucky bluegrass seed crops during the establishment year.

Materials and Methods

The experiment was located in an established commercial field of 'Merit' Kentucky bluegrass in the Grande Ronde Valley (GRV) of northeastern Oregon. Plots were 8 feet x 25 feet and arranged in a randomized complete block design with four replications. Soil at the site is a Palouse silt loam (37.6% sand, 52.0% silt, 10.4% clay), with 4.75% organic matter (OM), pH of 4.6, and cation exchange capacity (CEC) of 29.2 meq/100g).

The field was seeded during spring of 2014, and the third seed crop was harvested in July 2017. After baling the crop residue, the field was propane flamed on September 2, 2016, harrowed twice, and then reflamed. Starter fertilizer was applied on September 9, 2016. Pendimethalin (Prowl H2O) was applied at 5 pt/acre by the grower on September 10. Approximately 4 inches of irrigation water was applied with a wheel line sprinkler system following this preemergent (PRE) herbicide application.

Early postemergent (EPOST) herbicide treatments were applied on September 25, 2016 to emerging BROTE with coleoptiles 1 inch or less in height. Mid-postemergent (MPOST) treatments were applied on October 22, 2016. Late postemergent treatments were applied on November 13, 2016. Environmental conditions at the time of herbicide application are summarized in Table 1. Sequential treatment information and site of action descriptions for each active ingredient are listed in Tables 2 and 3 (respectively). All treatments were applied with a hand-held CO_2 sprayer delivering 22 gpa at 30 psi. To minimize drift potential, TeeJet air induction extended-range (AIXR) 11002 nozzle tips were used for all applications.

Seed yield was not determined in this study. The trial site was mowed in late May 2017 due to crop destruct requirements of using nonregistered herbicides.

Table 1. Environmental conditions at time of herbicide application.

Application date	Sept. 25, 2016	Oct. 22, 2016	Nov. 13, 2016
Application timing	Early post (EPOST)	Mid-post (MPOST)	Late post (LPOST)
KBG growth stage	0–4 inches regrowth	4–6 inches	4–6 inches
BROTE growth stage	Coleoptile, 1 inch	3 inches, 2–4 tillers	4 inches, 3–5 tillers
Air temperature (°F)	72	53	48
Relative humidity (%)	33	47	85
Cloud cover	Clear and sunny	Partly cloudy	100% overcast
Wind velocity (mph)	0–3 from SSW	0–4 from NNE	0–2 from NNE
Soil temperature, surface (°F)	72	54	49
Soil temperature, 1 inch (°F)	80	55	48
Soil temperature, 2 inch (°F)	74	54	49
Soil temperature, 4 inch (°F)	61	54	48

Results and Discussion

The late fall of 2016 in the GRV was wet due to significant rainfall events beginning in late September and continuing until December (Figure 1). Early-fall conditions were drier except for a few rainfall events, which resulted in 0.39 inch of rainfall (IMBO AgriMet) between July 15, 2016 and September 10, 2016. The trial site received approximately 0.22 inch of rainfall between the PRE and EPOST herbicide applications, which promoted BROTE germination and emergence. BROTE emergence began September 10–25. An additional 1.48 inches of rainfall was received between application of EPOST and MPOST treatments. BROTE had developed two to five tillers by mid-November.

Visual evaluations of BROTE control were taken on November 13, 2016; March 16, 2017; and May 4, 2017 (Figure 2). The trial site was heavily infested with a uniformly distributed BROTE population. Acceptable levels of BROTE control (75–79%) were documented

Table 2. Sequential herbicide applications for downy brome (BROTE) control in established Kentucky bluegrass in the Grande Ronde Valley of northeastern Oregon, 2017 (Exp. 17-102).

Treatment	Treatment[1]	Active ingredient	Rate	Application timing	Site of action
			(per acre)		(group #)
1	Untreated check				
2	Outlook	Dimethenamid-p	21 fl oz	EPOST	15
3	Goal 2XL	Oxyfluorfen	8 oz	EPOST	14
	+ metribuzin DF	Metribuzin	2.7 oz		5
4	Beacon	Primisulfuron	0.38 oz	EPOST	2
	+ Sinbar WDG	Terbacil	0.5 lb		5
5	Callisto	Mesotrione	6 fl oz	EPOST	27
	+ Sinbar WDG	Terbacil	0.5 lb		5
6	Beacon fb	Primisulfuron	0.38 oz	EPOST	2
	Beacon	Primisulfuron	0.38 oz	MPOST	2
	+ Sinbar WDG	Terbacil	0.5 lb		5
7	Goal 2XL	Oxyfluorfen	8 fl oz	MPOST	14
	+ Sinbar WDG	Terbacil	0.5 lb		5
8	Goal 2XL	Oxyfluorfen	8 fl oz	EPOST	14
	+ Everest	Flucarbazone	1 fl oz		2
9	Beacon fb	Primisulfuron	0.76 oz	EPOST	2
	Outlook	Dimethenamid-p	21 fl oz	MPOST	15
10	Goal 2XL	Oxyfluorfen	8 fl oz	EPOST	14
	+ metribuzin DF fb	Metribuzin	2.7 oz		5
	Beacon	Primisulfuron	0.38 oz	MPOST	2
	+ Sinbar	Terbacil	0.5 lb		5
11	Beacon fb	Primisulfuron	0.38 oz	EPOST	2
	Beacon	Primisulfuron	0.38 oz	MPOST	2
	+ Sinbar WDG fb	Terbacil	0.5 lb		5
	Prowl H2O	Pendimethalin	5 pt	LPOST	3
12	Goal 2XL	Oxyfluorfen	8 fl oz	EPOST	1
	+ Sinbar fb	Terbacil	0.5 lb		5
	Outlook	Dimethenamid-p	21 fl oz	LPOST	15
13	Fierce	Flumioxazin + pyroxasulfon	3 oz	MPOST	14 +15
	+ Goal 2XL	Oxyfluorfen	2 fl oz		14
			0.25% v/v		
14	Alion	Indaziflam	2 fl oz	MPOST	29
	+ Goal 2XL	Oxyfluorfen	3 fl oz		14
			1% v/v		
15	Impact	Topramezone	2 fl oz	MPOST	27

[1]fb = followed by

Table 3. Site of action descriptions for herbicides included in the 2016–2017 downy brome trial.

Group #	Description (Weed Science Society of America)
2	Inhibits ALS (branched chain amino acid synthesis/cell division in roots and shoots)
3	Inhibits microtubule assembly (cell division in roots and shoots); swelling of root tips
5	Inhibits photosystem II (photosynthesis); loss of chlorophyll and carotenoids; leaky cells
14	Inhibits protoporphyrinogen oxidase (PPO); loss of chlorophyll; leaky cell membranes
15	Inhibits synthesis of very long chain fatty acids (VLCFA); affects seedling emergence
27	Inhibits 4-HPPD enzyme for carotenoid synthesis; bleaches new tissues
29	Inhibits cellulose synthesis

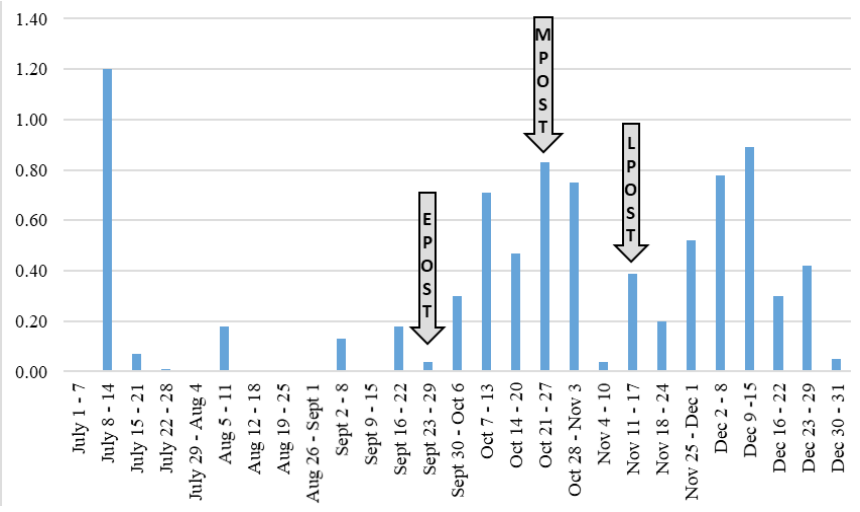

Figure 1. Weekly precipitation (inches) at Imbler AgriMet station (IMBO), fall 2016.

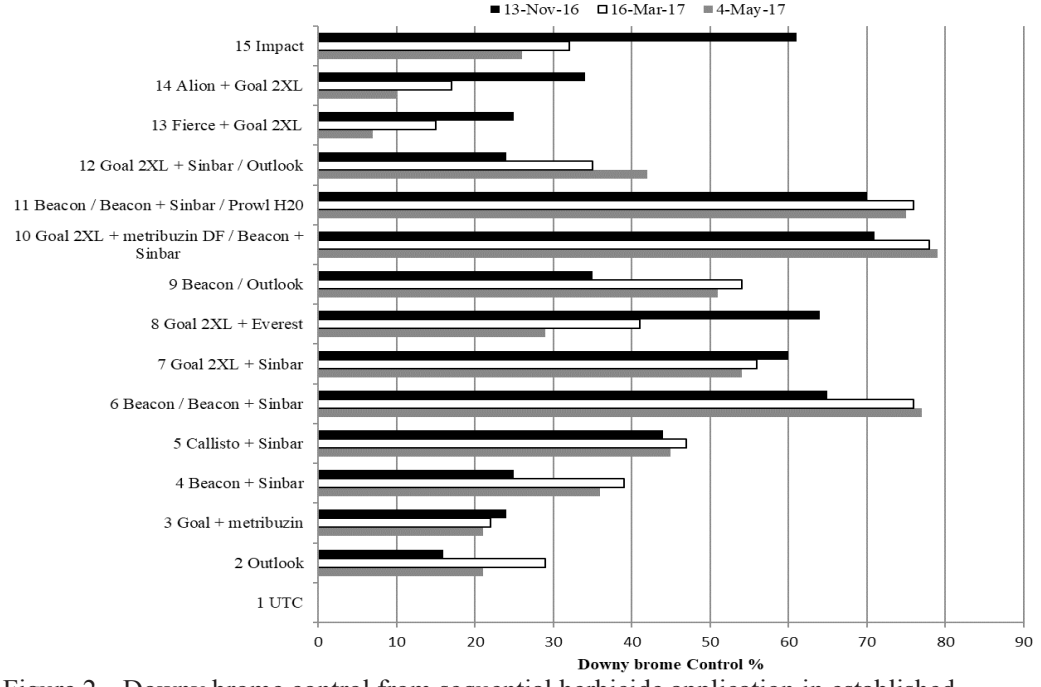

Figure 2. Downy brome control from sequential herbicide application in established Kentucky bluegrass in the Grande Ronde Valley of northeastern Oregon, fall 2016 and spring 2017.

from three sequential treatment combinations (Treatments 6, 10, and 11) following the PRE application of Prowl H2O (Figure 2). Treatments 6 and 11 included split application of Beacon (0.38 oz/acre) applied EPOST, followed by Beacon (0.38 oz/acre) + Sinbar (0.5 lb/acre) applied MPOST. Adding an LPOST application of Prowl H2O (5 pt/acre) did not appear to improve BROTE control (Treatment 11). Goal 2XL + metribuzin applied EPOST followed by Beacon + Sinbar (Treatment 10) resulted in slightly better BROTE control compared to Treatments 6 and 11, but slight crop injury (2%) was observed on May 4, 2017. No other treatments showed symptoms of crop injury in May 2017; however, most treatments did result in slight crop injury in November 2016 (Figure 3). Fierce, Alion, and Impact treatments did not provide adequate BROTE control (Figure 2). Product evaluations are for experimental purposes only; therefore, mention of the products used in this trial is not to be considered a recommendation for commercial use.

References

Ball, D.A. 2007. Crop tolerance of seedling Kentucky bluegrass to Velocity and Impact herbicides. *Eastern Oregon Weed Control Research Report.* Oregon State University Columbia Basin Agricultural Research Center. http://cbarc.aes.oregonstate.edu/sites/default/files/2007_rpts/07-761.pdf.

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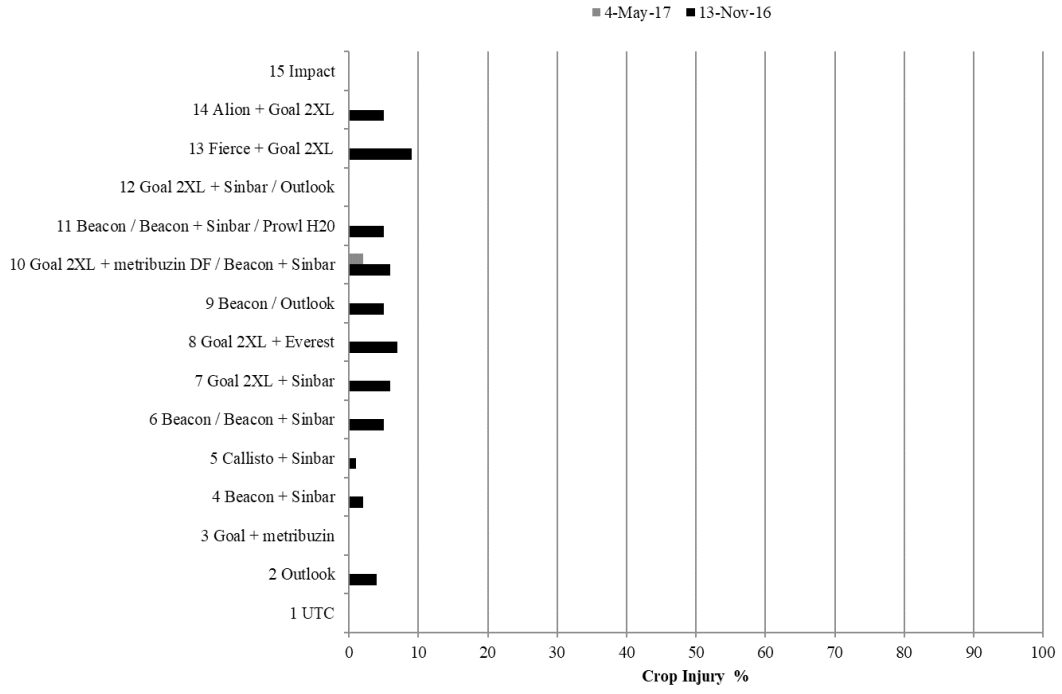

Figure 3. Crop injury from sequential herbicide applications in established Kentucky bluegrass in the Grande Ronde Valley of northeastern Oregon, fall 2016 and spring 2017.