

Annual Invasive Grass Weed Control with Indaziflam & Propoxycarbazone in CRP: Year 2

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The study was established on a conservation reserve program (CRP) site near Albion, WA. The objective was to evaluate Esplanade® (indaziflam), Lambient® (propoxycarbazone), Matrix® (rimsulfuron), Plateau 2XL® (imazapic), and Accord XRT II (glyphosate) for control of annual grasses (ventenata, *Ventenata dubia* (Leers) Coss., downy brome, *Bromus tectorum* L.) and medusahead, *Taeniatherum caput-medusae* (L.) Nevski., in Palouse prairie over several years.

Treatments were applied in the fall of 2016 when perennial grasses were dormant as a broadcast foliar application, detailed in Table 1 and Table 2. Treatments were applied with a CO₂ backpack sprayer at 20 gallons per acre (GPA). The study was conducted in a randomized complete block design with 4 replications of 10 ft by 30 ft long plots. The CRP site was established for more than ten years.

Percent cover for invasive annual grasses and desirable perennial grasses were visually assessed 7, 8, 22, and 34 months after treatment (MAT) (Table 2, 3, 4, & 5). First-year biomass for all species was collected August 8, 2018 and then sorted in the lab for assessment 21 months after treatment (MAT) (Table 5). The second- and third-year biomass for all species was collected August 8, 2018 and July 23, 2019, respectively (Table 4 & 5). Biomass was collected using 2 tenth meter squared quadrats randomly thrown in the plot. Cover data was collected using a 4 meter transect separated into 12 points. At each point, plant species were looked at a foot off either side and assessed on a presence/absence basis. All data were subjected to an analysis of variance using the statistical package built into the Agricultural Research Manager software system (ARM 8.5.0, Gylling Data Management).



Figure 1. Nontreated control of ICB0417. Contains medusahead, prickly lettuce, panicle willowweed and Idaho fescue.

Table 1. Treatment application details for ICB0417.

Study Application	
Date	November 9, 2016
Application volume (GPA)	15
Air Temperature (°F)	54
Soil Temperature (°F)	49
Wind velocity (mph, direction)	7, E
Cloud Cover	35%
Next rain occurred on	November 13, 2016

Results

During the first year: Ventenata (VETDU) percent cover was reduced 7 MAT for all treatments with less than 4% VETDU cover compared to the nontreated which had 13% VETDU cover (Table 2). Lambient alone (6%) did not significantly reduce VETDU cover compared to the nontreated (13%) 7

MAT. At 8 MAT, all treatments, except Plateau 2L (39%) and Accord XRT II (63%), reduced the percent cover for VETDU (less than 8%) compared to the nontreated control (51%) (Table 3). Esplanade in combination with either Lambient, Matrix, Plateau, or Accord XRT had the greatest reduction in VETDU cover (0%) 8 MAT (Table 2). Downy brome (BROTE) cover showed no differences however, there were low and uneven populations found onsite, making the data inconclusive. However, Plateau 2L released the downy brome (100% cover) 7 MAT compared to the nontreated (8%) (Table 2). Medusahead (ELYCM) percent cover was similar to the nontreated control for both 7 and 8 MAT (Table 2). At 7 and 8 MAT, prickly lettuce (LACSE) and field bindweed (CONAR) percent cover showed no differences to treatments.

Bluebunch wheatgrass percent cover was not different between treatments at 7 and 8 MAT (Table 3). Smooth brome 7 MAT was similar throughout the treatments. However, by 8 MAT smooth brome percent cover was the highest with Esplanade in combination with Lambient (73%), Plateau 2L (76%) and Accord XRT II (84%) (Table 3) compared to the nontreated (8%) (Table 3).

During the second year, there was a shift in the dominant invasive annual grass species present across the site. The dominant invasive annual grass was medusahead (ELYCM), possibly due to control of VETDU by the treatments applied in 2016.

Biomass for all species was collected and evaluated 21 MAT. Esplanade with either Matrix or Plateau 2L caused significant reduction in ELYCM biomass (0 g m^{-2}) compared to the nontreated (87 g m^{-2}). Esplanade alone (17 g m^{-2}), Accord XRT II (7 g m^{-2}), and Esplanade + Lambient (8 g m^{-2}) also greatly reduced ELYCM biomass although not significantly difference from the nontreated (87 g m^{-2}). Ventenata (VETDU) biomass was also the lowest for Esplanade + Matrix (1 g m^{-2}) and Esplanade + Plateau (0 g m^{-2}) but had similar biomass to the nontreated (8 g m^{-2}) possibly due to the high density of ELYCM (Table 4). Downy brome (BROTE) was significantly different from the nontreated (22 g m^{-2}) for all treatments ($<6 \text{ g m}^{-2}$) (Table 4). All invasive annual grasses were reduced with Esplanade mixed with Matrix or Plateau 2L (2 and 0 g m^{-2} respectively) (Table 4). All broadleaf species including prickly lettuce, panicle willowweed, field bindweed and western salsify were not affected by treatments. Ventenata cover was visually assessed 22 MAT. Esplanade (27%), Esplanade and Lambient (25%), Esplanade and Plateau 2L (2%), and Esplanade and Accord XRT II (0%) had the greatest reduction in VETDU cover compared to the nontreated (100%) (Table 6).

At 22 MAT, Idaho fescue (FESID) biomass was not affected by treatments (Table 4). The combination of all perennial grass species including Idaho fescue, bluebunch wheatgrass and smooth brome was not significantly different from the nontreated (Table 4). Perennial grass cover was not different between treatments (Table 4).

During the third year, the entire trial was treated with a blanket application of rimsulfuron. As a result, no invasive annual grasses except for small amounts of medusahead were found on the site.

At 32 MAT, medusahead (ELYCM) biomass was not significantly different from the nontreated (Table 5). ELYCM percent cover 34 MAT was significantly reduced when Esplanade with Lambient (0%), Matrix (0%), or with Plateau 2L (0%) compared to the nontreated (75%) (Table 5). Prickly lettuce (LACSE) and Western salsify (TRODM) biomass was not affected by treatments (Table 5). The combination of all broadleaf weeds did not show any differences between treatments. LACSE and TRODM percent cover was not reduced by any treatment compared to the nontreated (Table 5).

At 32 MAT, Idaho fescue (FESID) biomass was similar to the nontreated (Table 5). When esplanade was applied alone or in combination with another herbicide, it resulted in biomass greater than ($>24 \text{ g m}^{-2}$) than the nontreated (7 g m^{-2}). The combination of all perennial grasses biomass were similar among treatment (Table 5). FESID and AGRSP percent cover was not different between treatments.

Table 2. Percent cover of *ventenata* (VEIDU), downy brome (BROTE), medusa-head rye (ELYCM), prickly lettuce (LACSE), and field bindweed (CONAR) following application of indaziflam with different tank partners. Albion, WA, 2017. MAT = months after treatment. Means followed by the same letter are not significantly different ($\alpha=0.05$). A (-) indicates a non-assessable population.

Treatment	Rate lb ai/A	YEAR 1: Cover									
		June 2, 2017 (7 MAT)					June 30, 2017 (8 MAT)				
		Invasive Annual Grasses		Broadleaf Weeds		%	Invasive Annual Grasses		Broadleaf Weeds		%
VEIDU	BROTE	LACSE	CONAR	VEIDU	BROTE		ELYCM	LACSE	CONAR		
Nontreated	-	13 a	8	5	3	51 a	5	27	3	6	
Esplanade	7 fl oz/A	0.091	1 b	9	3	5 b	-	22	10	5	
NIS	0.25% v/v										
Lambient	1.2 oz/A	0.053	6 ab	3	9	8 b	3	29	14	3	
NIS	0.25% v/v										
Matrix	4 oz/A	0.063	1 b	26	-	1 b	-	13	20	10	
NIS	0.25% v/v										
Plateau 2L	7 fl oz/A	0.109	1 b	3	10	39 a	3	19	5	2	
NIS	0.25% v/v										
Accord XRT II	12 fl oz/A	0.475	4 b	-	13	63 a	5	0	-	8	
NIS	0.25% v/v										
Esplanade	7 fl oz/A	0.091	0 b	3	3	0 b	-	0	-	3	
Lambient	1.2 oz/A	0.053	0 b	3	3	0 b	-	0	-	3	
NIS	0.25% v/v										
Esplanade	7 fl oz/A	0.091	0 b	3	5	0 b	-	0	10	-	
Matrix	4 oz/A	0.063	0 b	3	5	0 b	-	0	10	-	
NIS	0.25% v/v										
Esplanade	7 fl oz/A	0.091	0 b	3	3	0 b	-	0	5	5	
Plateau 2L	7 fl oz/A	0.109	0 b	3	3	0 b	-	0	5	5	
NIS	0.25% v/v										
Esplanade	7 fl oz/A	0.091	0 b	-	4	0 b	-	0	-	18	
Accord XRT II	12 fl oz/A	0.475	0 b	-	4	0 b	-	0	-	18	
NIS	0.25% v/v										
LSD (P -value = 0.05)											
		7	NS	NS	NS	24	NS	NS	NS	NS	

Table 3. Percent cover of perennial grasses, bluebunch wheatgrass (*Agropyron spicatum*) and smooth brome (*Bromus inermis*), following application of indaziflam with different tank partners. Albion, WA, 2017. MAT = months after treatment. Means followed by the same letter are not significantly different ($\alpha=0.05$). A (-) indicates a non-assessable population.

YEAR 1: Cover						
Treatment	Rate		<i>June 2, 2017 (7 MAT)</i>		<i>June 30, 2017 (8 MAT)</i>	
	<i>field rate</i>	<i>lb ai/A</i>	Desirable Perennial Grasses		Desirable Perennial Grasses	
			Bluebunch wheatgrass	Smooth brome	Bluebunch wheatgrass	Smooth brome
			%			
Nontreated	-	-	13	34	-	8 c
Esplanade	7 fl oz/A	0.091	50	31	3	36 bc
NIS	0.25% v/v					
Lambient	1.2 oz/A	0.053	33	28	-	25 c
NIS	0.25% v/v					
Matrix	4 oz/A	0.063	34	29	25	46 abc
NIS	0.25% v/v					
Plateau 2L	7 fl oz/A	0.109	22	43	25	16 c
NIS	0.25% v/v					
Accord XRT II	12 fl oz/A	0.475	3	48	14	12 c
NIS	0.25% v/v					
Esplanade	7 fl oz/A	0.091	29	57	23	73 a
Lambient	1.2 oz/A	0.053				
NIS	0.25% v/v					
Esplanade	7 fl oz/A	0.091	50	63	63	68 ab
Rezilon	4 oz/A	0.063				
NIS	0.25% v/v					
Esplanade	7 fl oz/A	0.091	38	51	25	76 a
Plateau 2L	7 fl oz/A	0.109				
NIS	0.25% v/v					
Esplanade	7 fl oz/A	0.091	-	47	-	84 a
Accord XRT II	12 fl oz/A	0.475				
NIS	0.25% v/v					
<i>LSD</i>			<i>NS</i>	<i>NS</i>	<i>NS</i>	27

Table 4. Biomass of *ventenata* (VETDU), downy brome (BROTE), Idaho fescue (FESID), medusa-head rye (ELYCM), and all the invasive annual grasses, broadleaf weeds, or desirable perennial grasses combined (COMBINED) on August 8, 2018 (21 MAT) following application of indaziflam with different tank partners. Percent cover of *ventenata* (VETDU) and perennial grasses on September 11, 2018 (22 MAT). Albion, WA, 2018. MAT = months after treatment. Means followed by the same letter are not significantly different ($\alpha=0.05$).

Treatment	Field Rate	YEAR 2: Biomass & Cover									
		Biomass					Cover				
		August 8, 2018 (21 MAT)					September 11, 2018 (22 MAT)				
		Invasive Annual Grasses		Broadleaf Weeds		Desirable Perennial Grasses		Invasive Annual Grasses		Desirable Perennial Grasses	
VETDU	BROTE	ELYCM	COMBINED	COMBINED	FESID	COMBINED	VETDU	COMBINED	FESID	COMBINED	
g m ⁻²											
%											
Nontreated	-	8 b	22 a	87 ab	101 ab	11	15	26	100 a	100	100
Esplanade NIS	7 fl oz/A 0.25% v/v	11 b	5 b	17 ab	22 b	8	25	69	27 b	100	100
Lambiant NIS	1.2 oz/A 0.25% v/v	27 ab	3 b	114 a	142 a	16	26	35	90 a	100	100
Matrix NIS	4 oz/A 0.25% v/v	24 b	6 b	47 ab	80 ab	14	10	19	100 a	100	100
Plateau 2L NIS	7 fl oz/A 0.25% v/v	51 ab	5 b	31 ab	84 ab	12	25	57	100 a	100	100
Accord XRT II NIS	12 fl oz/A 0.25% v/v	46 ab	3 b	7 ab	86 ab	7	10	20	100 a	100	100
Esplanade Lambiant NIS	7 fl oz/A 1.2 oz/A 0.25% v/v	48 ab	1 b	8 ab	29 b	27	52	53	25 b	100	100
Esplanade Matrix NIS	7 fl oz/A 4 oz/A 0.25% v/v	1 b	2 b	0 b	2 b	20	71	71	50 ab	100	100
Esplanade Plateau 2L NIS	7 fl oz/A 7 fl oz/A 0.25% v/v	0 b	1 b	0 b	0 b	4	60	124	2 b	100	100
Esplanade Accord XRT II NIS	7 fl oz/A 12 fl oz/A 0.25% v/v	78 a	4 b	9 ab	20 b	3	93	143	0 b	100	100
LSD (P -value = 0.05)											
		52	4	6.7	63	NS	NS	NS	52.2	NS	NS

Table 5. Biomass of Idaho fescue (FESID), bluebunch wheatgrass (AGRSP), medusa-head rye (ELYCM), prickly lettuce (LACSE), western salsify (TRODM), and all broadleaf weeds or desirable perennial grasses combined (COMBINED) on July 23, 2019 (32 MAT) following application of indaziflam with different tank partners. Percent cover of Idaho fescue (FESID), bluebunch wheatgrass (AGRSP), medusa-head rye (ELYCM), prickly lettuce (LACSE), western salsify (TRODM), and panicle willowweed (EPIPC) on September 16, 2019 (34 MAT). Albion, WA, 2018. MAT = months after treatment. Means followed by the same letter are not statistically significantly different ($\alpha=0.05$).

Treatment	Field Rate	YEAR 3: Biomass & Cover												
		Biomass					Cover							
		July 23, 2019 (32 MAT)					September 16, 2019 (34 MAT)							
		Invasive Annual Grass	Broadleaf weeds		Desirable Perennial Grasses		Invasive Annual Grass	Broadleaf weeds		Desirable Perennial Grasses				
ELYCM	LACSE	TRODM	COMBINED	FESID	AGRSP	COMBINED	ELYCM	LACSE	TRODM	EPIPC	FESID	AGRSP		
g m ⁻²														
Nontreated	-	9	13	12	29	2	4	7	75 a	100	75	0	100	50
Esplanade	7 fl oz/A	37	10	32	33	4	15	25	38 ab	100	50	0	100	75
NIS	0.25% v/v													
Lambiant	1.2 oz/A	63	12	05	28	4	5	12	75 a	100	75	0	100	50
NIS	0.25% v/v													
Matrix	4 oz/A	25	27	17	59	0	6	6	75 a	100	100	8	75	50
NIS	0.25% v/v													
Plateau 2L	7 fl oz/A	42	7	12	20	4	10	20	58 ab	100	75	13	100	50
NIS	0.25% v/v													
Accord XRT II	12 fl oz/A	28	19	9	29	0	5	5	54 ab	100	100	8	75	50
NIS	0.25% v/v													
Esplanade	7 fl oz/A	1	16	19	25	1	41	48	0 b	100	75	0	75	75
Lambiant	1.2 oz/A													
NIS	0.25% v/v													
Esplanade	7 fl oz/A	1	15	26	41	4	14	24	0 b	100	100	0	75	50
Matrix	4 oz/A													
NIS	0.25% v/v													
Esplanade	7 fl oz/A	16	15	11	23	0	22	36	0 b	100	75	0	50	50
Plateau 2L	7 fl oz/A													
NIS	0.25% v/v													
Esplanade	7 fl oz/A	7	10	0	15	0	14	49	14 ab	100	50	6	75	50
Accord XRT II	12 fl oz/A													
NIS	0.25% v/v													
LSD (P-value = 0.05)		NS	NS	NS	NS	NS	NS	NS	44	NS	NS	NS	NS	NS

Figure 1. Climate (2017) from nearest weather station located ~4 miles east of trial site.

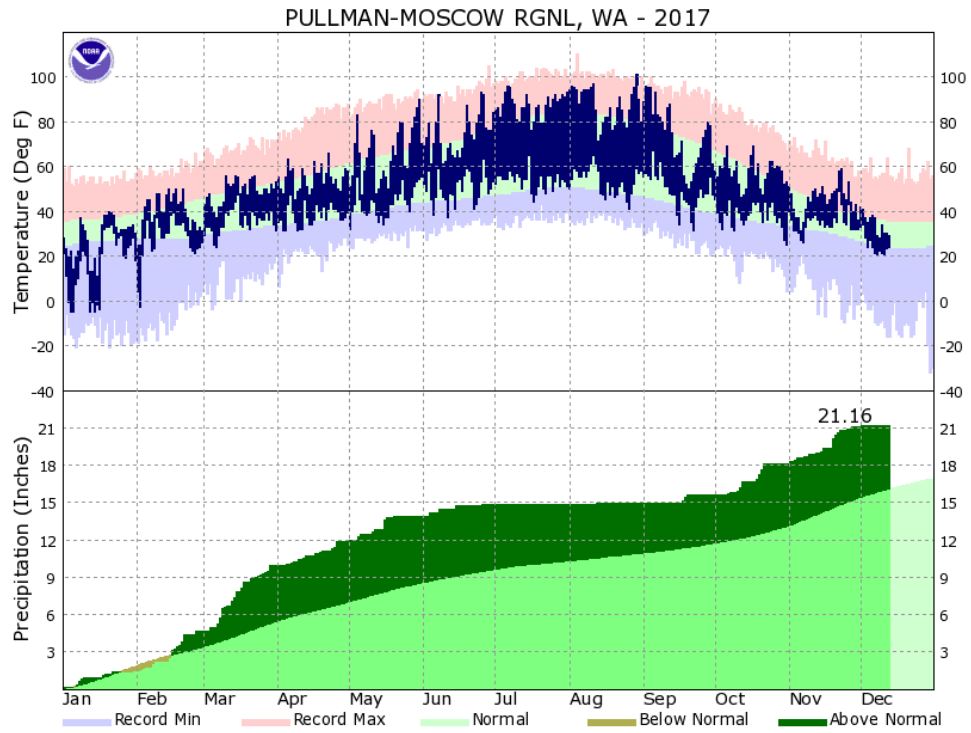


Figure 2. Climate (2018) from nearest weather station located ~4 miles east of trial site

