

ONION RESPONSE TO FOMESAFEN (REFLEX[®]) HERBICIDE APPLIED AT VARIOUS TIMINGS ON MINERAL SOIL

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Introduction

Weed control is an important component of onion production in order to minimize yield losses and realize acceptable marketable bulb size. Weed control in onions is difficult compared to other crops because of the lack of a complete crop canopy and limited herbicide options. The few herbicides registered for use in onion necessitate evaluation of product fitness as they come on the market. Reflex[®] herbicide would fit well into onion production systems in the Treasure Valley of eastern Oregon and southwestern Oregon because of its ability to suppress yellow nutsedge. The objectives of this study were to evaluate onion tolerance of Reflex herbicide and weed control efficacy under local conditions.

Materials and Methods

A field study was conducted at the Malheur Experiment Station, Ontario, Oregon in 2017 to evaluate the response of onion variety ‘Vaquero’ to Reflex (fomesafen) herbicide applied at various onion growth stages. Seeds of onion variety Vaquero were planted on April 7, 2017 in double rows spaced 3 inches apart with 4-inch seed spacing within each row. Each double row was planted on beds spaced 22 inches apart. On April 12, onion rows received a 7-inch band of Lorsban[®] at 3.7 oz/1000 ft of row (chlorpyrifos at 0.206 lb ai/acre) and the soil surface was rolled. The soil was a Greenleaf silt loam with a pH of 7.2 and 1.5% organic matter.

The study had a randomized complete block design with four replicates. Individual plots were 7.33 ft wide (4 beds) by 27 ft long. Plots for respective treatments (except untreated check plots) were treated with pendimethalin (Prowl[®] H₂O) at 2.0 pt/acre (0.95 lb ai/acre) or Reflex late pre-emergence (LPRE) on April 19 (Table 1). Postemergence treatments were sprayed on May 3 when onion plants were at the 2-leaf stage and on May 23 when plants were at the 4-leaf stage. The study was sprayed with Poast[®] herbicide at 1.5 pt/acre (sethoxydim at 0.287 lb ai/acre) plus crop oil concentrate at 2.5% v/v on May 10 to control grassy weeds.

Urea ammonium nitrate solution (URAN) to supply 30 lb nitrogen (N)/acre was applied through the drip tape on May 3. The same fertilizer solution was used to supply 50 lb N/acre at each occurrence on June 20, 29, and July 14. All weeds were counted and removed on June 20. All other operations including insect control followed recommended local production practices.

Plant tops were flailed and onion bulbs were lifted on September 6 and 7, respectively. Bulbs were hand-harvested from the two center beds on September 15 and graded on September 27. Bulbs were graded for yield and quality based on USDA standards as follows: bulbs without blemishes (U.S. No. 1), split bulbs (U.S. No. 2), bulbs infected with the fungus *Botrytis allii* in the neck or side, bulbs infected with the fungus *Fusarium oxysporum* (plate rot), bulbs infected with the fungus *Aspergillus niger* (black mold), and bulbs infected with unidentified bacteria in the external scales. The U.S. No. 1 bulbs were graded according to diameter: small (<2¼ inches), medium (2¼-3 inches), jumbo (3-4 inches), colossal (4-4¼ inches), and supercolossal (>4¼ inches). Marketable yield consisted of U.S. No.1 bulbs >2¼ inches.

Data were subjected to analysis of variance and the treatment means were compared using protected LSD at the 0.05% level of confidence.

Results

Onion emergence was observed on May 3, 2017. Generally, the plant population was low during the 2017 cropping season, possibly due to uncharacteristically high moisture from winter snow and spring precipitation. Treatments that received Reflex LPRE had the lowest plant stand compared to plots treated with Prowl H₂O (Table 1). Onion plant height was also variable across herbicide treatment, but there was no clear trend, suggesting plant stand may have been influenced by factors other than herbicide treatments. Onion injury was greater for plants in plots sprayed with Reflex LPRE. The injury was characterized by yellowing of the leaves and overall stunting.

Common lambsquarters control on May 23 (35 days after LPRE and 21 days after postemergence application) was ≥91% across herbicide treatments except for Reflex followed by Buctril® alone when onions were at the 2-leaf stage (Table 1). A similar trend was observed for redroot pigweed, kochia, and hairy nightshade control.

Evaluation on May 30 (28 days after postemergence application) revealed high onion injury for plots treated with Reflex at 4 fl oz/acre (LPRE) followed by Reflex at 16 fl oz/acre when onions were at the 2-leaf stage (Table 2). Control for common lambsquarters ranged from 53 to 95%, while control for redroot pigweed ranged from 49 to 98%. Kochia control ranged from 25 to 98% and hairy nightshade control was from 41 to 98% across herbicide treatments.

The number of weeds in the two center rows of each plot on June 26 is presented in Table 3. The most weeds were observed in plots treated LPRE with Reflex at 4 fl oz/acre or Prowl H₂O followed by Reflex.

Three treatment combinations resulted in onion marketable yield similar to the hand-weeded check (Table 4): Prowl H₂O followed by Buctril, Prowl H₂O followed by Reflex at the loop stage followed by Buctril at the 4-leaf stage, and Prowl H₂O followed by Reflex at the 2-leaf stage (Table 4). The lowest yield was observed when Reflex at 4 fl oz/acre was applied LPRE followed by Reflex at 8 fl oz/acre when onions were at the 2-leaf stage.

Results from this study suggest that Reflex may not be a viable candidate as a late pre-emergence-applied product to control weeds in onions. Reflex remains a good candidate for postemergence application to manage weeds in onions. The study will be repeated in 2018 to confirm these results.

Acknowledgements

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Table 1. Onion plant stand on May 23 and injury and weed control on May 24 in response to various fomesafen (Reflex) herbicide rates and application timing at the Malheur Experiment Station, Ontario, OR, 2017.

Treatment	Rate ^a lb ai/a	Product rate per acre	Timing ^b	Plant stand	Plant height inches	Injury	Weed control ^c			
							Common lambsquarters	Redroot pigweed	Kochia	Hairy nightshade
Untreated				79,640ab	29.3 f	0 c	0 c	0 c	0 d	0 c
Hand weeded				94,820a	33.9 a	1 c	100 a	100 a	100 a	100 a
Fomesafen	0.0625	4 fl oz	LPRE	78,100b	33.1 a-d	6 c	48 b	48 b	40 c	46 b
Buctril	0.188	12 fl oz	4-leaf							
Prowl H ₂ O	0.95	2 pt	LPRE	81,400ab	33.1 a-d	5 c	99 a	99 a	99 ab	100 a
Buctril	0.188	12 fl oz	4-leaf							
Prowl H ₂ O	0.95	2 pt	LPRE	72,930bc	33.5 abc	8 bc	100 a	100 a	100 a	100 a
Fomesafen	0.0625	4 fl oz	LOOP							
Buctril	0.188	12 fl oz	4-leaf							
Prowl H ₂ O	0.95	2 pt	LPRE	84,150ab	30.6 def	3 c	96 a	97 a	96 ab	96 a
Fomesafen	0.0625	4 fl oz	2-leaf							
Prowl H ₂ O	0.95	2 pt	LPRE	82,720ab	32.7 a-e	4 c	97 a	98 a	98 ab	98 a
Fomesafen	0.125	8 fl oz	2-leaf							
Prowl H ₂ O	0.95	2 pt	LPRE	79,310ab	33.8 ab	5 c	99 a	99 a	99 ab	99 a
Fomesafen	0.25	16 fl oz	2-leaf							
Prowl H ₂ O	0.95	2 pt	LPRE	68,750bc	31.2 b-f	9 abc	97 a	95 a	78 b	98 a
Buctril	0.188	12 fl oz	2-leaf							
Fomesafen	0.0625	4 fl oz	LPRE	56,760c	30.2 ef	18 ab	94 a	93 a	90 ab	96 a
Fomesafen	0.125	8 fl oz	2-leaf							
Fomesafen	0.0625	4 fl oz	LPRE	77,000b	31.0 c-f	8 bc	91 a	90 a	85 ab	90 a
Fomesafen	0.25	16 fl oz	2-leaf							
Prowl H ₂ O	0.95	2 pt	LPRE	57,310c	31.7 a-f	19 a	98 a	98 a	98 ab	96 a
Fomesafen	0.0625	4 fl oz	LOOP							
Fomesafen	0.0625	4 fl oz	2-leaf							
Fomesafen	0.0625	4 fl oz	4-Leaf							
LSD (<i>P</i> = 0.05)				16,296.9	2.62	10.16	9.81	12.45	22.46	10.61
Standard Deviation				11,286.6	1.81	7.04	6.80	8.62	15.56	7.35
CV				14.84	5.67	100.82	8.02	10.2	19.03	8.64

^aFomesafen = Reflex; Prowl H₂O = pendimethalin.

^bTiming LPRE-late pre-emergence (75% of seeds have germinated but no emergence); 2-leaf = onion seedlings at 2-leaf stage; 4-leaf = onion seedling at 4-leaf stage.

^cMeans within a column followed by same letter do not significantly differ (*P* = 0.05, LSD).

Table 2. Onion injury and weed control on May 30 in response to various Fomesafen (Reflex) rates and application timing at the Malheur Experiment Station, Ontario, OR.

Treatment	Rate ^a lb ai/acre	Product rate per acre	Timing ^b	Onion injury	Weed control ^c			
					Common lambsquarters	Redroot pigweed	Kochia	Hairy nightshade
					----- % -----			
Untreated				0 c	0 d	0 d	0 f	0 e
Hand weeded				0 c	100 a	100 a	100 a	100 a
Fomesafen	0.0625	4 fl oz	LPRE	10 bc	53 c	49 c	25 e	41 d
Buctril	0.188	12 fl oz	4-leaf					
Prowl H ₂ O	0.95	2 pt	LPRE	10 bc	95 ab	97 a	98 ab	95 a
Buctril	0.188	12 fl oz	4-leaf					
Prowl H ₂ O	0.95	2 pt	LPRE	1 c	95 ab	98 a	97 ab	97 a
Fomesafen	0.0625	4 fl oz	LOOP					
Buctril	0.188	12 fl oz	4-leaf					
Prowl H ₂ O	0.95	2 pt	LPRE	8 bc	76 abc	76 ab	76 bc	75 abc
Fomesafen	0.0625	4 fl oz	2-leaf					
Prowl H ₂ O	0.95	2.0 pt	LPRE	4 c	93 ab	95 ab	86 ab	87 ab
Fomesafen	0.125	8 fl oz	2-leaf					
Prowl H ₂ O	0.95	2 pt	LPRE	5 c	96 ab	98 a	97 ab	97 a
Fomesafen	0.25	16 fl oz	2-leaf					
Prowl H ₂ O	0.95	2 pt	LPRE	4 c	95 ab	95 ab	95 ab	98 a
Buctril	0.188	12 fl oz	2-leaf					
Fomesafen	0.0625	4 fl oz	LPRE	23 ab	61 c	69 bc	41 de	50 cd
Fomesafen	0.125	8 fl oz	2-leaf					
Fomesafen	0.0625	4 fl oz	LPRE	11 abc	73 bc	75 abc	53 cd	68 bc
Fomesafen	0.25	16 fl oz	2-leaf					
Prowl H ₂ O	0.95	2 pt	LPRE	28 a	92 ab	97 a	96a b	97 a
Fomesafen	0.0625	4 fl oz	LOOP					
Fomesafen	0.0625	4 fl oz	2-leaf					
Fomesafen	0.0625	4 fl oz	4-leaf					
LSD ($P = 0.05$)				17.04	24.58	26.54	23.67	25.18
Standard Deviation				11.80	17.03	18.38	16.39	17.44
CV				138.13	22.03	23.27	22.79	23.17

^aFomesafen = Reflex; Prowl H₂O = pendimethalin.

^bTiming LPRE-late pre-emergence (75% of seeds have germinated but no emergence); 2-leaf = onion seedlings at 2-leaf stage; 4-leaf = onion seedling at 4-leaf stage.

^cMeans within a column followed by same letter do not significantly differ ($P = 0.05$, LSD).

Table 3. Number of weeds in the two center rows of each plot (3.67 x 27 ft) on June 29, 2017 in response to Fomesafen (Reflex) applied at various timings in direct-seeded onion at the Malheur Experiment Station, Ontario, OR.

Treatment	Rate ^a lb ai/acre	Product rate per acre	Timing ^b	Number of weeds ^c				Total
				Common lambsquarters	Redroot pigweed	Kochia	Hairy nightshade	
Untreated				138 a	59 ab	18 a	30 a	244 a
Hand weeded				18 c	9 c	0 d	1 b	28 e
Fomesafen	0.0625	4 fl oz	LPRE	104 ab	32 abc	9 a-d	8 ab	154 bc
Buctril	0.188	12 fl oz	4-leaf					
Prowl H ₂ O	0.95	2 pt	LPRE	14 c	8 c	3 d	3 b	27 e
Buctril	0.188	12 fl oz	4-leaf					
Prowl H ₂ O	0.95	2 pt	LPRE	5 c	16 bc	0 d	0 b	22 e
Fomesafen	0.0625	4 fl oz	LOOP					
Buctril	0.188	12 fl oz	4-leaf					
Prowl H ₂ O	0.95	2 pt	LPRE	58 bc	72 a	8 a-d	31 a	169 abc
Fomesafen	0.0625	4 fl oz	2-leaf					
Prowl H ₂ O	0.95	2 pt	LPRE	58 bc	23 bc	4 cd	12 ab	97 cde
Fomesafen	0.125	8 fl oz	2-leaf					
Prowl H ₂ O	0.95	2 pt	LPRE	24 c	3 c	4 cd	0 b	31 e
Fomesafen	0.25	16 fl oz	2-leaf					
Prowl H ₂ O	0.95	2 pt	LPRE	7 c	14 c	0 d	0 b	20 e
Buctril	0.188	12 fl oz	2-leaf					
Fomesafen	0.0625	4 fl oz	LPRE	155 a	24 bc	15 ab	4 b	198 ab
Fomesafen	0.125	8 fl oz	2-leaf					
Fomesafen	0.0625	4 fl oz	LPRE	99 ab	11 c	14 abc	8 ab	131 bcd
Fomesafen	0.25	16 fl oz	2-leaf					
Prowl H ₂ O	0.95	2 pt	LPRE	46 bc	3 c	7 bcd	0 b	55 de
Fomesafen	0.0625	4 fl oz	LOOP					
Fomesafen	0.0625	4 fl oz	2-leaf					
Fomesafen	0.0625	4 fl oz	4-leaf					
LSD ($P = 0.05$)				72.7	45.9	9.5	23.6	86.3
Standard Deviation				50.3	31.8	6.6	16.3	59.8
CV				83.31	139.17	97.15	201.73	60.93

^aFomesafen = Reflex; Prowl H₂O = pendimethalin.

^bTiming LPRE-late pre-emergence (75% of seeds have germinated but no emergence); 2-leaf = onion seedlings at 2-leaf stage; 4-leaf = onion seedling at 4-leaf stage.

^cMeans within a column followed by same letter do not significantly differ ($P = 0.05$, LSD).

Table 4. Onion bulb yield in response to Fomesafen (Reflex) herbicide applied at various growth stages at the Malheur Experiment Station, Ontario, OR, 2017.

Treatment	Rate ^a lb ai/acre	Product rate per acre	Timing ^b	Unmarketable			Marketable ^c					Total
				Plate rot	US No. 2	<2¼ in	2¼-3 in	3-4 in	4-4¼ in	>4¼ in	cwt/acre ^d	
Untreated				0.0b	0.0b	0.0e	0.0 e	0.0f	0.0 e	0.0 e	0.0 g	
Hand weeded				6.5 a	2.3b	7.2bcd	15.2 cde	404.4 ab	379.1 a	152.1 a	950.7 a	
Fomesafen	0.0625	4 fl oz	LPRE	2.5 ab	5.0b	5.2cde	25.3 bcd	380.5 abc	228.6 bcd	73.5 bcd	707.9b-e	
Buctril	0.188	12 fl oz	4-leaf									
Prowl H ₂ O	0.95	2 pt	LPRE	0.9ab	2.3 b	4.2de	14.6 cde	358.5 abc	384.2 a	87.1 abc	844.5 ab	
Buctril	0.188	12 fl oz	4-leaf									
Prowl H ₂ O	0.95	2 pt	LPRE	1.1 ab	5.4 b	2.7 de	9.1 de	305.1 cde	376.6 a	116.5 ab	807.3 ab	
Fomesafen	0.0625	4 fl oz	LOOP									
Buctril	0.188	12 fl oz	4-leaf									
Prowl H ₂ O	0.95	2 pt	LPRE	1.8 ab	2.4 b	16.2 a	55.1 a	295.6 cde	152.2 cd	45.6 cde	548.5 def	
Fomesafen	0.0625	4 fl oz	2-leaf									
Prowl H ₂ O	0.95	2.0pt	LPRE	1.5 ab	1.0b	11.1 abc	31.9 bc	423.3 a	217.7 bcd	50.8 b-e	723.8bcd	
Fomesafen	0.125	8 fl oz	2-leaf									
Prowl H ₂ O	0.95	2 pt	LPRE	4.7 ab	6.5b	5.3cde	22.6 bcd	321.2bcd	312.4 ab	116.0 ab	772.2abc	
Fomesafen	0.25	16 fl oz	2-leaf									
Prowl H ₂ O	0.95	2 pt	LPRE	1.4 ab	8.8 b	7.4bcd	22.1 b-e	285.3 cde	201.1 bcd	80.9 bcd	589.4cde	
Buctril	0.188	12 fl oz	2-leaf									
Fomesafen	0.0625	4 fl oz	LPRE	0.6 b	1.8b	13.4 ab	32.2 bc	207.7 e	85.0 de	37.4 cde	362.4 f	
Fomesafen	0.125	8 fl oz	2-leaf									
Fomesafen	0.0625	4 fl oz	LPRE	3.2 ab	3.1 b	11.7 abc	40.4 ab	321.9 bcd	116.3 cde	20.4 de	499.1 ef	
Fomesafen	0.25	16 fl oz	2-leaf									
Prowl H ₂ O	0.95	2 pt	LPRE	2.8 ab	114.4 a	2.7 de	16.9 cde	234.0 de	245.8 abc	86.4 a-d	583.0cde	
Fomesafen	0.0625	4 fl oz	LOOP									
Fomesafen	0.0625	4 fl oz	2-leaf									
Fomesafen	0.0625	4 fl oz	4-leaf									
LSD (<i>P</i> = 0.05)				5.56	90.81	6.64	22.31	98.67	144.52	66.58	216.45	
Standard Deviation				3.85	62.89	4.60	15.45	68.33	100.09	46.11	149.90	
CV				170.15	493.26	63.29	64.94	23.18	44.5	63.84	24.35	

^aFomesafen = Reflex; Prowl H₂O = pendimethalin.

^bTiming LPRE-late pre-emergence (75% of seeds have germinated but no emergence); 2-leaf = onion seedlings at 2-leaf stage; 4-leaf = onion seedling at 4-leaf stage.

^cMeans within a column followed by same letter do not significantly differ (*P* = 0.05, LSD).

^dThe bulbs were graded according to diameter: small (<2¼ inches), medium (2¼-3 inches), jumbo (3-4 inches), colossal (4-4¼ inches), and supercolossal (>4¼ inches). Marketable yield is composed of medium, jumbo, colossal, and supercolossal grades. Split bulbs (No. 2s), bulbs infected with the fungus *Botrytis allii* in the neck or side, bulbs infected with the fungus *Fusarium oxysporum* (plate rot). Marketable yield consists of U.S. No.1 bulbs >2¼ inches.