COMMON LAMBSQUARTERS AND HAIRY NIGHTSHADE CONTROL IN POTATO WITH HERBICIDE TANK MIXTURES

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Abstract

The newer potato herbicides, Chateau® (flumioxazin) and Outlook® (dimethenamid-p), as well as standards, Matrix® (rimsulfuron) and Eptam® (EPTC), do not provide adequate control of common lambsquarters and hairy nightshade. Evaluation of tank-mixed herbicides is needed in order to develop a sound control program for common lambsquarters before this weed becomes even more of a problem in Oregon potato crop rotations than hairy nightshade. Proactive measures to prevent the shift to common lambsquarters as a major problem weed in potato would be much more effective than reactionary measures after such a shift occurs. The specific objective, therefore, was to evaluate Outlook and Dual Magnum® as well as the developmental herbicides Zidua® (pyroxasulfone) and Reflex® (fomesafen) in various combinations with each other and other potato herbicides such as Linex® (linuron), Sencor® (metribuzin) and Prowl® (pendimethalin) to determine the best tank mixtures for simultaneous control of common lambsquarters and hairy nightshade. Weed control evaluations at 14, 28, and 125 days after herbicide application indicated variation in weed control among treatments. Almost all herbicide combinations tested in 2013 provided good control for common lambsquarters. Hairy nightshade control at 125 days after herbicide application ranged from 58 to 98%, while kochia control was 80 to 100%. Late-season control for pigweed ranged from 83 to 100%; treatments that included Linex provided the lowest control. Potato yield was closely related to the degree of weed control and varied across herbicide treatments. The U.S. No. 1 yield varied across treatments, ranging from 222 to 504 cwt/acre for two-way herbicide tank mixtures and 384 to 435 cwt/acre for three-way herbicide tank mixtures. The results indicated that two-way tank mixtures could control weeds as well as three-way tank mixtures. However, control for kochia and hairy nightshade will require close attention in order to avoid reduced potato tuber yield from weed competition.

Material and Methods

A study was established in 2013 at Malheur Experiment Station, Ontario, Oregon, in a field previously planted to wheat. Tillage operations were done during the preceding fall following standard practices for potato production. The soil was Owyhee silt loam with a pH of 7.7 and 1.89% organic matter. Based on a soil test, 150 lb phosphate/acre and 100 lb sulfur/acre were broadcast in the fall of 2012. After fall fertilization the field was fumigated with Telone® II (1,3 dichloropropene) at 25 gal/acre and simultaneously bedded on a 36-inch row spacing. On March 20, 2013, 100 lb/acre of nitrogen and 20 oz/acre of Admire® (imidacloprid) were shanked in the bed centers before planting.

'Ranger Russet' potato seed was cut by hand into 2-oz seed pieces and treated with Topsin® M (thiophanate-methyl) dust and briefly stored to suberize. Potato seed pieces were planted on April 12, 2013 using a 2-row assist-feed planter with 9-inch seed spacing in 36-inch rows. After planting, the beds were reformed with a Lilliston rolling cultivator on April 15.

The experimental design was a randomized complete block with four replications. Each plot was 9 ft wide (3 rows) by 30 ft long. Herbicide treatments were applied on April 23 before potato and weed emergence using a CO_2-pressurized backpack sprayer fitted with a boom equipped with 6 EVS8002 flat-fan nozzles at a spray volume of 20 gal/acre (Tables 1 to 4). The field was sprinkler irrigated immediately after herbicide application to incorporate herbicides in the soil. Subsequent irrigations were scheduled based on six Watermark soil moisture sensors (Irrometer Co., Riverside, CA) connected to an AM400 data logger (M.K. Hansen Co., Wenatchee, WA) to prevent the soil at the seed-piece depth from drying beyond 60 kPa soil water tension.

Potato plants were evaluated for herbicide injury based on a 0% (no apparent injury) to 100% (complete crop damage) scale. The same scale was used to evaluate weed control in each plot at 14, 28, and 125 days after herbicide application.

Potatoes were harvested from the middle row of the three-row plot on October 14, 2013 and tubers were placed into burlap sacks and placed in a barn where they were kept under tarps until grading. Tubers were graded by market class (U.S. No. 1 and U.S. No. 2) and weight (<4 oz, 4-6 oz, 6-12 oz, and >12 oz). Tubers were graded as U.S. No. 2 if they had growth cracks, bottleneck shape, abnormally curved shape, or two or more knobs. Marketable tubers were considered to be U.S. No. 1 and U.S. No. 2 larger than 4 oz.

Data were subjected to analysis of variance using PROCGLM in SAS and means were compared using Fisher's protected least significant difference procedure at $P \leq 0.05$.

Results and Discussion

Potatoes began to emerge on May 12, 2013. Evaluations conducted on May 19 (26 days after herbicide application and 7 days after potato emergence) indicated no apparent injury to potato (Table 1). All herbicide treatments provided complete early season-long control for pigweed but not hairy nightshade. Similarly, the treatments provided almost complete control for common lambsquarters and kochia, except for Linex plus Dual Magnum that provided 95% and 94%, respectively. Early season control for kochia with Dual Magnum plus Prowl H_2O was 94% (Table 1).

Evaluations for weed control on May 21 (28 days after herbicide application) indicated variability among treatments for common lambsquarters control (Table 2). Control for common lambsquarters ranged from 88% for a tank mix of Dual Magnum plus Reflex to 100% with the three-way mixtures of Boundary plus Reflex plus Sencor and Boundary plus Reflex plus Prowl H_2O. Control for pigweed was 89, 86, and 85% for two-way tank mixtures of Linex plus Dual Magnum, Linex plus Prowl H_2O, and Dual Magnum plus Prowl H_2O, respectively, compared to >96% for the other herbicide treatments. Hairy nightshade control was similar and ranged from 69 to 98% across herbicide treatments. Kochia control was 69 to 79% for the two-way tank mixtures that included Linex and was greater than 86% across the other treatments. Potato row closure on June 18 was similar across treatments, ranging from 71 to 97% (Table 2).

Evaluations for late-season weed control on August 26 (125 days after herbicide application) indicated a similar level of control for common lambsquarters and ranged from 86 to 100%

across the herbicide treatments (Table 3). Control for pigweed ranged from 83 to 100% and once again treatments that included Linex provided the least control. Hairy nightshade control at 125 days after herbicide application ranged from 58 to 98%, while kochia control ranged from 80 to 100%.

Potato yield reflected the level of weed control and varied across herbicide treatments (Table 4). Yield for small tubers (<4 oz each) was similar among treatments and ranged from 45.2 to 76.6 cwt/acre across herbicide treatments. The U.S. No. 1 yield varied across treatments and ranged from 222 to 504 cwt/acre for two-way tank-mix treatments and 384 to 435 cwt/acre for three-way herbicide combinations. Yield for the hand-weeded and untreated treatments was 390 and 55 cwt/acre, respectively. The tank mix of Boundary® plus Reflex produced the highest marketable potato yield of 559 cwt/acre while Linex plus Prowl H_2O had the lowest (206 cwt/acre); the low yield was a consequence of poor kochia control.

The results indicated that some of the two-way herbicide tank mixtures adequately controlled weeds as well as three-way combinations. However, the results may have been influenced by droughty conditions that prevailed during the winter and spring preceding planting of potato. Due to droughty conditions, the field was cloddy and had to be disked again in spring prior to planting. Therefore, the moisture provided by the irrigation to activate the herbicides may not have been sufficient to move some products into the top soil layer. Consequently, kochia and a few other weeds were able to grow and compete with potato, particularly in the treatments containing Linex.

Table 1. Weed control and potato foliar injury responses to various herbicides on May 8, 2013 at Malheur Experiment Station, Oregon State University, Ontario, OR.

Treatment	Rate	Potato injury[a]	Weed control[b]			
			common lambsquarters	pigweed spp.	hairy nightshade	kochia
	lb ai/acre		%			
Untreated		0a	0c	0b	0b	0c
F6180 (pyroxasulfone)	0.133	0a	100a	100a	100a	100a
Sencor 75DF (metribuzin)	0.31					
Outlook (dimethenamid-p)	0.84	0a	100a	100a	100a	100a
Sencor 75DF (metribuzin)	0.31					
Dual Magnum (s-metolachlor)	1.33	0a	100a	100a	100a	99a
Sencor 75DF (metribuzin)	0.31					
F6180 (pyroxasulfone)	0.133	0a	100a	100a	100a	96a
Reflex (fomesafen)	0.25					
Outlook (dimethenamid-p)	0.84	0a	100a	100a	99a	98a
Reflex (fomesafen)	0.25					
Dual Magnum (s-metolachlor)	1.33	0a	100a	100a	100a	95a
Reflex (fomesafen)	0.25					
Hand weeded		0a	100a	100a	100a	100a
Linex (linuron)	0.75	0a	95b	100a	99a	84b
Dual Magnum (s-metolachlor)	1.33					
Linex (linuron)	0.75	0a	99a	100a	100a	91ab
Prowl H_2O (pendimethalin)	1.0					
Boundary (s-metolachlor + metribuzin)	1.63	0a	100a	100a	100a	99a
Reflex (fomesafen)	0.25					
Boundary (s-metolachlor + metribuzin)	1.63	0a	100a	100a	100a	100a
Reflex (fomesafen)	0.25					
Sencor 75DF (metribuzin)	0.2					
Boundary (s-metolachlor + metribuzin)	1.63	0a	100a	100a	100a	100a
Reflex (fomesafen)	0.25					
Prowl H_2O (pendimethalin)	1.0					
Dual Magnum (s-metolachlor)	1.33	0a	100a	100a	99a	99a
Reflex (fomesafen)	0.25					
Prowl H_2O (pendimethalin)	1.0					
Boundary (s-metolachlor + metribuzin)	1.63	0a	100a	100a	100a	99a
Reflex (fomesafen)	0.25					
Matrix (rimsulfuron)	0.07					
Outlook (dimethenamid-p)	0.98	0a	100a	100a	100a	96a
Reflex (fomesafen)	0.25					
Dual Magnum (s-metolachlor)	1.33	0a	100a	100a	100a	94ab
Prowl H_2O (pendimethalin)	1.0					

[a]Injury was evaluated on May 20, 2013.

[b]Means within a column followed by the same letter do not significantly differ ($P = 0.05$, Student-Newman-Keuls).

Table 2. Weed control and potato row closure in response to various herbicides on May 21, 2013 at Malheur Experiment Station, Oregon State University, Ontario, OR.

Treatment	Rate	Potato row closure[a]	Weed control[b]			
			common lambsquarters	pigweed spp.	hairy nightshade	kochia
	lb ai/acre		%			
Untreated		71b	0d	0c	0b	0d
F6180 (pyroxasulfone)	0.133	77a	99ab	96a	79a	100a
Sencor 75DF (metribuzin)	0.31					
Outlook (dimethenamid-p)	0.84	75a	98ab	99a	68a	100a
Sencor 75DF (metribuzin)	0.31					
Dual Magnum (s-metolachlor)	1.33	78a	99ab	100a	81a	99a
Sencor 75DF (metribuzin)	0.31					
F6180 (pyroxasulfone)	0.133	77a	90bc	98a	98a	95ab
Reflex (fomesafen)	0.25					
Outlook (dimethenamid-p)	0.84	78a	96ab	100a	98a	95ab
Reflex (fomesafen)	0.25					
Dual Magnum (s-metolachlor)	1.33	78a	88c	97a	96a	93ab
Reflex (fomesafen)	0.25					
Hand weeded		75a	100a	98a	95a	100a
Linex (linuron)	0.75	76a	93abc	89b	93a	69c
Dual Magnum (s-metolachlor)	1.33					
Linex (linuron)	0.75	78a	91abc	86b	88a	79bc
Prowl H_2O (pendimethalin)	1.0					
Boundary (s-metolachlor + metribuzin)	1.63	77a	99ab	100a	98a	99a
Reflex (fomesafen)	0.25					
Boundary (s-metolachlor + metribuzin)	1.63	78a	100a	100a	98a	100a
Reflex (fomesafen)	0.25					
Sencor 75DF (metribuzin)	0.2					
Boundary (s-metolachlor + metribuzin)	1.63	78a	100a	100a	98a	100a
Reflex (fomesafen)	0.25					
Prowl H_2O (pendimethalin)	1.0					
Dual Magnum (s-metolachlor)	1.33	78a	98ab	100a	98a	96a
Reflex (fomesafen)	0.25					
Prowl H_2O (pendimethalin)	1.0					
Boundary (s-metolachlor + metribuzin)	1.63	78a	99ab	100a	98a	98a
Reflex (fomesafen)	0.25					
Matrix (rimsulfuron)	0.07					
Outlook (dimethenamid-p)	0.98	76a	93abc	99a	95a	95ab
Reflex (fomesafen)	0.25					
Dual Magnum (s-metolachlor)	1.33	79a	95abc	85b	69a	86ab
Prowl H_2O (pendimethalin)	1.0					

[a]Row closure was assessed on June 18, 2013.

[b]Means within a column followed by the same letter do not significantly differ ($P = 0.05$, Student-Newman-Keuls).

Table 3. Weed control in potato in response to various herbicides on August 26, 2013 at Malheur Experiment Station, Oregon State University, Ontario, OR.

Treatment	Rate	Weed control[a]			
		common lambsquarters	pigweed spp.	hairy nightshade	kochia
	lb ai/acre		%		
Untreated		0b	0c	0c	0e
F6180 (pyroxasulfone)	0.133	99a	96a	76ab	100a
Sencor 75DF (metribuzin)	0.31				
Outlook (dimethenamid-p)	0.84	98a	99a	58b	100a
Sencor 75DF (metribuzin)	0.31				
Dual Magnum (s-metolachlor)	1.33	96a	98a	79ab	96a
Sencor 75DF (metribuzin)	0.31				
F6180 (pyroxasulfone)	0.133	89a	98a	98a	94a
Reflex (fomesafen)	0.25				
Outlook (dimethenamid-p)	0.84	93a	100a	96a	95a
Reflex (fomesafen)	0.25				
Dual Magnum (s-metolachlor)	1.33	88a	98a	96a	84ab
Reflex (fomesafen)	0.25				
Hand weeded		100a	98a	95a	99a
Linex (linuron)	0.75	93a	89b	93a	41d
Dual Magnum (s-metolachlor)	1.33				
Linex (linuron)	0.75	86a	83b	83ab	69c
Prowl H_2O (pendimethalin)	1.0				
Boundary (s-metolachlor + metribuzin)	1.63	97a	100a	98a	99a
Reflex (fomesafen)	0.25				
Boundary (s-metolachlor + metribuzin)	1.63	100a	100a	96a	100a
Reflex (fomesafen)	0.25				
Sencor 75DF (metribuzin)	0.2				
Boundary (s-metolachlor + metribuzin)	1.63	100a	100a	98a	100a
Reflex (fomesafen)	0.25				
Prowl H_2O (pendimethalin)	1.0				
Dual Magnum (s-metolachlor)	1.33	97a	100a	98a	98a
Reflex (fomesafen)	0.25				
Prowl H_2O (pendimethalin)	1.0				
Boundary (s-metolachlor + metribuzin)	1.63	99a	100a	96a	98a
Reflex (fomesafen)	0.25				
Matrix (rimsulfuron)	0.07				
Outlook (dimethenamid-p)	0.98	91a	98a	95a	94a
Reflex (fomesafen)	0.25				
Dual Magnum (s-metolachlor)	1.33	93a	83b	64ab	80b
Prowl H_2O (pendimethalin)	1.0				

[a]Means within a column followed by the same letter do not significantly differ ($P = 0.05$, Student-Newman-Keuls).

Table 4. Potato yield in response to weed control with different herbicides at Malheur Experiment Station, Oregon State University, Ontario, OR, 2013.

Treatment	Rate	U.S. No. 1				U.S. No. 2	Marketable	<4 oz	Total yield
		4-6 oz	6-12 oz	>12 oz	total				
	lb ai/acre	cwt/acre							
Untreated		35.6	18.1	1.0	54.6	4.0	58.6	55.4	114.0
F6180 (pyroxasulfone)	0.133	97.7	212.5	80.3	390.5	50.7	441.1	57.6	498.8
Sencor 75DF (metribuzin)	0.31								
Outlook (dimethenamid-p)	0.84	106.5	211.5	29.7	347.7	27.2	374.8	60.1	434.9
Sencor 75DF (metribuzin)	0.31								
Dual Magnum (s-metolachlor)	1.33	104.1	246.1	65.1	415.3	62.9	478.2	53.3	531.5
Sencor 75DF (metribuzin)	0.31								
F6180 (pyroxasulfone)	0.133	104.1	207.6	55.2	366.9	38.4	405.3	57.2	462.5
Reflex (fomesafen)	0.25								
Outlook (dimethenamid-p)	0.84	105.3	184.2	38.1	327.5	23.6	351.1	60.2	411.3
Reflex (fomesafen)	0.25								
Dual Magnum (s-metolachlor)	1.33	82.9	191.4	46.9	321.1	35.4	356.5	45.2	401.8
Reflex (fomesafen)	0.25								
Hand weeded		87.1	239.5	62.9	389.5	48.5	438.0	53.5	491.5
Linex (linuron)	0.75	93.4	155.0	41.8	290.2	29.9	320.1	63.0	383.2
Dual Magnum (s-metolachlor)	1.33								
Linex (linuron)	0.75	89.6	84.8	10.2	184.7	21.0	205.6	76.6	282.3
Prowl H_2O (pendimethalin)	1.0								
Boundary (s-metolachlor + metribuzin)	1.63	106.1	325.2	72.7	504.0	55.1	559.1	55.0	614.1
Reflex (fomesafen)	0.25								
Boundary (s-metolachlor + metribuzin)	1.63	92.7	245.2	52.9	390.8	50.9	441.7	60.7	502.4
Reflex (fomesafen)	0.25								
Sencor 75DF (metribuzin)	0.2								
Boundary (s-metolachlor + metribuzin)	1.63	91.4	271.4	71.9	434.7	62.9	497.6	43.9	541.5
Reflex (fomesafen)	0.25								
Prowl H_2O (pendimethalin)	1.0								
Dual Magnum (s-metolachlor)	1.33	95.0	240.7	57.0	392.7	50.4	443.1	43.9	487.0
Reflex (fomesafen)	0.25								
Prowl H_2O (pendimethalin)	1.0								
Boundary (s-metolachlor + metribuzin)	1.63	106.2	234.4	43.3	383.9	26.1	410.0	45.2	455.2
Reflex (fomesafen)	0.25								
Matrix (rimsulfuron)	0.07								
Outlook (dimethenamid-p)	0.98	88.0	221.1	62.5	371.6	44.2	415.8	52.2	468.0
Reflex (fomesafen)	0.25								
Dual Magnum (s-metolachlor)	1.33	94.2	111.7	16.3	222.2	27.2	249.3	57.9	307.2
Prowl H_2O (pendimethalin)	1.0								
LSD (0.05)		NS	86.7	42.1	105.2	26.9	109.7	NS	105.2