EVALUATION OF FOMESAFEN (REFLEX®) HERBICIDE FOR WEED CONTROL IN RANGER RUSSET POTATO AND RESPONSE OF SUBSEQUENT CROPS TO SOIL RESIDUES

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Introduction

Weed control is an important component of potato production. Weeds present a major production concern for potato growers because they often reduce potato yield, quality, and may possibly serve as alternative hosts for other crop pests. In eastern Oregon, furrow irrigation and warm growing conditions provide ideal conditions for weed growth. Also, yellow nutsedge is a major weed problem in eastern Oregon agriculture. It is imperative that weed control programs in every crop grown in a rotation include products that provide control of yellow nutsedge. Fomesafen (Reflex®) is currently going through the registration process with the U.S. Environmental Protection Agency (EPA) (Glenn Letendre, Syngenta Crop Protection, personal communication) for use in different crops for weed control. The herbicide has potential to control yellow nutsedge in potato, especially when used as a tank-mix partner with other products including *S*-metolachlor (Dual Magnum®) and dimethenamid-p (Outlook®). Studies conducted at the Malheur Experiment Station in 2010 and 2011 indicated that fomesafen controls most annual broadleaf weeds and provides partial control of yellow nutsedge.

The registration of fomesafen will bring new herbicide chemistry for weed control in potato. Use of different herbicide groups to control weeds is recommended as a tactic to avoid selection for weed resistance to herbicides. At the same time, understanding the response of crops grown following potato to fomesafen soil residues is needed to generate support data that are required for soliciting EPA for a Section 24-C registration to use fomesafen on potato in Oregon. Growers are likely to experience better weed control by tank-mixing fomesafen with either *S*-metolachlor or dimethenamid-p, which are generally used as foundation products for weed control programs in potato. Growers whose fields are infested with yellow nutsedge prefer to use dimethenamid-p and *S*-metolachlor herbicides because they provide effective control of the weed. Better weed control produces high quality potato, which in turn benefits growers, the processing industry, and consumers of this nutritious produce.

This study is part of broader efforts to evaluate herbicides for use on potato in managing yellow nutsedge in the Treasure Valley of eastern Oregon. Because the herbicide half-life in the soil is affected by soil pH, it is crucial to evaluate fomesafen performance in the high pH soils of eastern Oregon. We need to determine the response of crops grown following potato to fomesafen soil residues. Our goal is to provide growers with tools to manage weeds without affecting subsequent crops grown in rotation with potato.

The overall goal of these studies was to evaluate new effective herbicide combinations for weed control in potato. The specific objectives were (1) evaluate fomesafen herbicide for weed control when applied alone or as a tank-mix partner with standard potato herbicides; and (2) evaluate the response of crops grown following potato (rotational crops) to fomesafen soil residues. Objective 2 will be completed during the 2012 season.

Materials and Methods

Two studies were established in 2011 at the Malheur Experiment Station in a field previous planted to wheat. Tillage operations were done the preceding fall following standard practices for potato production. The soil was an Owyhee silt loam with a pH 7.7 and 1.89 percent organic matter. The first study aimed to evaluate herbicides for weed control in potato, while the second study was to prepare the field to study the response of rotational crops (in 2012) to the fomesafen soil residues applied to potato in 2011. Seven rotational crops (winter and spring wheat, onion, sugar beet, sweet corn, and barley) will be planted in 2012 to assess the response to fomesafen soil residues.

The herbicide evaluation study (objective 1) followed a randomized complete block design with four replications. Individual plots were 9 ft wide (3 rows) by 30 ft long. The study had seven treatments (Tables 1–3). Plots were monitored for potato plant injury and evaluated for weed control at 19 and 54 days after treatment (DAT). Evaluations were based on a scale of 0-100 percent (0 = no weed control/no crop injury and 100 = complete weed control/total crop damage).

The study of the effect of fomesafen soil residues on rotational crops (objective 2) followed a split-plot design with four herbicide treatments forming the main plots onto which seven rotational crops will be randomly assigned as subplots in 2012. Each main plot was 63 ft wide (21 rows) by 30 ft long with 3 replications. Treatments for the fomesafen soil residues effects experiments are presented in Table 4. In order to minimize weed competition in crops grown in 2012, plots for the fomesafen soil residue study were kept weed free with periodic hand weeding when vine growth could still allow walking through the rows.

Both studies were planted with ‘Ranger Russet’ potato seed pieces on April 20, 2011 using a 2-row assist-feed planter with 9-inch spacing within the row in 36-inch center beds. Emergence was observed on May 26, 2011. Plots were fertilized based on soil tests and all other recommended production practices including spraying for insects and diseases were followed.

Herbicide treatments for both studies were applied on May 21, 2011 before potato and weed emergence using a CO_2-pressurized backpack sprayer fitted with a boom equipped with six EVS8002 flat-fan nozzles calibrated to deliver 20 gal of spray solution per acre. Plots were irrigated immediately after herbicide application to incorporate herbicides into 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.

A mechanical harvester was used to lift the potatoes at maturity on October 31, 2011 from one row per plot to determine yield. All other potatoes were hand-picked and disposed of to avoid volunteer plants in subsequent crops. Potatoes were transported to the station and graded following USDA recommended standards. The data were subjected to analysis of variance using PROCGLM in Statistical Analysis Software (SAS) and means were compared using Fisher's protected least significant difference procedure at $P \leq 0.05$.

Results and Discussion

Evaluations on June 9 indicated that there was no significant potato injury from the herbicide treatments, except for transient foliar yellowing (Table 1). Herbicide treatments provided complete control for common lambsquarters, redroot pigweed, and barnyardgrass. Control of volunteer wheat on June 9 ranged from 90 to 100 percent among the different herbicide treatments. Midseason weed control on July 14 was 100 percent for common lambsquarters and barnyardgrass (Table 2). Control for redroot pigweed ranged from 98 to 100 percent among the herbicide treatments. Volunteer wheat control ranged from 90 to 100 percent. There were no differences in potato yield among herbicide treatments for the 4- to 6-oz and the over 12 oz potato categories (Table 3). The yield varied among herbicide treatments for the 6 to 12 oz category, whose yield ranged from 272 to 318 cwt/acre. The U.S. No. 1 potato yield varied among herbicide treatments because it was generally influenced by the 6- to 12-oz potato category. Potato yield for the U.S. No. 2 and under 4 oz categories was similar among herbicide treatments. The results suggest that herbicide treatments that included fomesafen provided complete weed control and potato yield was similar to a grower standard of *S*-metolachlor plus pendimethalin plus Eptam® at 1.49, 0.95, and 4.38 lb ai/acre, respectively.

Plots for the evaluation of rotational crop response to fomesafen soil residues were kept weed-free throughout the season. Even though the potato yield for the 4- to 6-oz and 6- to 12-oz categories varied among treatments, the total U.S. No.1 yield was similar among herbicide treatments (Table 4). The marketable and U.S. No.2 categories were also similar across treatments. Treatments varied in the potato yield for the under4-oz category that ranged from 64 to 85 cwt/acre. These results corroborate our previous results in 2010 that fomesafen is a valuable tank-mix herbicide partner for weed control in potato. The response of crops grown following potato will be assessed in 2012.

Table 1. Weed control in potato on June 9, 2011 with different herbicides at the Malheur Experiment Station, Ontario, OR, 2011.

Treatment	Rate	Crop injury	Weed control			
			Common lambsquarters	Redroot pigweed	Barnyardgrass	Volunteer wheat
	lb ai/acre	---------- % ----------				
Untreated		0	0	0	0	25
Linuron + Dimethenamid-p	0.75 0.66	0	100	100	100	100
Linuron + *S*-metolachlor	0.75 1.43	0	100	100	100	90
S-metolachlor + Pendimethalin + Fomesafen	1.27 0.95 0.25	3	100	100	100	95
S-metolachlor + Pendimethalin + Fomesafen	1.27 0.95 0.5	3	100	100	100	95
Fomesafen + *S*-metolachlor + Metribuzin	0.25 1.63 0.312	0	100	100	100	100
S-metolachlor + Pendimethalin + Eptam	1.43 0.95 4.38	0	100	100	100	100
LSD (P = 0.05)		2.5	--	--	--	29.2
Standard deviation		1.7	0.0	0.0	0.0	19.7

Table 2. Weed control in potato on July 14, 2011 with different herbicides at the Malheur Experiment Station, Ontario, OR, 2011.

Treatment	Rate	Crop injury	Weed control			
			Common lambsquarters	Redroot pigweed	Barnyardgrass	Volunteer wheat
	lb ai/acre	----------	----------	%	----------	----------
Untreated		0a	0	0	0	25
Linuron + Dimethenamid-p	0.75 0.66	0a	100	98	100	100
Linuron + *S*-metolachlor	0.75 1.43	0a	100	100	100	90
S-metolachlor + Pendimethalin + Fomesafen	1.27 0.95 0.25	0a	100	100	100	95
S-metolachlor + Pendimethalin + Fomesafen	1.27 0.95 0.5	0a	100	100	100	95
Fomesafen + *S*-metolachlor + Metribuzin	0.25 1.63 0.312	0a	100	99	100	100
S-metolachlor + Pendimethalin + Eptam	1.43 0.95 4.38	0a	100	100	100	100
LSD (P = 0.05)		NS	--	2.0	--	29.2
Standard deviation		0.0	0.0	1.4	0.0	19.7

Table 3. Russet Ranger potato yield in response to different herbicides applied preemergence at the Malheur Experiment Station, Ontario, OR, 2011.

		Potato yield							
		U.S. No.1							
Treatment	Rate	4-6 oz	6-12 oz	>12 oz	Total	US No. 2	Marketable	<4 oz	Total
	lb ai/acre	cwt/acre							
Untreated		117.3	222.8	33.0	373.1	2.4	375.5	75.2	450.6
Linuron + Dimethenamid-p	0.75 0.66	114.7	272.1	69.4	456.1	8.0	464.1	65.8	529.9
Linuron + *S*-metolachlor	0.75 1.43	102.7	318.6	43.9	465.2	2.7	467.9	66.8	534.8
S-metolachlor + Pendimethalin + Fomesafen	1.27 0.95 0.25	134.9	259.3	53.7	447.9	8.0	456.0	64.1	520.1
S-metolachlor + Pendimethalin + Fomesafen	1.27 0.95 0.5	119.0	304.4	68.5	491.8	4.5	496.4	70.8	567.2
Fomesafen + *S*-metolachlor + Metribuzin	0.25 1.63 0.312	112.2	282.2	53.7	448.1	2.3	450.4	62.5	512.9
S-metolachlor + Pendimethalin + Eptam	1.43 0.95 4.38	116.0	275.9	42.9	434.7	2.8	437.5	80.4	517.9
LSD (*P* = 0.05)		NS	66.0	NS	78.4	NS	76.5	NS	79.6
Standard deviation		28.65	44.4	27.74	52.8	4.09	51.5	15.34	53.6

Table 4. Potato yield in response to fomesafen (Reflex®) herbicide treatments at the Malheur Experiment Station, Ontario, OR. 2011.

Treatment	Rate	U.S. No. 1 4-6 oz	U.S. No. 1 6-12 oz	U.S. No. 1 >12 oz	U.S. No. 1 Total	Marketable	U.S. No. 2	<4 oz	Total yield
	lb ai/acre	cwt/acre							
Fomesafen	0.25	102	306	77	485	490	5	64	554
Fomesafen	0.5	117	259	56	431	436	5	69	506
S-metolachlor + Fomesafen	1.27 0.25	117	283	66	466	473	7	71	545
S-metolachlor + Pendimethalin	1.27 0.95	129	294	45	468	475	7	85	561
LSD (P = 0.05)		25	35	NS	NS	NS	NS	12.7	64.9
Standard deviation		12.4	17.7	30.3	36.3	31.2	4.5	6.4	32.5