ROTATIONAL RESPONSE OF ALFALFA AND SUGAR BEET TO CLARION™ AND STEADFAST™ HERBICIDES

Corey V. Ransom, Charles A. Rice, and Joey K. Ishida
Malheur Experiment Station
Oregon State University
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Introduction

Informed herbicide selection in diverse crop rotations is crucial to avoid adverse effects on future crops from herbicide carryover. Sulfonylurea herbicides are some of the most effective and low-use rate herbicides available. However, the rotational restrictions can be as long as 26 months for selected crops. One such herbicide is Steadfast 75 WDG which is a premix of the sulfonylurea herbicides nicosulfuron and rimsulfuron at a 2:1 ratio. Steadfast provides selective postemergence (POST) grass and broadleaf weed control in field corn. Steadfast has a rotational restriction of 12 months for alfalfa and 10-18 months, depending on soil pH, for sugar beet. A newly registered product, Clarion 75 WDG (formerly DPX-79406) also consists of nicosulfuron and rimsulfuron but in a 1:1 ratio. The reduced amount of nicosulfuron in Clarion compared to Steadfast may potentially decrease the rotational restrictions for sugar beet and alfalfa. A field trial was conducted to evaluate the rotational tolerance of alfalfa and sugar beet to Clarion and Steadfast herbicides.

Materials and Methods

Clarion and Steadfast were applied postemergence (POST) to field corn on May 29, 2002 preceding alfalfa and sugar beet establishment in the spring of 2003. Clarion was applied at the labeled rate of 0.375 oz ai/acre and at twice the labeled rate at 0.75 oz ai/acre. Steadfast also was applied at 1x and 2x rates of 0.56 and 1.12 oz ai/acre, respectively. Steadfast and Clarion were applied to corn plots measuring 20 by 30 ft. Treatments were arranged in a randomized complete block design with four replicates. Plot size for the rotational crops measured 10 by 30 ft with half of the original 20 by 30 ft plots planted to alfalfa and the other half to sugar beet in 2003. Following corn harvest the trial area was roto-tilled on October 28 and bedded on 22-inch rows on November 7, 2002. Alfalfa (var. Surpass) was seeded at a rate of 20 lb/acre on April 30, 2003 (11 months after treatment [MAT]). Sugar beets (var. Hilleshog PM 21) were planted on April 30, 2003 (11 MAT) at a 2-inch seed spacing (~142,000 seeds/acre). After sugar beet planting, the trial was corrugated and Counter 20 CR was applied in a 7-inch band over the row at a rate of 6 oz/1,000 ft of row. Temik 15G was applied on June 2 for sugar beet root maggot control at a rate of 9.5 oz/1,000 ft of row. Plots were sidedressed with 176 lb nitrogen, 96 lb phosphate, 100 lb potash, 38 lb sulfates, 62 lb elemental sulfur, 2 lb zinc, and 1 lb/acre of boron on June 3, 2003. Sugar beets were thinned to an 8-inch plant spacing (~35,640 plants/acre) on June 10, 2003. The soil

was an Owyhee silt loam with a sand, silt, and clay content of 19, 63, and 18 percent, respectively. A soil test determined a pH of 8.0, cation exchange capacity of 12, and an organic matter content of 1.8 percent. Weeds were controlled in both the alfalfa and sugar beet plots using hand labor.

Sugar beet and alfalfa injury were evaluated throughout the season. The alfalfa stand was evaluated by counting seedlings within four, 1-ft² quadrats in each plot on May 29. The sugar beet stand was evaluated by counting the number of plants within the entire length of the center two rows in each plot prior to thinning on May 29 and again prior to harvest on October 7. Sugar beet yields were determined by harvesting the center two rows of each plot on October 7. Sugar beet yields were adjusted to account for a 5 percent tare. One sample of 16 beets was taken from each plot for quality analysis. The samples were coded and sent to Hilleshog Mono-Hy Research Station in Nyssa, Oregon, to determine beet pulp sucrose content and purity. Sucrose content and recoverable sucrose were estimated using empirical equations. Alfalfa yields were determined by cutting a 3-ft by 26-ft swath from the center of each plot using a flail mower on July 15 and August 13. Biomass from the harvest area was weighed to determine the total fresh weight. A subsample was weighed from each plot and dried in a forced air dryer at 140°F. Once dry, the sample was removed and reweighed to determine the percent moisture at the time of cutting. Alfalfa forage yield was reported based on 12 percent moisture.

Data were analyzed using analysis of variance procedures and means were separated using protected LSD at the 95 percent confidence interval (P = 0.05). The untreated control was not included in the analysis of variance for crop injury.

Results and Discussion

Injury to seedling alfalfa planted 11 months after POST-applied Steadfast and Clarion ranged from 20 to 66 percent on May 29, 2003 (365 days after treatment [DAT]) (Table 1). Injury to alfalfa seedlings consisted of stunting and chlorosis of new growth. The greatest alfalfa injury was observed with Steadfast at 1.12 oz ai/acre. Clarion applied at 0.375 oz ai/acre produced significantly less injury than all other herbicide treatments 365 DAT. Herbicide carryover also resulted in reduced alfalfa stand. At 365 DAT, all herbicide treatments except Clarion applied at 0.375 oz ai/acre resulted in a significant alfalfa stand loss compared to the untreated control. Alfalfa injury on July 1 (397 DAT) was similar with both Clarion treatments and Steadfast at 0.56 oz ai/acre. Injury with Steadfast at 1.12 oz ai/acre was greater than all other herbicide treatments at 38 percent. Injury associated with Clarion treatment did not significantly reduce forage yield on July 15. Herbicide injury resulted in reduced forage yield on July 15 for both Steadfast treatments. There was no visually detectable injury to alfalfa regrowth on July 24, 10 days after the first cutting (data not shown). Yields from the second cutting on August 20 were similar among all treatments.

Sugar beet injury on May 29, (365 DAT), ranged from 5 to 59 percent (Table 2). Injury was greater with Steadfast at 1.12 oz ai/acre than from all other treatments. Sugar beet

injury was similar with the labeled rate of Steadfast (0.56 oz ai/acre) and with Clarion applied at twice its labeled rate at 0.75 oz ai/acre. Clarion applied at the labeled rate of 0.375 oz ai/acre injured sugar beet significantly less than all other herbicide treatments on May 29, 2003. Sugar beet injury on July 1 (397 DAT) was greatest with Steadfast applied at 1.12 oz ai/acre. All other herbicide treatments provided similar injury. Sugar beet stand on May 29 (365 DAT) was not different among treatments prior to thinning. Steadfast applied at 1.12 oz ai/acre was the only treatment that reduced stand compared to the untreated control prior to harvest on October 7. There were no significant differences among treatments with regard to root yield, percent sucrose content, or estimated recoverable sucrose yields.

Since this trial was conducted, Clarion has been registered for use in field corn. The label stipulates the same rotational restriction of 12 months for alfalfa as does the Steadfast label. The rotational restriction for sugar beet following Steadfast application is 10 months for soils with pH $\leq$ 6.5 and 18 months with pH > 6.5. The rotational restriction for sugar beet following Clarion application is 10 months, regardless of soil pH.

Table 1. Alfalfa injury, stand, and yield in response to Clarion™ and Steadfast™ herbicides applied the previous year to field corn, Malheur Experiment Station, Oregon State University, Ontario, OR, 2003.

		Alfalfa‡				
		Injury§		Stand	Yield¶	
Treatment*	Rate†	5/29	7/1	5/29	7/15	8/13
	oz ai/acre	---------- % ----------		No/ft²	------ ton/acre ------	
Clarion	0.375	20	4	47	1.54	1.82
Clarion	0.75	38	9	40	1.50	1.76
Steadfast	0.56	43	5	37	1.40	1.72
Steadfast	1.12	66	38	31	1.34	1.72
Untreated control	--	--	--	59	1.65	1.81
LSD (0.05)		14	10	18	0.17	NS

*Treatments were applied to field corn on May 29, 2002.
†Clarion and Steadast were applied at 1x (0.375 or 0.56 oz ai/acre) and 2x (0.75 or 1.12 oz ai/acre) the labeled rates, respectively.
‡Alfalfa was seeded on April 30, 2002.
§The untreated control was not included in the analysis of variance for alfalfa injury.
¶Alfalfa forage yields were adjusted to a moisture content of 12 percent.

Table 2. Sugar beet injury, stand, and yield in response to Clarion™ and Steadfast™ herbicides applied the previous year to field corn, Malheur Experiment Station, Oregon State University, Ontario, OR, 2003.

		Sugar beet‡						
		Injury		Stand§		Yield¶		
Treatment*	Rate †	5/29	7/1	5/29	10/7	Root	Sucrose	ERS
	oz ai/acre	--------- % ----------		------ No./10' ------		ton/acre	%	lb/acre
Clarion	0.375	5	8	42.7	16.1	36.7	16.1	10,902
Clarion	0.75	25	11	44.8	16.2	37.5	15.9	10,928
Steadfast	0.56	24	8	39.6	16.6	36.2	16.3	10,807
Steadfast	1.12	59	24	39.0	15.2	36.9	15.9	10,759
Untreated control	--	--	--	43.7	17.0	35.5	16.6	10,909
LSD (0.05)		16	11	NS	1.0	NS	NS	NS

*Treatments were applied to field corn on May 29, 2002.
†Clarion and Steadast were applied at 1x (0.375 or 0.56 oz ai/acre) and 2x (0.75 or 1.12 oz ai/acre) the labeled rates, respectively.
‡Sugar beets were planted April 30 and harvested on October 7, 2003. The untreated control was not included in the analysis of variance for sugar beet injury.
§Sugar beet stands on May 29 were recorded prior to hand thinning on June 10, 2003.
¶ERS = Estimated recoverable sucrose.