ONION RESPONSE TO DELAYED PRE-EMERGENCE APPLICATION OF SONALAN®

Joel Felix and Joey Ishida, Malheur Experiment Station, Oregon State University, Ontario, OR

Introduction

Weed control in onion is essential in order to maintain high productivity and quality. With fewer products registered for weed control in specialty crops, it becomes essential to evaluate herbicides with potential for use to control weeds in direct-seeded onion. It is particularly essential to identify herbicides that could be used prior to onion emergence in order to minimize crop–weed competition. The objective of this study was to evaluate onion response and weed control with Sonalan® herbicide applied prior to onion emergence. The use pattern would be similar to that for Prowl® H_2O (i.e., application after 75% of the planted onion seeds have germinated, but not yet emerged).

Materials and Methods

A field study was initiated during fall 2019 at the Malheur Experiment Station to evaluate the potential use of Sonalan herbicide for delayed pre-emergence application to control weeds in direct-seeded onion. The predominant soil was an Owyhee silt loam with a pH of 7.8 and 2.78% soil organic matter. Wheat stubble was flailed and the field was irrigated, disked, ripped, plowed, and groundhogged during fall 2018. Based on soil analysis, fertilizer was broadcast applied during fall at 50 lb nitrogen (N)/acre, 50 lb phosphorus (P)/acre, 80 lb sulfur (S)/acre, 12 lb manganese (Mn)/acre, and 1 lb boron (B)/acre. The field was fumigated with K-Pam® at 15 gal/acre and beds were formed at 22-inch spacing on October 18, 2018.

The beds were harrowed down and onion seed of hybrid 'Vaquero' was planted in double rows spaced 3 inches apart with 4-inch seed spacing within each row on March 21, 2019. Each pair of rows was planted on beds spaced 22 inches apart. On April 2, 2019, each onion bed received a 7-inch band of Lorsban® 15G at 3.7 oz/1000 ft of row (chlorpyrifos 0.101 lb ai/acre) and the soil surface was rolled.

The study had a randomized complete block design with four replicates. Individual plots were 7.33 ft wide (4 beds) by 27 ft long. All herbicide treatments were applied using a CO_2 pressurized backpack sprayer fitted with a boom equipped with 8002EVS Teejet nozzles calibrated to deliver 20 gal/acre.

Delayed pre-emergence herbicide treatments were Sonalan HFP at 2 or 3 pt/acre (ethalfluralin 0.75 or 1.13 lb ai/acre) and Prowl H_2O at 2 pt/acre (pendimethalin 0.95 lb ai/acre), which were applied on April 11, 2019 or post-emergence on May 10, 2019 (Table 1). Because of wet conditions due to higher than normal spring precipitation in the area, a small percentage of onion seedlings had emerged at the time of delayed pre-emergence treatment applications. Post-

emergence applications of Brox® 2EC at 12 fl oz/acre (bromoxynil at 0.188 lb ai/acre) plus GoalTender® at 4 fl oz/acre (oxyfluorfen at 0.125 lb/ai acre) were made when onion seedlings were at the 2- and 4-leaf stages (May 10 and June 17, 2019). On May 7, a tank-mix of Poast® at 1.5 pt/acre (sethoxydim at 0.28 lb ai/acre) plus crop oil concentrate at 2 pt/acre was applied to control grassy weeds.

In-season fertilizer was applied according to soil and tissue test results. Fertilizer was applied through drip irrigation on June 6 and June 24 to supply 50 lb N/acre and on July 15 to supply 25 lb N/acre. Preventative sprays for diseases and insects were applied aerially by a commercial contractor using various insecticides including Movento® (spirotetramat), Radiant® (spinetoram), and Lannate® (methomyl). All other operations followed recommended local production practices.

Visible plant injury and weed control were assessed based on a scale of 0% (no onion injury or no yellow nutsedge control) to 100% (complete onion plant kill or total yellow nutsedge control). Weed control was assessed on May 20 (40 days after the delayed pre-emergence treatment) and May 27 (47 days after the delayed pre-emergence treatment).

The field was drip irrigated 23 times from April 29 to August 19, 2019. Each irrigation event lasted 12 hours.

Plant tops were flailed on September 10, and onion bulbs were lifted on September 11, 2019 and left in the field to cure. Bulbs were hand harvested from the two center beds on September 20, 2019. Bulbs were graded for yield and quality based on USDA standards as follows: bulbs without blemishes (U.S. No. 1), split bulbs (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 super colossal (>4¼ inches). Marketable yield consisted of U.S. No.1 bulbs greater than 2¼ inches in diameter.

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 April 23, 2019. Evaluations of May 20, 2019 indicated low visible injury at 4 to 13% across herbicide treatments (Table 1). Common lambsquarters control ranged from 79 to 94%, redroot pigweed 84 to 95%, hairy nightshade 65 to 93%, and lady's thumb 45 to 90%. There was a trend towards improved weed control with delayed pre-emergence treatment compared to Sonalan and Prowl H_2O applied when onions were at the 2-leaf stage. This was particularly so for hairy nightshade and lady's thumb. Evaluations on May 27 indicated onion injury ranged from 0 to 4% across herbicide treatments. Control for common lambsquarters, redroot pigweed, hairy nightshade, and lady's thumb was 95 to 97% across herbicide treatments.

The number of harvested bulbs in response to Sonalan and Prowl H_2O delayed pre-emergence application is presented in Table 2. The number of marketable bulbs (2¼ to >4¼ in) ranged from 87,912 to 107,712 bulbs/acre and was statistically similar across herbicide treatments.

Marketable yield varied across herbicide treatments (Table 3). The greatest marketable yield was obtained when Sonalan was applied delayed pre-emergence at 2 pt/acre, which was comparable to that for Prowl H_2O at 2 pt/acre at the same application timing.

The results demonstrated that Sonalan could be used safely to manage weeds in onion under the testing conditions. Precipitation was above average during spring 2019, but it wasn't apparent that it played a role in the observed results.

Acknowledgements

This project was partly funded by the Idaho-Eastern Oregon Onion Committee, Oregon State University, the Malheur County Education Service District, and supported by Formula Grant nos. 2019-31100-06041 and 2019-31200-06041 from the USDA National Institute of Food and Agriculture.

Table 1. Onion response and weed control with Prowl H_2O (pendimethalin) and Sonalan (ethalfluralin) at the Malheur Experiment Station, Oregon State University, Ontario, OR 2019

Treatment [a]	Rate	Timing [b]	Crop injury	Weed control (5/20/2019)[c]				Crop injury	Weed control (5/27/2019)[c]			
				Common lambsquarters	Redroot pigweed	Hairy nightshade	Lady's thumb		Common lambsquarters	Redroot pigweed	Hairy nightshade	Lady's thumb
	unit/acre		%									
Untreated			0 c	0 c	0 d	0 e	0 c	0 c	0 c	0 b	0 c	0 b
Sonalan HFP	2 pt	LPRE	4 bc	80 b	88 abc	81 c	51 b	0 c	96 ab	98 a	97 a	97 a
Brox 2EC	12 fl oz	2-leaf										
GoalTender	4 fl oz	2-leaf										
Sonalan HFP	3 pt	LPRE	5 abc	90 a	93 ab	89 ab	66 ab	1 bc	97 ab	98 a	98 a	97 a
Brox 2EC	12 fl oz	2-leaf										
GoalTender	4 fl oz	2-leaf										
Sonalan HFP	2 pt	2-leaf	9 ab	85 ab	90 abc	81 c	48 b	4 a	96 ab	97 a	97 a	96 a
Brox 2EC	12 fl oz	2-leaf										
GoalTender	4 fl oz	2-leaf										
Sonalan HFP	3 pt	2-leaf	13 a	80 b	86 bc	85 bc	64 b	3 ab	96 ab	97 a	98 a	97 a
Brox 2EC	12 fl oz	2-leaf										
GoalTender	4 fl oz	2-leaf										
Prowl H_2O	2 pt	LPRE	4 bc	94 a	95 a	93 a	90 a	1 bc	97 a	97 a	98 a	97 a
Brox 2EC	12 fl oz	2-leaf										
GoalTender	4 fl oz	2-leaf										
Prowl H_2O	2 pt	2-leaf	8 abc	79 b	84 c	65 d	45 b	1 bc	95 b	98 a	95 b	96 a
Brox 2EC	12 fl oz	2-leaf										
GoalTender	4 fl oz	2-leaf										
LSD (P = 0.05)			8	9	8	7	24	3	2	2	1	2

[a] Herbicide treatments: Sonalan 2 pt/acre = ethalfluralin 0.75 lb ai/acre; Sonalan 3 pt/acre = ethalfluralin 1.13 lb ai/acre; Prowl H_2O 2 pt/acre = pendimethalin 0.95 lb ai/acre; Brox 2EC = bromoxynil 0.188 lb ai/acre; GoalTender 4 fl oz/acre = oxyfluorfen 0.125 lb ai/acre.

[b] Application timing: LPRE = late pre-emergence (prior to onion emergence) applied on 4/11/2019; 2-leaf = onion at 2-leaf stage applied on 5/10/2019.

[c] Means within a column followed by same letter do not significantly differ (P = 0.05, LSD)

Table 2. Number of harvested bulbs in response to Prowl H_2O or Sonalan applied late pre-emergence (LPRE) timing for weed control at the Malheur Experiment Station, Oregon State University, Ontario, OR, 2019.

				Unmarketable[c]			Marketable[c]				
Treatment[a]	Rate	Product rate	Timing[b]	Neck rot	No. 2s	<2¼ in	2¼-3 in	3-4 in	4-4¼ in	>4¼ in	Total
	lb ai/acre	units/acre		number of bulbs/acre[d]							
Untreated	--	--	--	0 a	0 c	0 b	0 c	0 c	0 d	0 d	0 b
Sonalan HFP	0.75	2 pt	LPRE	198 a	0 c	5,544 ab	11,682 ab	42,768 ab	30,888 ab	22,374 ab	107,712 a
Brox 2EC	0.188	12 fl oz	2&4-leaf								
GoalTender	0.125	4 fl oz	2&4-leaf								
Sonalan HFP	1.13	3 pt	LPRE	198 a	792 ab	5,346 ab	4,752 bc	33,858 b	25344 bc	23,958 a	87,912 a
Brox 2EC	0.188	12 fl oz	2&4-leaf								
GoalTender	0.125	4 fl oz	2&4-leaf								
Sonalan HFP	0.75	2 pt	2&4-leaf	0 a	0 c	10,890 a	13,266 a	51,084 a	26,532 bc	13,860 c	104,742 a
Brox 2EC	0.188	12 fl oz	2&4-leaf								
GoalTender	0.125	4 fl oz	2&4-leaf								
Sonalan HFP	1.13	3 pt	2&4-leaf	0 a	198 bc	9,702 a	10,890 ab	41,778 ab	23,364 bc	17,622 bc	93,654 a
Brox 2EC	0.188	12 fl oz	2&4-leaf								
GoalTender	0.125	4 fl oz	2&4-leaf								
Prowl H_2O	0.95	2 pt	LPRE	0 a	1188 a	2,970 b	5,544 bc	39,402 ab	35,838 a	25,542 a	106,326 a
Brox 2EC	0.188	12 fl oz	2&4-leaf								
GoalTender	0.125	4 fl oz	2&4-leaf								
Prowl H_2O	0.95	2 pt	2&4-leaf	0 a	198 bc	10,692 a	13,662 a	43,956 ab	21,186 c	12,078 c	90,882 a
Brox 2EC	0.188	12 fl oz	2&4-leaf								
GoalTender	0.125	4 fl oz	2&4-leaf								
LSD (P = 0.05)				323	752	5,866	7,291	14,481	9,286	5,583	24,346

[a]Herbicide treatments: Sonalan 2 pt/acre = ethalfluralin 0.75 lb ai/acre; Sonalan 3 pt/acre = ethalfluralin 1.13 lb ai/acre; Prowl H_2O 2 pt/acre = pendimethalin 0.95 lb ai/acre; Brox 2EC 12 fl oz/acre = bromoxynil 0.188 lb ai/acre; GoalTender 4 fl oz/acre = oxyfluorfen 0.125 lb ai/acre.

[b]Application timing: LPRE = late pre-emergence (prior to onion emergence) applied on 4/11/2019; 2 & 4-leaf = onion at 2- & 4-leaf stages applied on 5/10/2019 and June 17, 2019, respectively.

[c]The bulbs were graded according to diameter: small (<2¼ inches), medium (2¼-3 inches), jumbo (3-4 inches), colossal (4-4¼ inches), and super colossal (>4¼ inches). Marketable yield is composed of 2¼ to >4¼ in (medium, jumbo, colossal, and super colossal grades) in diameter. Unmarketable bulbs are split bulbs (No. 2s), bulbs infected with the fungus *Botrytis allii* in the neck or side, or bulbs infected with the fungus *Fusarium oxysporum* (plate rot).

[d]Means within a column followed by same letter do not significantly differ (P = 0.05, LSD).

Table 3. Onion yield in response to application of Prowl H_2O or Sonalan late pre-emergence (LPRE) timing for weed control at the Malheur Experiment Station, Oregon State University, Ontario, OR, 2019.

				Unmarketable[c]			Marketable[c]				
Treatment[a]	Rate	Product rate	Timing[b]	Neck rot	No. 2s	<2¼ in	2¼-3 in	3-4 in	4-4¼ in	>4¼ in	Total
	lb ai/acre	units/acre		Number of bulbs/acre[d]							
Untreated				0.0 a	0.0 b	0.0 c	0.0 d	0.0 c	0.0 c	0.0 d	0.0 d
Sonalan HFP	0.75	2 pt	LPRE	1.0 a	0.0 b	13.4 ab	44.1 abc	369.9 ab	415.3 ab	413.8 ab	1,243.0 ab
Brox 2EC	0.188	12 fl oz	2&4-leaf								
GoalTender	0.125	4 fl oz	2&4-leaf								
Sonalan HFP	1.13	3 pt	LPRE	1.7 a	7.3 ab	12.5 ab	18.3 cd	300.2 b	352.9 b	447.4 a	1,118.7 bc
Brox 2EC	0.188	12 fl oz	2&4-leaf								
GoalTender	0.125	4 fl oz	2&4-leaf								
Sonalan HFP	0.75	2 pt	2&4-leaf	0.0 a	0.0 b	23.0 a	49.4 ab	430.1 a	352.5 b	257.4 c	1,089.3 bc
Brox 2EC	0.188	12 fl oz	2&4-leaf								
GoalTender	0.125	4 fl oz	2&4-leaf								
Sonalan HFP	1.13	3 pt	2&4-leaf	0.0 a	4.1 b	19.8 a	38.3 abc	361.5 ab	320.3 b	322.7 bc	1,042.8 bc
Brox 2EC	0.188	12 fl oz	2&4-leaf								
GoalTender	0.125	4 fl oz	2&4-leaf								
Prowl H_2O	0.95	2 pt	LPRE	0.0 a	17.0 a	6.9 bc	22.9 bcd	356.5 ab	503.1 a	464.3 a	1,346.8 a
Brox 2EC	0.188	12 fl oz	2&4-leaf								
GoalTender	0.125	4 fl oz	2&4-leaf								
Prowl H_2O	0.95	2 pt	2&4-leaf	0.0 a	2.7 b	19.7 a	51.5 a	365.5 ab	292.7 b	215.2 c	924.9 c
Brox 2EC	0.188	12 fl oz	2&4-leaf								
GoalTender	0.125	4 fl oz	2&4-leaf								
LSD (P = 0.05)				2.3	9.7	10.6	27.5	121.7	122.9	114.7	217.0

[a]Herbicide treatments: Sonalan 2 pt/acre = ethalfluralin 0.75 lb ai/acre; Sonalan 3 pt/acre = ethalfluralin 1.13 lb ai/acre; Prowl H_2O 2 pt/acre = pendimethalin 0.95 lb ai/acre; Brox 2EC 12 fl oz/acre = bromoxynil 0.188 lb ai/acre; GoalTender 4 fl oz/acre = oxyfluorfen 0.125 lb ai/acre.

[b]Application timing: LPRE = late pre-emergence (prior to onion emergence) applied on 4/11/2019; 2 & 4-leaf = onion at 2- & 4-leaf stages applied on 5/10/2019 and June 17, 2019, respectively.

[c]The bulbs were graded according to diameter: small (<2¼ inches), medium (2¼-3 inches), jumbo (3-4 inches), colossal (4-4¼ inches), and super colossal (>4¼ inches). Marketable yield is composed of 2¼ to >4¼ in (medium, jumbo, colossal, and super colossal grades) in diameter. Unmarketable bulbs are split bulbs (No. 2s), bulbs infected with the fungus *Botrytis allii* in the neck or side, or bulbs infected with the fungus *Fusarium oxysporum* (plate rot).

[d]Means within a column followed by same letter do not significantly differ (P = 0.05, LSD).