

EVALUATION OF SEVERAL HERBICIDES FOR POSSIBLE USE TO CONTROL WEEDS IN DIRECT-SEEDED ONION

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Introduction

Very few herbicides are available for weed control in direct-seeded onions. Evaluation of herbicides for weed control in specialty crops is necessary because most product labels include only major crops (wheat, corn, soybean, and cotton) when they are first registered. Therefore, evaluation of herbicide performance is the first step before products can be registered by the U.S. Environmental Protection Agency for use on any specialty crop. Weed control in direct-seeded onion is essential in order to realize acceptable bulb size and yield. The weed program at the Malheur Experiment Station endeavors to evaluate new herbicides that come on the market and to determine the use rates for direct-seeded onions grown under furrow-irrigation system. The objective of this study was to evaluate herbicides recently registered in other crops for weed efficacy and tolerance by direct-seeded dry bulb onions.

Materials and Methods

A field study was conducted in 2010 at the Malheur Experiment Station, Ontario, Oregon to evaluate onion response and weed control with several herbicides. The field was plowed and disked to create a seedbed suitable for onion production. Twenty-two-inch-wide beds were made to facilitate furrow irrigation. Onion seeds of variety 'Vaquero' were planted on March 24, 2010 in double rows spaced 3.7 inches apart and 3.9 inches within the row on 22-inch beds. Lorsban[®] 15G was banded at 3.7 oz/1,000 ft of row (chlorpyrifos at 0.125 lb ai/acre) over the entire field on March 29 as a preventive measure against onion maggot. The study area was irrigated on March 30 to stimulate onion germination and emergence.

The study followed a randomized complete block design with 4 replications; individual plots were 7.3 ft wide (4 rows) by 30.0 ft long. The products tested included Sharpen[™] at 3 oz/acre (saflufenacil at 1.07 oz ai/acre), which was applied pre-emergence. The following herbicides were applied post-emergence when onions were at the 2-leaf stage. Integrity[™] at 6.5 or 13 fl oz/acre (premix of saflufenacil and dimethenamid-p at 4.53 or 9.05 oz ai/acre); MON63410 at 0.187 pt/acre (acetochlor at 1.125 oz ai/acre); Huskie[®] at 11 or 15 fl oz/acre (premix of pyrasulfotole plus bromoxynil at 2.94 or 4 oz ai/acre); and Starane[®] at 0.35 pt/acre (1.96 oz ae/acre) alone or tankmixed with GoalTender at 0.25 or 0.5 pt/acre (oxyfluorfen at 2 or 4 oz ai/acre). The study also included a grower standard, which was treated with Prowl H₂O[®] at 2.1 pt/acre (pendimethalin at 1 lb ai/acre) pre-emergence followed by a tankmix of Goal 2XL[®] and Buctril[®] post-emergence when onion plants were at the 2-leaf stage. An untreated control was

also included. The pre-emergence herbicide treatment was applied on April 9 and at the 2-leaf stage on May 31. All herbicide treatments were applied using a CO₂-pressurized backpack sprayer fitted with a boom equipped with four Teejet 8002EVS nozzles and calibrated to deliver 20 gal/acre of spray solution.

Plants were sprayed with Lorsban[®] 4E at 1 qt/acre (chlorpyrifos at 1 lb ai/acre) on May 6 to control onion maggot. Fertilizer was applied on June 8 to supply 250, 180, 9, 5, 4, and 1 lb/acre of nitrogen, phosphorus, potassium, zinc, manganese, and boron, respectively. Plants were sprayed with Movento[®] at 5 fl oz/acre (spirotetramat at 1.25 oz ai/acre) on June 23 for thrips control. Subsequent spraying for thrips control on June 30 used Success[®] (8 oz/acre) plus Aza-Direct[®] (16 oz/acre) plus Ad-wet[®] non-ionic surfactant at 1 qt/acre (spinosad at 0.125 lb ai/acre + Azadirachtin at 0.0123 lb ai/acre + Ad-wet at 1.25% V/V). The trial was sprayed for thrips control again on August 26 using Lannate[®] at 3 pt/acre (methomyl at 0.9 lb ai/acre). Irrigation was scheduled to maintain moisture at a level suitable for onion production.

Visual evaluations for onion injury and weed control were conducted on June 7, July 27, and September 7 based on a scale of 0-100 percent, where 0 percent = no injury or no weed control and 100 percent = total crop damage or complete weed control. Onions were lifted on September 14 and hand harvested from 27 ft of the 2 center rows on September 16. Onions were graded based on USDA standards on September 20, 2010. The data were subjected to analysis of variance and means compared using the least significance difference (LSD, $P = 0.05$).

Results and Discussion

Visual evaluations on June 7 indicated variability in onion injury among herbicide treatments (Table 1). Onion injury ranged from 9 percent with the grower standard and MON63410 to 80 percent with Sharpen at 3 oz/acre applied prior to onion emergence (PRE). All herbicides provided complete control for redroot pigweed, hairy nightshade, and common lambsquarters on June 7. Evaluations on July 27 indicated onion injury had subsided for plants treated with Starane Ultra, MON63410, and the grower standard (Table 2). However, onion injury was still high for plants treated with Sharpen pre-emergence at 3 oz/acre. Control for redroot pigweed on July 27 was 97 percent or greater across herbicide treatments. Hairy nightshade control was complete at 100 percent across herbicide treatments. Control for common lambsquarters ranged from 69 to 100 percent on July 27 and 64 to 100 percent on September 7.

The number of onion bulbs per acre varied among herbicide treatments (Table 3). The lowest number of bulbs per acre (26,510 and 40,920) was observed when Integrity at 3 oz/acre and Sharpen at 13 fl oz/acre were applied pre-emergence and post-emergence when onions were at the 2-leaf stage, respectively. The total onion yield varied among herbicide treatments with the lowest yield recorded when Integrity at 13 fl oz/acre was applied to onions at the 2-leaf stage. The lowest marketable onion yield was also recorded when Integrity was applied at 13 fl oz/acre. The results indicate that there is potential for MON63410 to be developed for weed control in onions. However, more studies are needed to confirm weed efficacy, crop tolerance, and low pesticide residues in the produce as well as the best application timing of MON63410 to onions.

Table 1. Early weed control and onion response to several **unregistered** herbicides applied to control weeds in onions at Malheur Experiment Station, Ontario, OR, 2010.

Treatment	Rate (per acre)	Timing	Onion injury Jun 7	Weed control ^a		
				Redroot pigweed	Hairy nightshade	Common lambquarters
				----- % -----		
1 Untreated			0 g	0 b	0 b	0 c
2 Sharpen	3 oz	PRE	80 b	100 a	100 a	100 a
GoalTender	0.5 pt	2-leaf				
3 Integrity	6.5 fl oz	2-leaf	29 cde	100 a	100 a	100 a
4 Integrity	13 fl oz	2-leaf	95 a	100 a	100 a	100 a
5 MON63410	0.187 pt	2-leaf	9 fg	100 a	100 a	100 a
6 HUSKIE	11 fl oz	2-leaf	33 cd	100 a	100 a	100 a
7 HUSKIE	15 fl oz	2-leaf	39 c	100 a	100 a	100 a
8 STARANE Ultra	0.35 pt	2-leaf	18 ef	100 a	100 a	100 a
9 STARANE Ultra	0.35 pt	2-leaf	25 cde	100 a	100 a	99 b
GoalTender	0.25 pt					
10 STARANE Ultra	0.35 pt	2-leaf	29 cde	100 a	100 a	100 a
GoalTender	0.5 pt					
11 STARANE Ultra	0.35 pt	2-leaf	28 cde	100 a	100 a	100 a
GoalTender	0.5 pt					
Buctril	0.5 pt					
12 STARANE Ultra	0.35 pt	2-leaf	23 def	100 a	100 a	100 a
Buctril	0.5 pt					
13 Grower standard ^b	2.1 pt	2-leaf	9 fg	100 a	100 a	100 a
GoalTender	0.5 pt					

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

^bGrower standard was treated with Prowl H2O at 2 pt/a (pendimethalin at 1 lb ai/acre) before onion emergence, followed by Buctril and Goal 2XL herbicides at 0.5 pt/acre (bromoxynil and oxyfluorfen at 0.125 lb ai/acre).

Table 2. Mid- and late-season weed control and onion response to several *unregistered* herbicides at Malheur Experiment Station, Ontario, OR 2010.

Treatment	Rate (per acre)	Timing	Weed control ^a				
			Onion injury	July 27		Sept. 7	
				Redroot pigweed	Hairy nightshade	Common lambsquarters	
			----- % -----				
1 Untreated			0 e	0 c	0 b	0 d	0 d
2 Sharpen	3 oz	PRE	86 a	99 a	100 a	69 c	64 c
GoalTender	0.5 pt	2-leaf					
3 Integrity	6.5 fl oz	2-leaf	16 cd	98 ab	100 a	94 ab	93 a
4 Integrity	13 fl oz	2-leaf	88 a	98 ab	100 a	96 ab	95 a
5 MON63410	0.187 pt	2-leaf	5 de	96 ab	100 a	88 ab	73 bc
6 HUSKIE	11 fl oz	2-leaf	24 bc	99 a	100 a	100 a	98 a
7 HUSKIE	15 fl oz	2-leaf	34 b	99 a	100 a	98 ab	97 a
8 STARANE Ultra	0.35 pt	2-leaf	5 de	97 ab	100 a	91 ab	88 ab
9 STARANE Ultra	0.35 pt	2-leaf	5 de	95 b	100 a	84 bc	73 bc
GoalTender	0.25 pt						
10 STARANE Ultra	0.35 pt	2-leaf	6 de	99 a	100 a	91 ab	87 ab
GoalTender	0.5 pt						
11 STARANE Ultra	0.35 pt	2-leaf	6 de	99 a	100 a	100 a	100 a
GoalTender	0.5 pt						
Buctril	0.5 pt						
12 STARANE Ultra	0.35 pt	2-leaf	5 de	98 ab	100 a	95 ab	94 a
Buctril	0.5 pt						
13 Grower standard ^b	2.1 pt	2-leaf	4 e	99 a	100 a	91 ab	90 a
GoalTender	0.5 pt						

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

^bGrower standard was treated with Prowl H₂O at 2 pt/acre (pendimethalin at 1 lb ai/acre) before onion emergence, followed by Buctril and Goal 2XL herbicides at 0.5pt/acre (bromoxynil and oxyfluorfen at 0.125 lb ai/acre).

Table 3. Dry bulb onion yield in response to several *unregistered* herbicides used to control weeds at Malheur Experiment Station, Ontario, OR, 2010.

Treatment	Rate per acre	Timing	Onion bulbs/acre	Onion yield ^a					
				Total	Small	Medium	Jumbo	Colossal	Marketable
				cwt/acre					
1 Untreated			93720 b	90.4 g	67.9 a	16.7 f	5.8 h	0.0 a	22.6 g
2 Sharpen	3 oz	PRE	40920 c	206.3 f	10.6 f	47.0 f	148.7 ef	0.0 a	195.7 f
GoalTender	0.5 pt	2-leaf							
3 Integrity	6.5 fl oz	2-leaf	118580 a	450.0 cd	23.7 def	195.3 a-d	231.0 def	0.0 a	426.3 cd
4 Integrity	13 fl oz	2-leaf	26510 c	95.5 g	14.4 ef	45.6 f	35.5 gh	0.0 a	81.1 g
5 MON 63410	0.187 pt	2-leaf	119240 a	532.0 abc	35.4 bcd	224.5 a	269.6 bcd	2.5 a	496.6 abc
6 HUSKIE	11 fl oz	2-leaf	104500 ab	403.4 de	49.7 abc	168.9 cde	183.5 def	0.0 a	353.7 de
7 HUSKIE	15 fl oz	2-leaf	96250 b	320.3 e	52.8 ab	139.6 e	127.9 fg	0.0 a	267.5 ef
8 STARANE Ultra	0.35 pt	2-leaf	110770 ab	546.1 ab	20.6 def	157.8 de	367.7 ab	0.0 a	525.5 ab
9 STARANE Ultra	0.35 pt	2-leaf	119020 a	518.8 abc	27.7 def	217.8 ab	273.3 bcd	0.0 a	491.1 abc
GoalTender	0.25 pt								
10 STARANE Ultra	0.35 pt	2-leaf	116160 a	490.1 a-d	23.1 def	178.4 b-e	288.6 bcd	0.0 a	467.0 bc
GoalTender	0.5 pt								
11 STARANE Ultra	0.35 pt	2-leaf	119900 a	516.0 abc	18.9 def	154.3 de	342.8 abc	0.0 a	497.1 abc
GoalTender	0.5 pt								
Buctril	0.5 pt								
12 STARANE Ultra	0.35 pt	2-leaf	106260 ab	578.2 a	13.6 ef	151.8 de	410.2 a	2.5 a	564.6 a
Buctril	0.5 pt								
13 Grower standard ^b	2.1 pt	2-leaf	110880 ab	483.0 bcd	31.6 cde	212.7 abc	238.7 cde	0.0 a	451.4 bc
GoalTender	0.5 pt								

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

^b Grower standard was treated with Prowl H₂O at 2 pt/acre (pendimethalin at 1 lb ai/acre) before onion emergence, followed by Buctril and Goal 2XL herbicides at 0.5 pt/acre (bromoxynil and oxyfluorfen at 0.125 lb ai/acre) when onions were at the 2-leaf stage.