ONION RESPONSE AND WEED CONTROL WITH REFLEX® (FOMESAFEN) AND BICYCLOPYRONE

Joel Felix, Joey Ishida, and Joshua Noble, Malheur Experiment Station, Oregon State University, Ontario, OR, 2016

Introduction

Good weed control is essential for high onion productivity and quality. Onions are vulnerable to weed competition because of their low early development and lack of a complete canopy cover to shade out weeds. There are relatively fewer herbicides registered for weed control in direct-seeded onion compared with other major crops. Therefore, it is important to evaluate newly registered herbicides for possible use to control weeds in onion. Herbicides remain an essential tool to minimize weed competition and to realize acceptable bulb size and overall yield.

Evaluation of recently registered herbicides for weed control in specialty crops is a necessary step before the product can be granted an EPA label for use on the targeted crop. The herbicides Reflex® (fomesafen) and bicyclopyrone have a potential fit in onion production systems of the Treasure Valley. Both products could be used postemergence to control emerged weeds and also remain active in the soil. Importantly, Reflex is reported to suppress yellow nutsedge. The objectives of this study were to evaluate onion tolerance of Reflex and bicyclopyrone and weed control efficacy under local conditions when applied starting at the 2-leaf stage.

Materials and Methods

Field experiments were conducted at the Malheur Experiment Station, Ontario, Oregon in 2016 in a field previously planted to wheat. Based on a soil test, fertilizer was applied to supply100 lb nitrogen/acre, 60 lb phosphorus/acre, 100 lb elemental sulfur/acre, 4 lb zinc/acre, 1 lb copper/acre, and 1 lb boron/acre. The field was moldboard plowed and rototilled. On October 31, 2015, the soil was fumigated using Telone® C-17 at 18 gal/acre and simultaneously bedded on 22-inch spacing. The beds were harrowed and flattened on March 4, 2016. Onion seeds of variety 'Vaquero' were planted on March 24 in double rows spaced 3.7 inches apart and 3.9 inches within each row. Lorsban® 15G was banded at 3.7 oz/1,000 ft of row (0.125 lb ai/acre) on March 28 as a preventive measure against onion maggot.

The study with Reflex had 10 treatments and the study with bicyclopyrone had 12 treatments. Both studies had a randomized complete block designs with four replicates. Individual plots were 7.3 ft wide (4 beds) by 27 ft long. Pre-emergence treatments were applied on April 6. Postemergence treatments were applied with and without a non-ionic surfactant (NIS) at 0.25% v/v or tank-mixed with Buctril® at 0.75 pt/acre (Tables 1-4). The grower standard weed control treatment was treated with Prowl® H_2O at late pre-emergence followed by Buctril and GoalTender® and an untreated control treatment were included. Postemergence treatments were applied on May 2 and 11. All other operations including fertilizers, irrigation, and insecticide sprays followed the recommended local practices.

Onion plant tops were flailed on September 7 and the bulbs were lifted on September 8, 2016. Bulbs were hand-harvested from the two center beds of each 4-bed plot on September 14 and graded on September 19. The bulbs were graded according to quality as follows: bulbs without blemishes (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 No. 1 bulbs were graded according to diameter: small (<2¼ inches), medium (2¼-3 inches), jumbo (3-4 inches), colossal (4-4¼ inches), and supercolossal (>4¼ inches). Marketable yield consisted of No.1 bulbs >2¼ inches. The data were subjected to analysis of variance and means compared using the least significance difference (LSD, $P = 0.05$).

Results

Onion emergence was observed on April 12, 2016. Evaluations on May 23 indicated variable onion injury attributable to the Reflex herbicide rate and the inclusion of NIS or lack thereof (Table 1). Injury at 7 days after treatment was <10% when NIS was not included and 18-21% when NIS was added, compared to 3% for the grower standard. Evaluations at 28 days after herbicide application indicated onion injury <1 to 11% without NIS and 13-26% when NIS was added. Yellow nutsedge control ranged from 18 to 41% following an increasing rate gradient and the use of adjuvant. Control for common lambsquarters and redroot pigweed was between 55 and 93%. Marketable onion yield was similar across Reflex treatments and ranged from 475 to 567 cwt/acre compared to 541 cwt/acre for the grower standard and 776 cwt/acre for the untreated hand-weeded control (Table 2).

No onion injury was observed from bicyclopyrone treatments (Table 3). Yellow nutsedge control varied across treatments and was relatively low. The control increased with an increase in bicyclopyrone rate. On May 10, yellow nutsedge control ranged from 5 to 60% depending on herbicide rate compared to 8% for the grower standard. Evaluations on May 24 indicated 0 to 36% control, again increasing with the increase in herbicide rate. Onion yield was similar for the medium and jumbo grades, but varied among bicyclopyrone herbicide rates for the total marketable yield (Table 4). The marketable yield ranged from 512 to 667 cwt/acre across bicyclopyrone treatments compared to 601 cwt/acre for the grower standard.

The results suggested that both Reflex and bicyclopyrone have the potential to be used to manage weeds in direct-seeded onion. This research will be continued with the hope of acquiring registrations for Reflex and bixyclopyrone use on onion in the future.

Table 1. Onion injury and yellow nutsedge and pigweed control with various weed control treatments evaluating Reflex (fomesafen) on June 23 at the Malheur Experiment Station, Ontario, OR, 2016.

			Onion injury[a]			Weed control[a]		
Treatment[b]	Product rate	Timing[c]	May 23	Jun 13	Jun 23	Yellow nutsedge	Common lambsquarters	Redroot pigweed
			%					
Untreated-weed free			0.0 c	0.0 c	0.0 f	100.0 a	100.0 a	100.0 a
Reflex	8 fl oz/acre	B	5.0 c	3.8 bc	0.0 f	17.5 c	65.0 c	47.5 b
Reflex	8 fl oz/acre	B	21.3 abc	20.0 ab	12.5 cd	33.8 bc	61.3 c	54.5 b
NIS	11.2 fl oz/acre	C						
Reflex	16 fl oz/acre	B	8.8 bc	6.3 bc	1.3 ef	40.0 b	73.8 bc	68.8 ab
Reflex	16 fl oz/acre	B	18.8 bc	13.8 bc	15.0 c	35.0 bc	96.3 a	94.0 a
NIS	11.2 fl oz/acre	C						
Reflex	8 fl oz/acre	B	13.8 bc	8.8 bc	8.8 c-f	27.5 bc	93.3 ab	68.8 ab
Reflex	8 fl oz/acre	C						
Reflex	8 fl oz/acre	B	6.3 bc	5.0 bc	26.3 b	41.3 b	94.0 ab	90.0 a
NIS	11.2 fl oz/acre	B						
Reflex	8 fl oz/acre	C						
NIS	11.2 fl oz/acre	C						
Reflex	16 fl oz/acre	B	27.5 ab	20.0 ab	11.3 cde	40.0 b	89.5 ab	74.5 ab
Reflex	16 fl oz/acre	C						
Reflex	16 fl oz/acre	B	41.3 a	32.5 a	38.8 a	30.5 bc	94.5 ab	93.3 a
NIS	11.2 fl oz/acre	B						
Reflex	16 fl oz/acre	C						
NIS	11.2 fl oz/acre	C						
Prowl H_2O (Grower std)	2 pt/acre	A	2.5 c	3.8 bc	2.5 def	30.0 bc	100.0 a	100.0 a
Outlook	21 fl oz/acre	B						
Buctril	12 fl oz/acre	B, C						
GoalTender	8 fl oz/acre	B, C						

[a]Means within a column followed by the same letter do not significantly differ (*P* = 0.05, LSD).
[b]Reflex 8 fl oz/acre = fomesafen 0.125 lb ai/acre; Reflex 16 fl oz/acre = fomesafen 0.25 lb ai/acre; Buctril 12 fl oz/acre = bromoxynil 0.187 lb ai/acre; GoalTender 8 fl oz/acre = oxyfluorfen 0.25 lb ai/acre; Outlook 21 fl oz/acre = dimethenmid-p 0.98 lb ai/acre.
[c]Timing A = Late-preemergence (April 6); B = 2-leaf (May 2); C = 4-leaf stage (May 11).

Table 2. Onion yield and grade in response to various weed control treatments evaluating Reflex (fomesafen) at the Malheur Experiment Station, Ontario, OR 2016

						Marketable[a]				
Treatment[b]	Product rate	Timing[c]	Small	No. 2	Rot	Medium	Jumbo	Colossal	Supercolossal	Total
			---------- cwt/acre ----------							
Untreated-weed free			3.6 d	1.4 a	0.7 a	17.8 d	237.4 a	111.0 a	22.5 a	776.4 a
Reflex	8 fl oz/acre	B	18.2 a	0.0 a	0.2 a	33.0 abc	181.7 a	23.5 cd	0.0 b	475.7 b
Reflex	8 fl oz/acre	B	14.2 ab	1.4 a	0.0 a	39.6 a	183.9 a	37.1 bcd	1.2 b	523.0 b
NIS	11.2 fl oz/acre	C								
Reflex	16 fl oz/acre	B	9.1 bcd	0.0 a	0.4 a	22.2 cd	219.2 a	40.6 bc	0.8 b	565.0 b
Reflex	16 fl oz/acre	B	10.8 bcd	0.0 a	0.9 a	22.4 cd	179.1 a	59.3 b	3.3 b	527.5 b
NIS	11.2 fl oz/acre	C								
Reflex	8 fl oz/acre	B	11.1 abc	0.0 a	1.2 a	33.2 abc	221.1 a	29.4 cd	0.0 b	566.6 b
Reflex	8 fl oz/acre	C								
Reflex	8 fl oz/acre	B	9.0 bcd	0.3 a	0.9 a	26.9 a-d	205.2 a	10.1 d	0.8 b	485.4 b
NIS	11.2 fl oz/acre	B								
Reflex	8 fl oz/acre	C								
NIS	11.2 fl oz/acre	C								
Reflex	16 fl oz/acre	B	6.4 cd	0.0 a	0.0 a	23.0 bcd	184.8 a	27.0 cd	0.9 b	470.9 b
Reflex	16 fl oz/acre	C								
Reflex	16 fl oz/acre	B	12.3 abc	0.0 a	0.0 a	37.3 ab	168.3 a	8.8 d	0.0 b	428.2 b
NIS	11.2 fl oz/acre	B								
Reflex	16 fl oz/acre	C								
NIS	11.2 fl oz/acre	C								
Prowl H_2O (Grower std)	2 pt/acre	A	9.3 bcd	0.9 a	0.6 a	29.5 a-d	198.3 a	37.6 bcd	5.4 b	540.8 b
Roundup PowerMax	22 fl oz/acre	B								
Outlook	21 fl oz/acre	B, C								
Buctril	12 fl oz/acre	B, C								
GoalTender	8 fl oz/acre									

[a]Means within a column followed by the same letter do not significantly differ (*P* = 0.05, LSD).
[b]Reflex 8 fl oz/acre = fomesafen 0.125 lb ai/acre; Reflex 16 fl oz/acre = fomesafen 0.25 lb ai/acre; Buctril 12 fl oz/acre = bromoxynil 0.187 lb ai/acre; GoalTender 8 fl oz/acre = oxyfluorfen 0.25 lb ai/acre; Outlook 21 fl oz/acre = dimethenamid-p 0.98 lb ai/acre.
[c]Timing A = Late-preemergence (April 6); B = 2-leaf (May 2); C = 4-leaf stage (May 11).

Table 3. Onion injury and yellow nutsedge control with various weed control treatments evaluating bicyclopyrone at Malheur Experiment Station, Ontario, OR, 2016.

	Treatments	Rate	Unit	Product	Rate	Stage	Timing[b]	Onion % injury[a] May 10	Yellow nutsedge % control May 10	Onion % injury May 24	Yellow nutsedge % control May 24
1	Untreated							0.0 a	0.0h	0.0a	0.0 d
2	A16003 (bicyclopyrone)	37.5	g ai/ha	2.57	fl oz/acre	2-leaf	B	0.0 a	16.3cde	0.0a	7.5 c
3	A16003 (bicyclopyrone)	50.0	g ai/ha	3.42	fl oz/acre	2-leaf	B	0.0 a	5.0gh	0.0a	3.8 cd
4	A16003 (bicyclopyrone)	100.0	g ai/ha	6.84	fl oz/acre	2-leaf	B	0.0 a	13.8def	0.0a	7.5 c
5	A16003 (bicyclopyrone)	37.5	g ai/ha	2.57	fl oz/acre	2 leaf	B	0.0 a	6.3fgh	0.0a	0.0 d
	NIS	0.25%	v/v	0.7	pt/acre	2 leaf	B				
6	A16003 (bicyclopyrone)	50.0	g ai/ha	3.42	fl oz/acre	2 leaf	B	0.0 a	22.5bc	0.0a	1.3 d
	NIS	0.25%	v/v	0.7	pt/acre	2 leaf	B				
7	A16003 (bicyclopyrone)	100.0	g ai/ha	6.84	fl oz/acre	2 leaf	B	0.0 a	60.0a	0.0a	36.3 a
	NIS	0.25%	v/v	0.7	pt/acre	2 leaf	B				
8	A16003 (bicyclopyrone)	37.5	g ai/ha	2.57	fl oz/acre	2-leaf	B	0.0 a	8.8efg	0.0a	0.0 d
	Buctril	210	g ai/ha	0.75	pt/acre	2-leaf	B				
	Buctril	210	g ai/ha	0.75	pt/acre	2-leaf	B				
	GoalTender	140	g ai/ha	0.25	pt/acre	4-6 leaf	C				
9	A16003 (bicyclopyrone)	50	g ai/ha	3.42	fl oz/acre	2 leaf	B	0.0 a	18.8bcd	0.0a	2.5 d
	Buctril	210	g ai/ha	0.75	pt/acre	2-leaf	B				
	Buctril	210	g ai/ha	0.75	pt/acre	4-6 leaf	C				
	GoalTender	140	g ai/ha	0.25	pt/acre	4-6 leaf	C				
10	A16003 (bicyclopyrone)	100	g ai/ha	6.84	fl oz/acre	2-leaf	B	0.0 a	25.3b	0.0a	18.8 b
	Buctril	210	g ai/ha	0.75	pt/acre	2-leaf	B				
	Buctril	210	g ai/ha	0.75	pt/acre	4-6 leaf	C				
	GoalTender	140	g ai/ha	0.25	pt/acre	4-6 leaf	C				
11	A16003 (bicyclopyrone)	37.6	g ai/ha	2.57	fl oz/acre	2- leaf	B	0.0 a	6.3fgh	0.0a	3.8 cd
	Reflex	140	g ai/ha	0.50	pt/acre	2- leaf	B				
	Dual Magnum	1070	g ai/ha	1.00	pt/acre	2- leaf	B				
	Buctril	210	g ai/ha	0.75	pt/acre	4-6 leaf	C				
	GoalTender	140	g ai/ha	0.25	pt/acre	4-6 leaf	C				
12	Prowl H_2O (Grower std)	1070	g ai/ha	2	pt/acre	LPRE	A	0.0 a	7.5fgh	0.0a	1.3 d
	Roundup PowerMax	870	g ae/ha	22	fl oz/acre	LPRE	A				
	Outlook	1100	g ai/ha	21	fl oz/acre	POST1	B				
	Buctril	210	g ai/ha	0.75	pt/acre	2-leaf	B; C				
	GoalTender	140	g ai/ha	0.25	pt/acre	2-leaf	B; C				

[a]Timing A = Late-preemergence (April 6); B = 2-leaf (May 2); C = 4-leaf stage (May 11).
[b]Means within a column followed by the same letter do not significantly differ (*P* = 0.05, LSD).

Table 4. Onion yield and grade in response to various weed control treatments evaluating bycyclopyrone at Malheur Experiment Station, Ontario, OR, 2016.

								Marketable[b]				
	Treatment	Rate	Unit	Timing[a]	Small	No. 2	Rot	Medium	Jumbo	Colossal	Supercolossal	Total
							cwt/acre					
1	Untreated				14.4 bc	0.0 a	0 a	35.4 a	300 a	175.0 bc	93.5 abc	603.7 abc
2	A16003 (bicyclopyrone)	2.57	fl oz/acre	2-leaf	19.5 ab	0.0 a	4 a	39.3 a	242 a	223.5 abc	129.0 a	633.9 abc
3	A16003 (bicyclopyrone)	3.42	fl oz/acre	2-leaf	14.6 bc	0.0 a	1 a	45.9 a	318 a	256.4 a	65.5 bcd	685.9 a
4	A16003 (bicyclopyrone)	6.84	fl oz/acre	2-leaf	24.2 a	0.0 a	0 a	57.7 a	245 a	156.3 c	53.9 cd	512.6 c
5	A16003 (bicyclopyrone)	2.57	fl oz/acre	2-leaf	18.3 ab	2.2 a	1 a	58.4 a	280 a	158.4 c	39.9 d	536.6 bc
	NIS	0.7	pt/acre	2-leaf								
6	A16003 (bicyclopyrone)	3.42	fl oz/acre	2-leaf	13.9 bc	0.0 a	2 a	35.9 a	302 a	208.2 abc	115.4 ab	661.6 ab
	NIS	0.7	pt/acre	2-leaf								
7	A16003 (bicyclopyrone)	6.84	fl oz/acre	2-leaf	16.3 abc	0.0 a	2 a	53.0 a	300 a	221.2 abc	80.2 a-d	654.3 ab
	NIS	0.7	pt/acre	2-leaf								
8	A16003 (bicyclopyrone)	2.57	fl oz/acre	2-leaf	16.5 abc	0.0 a	0 a	38.9 a	259 a	160.3 c	58.2 cd	516.0 c
	Buctril	0.75	pt/acre	2-leaf								
	Buctril	0.75	pt/acre	2-leaf								
	GoalTender	0.25	pt/acre	4-6 leaf								
9	A16003 (bicyclopyrone)	3.42	fl oz/acre	2-leaf	9.7 c	0.7 a	3 a	33.2 a	288 a	241.3 ab	63.9 cd	626.8 abc
	Buctril	0.75	pt/acre	2-leaf								
	Buctril	0.75	pt/acre	4-6 leaf								
	GoalTender	0.25	pt/acre	4-6 leaf								
10	A16003 (bicyclopyrone)	6.84	fl oz/acre	2-leaf	14.7 bc	2.1 a	0 a	42.7 a	296 a	208.5 abc	86.3 a-d	633.4 abc
	Buctril	0.75	pt/acre	2-leaf								
	Buctril	0.75	pt/acre	4-6 leaf								
	GoalTender	0.25	pt/acre	4-6 leaf								
11	A16003 (bicyclopyrone)	2.57	fl oz/acre	2-leaf	11.9 bc	1.2 a	2 a	39.9 a	300 a	244.4 ab	68.9 bcd	653.4 ab
	Reflex	0.50	pt/acre	2-leaf								
	Dual Magnum	1.00	pt/acre	2-leaf								
	Buctril	0.75	pt/acre	4-6 leaf								
	GoalTender	0.25	pt/acre	4-6 leaf								
12	Prowl H_2O (Grower std)	2	pt/acre	LPRE	12.8 bc	0.0 a	1 a	37.0 a	229 a	209.9 abc	124.7 a	601.0 abc
	Outlook	21	fl oz/acre	POST1								
	Buctril	0.75	pt/acre	2&4-leaf								
	GoalTender	0.25	pt/acre	2&4-leaf								

[a]Timing A = Late-preemergence (April 6); B = 2-leaf (May 2); C = 4-leaf stage (May 11).
[b]Means within a column followed by the same letter do not significantly differ (*P* = 0.05, LSD).