EVALUATION OF PYROXASULFONE FOR WEED CONTROL IN DIRECT-SEEDED ONION

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Introduction

Relatively fewer herbicides are registered for weed control in direct-seeded onions and vegetables in general compared to agronomic crops such as corn. Consequently, 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. To that end, the weed program at the Malheur Experiment Station endeavors to evaluate new herbicides that come on the market and to determine their fitness for weed control in direct-seeded onions grown under furrow irrigation. The objective of this study was to evaluate KIH-485 (pyroxasulfone) for weed efficacy and tolerance by direct-seeded dry bulb onion grown under furrow-irrigation conditions.

Materials and Methods

Onion response to KIH-485 and its weed control efficacy under furrow-irrigated conditions were evaluated in 2011 at the Malheur Experiment Station, Ontario, Oregon. The herbicide KIH-485 was applied at 1.06, 1.28, or 1.7 oz ai/acre at one of the following four timings: preplant incorporated (PPI), preemergence (PRE), or when onion plants were at the one-leaf or two-leaf stage.

The wheat stubble was flailed and the field plowed during fall of 2010. Fertilizer was immediately applied to provide 21, 102, 102, 2, and 1 lb/acre of nitrogen, phosphate, sulfur, manganese, and boron, respectively. The field was later groundhogged and 22-inch-wide beds formed. The beds were harrowed and reshaped on April 6, 2011. The PPI herbicide treatments were applied on April 7 and onion variety ‘Vaquero’ planted later that day. Onion seeds were planted in double rows spaced 3 inches apart and 4-inch spacing within each row. Double rows were planted on beds spaced 22 inches apart. The treatments were laid out in randomized complete block design with four replications. Individual plots measured 7.33 ft (4 beds wide) by 27 ft long. On April 14, Lorsban® 15G at 3.7 oz/1,000 ft of row (chlorpyrifos at 0.101 lb ai/acre) was banded over the top of the onion rows and the soil surface was rolled. Roundup® was applied at 22 fl oz/acre (glyphosate at 0.77 lb acid equivalent [ae]/acre) on April 22 to control all weeds that had emerged prior to onion emergence.

The first furrow irrigation was applied on May 8 and lasted 24 hours to supply about 4 inches of water (including runoff). All subsequent irrigations (12 times from June 10 to August 29, 2011) were of the same duration and delivered the same amount of water.

The postemergence treatments were applied May 11 and May 22 when onions were at the one- and two-leaf stages, respectively. GoalTender® and Buctril® were applied at the rates of 0.5 pt/acre equivalent to oxyfluorfen at 0.25 lb ai/acre and bromoxynil at 0.125 lb ai/acre, respectively.

Onion plants were sprayed with Movento® (spirotetramat) at 0.078 lb ai/acre tank-mixed with Pierce (crop oil concentrate) at 1.57 lb ai/acre on June 13 to control thrips. Plants were sidedressed with urea fertilizer on June 21 to supply nitrogen at 225 lb/acre. Onion plants were sprayed again for thrips control on June 22 and July 5 using Radiant® (spinetoram) at 0.078 lb ai/acre tank-mixed with a crop oil concentrate. Plots were visually evaluated for weed control and crop injury on May 10 and July 15 based on 0 to 100 percent where 0 percent = no weed control or crop injury and 100 percent = complete weed control or complete crop kill.

Results and Discussion

There was no onion injury observed from any of the herbicide rates and application timings evaluated in this study (Tables 1 and 2). Early season control for common lambsquarters varied by the herbicide application timing and ranged from 75 to 90 percent compared to 98 percent for Prowl H2O® (Table 1). Control for hairy nightshade ranged from 80 to 90 percent, while redroot pigweed was controlled 80 to 90 percent. Kochia control ranged from 85 to 97 percent across herbicide rates and application timing.

Postemergence application of GoalTender at 2 oz ai/acre improved the midseason weed control regardless of the KIH-485 rate and application timing (Table 2). Common lambsquarters was controlled 85 to 90 percent compared to 98 percent for Prowl H2O followed by GoalTender (grower standard). Midseason control for hairy nightshade was 90 to 98 percent compared to 100 percent for the grower standard. Delaying the application of KIH-485 until onions were at the two-leaf stage provided lower hairy nightshade control (90 percent). Application of KIH-485 at 1.06 to 1.7 oz ai/acre followed by GoalTender at 2 oz ai/acre provided almost complete control for redroot pigweed (97 to 100 percent) regardless of the application timing. Kochia control ranged from 90 to 99 percent with the lower control associated with KIH-485 at 1.06 to 1.7 oz ai/acre applied when onions were at one- and two-leaf stages.

The number of onion bulbs varied across herbicide treatments (Table 3); small bulbs ranged from 1,782 to 5,346 bulbs/acre, medium bulbs ranged from 10,494 to 21,780 bulbs/acre, while jumbo bulbs varied from 72,666 to 100,386/acre. There was no difference in the number of jumbo bulbs across herbicide treatment rates and application timing. The highest number of colossal bulbs (12,276/acre) was obtained when KIH-485 was applied at 1.7 oz ai/acre prior to planting onion. Similarly, the highest number of U.S. No. 1 onion bulbs was obtained when KIH-485 was applied prior to onion emergence at 1.28 and 1.7 oz ai/acre. Application of KIH-485 at 1.28 oz ai/acre when onions were at the one-leaf stage produced the lowest number of bulbs (89,496/acre).

Yield for the medium, colossal, and super colossal categories varied across herbicide treatments

(Table 4); however, when grouped together, there was no significant difference among KIH-485 herbicide rates and application timing for the U.S. No. 1 category or the total yield per acre.

These results indicated that KIH-485 may be a potential herbicide for weed control in direct-seeded dry bulb onions. It is unclear whether or not the mild weather in 2011 played any role in these results, so we do not know whether KIH-485 would damage onions with hotter weather. Therefore, this study will be repeated in 2012 to confirm these results and evaluate further the weed control and onion response to this product.

Table 1. Weed control on May 10 in direct-seeded dry bulb onion treated with KIH-485 (pyroxasulfone) at the Malheur Experiment Station at Ontario, OR, 2011.

Treatment	Rate	Timing[a]	Crop injury	Weed control			
				Common lambsquarters	Hairy nightshade	Redroot pigweed	Kochia
	oz ai/acre		----------	---------- no./acre ----------			
Untreated			0	0	0	0	0
KIH-485	1.06	A	0	80	80	85	90
KIH-485	1.28	A	0	85	85	90	90
KIH-485	1.7	A	0	85	90	90	97
KIH-485	1.06	B	0	85	85	90	90
KIH-485	1.28	B	0	85	85	95	90
KIH-485	1.7	B	0	90	90	95	95
KIH-485	1.06	C	0	75	80	80	85
KIH-485	1.28	C	0	80	80	85	85
KIH-485	1.7	C	0	80	80	85	85
KIH-485	1.06	D	0	--[b]	--	--	--
KIH-485	1.28	D	0	--	--	--	--
KIH-485	1.7	D	0	--	--	--	--
Prowl H2O (Grower standard)	11.4	B	0	98	98	98	98
LSD (*P* = 0.05)			--	5	8	9	7

[a] Herbicide application timing: A = preplant incorporated; B = preemergence; C = onion at one-leaf stage; D = onion at 2-leaf stage.
[b] Ratings taken before the treatments were applied.

Table 2. Weed control on July 15 in direct-seeded onion treated with KIH-485 (pyroxasulfone) at the Malheur Experiment Station at Ontario, OR, 2011.

Treatment	Rate	Timing[a]	Crop injury	Weed control			
				Common lambsquarters	Hairy nightshade	Redroot pigweed	Kochia
	oz ai/acre		----------	---------- no./acre ----------			
Untreated			0	0	0	0	0
KIH-485	1.06	A	0	90	95	97	99
GoalTender	2	D					
KIH-485	1.28	A	0	95	98	98	99
GoalTender	2	D					
KIH-485	1.7	A	0	90	98	98	99
GoalTender	2	D					
KIH-485	1.06	B	0	95	98	99	99
GoalTender	2	D					
KIH-485	1.28	B	0	95	98	99	99
GoalTender	2	D					
KIH-485	1.7	B	0	95	98	99	99
GoalTender	2	D					
KIH-485	1.06	C	0	90	98	98	99
GoalTender	2	D					
KIH-485	1.28	C	0	90	98	98	90
GoalTender	2	D					
KIH-485	1.7	C	0	90	98	98	90
GoalTender	2	D					
KIH-485	1.06	D	0	80	90	95	90
GoalTender	2	D					
KIH-485	1.28	D	0	90	90	95	90
GoalTender	2	D					
KIH-485	1.7	D	0	85	90	95	90
GoalTender	2	D					
Prowl H2O	11.4	B	0	98	100	100	100
GoalTender	2	D					
(Grower standard)							
LSD (*P* = 0.05)			--	5	7	NS	8

[a] Herbicide application timing: A = preplant incorporated; B = preemergence; C = onion at one-leaf stage; D = onion at 2-leaf stage.

Table 3. Plant stand in response to KIH-485 (pyroxasulfone) application on direct-seeded onion at the Malheur Experiment Station at Ontario, OR, 2011.

Treatment	Rate	Timing[a]	Number of onion bulbs						
			Small	Medium	Jumbo	Colossal	Super colossal	U.S. No. 1	Total number
	oz ai/acre		---------- no./acre ----------						
Untreated			2,970	16,830	72,468	2,772	0	92,070	95,040
KIH-485	1.06	A	4,158	18,018	90,486	5,346	198	114,048	118,206
GoalTender	2	D							
KIH-485	1.28	A	2,574	11,682	90,882	9,702	1,386	113,652	116,226
GoalTender	2	D							
KIH-485	1.7	A	2,574	10,692	72,666	12,276	594	96,228	98,802
GoalTender	2	D							
KIH-485	1.06	B	3,168	18,018	97,218	3,564	0	118,800	121,968
GoalTender	2	D							
KIH-485	1.28	B	2,178	17,424	98,604	4,950	0	120,978	123,156
GoalTender	2	D							
KIH-485	1.7	B	5,346	21,780	100,386	3,168	0	125,334	130,680
GoalTender	2	D							
KIH-485	1.06	C	3,762	18,810	92,070	7,524	396	118,800	122,562
GoalTender	2	D							
KIH-485	1.28	C	3,366	10,494	74,646	4,158	198	89,496	92,862
GoalTender	2	D							
KIH-485	1.7	C	2,178	15,840	85,536	4,356	594	106,326	108,504
GoalTender	2	D							
KIH-485	1.06	D	2,574	13,068	96,624	7,920	0	117,612	120,186
GoalTender	2								
KIH-485	1.28	D	1,782	14,256	97,218	5,346	396	117,216	118,998
GoalTender	2								
KIH-485	1.7	D	2,970	11,880	81,774	5,544	0	99,198	102,168
GoalTender	2								
Prowl H2O	11.4	B	3,168	17,424	90,684	6,336	0	114,444	117,612
GoalTender (Grower std)	2	D							
LSD (P = 0.05)			3,206	10,860	NS	6,608	691	34,084	34,979

[a] Herbicide application timing: A = preplant incorporated; B = preemergence; C = onion at one-leaf stage; D = onion at two- leaf stage.

Table 4. Onion yield in response to KIH-485 (pyroxasulfone) application on direct-seeded onion at the Malheur Experiment Station at Ontario, OR, 2011.

Treatment	Rate	Timing[a]	Onion yield						
			Small	Medium	Jumbo	Colossal	Super colossal	U.S. No. 1	Total yield
	oz ai/acre		cwt/acre						
Untreated			6.3	64.6	567.5	31.1	0.0	663.1	669.4
KIH-485	1.06	A	8.9	66.4	681.0	60.2	3.4	811.0	819.9
GoalTender	2	D							
KIH-485	1.28	A	5.7	42.2	688.2	111.3	18.9	860.6	866.3
GoalTender	2	D							
KIH-485	1.7	A	6.3	42.2	647.3	147.9	9.8	847.2	853.5
GoalTender	2	D							
KIH-485	1.06	B	8.0	67.8	738.1	39.5	0.0	845.4	853.4
GoalTender	2	D							
KIH-485	1.28	B	4.7	67.5	759.4	58.1	0.0	885.0	889.7
GoalTender	2	D							
KIH-485	1.7	B	12.8	89.0	654.9	39.0	0.0	783.0	795.8
GoalTender	2	D							
KIH-485	1.06	C	7.9	70.1	682.7	89.0	6.9	848.7	856.6
GoalTender	2	D							
KIH-485	1.28	C	8.0	38.1	588.9	49.2	2.9	679.1	687.0
GoalTender	2	D							
KIH-485	1.7	C	6.3	61.4	650.3	50.9	9.8	772.5	778.8
GoalTender	2	D							
KIH-485	1.06	D	5.4	51.8	730.9	96.8	0.0	879.4	884.9
GoalTender									
KIH-485	1.28	D	4.2	52.8	753.4	64.7	6.9	877.9	882.0
GoalTender									
KIH-485	1.7	D	7.0	41.1	657.6	66.0	0.0	764.7	771.7
GoalTender									
Prowl H2O	11.4	B	7.0	68.7	686.1	75.5	0.0	830.3	837.3
GoalTender	2	D							
(Grower standard)									
LSD (*P* = 0.05)			7	43.1	NS	78.3	10.9	NS	NS

[a] Herbicide application timing: A = preplant incorporated; B = preemergence; C = onion at one- leaf stage; D = onion at two-leaf stage.