

EVALUATION OF OUTLOOK[®] APPLIED THROUGH DRIP IRRIGATION TO CONTROL YELLOW NUTSEdge

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Introduction

Yellow nutsedge continues to be a problem weed of direct-seeded onion in the Treasure Valley of eastern Oregon and southwestern Idaho. Research has shown a 42% reduction in onion marketable yield in heavily infested fields. A factor contributing to poor yellow nutsedge control is the application timing of herbicides Outlook[®] and Dual Magnum[®] (dimethenamid-p and *s*-metolachlor), which because of plant sensitivity are registered for use only after onions have attained the two true leaf stage. In order for dimethenamid-p and *s*-metolachlor to control yellow nutsedge they have to be applied preemergence because these products generally do not control emerged weeds. There is anecdotal evidence to suggest that dimethenamid-p applied through drip irrigation starting when onions are at the 2-leaf stage provides better yellow nutsedge control compared to conventional postemergence applications on the soil surface.

Material and Methods

A field study was conducted in 2014 at the Malheur Experiment Station, Ontario, Oregon to evaluate the response of direct-seeded onion to dimethenamid-p herbicide applied through the irrigation drip to control yellow nutsedge. Applications were initiated when onion plants were at the 2-leaf stage. Onion seed of variety 'Vaquero' was planted on March 26, 2014 in double rows spaced 3 inches apart with 4-inch seed spacing within each row. Each double row was planted on beds spaced 22 inches apart. Planting was done with customized John Deere Flexi Planter units equipped with disc openers. Immediately after planting, the onion rows received a narrow band of Lorsban[®] 15G at 3.7 oz/1,000 ft of bed (0.82 lb ai/acre), and the soil surface was rolled. The soil was a Greenleaf silt loam with a pH 7.2 and 1.8% organic matter.

On April 8, 2014 the entire study area was sprayed with glyphosate at 0.77 lb ae/acre (Roundup PowerMax[®] at 22 fl oz/acre) plus pendimethalin at 0.95 lb ai/acre (Prowl[®]H₂O at 32 fl oz/acre) to control all emerged weeds prior to onion emergence. Onion emergence started on April 11. On May 21, oxyfluorfen at 0.25 lb ai/acre (GoalTender[®] at 8 oz/acre) plus bromoxynil at 0.125 lb ai/acre (Buctril[®] at 8 oz/acre) plus sethoxydim at 0.28 lb ai/acre (Poast[®] at 1.5 pt/acre) were broadcast to control grassy and broadleaf weeds. All other cultural practices followed the standard local onion production practices. Herbicide treatment details are presented in Table 1. The plants were fertilized with 50 lb nitrogen (N)/acre applied through the drip on June 6 and

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July 1, 2014 on each occurrence. The study followed a randomized complete block design with four replications.

In order to achieve uniform herbicide distribution in the top soil layer, dimethenamid-p herbicide was mixed into 35 or 5 gal of water and metered into the drip at a continuous uniform rate during the middle irrigation period as illustrated in the treatment list in Table 1. On May 16, 2014, 10 plants were identified randomly from each plot and measured from the ground to the tip of the longest fully extended leaf to determine the average plant height.

To control thrips, onions were sprayed with a tank mix of Movento[®] at 5 oz/acre (spirotetramat at 0.078 lb ai/acre) plus Radiant[®] at 8 oz/acre (spinetoram at 1 oz ai/acre) and Pierce (crop oil concentrate) at 16 oz/100 gal of water on May 29 and again on June 3, 2014. Onions were sprayed again on June 12 and 17 using Agri-Mek[®] at 3.5 oz/acre plus non-ionic surfactant (NIS) at 10 oz/100 gal of water to control thrips. Later sprays to control thrips were conducted aerially as follows: Agri-Mek at 3.5 oz/acre plus NIS at 10 oz/100 gallons of water on June 30, Lannate[®] at 3 pt/acre (methomyl at 0.9 lb ai/acre) on July 6 and 13, and Radiant at 10 oz/acre (spinetoram at 1.25 oz ai/acre) on July 22 and 27, 2014.

Plant tops were flailed and onion bulbs were lifted on September 3 and 5, 2014, respectively. Bulbs were hand-harvested from the two center beds on September 10 and graded on September 12, 2014. Bulbs were graded for yield and quality based on USDA standards. Data were subjected to analysis of variance and the treatment means were compared using protected LSD at 0.05% level of confidence.

Results and Discussion

Rainfall and drip irrigation activities during the season are presented in Table 2. Visual evaluations on July 7, 2014 indicated plant injury ranging from 0 to 6% that was characterized by twisting of leaves (known as rattail) (Table 3). Yellow nutsedge control on July 7 ranged from 80 to 89% for the treatments that included dimethenamid-p through the drip compared to 21% for the conventional application to the soil when onions are at the 2-leaf stage. The average plant height ranged from 31 to 33 inches (79 to 83 cm) for the treatments that included dimethenamid-p through the drip compared to 35 inches (88 cm) for the standard application to the soil. The increase in the height for plants that received the conventional application of Outlook to the soil was probably due to excessive competition with yellow nutsedge.

Yield of small onion bulbs was similar across herbicide treatments and ranged from 11 to 18 cwt/acre (Table 4). Yield for jumbo, colossal, and supercolossal onion grades were similar across herbicide treatments. The standard application of dimethenamid-p on the soil when onions were at the 2-leaf stage had a higher number of medium grade onions (179 cwt/acre) compared to 55 to 91 cwt/acre for the treatments that included dimethenamid-p through the drip. The higher number of medium grade onions for the standard application of dimethenamid-p reflected the increased effect of onion/yellow nutsedge competition compared to the other treatments. Season-long yellow nutsedge competition tends to reduce onion size.

Results for the number of harvested onion bulbs per acre are presented in Table 5. The trend for the number of bulbs was similar to the yield. The standard application of dimethenamid-p on the

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ground had a higher number of medium bulbs compared to treatments that had dimethenamid-p applied through the irrigation drip.

These results suggested no adverse effects to onions when dimethenmid-p was applied through the drip irrigation starting at the 2-leaf stage. If registered, this use would improve yellow nutsedge control in direct-seeded onion in the Treasure Valley and would not affect onion yield.

Acknowledgements

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Table 1. List of herbicide treatments for the study to evaluate dimethenamid-p applied through the irrigation drip to control yellow nutsedge in onion at the Malheur Experiment Station, Oregon State University, Ontario, OR, 2014.

Treatment	Rate (lb ai/acre)	Product/acre	Growth stage	Application		
				Timing ^b	Description	Duration ^a
1 Prowl H ₂ O	0.95	2pt/acre	PRE	A	Preemergence	Mixed in 35 gal of water and applied for 7 hours
Outlook	0.516	11 fl oz/acre	2-leaf	B	2-leaf stage	
Outlook	0.47	10 fl oz/acre		C	2 weeks after B	
2 Prowl H ₂ O	0.95	2pt/acre	PRE	A	Preemergence	Mixed in 5 gal of water and applied for 1 hour
Outlook	0.516	11 fl oz/acre	2-leaf	B	2-leaf stage	
Outlook	0.47	10 fl oz/acre		C	2 weeks after B	
3 Prowl H ₂ O	0.95	2pt/acre	PRE	A	Preemergence	Mixed in 35 gal of water and applied for 7 hours
Outlook	0.328	7 fl oz/acre	2-leaf	B	2-leaf stage	
Outlook	0.328	7 fl oz/acre		C	1 week after B	
Outlook	0.328	7 fl oz/acre		D	1 week after C	
4 Prowl H ₂ O	0.95	2pt/acre	PRE	A		Mixed in 5 gal of water and applied for 1 hour
Outlook	0.328	7 fl oz/acre	2-leaf	B		
Outlook	0.328	7 fl oz/acre		C	1 week after B	
Outlook	0.328	7 fl oz/acre		D	1 week after C	
5 Prowl H ₂ O	0.95	2pt/acre	PRE	A	Preemergence	Mixed in 35 gal of water and applied for 7 hours
Outlook	0.516	11 fl oz/acre	2-leaf	B	2-leaf stage	
Outlook	0.47	10 fl oz/acre		C	1 week after B	
Outlook	0.516	11 fl oz/acre		D	1 week after C	
Outlook	0.47	10 fl oz/acre		E	1 week after D	
6 Prowl H ₂ O	0.95	2pt/acre	PRE	A	Preemergence	Sprayed in 20 gal of water/acre
Outlook	0.98	21 fl oz/acre	2-leaf	B**	Grower standard	

^a Treatments 1, 3, and 6 were drip irrigated for 1 hour with water followed by 7 hours of herbicide mixture and 1 hour of water to flush out the herbicides. Treatments 2 and 4 were drip irrigated for 7 hours with water followed by the herbicide mixture for 1 hour and 1 hour to flush the herbicide through the system. Treatment 6 was applied in 20 gal of water/acre on the soil when onions were at the 2-leaf stage.

^b Application timing: A = pre-emergence on 4/8/2014; B = dimethenamid-p applied through drip irrigation when onions were at the 2-leaf stage on 5/15/2014; ** treatment 6 was the standard application of dimethenamid-p on the ground when onions were at the 2-leaf stage; C = dimethenamid-p applied through irrigation drip on 5/22/2014; D = dimethenamid-p applied through irrigation drip on 5/29/2014; E = dimethenamid-p applied through irrigation drip on 6/5/2014

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Table 2. Irrigation and rain dates for the study to evaluate dimethenamid-p through the irrigation drip at the Malheur Experiment Station, Ontario, OR 2014.

Rain or irrigation date	Duration	Amount	Description
	hrs	inches	
Apr 2		0.22	rain
Apr 23		0.13	rain
Apr 24		0.18	rain
Apr 25		0.18	rain
Apr 26		0.11	rain
Apr 28		0.10	rain
May 6		0.04	rain
May 9		0.28	rain
May 9	20		drip irrigation system
May 10		0.09	rain
May 11		0.02	rain
May 15	24		drip irrigation system
May 18		0.01	rain
May 19		0.01	rain
May 22	24		drip irrigation system
May 30	24		drip irrigation system
Jun 5	24		drip irrigation system
Jun 18	24		drip irrigation system
Jun 24	24		drip irrigation system
Jul 1	24		drip irrigation system
July 10	24		drip irrigation system

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Table 3. Yellow nutsedge control and direct-seeded onion response (on July 7, 2014) to dimethenamid-p applied through drip irrigation at the Malheur Experiment Station, Oregon State University, Ontario, OR.

Treatment	Amount/acre	Growth ^a Stage	Application ^b timing	Yellow nutsedge ^c		
				Injury	Control	Plant height ^d
				----- % -----		inches
1 Prowl H ₂ O	2 pt	PRE	A	0a	86ab	33 ab
Outlook	11 fl oz	2-leaf	B			
Outlook	10 fl oz		C			
2 Prowl H ₂ O	2 pt	PRE	A	0a	80b	33 ab
Outlook	11 fl oz	2-leaf	B			
Outlook	10 fl oz		C			
3 Prowl H ₂ O	2 pt	PRE	A	0a	91a	33 ab
Outlook	7 fl oz	2-leaf	B			
Outlook	7 fl oz		C			
Outlook	7 fl oz		D			
4 Prowl H ₂ O	2 pt	PRE	A	0a	86ab	32 ab
Outlook	7 fl oz	2-leaf	B			
Outlook	7 fl oz		C			
Outlook	7 fl oz		D			
5 Prowl H ₂ O	2 pt	PRE	A	6a	89ab	31 b
Outlook	11 fl oz	2-leaf	B			
Outlook	10 fl oz		C			
Outlook	11 fl oz		D			
Outlook	10 fl oz		E			
6 Prowl H ₂ O	2 pt	PRE	A	0a	21c	35 a
Outlook	21 fl oz	2-leaf	B**			
(Grower standard)						
LSD (P=0.05)				5	7	2

^a Abbreviations: PRE = herbicide applied preemergence, 2-leaf = onion at 2-leaf stage.

^b Application timing: A = preemergence on 4/8/2014; B = dimethenamid-p applied through drip irrigation when onions were at the 2-leaf stage on 5/15/2014; ** treatment 6 was the standard application of dimethenamid-p on the ground when onions were at the 2-leaf stage; C = dimethenamid-p applied through irrigation drip on 5/22/2014; D = dimethenamid-p applied through irrigation drip on 5/29/2014; E = dimethenamid-p applied through irrigation drip on 6/5/2014.

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

^d Average plant height (10 plants/plot measured from base to longest leaf) on 7/7/2014.

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Table 4. Dry bulb onion yield in response to dimethenamid-p applied through irrigation drip to control yellow nutsedge at the Malheur Experiment Station, Oregon State University, Ontario, OR, 2014.

Treatment	Rate/acre	Growth stage	Application timing ^{bc}	Onion yield per acre ^{ad}					Marketable	Total yield
				Small	Medium	Jumbo	Colossal	Super-colossal		
1 Prowl H ₂ O	2 pt	PRE	A	10.9a	55.1b	565.9a	20.5a	0.0a	641.5a	652.3a
Outlook	11 fl oz	2-leaf	B							
Outlook	10 fl oz		C							
2 Prowl H ₂ O	2 pt	PRE	A	13.8a	74.8b	533.8a	0.0a	0.0a	608.6a	622.4a
Outlook	11 fl oz	2-leaf	B							
Outlook	10 fl oz		C							
3 Prowl H ₂ O	2 pt	PRE	A	12.7a	64.5b	512.7a	14.6a	3.5a	595.3a	608.0a
Outlook	7 fl oz	2-leaf	B							
Outlook	7 fl oz		C							
Outlook	7 fl oz		D							
4 Prowl H ₂ O	2 pt	PRE	A	12.5a	84.3b	488.1a	3.1a	0.0a	575.4a	587.9a
Outlook	7 fl oz	2-leaf	B							
Outlook	7 fl oz		C							
Outlook	7 fl oz		D							
5 Prowl H ₂ O	2 pt	PRE	A	12.2a	90.9b	487.1ab	11.5a	0.0a	589.5a	601.7a
Outlook	11 fl oz	2-leaf	B							
Outlook	10 fl oz		C							
Outlook	11 fl oz		D							
Outlook	10 fl oz		E							
6 Prowl H ₂ O	2 pt	PRE	A	17.5a	178.6a	367.6b	5.0a	0.0a	551.1a	568.6a
Outlook	21 fl oz	2-leaf	B**							
(Grower standard)										
LSD ($P = 0.05$)				8.4	52.2	135.9	NS	NS	NS	NS
CV				42.1	37.9	18.3	207.3	489.9	12.9	12.4

^a Means within a column followed by same letter do not significantly differ ($P = 0.05$, LSD). Onions were harvested on September 12, 2014 and graded on September 17, 2014.

^b Application timing: A = pre-emergence on 4/8/2014; B = dimethenamid-p applied through drip irrigation when onions were at the 2-leaf stage on 5/15/2014; ** treatment 6 was the standard application of dimethenamid-p on the ground when onions were at the 2-leaf stage; C = dimethenamid-p applied through irrigation drip on 5/22/2014; D = dimethenamid-p applied through irrigation drip on 5/29/2014; E = dimethenamid-p applied through irrigation drip on 6/5/2014.

^c Treatments 1, 2, 3, 4, and 5 were applied through drip irrigation, while treatment 6 was applied postemergence to the crop and ground.

^d The 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). U.S. No.1 is comprised of medium, jumbo, colossal and supercolossal. Marketable yield is composed of medium, jumbo, colossal, and supercolossal grades.

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Table 5. Number of harvested dry bulb onions/acre in response to application of dimethenamid-p through the irrigation drip at the Malheur Experiment Station, Oregon State University, Ontario, OR 2014.

Treatment	Rate/acre	Growth Stage	Application timing ^{bc}	Dry bulb number ^{ad}					Marketable	Total yield
				Small	Medium	Jumbo	Colossal	Super-Colossal		
----- Number per acre -----										
1 Prowl H ₂ O	2 pt	PRE	A	5,935 a	14,837 b	82,194 a	1,780 a	0 a	98,811 ab	104,746 ab
Outlook	11 fl oz	2-leaf	B							
Outlook	10 fl oz		C							
2 Prowl H ₂ O	2 pt	PRE	A	6,825 a	20,771 b	77,150 a	0 a	0 a	97,921 ab	104,746 ab
Outlook	11 fl oz	2-leaf	B							
Outlook	10 fl oz		C							
3 Prowl H ₂ O	2 pt	PRE	A	6,825 a	18,101 b	66,764 ab	1,187 a	297 a	86,349 b	93,173 b
Outlook	7 fl oz	2-leaf	B							
Outlook	7 fl oz		C							
Outlook	7 fl oz		D							
4 Prowl H ₂ O	2 pt	PRE	A	6,825 a	22,848 b	69,732 ab	297 a	0 a	92,877 ab	99,701 b
Outlook	7 fl oz	2-leaf	B							
Outlook	7 fl oz		C							
Outlook	7 fl oz		D							
5 Prowl H ₂ O	2 pt	PRE	A	7,715 a	25,222 b	69,435 a	1,187 ab	0 a	95,844 ab	103,559 ab
Outlook	11 fl oz	2-leaf	B							
Outlook	10 fl oz		C							
Outlook	11 fl oz		D							
Outlook	10 fl oz		E							
6 Prowl H ₂ O	2 pt	PRE	A	10,386 a	46,883 a	56,675 a	297 a	0 a	103,856 a	114,241 a
Outlook	21 fl oz	2-leaf	B**							
(Grower standard)										
LSD ($P = 0.05$)				NS	13,690	17,347	2,451	NS	13,527	14,071
CV				45	37	16	206	490	9	9

^a Means within a column followed by same letter do not significantly differ ($P = 0.05$, LSD). Onions were harvested on September 12, 2014 and graded on September 17, 2014.

^b Application timing: A = pre-emergence on 4/8/2014; B = dimethenamid-p applied through drip irrigation when onions were at the 2-leaf stage on 5/15/2014; ** treatment 6 was the standard application of dimethenamid-p on the ground when onions were at the 2-leaf stage; C = dimethenamid-p applied through irrigation drip on 5/22/2014; D = dimethenamid-p applied through irrigation drip on 5/29/2014; E = dimethenamid-p applied through irrigation drip on 6/5/2014.

^c Treatments 1, 2, 3, 4, and 5 were applied through drip irrigation, while treatment 6 was applied postemergence to the crop and ground.

^d Onion 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). U.S. No.1 is comprised of medium, jumbo, colossal and supercolossal. Marketable yield is composed of medium, jumbo, colossal, and supercolossal grades.

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