

ONION YIELD AND SINGLE CENTERS IN RESPONSE TO APPLICATION OF OUTLOOK[®] THROUGH DRIP IRRIGATION WITH OR WITHOUT FERTILIZER

Joel Felix and Joey Ishida, Malheur Experiment Station, Oregon State University, Ontario, OR, 2018

Introduction

Approval for the application of dimethenamid-p (Outlook[®]) through drip irrigation to control yellow nutsedge in dry bulb onions grown in the Treasure Valley of eastern Oregon and southwestern Idaho was granted in 2016. In Oregon, the Section 24C Special Local Need (SLN) No. OR-160004 allows applications of Outlook through drip irrigation for onion growers in Malheur County only. In Idaho, SLN No. ID-160001 restricts the use to Ada, Canyon, Gem, Owyhee, Payette, and Washington counties. Both labels reference the chemigation section of the federal label regarding restrictions and directions on how to properly chemigate Outlook in onion production. The user is required to have both the entire Outlook container label and the SLN label in their possession at the time of application.

The research conducted at the Oregon State University's Malheur Experiment Station near Ontario, Oregon indicated improved yellow nutsedge control with Outlook applied through drip irrigation compared to broadcast spraying. The labels still limit the maximum use rate to 21 fl oz/acre/season (0.98 lb ai/acre/season). Sequential applications totaling 21 fl oz/acre/season are allowed. Applications through drip irrigation are allowed starting when onions are at the 2-leaf but not after the 6-leaf stage. The current registration restricts the applications through drip irrigation only to Spanish yellow onions and does not allow mixtures with fertilizer or any other pesticide.

The objective of this study was to evaluate the response of direct-seeded onions to a mixture of Outlook herbicide with liquid fertilizer applied through drip irrigation. The study used onion variety 'Vaquero' and URAN fertilizer.

Materials and Methods

A field study was conducted at the Malheur Experiment Station, Ontario, Oregon in 2018 to evaluate the response of onion variety 'Vaquero' to Outlook herbicide applied through drip irrigation with or without nitrogen (N) fertilizer. Onion seed of variety 'Vaquero' was planted on March 28 in double rows spaced 3 inches apart with 4.75-inch seed spacing within each row. Each double row was planted on beds spaced 22 inches apart. Immediately after planting, onion beds received a 7-inch band of Lorsban[®] 15G at 3.7 oz/1000 ft of row (0.125 lb ai/acre) and the soil surface was rolled. The soil was an Owyhee silt loam with a pH 7.2 and 1.8% organic matter. Application of herbicide/fertilizer solution was initiated when onion seedlings were at the 2-leaf stage on May 16.

The study had randomized complete blocks with four replicates. Individual plots were 7.33 ft wide (4 beds) by 42 ft long. The study area (except the hand-weeded check plots) was treated with pendimethalin (Prowl[®] H₂O) at 2.0 pt/acre (0.95 lb ai/acre) late pre-emergence on April 19. Postemergence application of Buctril[®] 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) occurred when onion seedlings were at the 2- and 4-leaf stages. The study was sprayed with Poast[®] herbicide at 1.5 pt/acre (sethoxydim at 0.287 lb ai/acre) to control grassy weeds.

In order to achieve uniform herbicide distribution in the top soil layer, each Outlook herbicide rate and URAN fertilizer to supply 20 lb N/acre was mixed into 35 gal of water and metered into the drip irrigation system at a continuous uniform rate of 5 gal/hour during the middle of the irrigation period. Applications were initiated when onion plants were at the 2-leaf stage on May 16. Sequential applications on a weekly or biweekly schedule continued through June 5 (Tables 1 and 2).

Treatments with Outlook plus URAN fertilizer to supply 20 lb N/acre were applied on May 16, 22, 29, and June 5, 2018. Treatments receiving only Outlook solution were fertilized using URAN solution to supply 20 lb N/acre the day after the Outlook plus fertilizer treatments. Additional fertilizer to supply 50 lb N/acre was applied through drip irrigation on June 14, 29, and July 5, and 10, 2018. All other operations including insect control followed recommended local production practices.

Single Center Assessment

After harvest, 25 bulbs from the center two rows in each plot were rated for single centers following the methods as described by Shock et al. 2005. Twenty-five consecutive onions ranging in diameter from 3½ to 4¼ inches were rated. The onions were cut equatorially through the bulb middle and separated into single-centered (bullet) and multiple-centered bulbs. The multiple-centered bulbs had the long axis of the inside diameter of the first single ring measured. These multiple-centered onions were ranked according to the inside diameter of the first entire single ring: small had diameters less than 1½ inches, medium had diameters from 1½ to 2¼ inches, and large had diameters greater than 2¼ inches. Onion bulbs were considered "functionally single centered" for processing if they were single centered (bullet) or had a small multiple center (<1½ inches).

Plant tops were flailed and onion bulbs were lifted on September 11 and bulbs were hand-harvested from the two center beds on September 12. Bulbs were graded for yield and quality on September 22 based on USDA standards as follows: bulbs without blemishes (U.S. No. 1), split bulbs (No. 2s), 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 (classified as neck rot). 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 supercolossal (>4¼ inches). Marketable yield consisted of U.S. No.1 bulbs greater than 2¼ inches.

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 18, 2018. Evaluations on June 8 (3 days after the last application of Outlook through drip irrigation) indicated plant population ranging from 106,856 to 109,339 plants/acre for sequential applications of up to 7 fl oz/acre, which was similar to 105,088 plants/acre for the grower standard and 106,715 plants/acre for the hand-weeded treatment (Table 1).

The number of marketable onion bulbs reflected onion plant stand (Table 1). The number of small bulbs was variable across treatments ranging from 1,484 to 3,264 bulbs/acre. The number of No. 2s and bulbs with neck rot was similar across treatments.

The highest marketable yield was obtained when Outlook was sequentially chemigated at 7 fl oz/acre with fertilizer (1,313 cwt/acre) or without fertilizer (1,391 cwt/acre) (Table 2). That marketable yield was comparable to the grower standard (1,388 cwt/acre) and hand-weeded control (1,447 cwt/acre). Marketable yield for the small bulb category was variable across treatments and ranged from 2.5 to 7.2 cwt/acre. There were no yield differences among treatments for the number No. 2s and neck rot bulb categories.

Sequential application of Outlook at 21 fl oz/acre on a biweekly schedule produced the lowest marketable yield regardless of whether Outlook was applied alone (1,218 cwt/acre) or mixed with fertilizer (1,238 cwt/acre) compared to 1,447 cwt/acre for the hand-weeded check.

Onion single center results are presented in Table 3. The percentage of functionally single-centered onion bulbs was highly variable across treatments. The percentage of functionally single bulbs was similar for the hand-weeded treatment, grower standard, and weekly sequential application of Outlook at 7, or 6 fl oz/acre followed by 5, 5, 5 fl oz/acre.

These results indicated no adverse effects when Outlook at 7 fl oz/acre was applied through the irrigation drip with or without URAN fertilizer solution to onion variety ‘Vaquero’ starting at the 2-leaf stage. It is not clear why the marketable yield was reduced when the weekly sequential application of Outlook at 6, 5, 5, 5 fl oz/acre was used with or without fertilizer. The study will be repeated in 2019 to confirm these results.

Acknowledgements

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References

Shock, C.C, E. Feibert, and L.D. Saunders. 2005. Single-centered and supercolossal bulbs from yellow onion cultivars. *HortTechnology* 15:399-408.

Table 1. Onion plant stand on June 8 and number of harvested bulbs in response to various Outlook® (dimethenamid-p) herbicide treatments applied with or without liquid fertilizer through drip irrigation at the Malheur Experiment Station, Ontario, OR, 2018.

Treatment	With fertilizer	Rate ^a fl oz/acre	Timing ^b	Marketable bulb number by grade ^c						Unmarketable ^c		
				Plant stand No./acre	Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	<2¼ in	No. 2	Neck rot
Outlook	Yes	7	A = 2 leaf	109,402 a	105,339 a	22,848 bcd	40,059 a	37,536 abc	4,896 a	3,264 a	890	890
Outlook	Yes	7	14 days after A									
Outlook	Yes	7	21 days after A									
Outlook	No	7	A = 2 leaf	106,856 a	104,152 ab	27,744 abc	41,542 a	31,157 bc	3,709 abc	1,187 c	593	593
Outlook	No	7	7 days after A									
Outlook	No	7	14 D after A									
Outlook	Yes	6	A = 2 leaf	105,937 a	96,882 ab	24,332 bcd	34,569 ab	35,311 abc	2,671 bc	1,632 bc	890	593
Outlook	Yes	5	7 days after A									
Outlook	Yes	5	14 days after A									
Outlook	Yes	5	21 days after A									
Outlook	No	6	A = 2 leaf	108,766 a	103,114 ab	19,436 cd	37,981 ab	40,949 ab	4,748 ab	3,264 a	1929	445
Outlook	No	5	7 days after A									
Outlook	No	5	14 days after A									
Outlook	No	5	21 days after A									
Outlook	Yes	21	A = 2 leaf	97,097 b	95,696 b	25,816 bcd	32,047 b	33,234 abc	4,599 ab	1,632 bc	1039	742
Outlook	Yes	21	14 days after A									
Outlook	No	21	A = 2 leaf	106,786 a	100,592 ab	16,320 d	37,833 ab	42,581 a	3,857 abc	2,522 ab	1484	1335
Outlook	No	21	14 days after A									
Outlook-Grower standard		21	A = 2 leaf-broadcast	105,088 ab	101,630 ab	31,750 ab	39,168 ab	27,299 c	3,412 abc	1,484 bc	890	445
Hand-weeded check				106,715 a	102,520 ab	37,833 a	35,014 ab	27,448 c	2,225 c	1,632 bc	890	890
LSD ($P = 0.05$)				8,048	8,963	11,035	7147	10,963	2,216	1,159	NS	NS

^aHerbicide rate; Outlook (dimethenamid-p) 5 fl oz/acre = 0.234 lb ai/acre; 6 fl oz/acre = 0.28 lb ai/acre; 7 fl oz/acre = 0.328 lb ai/acre; 21 fl oz/acre = 0.98lb ai/acre.

^bHerbicide application timing; A = onions at 2-leaf stage (May 16, 2018); 7 days after A (May 22, 2018); 14 days after A (May 29, 2018); 21 days after A (Jun 5, 2018).

^cThe 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 is composed of medium, jumbo, colossal, and supercolossal grades. 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).

Table 2. Onion yield in response of various Outlook® (dimethenamid-p) herbicide treatments applied with and without liquid fertilizer through drip irrigation at the Malheur Experiment Station, Ontario, OR, 2017.

Treatment	With fertilizer	Rate ^a fl oz/acre	Timing ^b	Marketable yield by grade ^c					Unmarketable ^c		
				Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	<2¼ in	No. 2	Neck rot
				----- cwt/acre -----							
Outlook	Yes	7	A = 2 leaf	1,313.3 abc	393.2 bcd	553.8 a	349.9 ab	16.4 ab	7.2 a	4.2	2.6
Outlook	Yes	7	14 days after A								
Outlook	Yes	7	21 days after A								
Outlook	No	7	A = 2 leaf	1,391.3 ab	510.3 abc	569.3 a	297.9 ab	13.8 ab	2.5 c	2.3	2.3
Outlook	No	7	7 days after A								
Outlook	No	7	14 D after A								
Outlook	Yes	6	A = 2 leaf	1,273.9 bc	456.2 bcd	475.4 ab	332.2 ab	10.0 ab	4.3 abc	5.3	2.8
Outlook	Yes	5	7 days after A								
Outlook	Yes	5	14 days after A								
Outlook	Yes	5	21 days after A								
Outlook	No	6	A = 2 leaf	1,266.9 bc	352.8 cd	525.6 ab	370.1 a	18.5 a	6.9 ab	11.5	4.0
Outlook	No	5	7 days after A								
Outlook	No	5	14 days after A								
Outlook	No	5	21 days after A								
Outlook	Yes	21	A = 2 leaf	1,237.7 c	478.3 bcd	439.5 b	303.2 ab	16.7 ab	4.4 abc	6.6	2.5
Outlook	Yes	21	14 days after A								
Outlook	No	21	A = 2 leaf	1,217.9 c	298.1 d	523.9 ab	380.2 a	15.7 ab	6.4 ab	12.2	6.3
Outlook	No	21	14 days after A								
Outlook-Grower standard		21	A = 2 leaf-broadcast	1,388.4 ab	581.9 ab	538.3 a	257.2 b	10.9 ab	3.6 bc	5.6	1.9
Hand-weeded check				1,447.2 a	698.1 a	486.8 ab	254.0 b	8.4 b	3.7 bc	8.7	4.4
LSD (<i>P</i> = 0.05)				147.2	207.1	98.7	103.6	9.5	3.4	NS	NS

^aHerbicide rate; Outlook (dimethenamid-p) 5 fl oz/acre = 0.234 lb ai/acre; 6 fl oz/acre = 0.28 lb ai/acre; 7 fl oz/acre = 0.328 lb ai/acre; 21 fl oz/acre = 0.98lb ai/acre.

^bHerbicide application timing; A = onions at 2-leaf stage (May 16, 2018); 7 days after A (May 22, 2018); 14 days after A (May 29, 2018); 21 days after A (Jun 5, 2018).

^cThe 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 is composed of medium, jumbo, colossal, and supercolossal grades. 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).

Table 3. Onion bulb single centers in response to application of Outlook® (dimethenamid-p) through drip irrigation with or without fertilizer at the Malheur Experiment Station, Ontario, OR 2018.

Treatment	With fertilizer	Rate	Application timing ^a	Multiple center ^b			Single center ^b	
				Large >2.25"	Medium 1.5 - 2.25"	Small <1.5"	Bullet	Functionally ^c single
fl oz/acre				----- % -----				
Outlook	Yes	7	A-2 Leaf	20 ab	24 ab	7 a	50 abc	57 bc
Outlook	Yes	7	14 days after A					
Outlook	Yes	7	21 days after A					
Outlook	No	7	A-2 Leaf	17 ab	18 ab	6 a	60 ab	66 ab
Outlook	No	7	7 days after A					
Outlook	No	7	14 days after A					
Outlook	Yes	6	A-2 Leaf	13 ab	26 a	8 a	54 abc	62 abc
Outlook	Yes	5	7 days after A					
Outlook	Yes	5	14 days after A					
Outlook	Yes	5	21 days after A					
Outlook	No	6	A-2 Leaf	9 b	21 ab	8 a	62 a	70 ab
Outlook	No	5	7 days after A					
Outlook	No	5	14 days after A					
Outlook	No	5	21 days after A					
Outlook	Yes	21	A-2 Leaf	23 a	27 a	8 a	42 c	50 c
Outlook	Yes	21	14 days after A					
Outlook	No	21	A-2 Leaf	12 ab	28 a	15 a	46 bc	61 bc
Outlook	No	21	14 days after A					
Outlook-Grower standard		21	A-2 Leaf-broadcast	13 ab	20 ab	13 a	58 ab	71 ab
Hand-weeded control				9 b	14 b	13 a	64 a	77 a
LSD ($P = 0.05$)				12	11	NS	15	16
Standard Deviation				8	7.4	6.3	9.9	10.7

^aHerbicide application timing; A = onions at 2-leaf stage (May 16, 2018); 7 days after A (May 22, 2018); 14 days after A (May 29, 2018); 21 days after A (Jun 5, 2018).

^bMeans followed by same letter do not significantly differ ($P = 0.05$, LSD).

^cFunctionally single-centered bulbs are the small multiple-centered plus the bullet-centered onions.