

RED AND WHITE ONION CULTIVAR RESPONSE TO OUTLOOK® APPLIED THROUGH DRIP IRRIGATION

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

Introduction

In 2016, Oregon and Idaho departments of agriculture approved the application of dimethenamid-p (Outlook®) herbicide through drip irrigation systems to control yellow nutsedge in onion. The current Section 24C Special Local Need (SLN) label allows this use on yellow onions grown in the Treasure Valley of eastern Oregon and southwestern Idaho. In Oregon, the application of Outlook through drip irrigation is allowed only in Malheur County. The Idaho label allows application through drip irrigation in 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 Outlook applied by broadcast spraying. The label still limits the maximum use rate to 21 fl oz/acre/season (0.98 lb ai/acre/season). Sequential applications are allowed as long as the total amount does not exceed 21 fl oz/acre/season. Applications through drip irrigation are allowed starting when onions are at the 2-leaf stage but not after the 6-leaf stage.

This study was conducted to generate data needed in order to allow the use of Outlook through drip irrigation in red and white onions. The study included three red and three white varieties.

Materials and Methods

A field study was conducted at the Malheur Experiment Station, Ontario, Oregon in 2018 to evaluate the response of red and white onion cultivars to various Outlook herbicide rates applied through drip irrigation. The study included three red cultivars ('Red Beret', SV4643NT, and 'Red Wing') and three white cultivars ('Antarctica', 'White Cloud', and SV4058NU). Onion seed was planted on March 28, 2018 in double rows spaced 3 inches apart with 4-inch seed spacing within each row. Each pair of rows was planted on beds spaced 22 inches apart. Immediately after planting, each onion bed 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.

The study had a split-block design and treatments were arranged in randomized complete blocks with three replicates. Onion cultivars formed the main plot onto which herbicide treatments were

randomly assigned. Individual plots were 7.33 ft wide (4 beds) by 27 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 17, 2018. Postemergence applications of Buctril® at 12 fl oz/acre (bromoxynil at 0.188lb ai/acre) plus GoalTender® at 4 fl oz/acre (oxyfluorfen at 0.125 lb/ai acre) were made when onion seedlings were at the 2- and 4-leaf stages.

In order to achieve uniform herbicide distribution in the top soil layer, each Outlook herbicide rate 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 irrigation period. Applications were initiated when onion plants were at the 2-leaf stage and were made on May 15, 22, 29, and June 5, 2018. Fertilizer was applied through drip irrigation on May 31, June 14 and 29, and July 5 to supply 50 lb nitrogen (N)/acre per application. All other operations followed recommended local production practices.

Plant tops were flailed and onion bulbs lifted on September 11, 2018. Bulbs were hand-harvested from the two center beds on September 12, 2018. Bulbs were graded for yield and quality based on USDA standards as follows: bulbs without blemishes (U.S. 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 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 in diameter.

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. Data analysis indicated variability attributed to varietal differences or herbicide treatments without any interactions between variety and herbicide rates. Therefore, the data presented here illustrate variety and herbicide effects on plant stand and the number of harvested bulbs in each category (Table 1) and bulb yield (Table 2).

Evaluations on June 7 (49 days after onion emergence) indicated no variations in plant stand attributed to variety or herbicide treatments (Table 1). Plant stand ranged from 87,413 to 120,707 plants/acre across onion varieties. The number of harvested bulbs for different categories is presented in Table 1. Variations in the number of small bulbs were attributed to varieties and herbicide rates and the interaction of herbicide by varieties. Variations in the number of harvested medium (2¼-3 in) and colossal (4-4¼ in) bulbs were individually affected by varieties and herbicide rates without any interaction of the two. Varieties and herbicide rates interacted to affect the number of harvested supercolossal (>4¼ in) bulbs. However, there were no differences attributed to varieties or herbicide rates when bulbs were grouped into marketable category (2¼ - >4¼ in).

Onion yield for various bulb categories is presented in Table 2. The yield for bulbs with neck rot was related to varieties and herbicide rates. Yield for No. 2s, small, medium, and jumbo was similar across varieties and herbicide rates (Table 2). Yield variations in the colossal bulb

category was attributed to varieties only. Varieties and herbicide rates interacted to affect the supercolossal yield. Overall, variations in marketable bulb yield (2¼ - >4¼ in) were primarily attributed to varietal differences.

The results demonstrated that red and white onion varieties were not adversely affected by the application of Outlook through drip irrigation. The results were largely similar to the response of yellow bulb onions.

These results will be used to solicit changes to the current Outlook SLN labels to include red- and white-colored varieties. The outcome will depend on the feedback from the registrant as well as the Oregon Department of Agriculture and Idaho State Department of Agriculture. This use is needed in order to improve yellow nutsedge control in onions.

The current SLN label allowing the application of Outlook through drip irrigation applies only to yellow varieties, and will remain so until it is changed to include red and white onion types.

Growers are advised to be extra careful as they adopt this application technique because of the potential for onion injury if one is not precise in determining the area being treated and/or measuring the product. It is critical that Outlook herbicide be mixed into water and the solution metered into the drip irrigation system for 8 to 10 hours.

Acknowledgements

This project was funded by the Idaho-Eastern Oregon Onion Committee, cooperating onion seed companies, Oregon State University, the Malheur County Education Service District, and was supported by Formula Grant nos. 2018-31100-06041 and 2018-31200-06041 from the USDA National Institute of Food and Agriculture.

Table 1. Onion plant stand (June 7) and the number of harvested bulbs for three red and three white onion cultivars in response to various Outlook® (dimethenamid-p) herbicide rates applied through drip irrigation at the Malheur Experiment Station, Ontario, OR, 2018.

Variety	Bulb color	Treatment fl oz/acre	Timing	Plant stand	Unmarketable ^b			Marketable number by grade ^b					Total
					Neck rot	No.2s	<2¼ in	2¼-3 in	3-4 in	4-4¼ in	>4¼ in		
Red Beret	Red			99,293	293	293	5,573	12,467	52,947	2,200	0	67,613	
Outlook		11	2 leaves (A)										
Outlook		10	14 d after A										
SV4643NT	Red			114,107	733	1,907	5,720	12,613	53,680	6,013	440	72,747	
Outlook		11	2 leaves (A)										
Outlook		10	14 d after A										
Red Wing	Red			116,600	440	587	10,560	19,653	32,636	14,822	1,314	68,426	
Outlook		11	2 leaves (A)										
Outlook		10	14 d after A										
Antarctica	White			107,067	733	587	1,760	2,933	42,680	24,347	6,013	75,973	
Outlook		11	2 leaves (A)										
Outlook		10	14 d after A										
White Cloud	White			111,027	5,573	2,347	2,443	6,615	37,315	24,083	10,120	78,132	
Outlook		11	2 leaves (A)										
Outlook		10	14 d after A										
SV4058NU	White			118,800	2,347	293	2,053	2,493	47,373	27,133	6,893	83,893	
Outlook		11	2 leaves (A)										
Outlook		10	14 d after A										

^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.

^bThe 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 1. **(Continued)** Onion plant stand (June 7) and the number of harvested bulbs for three red and three white onion cultivars in response to various Outlook^a (dimethenamid-p) herbicide rates applied through drip irrigation at the Malheur Experiment Station, Ontario, OR, 2018.

Variety	Bulb	Treatment	Timing	Plant stand	Unmarketable ^b			Marketable number by grade ^b				
					Neck rot	U.S No.2	<2¼ in	2¼-3 in	3-4 in	4-4¼ in	>4¼ in	Total
		fl oz/acre		No. of bulbs/acre								
Red Beret	Red			102,373	733	293	6,453	14,373	50,893	3,080	147	68,493
Outlook		7	2 leaves (A)									
Outlook		7	7 D after A									
Outlook		7	14 D after A									
SV4643NT	Red			99,293	0	2,640	3,227	8,800	49,427	8,067	1,320	67,613
Outlook		7	2 leaves (A)									
Outlook		7	7 D after A									
Outlook		7	14 D after A									
Red Wing	Red			116,893	293	440	8,360	18,627	53,973	1,027	147	73,773
Outlook		7	2 leaves (A)									
Outlook		7	7 D after A									
Outlook		7	14 D after A									
Antarctica	White			108,973	587	440	1,907	3,960	48,107	23,613	3,227	78,907
Outlook		7	2 leaves (A)									
Outlook		7	7 D after A									
Outlook		7	14 D after A									
White Cloud	White			119,240	4,400	2,493	3,080	5,133	43,560	22,587	7,920	79,200
Outlook		7	2 leaves (A)									
Outlook		7	7 D after A									
Outlook		7	14 D after A									
SV4058NU	White			118,213	2,053	440	2,200	4,840	51,040	21,413	6,160	83,453
Outlook		7	2 leaves (A)									
Outlook		7	7 D after A									
Outlook		7	14 D after A									

^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.

^bThe 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 1. **(Continued)** Onion plant stand (June 7) and the number of harvested bulbs for three red and three white onion cultivars in response to various Outlook^a (dimethenamid-p) herbicide rates applied through drip irrigation at the Malheur Experiment Station, Ontario, OR, 2018.

Variety	Bulb	Treatment fl oz/acre	Timing	Plant stand	Unmarketable ^b			Marketable number by grade ^b				Total
					Neck rot	No.2	<2¼ in	2¼-3 in	3-4 in	4-4¼ in	>4¼ in	
Red Beret	Red			87,413	587	440	3,813	11,000	44,293	4,107	440	59,840
Outlook		6	2 leaves (A)									
Outlook		5	7 D after A									
Outlook		5	14 D after A									
Outlook		5	21 D after A									
SV4643NT	Red			101,787	733	2,200	1,907	8,507	42,387	6,893	2,200	59,987
Outlook		6	2 leaves (A)									
Outlook		5	7 D after A									
Outlook		5	14 D after A									
Outlook		5	21 D after A									
Red Wing	Red			111,760	147	440	4,107	13,053	60,133	3,813	293	77,293
Outlook		6	2 leaves (A)									
Outlook		5	7 D after A									
Outlook		5	14 D after A									
Outlook		5	21 D after A									
Antarctica	White			100,760	733	1,320	1,760	3,227	35,053	26,400	8,507	73,187
Outlook		6	2 leaves (A)									
Outlook		5	7 D after A									
Outlook		5	14 D after A									
Outlook		5	21 D after A									
White Cloud	White			120,413	3,813	1,760	2,933	4,400	42,973	23,760	10,853	81,987
Outlook		6	2 leaves (A)									
Outlook		5	7 D after A									
Outlook		5	14 D after A									
Outlook		5	21 D after A									
SV4058NU	White			120,707	2,053	1,467	3,667	4,547	46,493	23,320	6,453	80,813
Outlook		6	2 leaves (A)									
Outlook		5	7 D after A									
Outlook		5	14 D after A									
Outlook		5	21 D after A									

Table 1. **(Continued)** Onion plant stand (June 7) and the number of harvested bulbs for three red and three white onion cultivars in response to various Outlook^a (dimethenamid-p) herbicide rates applied through drip irrigation at the Malheur Experiment Station, Ontario, OR, 2018.

Variety	Bulb	Treatment fl oz/acre	Timing	Plant stand	Unmarketable ^b			Marketable number by grade ^b					Total
					Neck rot	U.S No.2	<2¼ in	2¼-3 in	3-4 in	4-4¼ in	>4¼ in		
					----- No of bulbs/acre -----								
Red Beret	Red			107,360	293	147	11,440	17,307	46,933	2,347	293	66,880	
Outlook		21	2 leaves (A)										
Outlook		21	14 D after A										
SV4643NT	Red			108,827	147	1,760	6,747	22,293	40,773	4,400	880	68,347	
Outlook		21	2 leaves (A)										
Outlook		21	14 D after A										
Red Wing	Red			107,800	0	880	8,213	22,000	45,320	1,760	147	69,227	
Outlook		21	2 leaves (A)										
Outlook		21	14 D after A										
Antarctica	White			98,853	587	587	3,520	4,107	37,107	19,947	7,920	69,080	
Outlook		21	2 leaves (A)										
Outlook		21	14 D after A										
White Cloud	White			111,467	2,640	1,760	4,693	7,040	37,987	22,293	8,947	76,267	
Outlook		21	2 leaves (A)										
Outlook		21	14 D after A										
SV4058NU	White			118,653	2,053	733	4,400	4,987	44,880	23,320	7,333	80,520	
Outlook		21	2 leaves (A)										
Outlook		21	14 D after A										

^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.

^bThe 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 1. **(Continued)** Onion plant stand (June 7) and the number of harvested bulbs for three red and three white onion cultivars in response to various Outlook^a (dimethenamid-p) herbicide rates applied through drip irrigation at the Malheur Experiment Station, Ontario, OR, 2018.

Variety	Bulb	Treatment	Timing	Plant	Unmarketable ^b			Marketable number by grade ^b					Total
					Neck Rot	No.2s	<2¼ in	2¼-3 in	3-4 in	4-4¼ in	>4¼ in		
		fl oz/acre			No. of bulbs/acre								
Red Beret	Red			99,147	880	1,907	3,960	11,880	53,973	6,307	440	72,600	
Outlook		21	2 lf-Broadcast										
SV4643NT	Red			104,133	587	3,080	3,960	10,120	46,053	9,680	2,640	68,493	
Outlook		21	2 lf-Broadcast										
Red Wing	Red			117,773	0	1,173	3,227	11,000	61,013	6,747	0	78,760	
Outlook		21	2 lf-Broadcast										
Antarctica	White			101,347	1,613	1,320	1,907	2,787	28,453	26,400	12,613	70,253	
Outlook		21	2 lf-Broadcast										
White Cloud	White			105,307	3,080	2,053	1,320	2,640	24,200	24,933	20,973	72,747	
Outlook		21	2 lf-Broadcast										
SV4058NU	White			120,560	2,933	880	2,787	6,160	40,627	27,280	13,053	87,120	
Outlook		21	2 lf-Broadcast										
Red Beret	Red			105,453	440	587	4,253	15,107	56,467	3,960	293	75,827	
Handweeded													
SV4643NT	Red			115,720	587	1,760	4,253	10,707	56,907	6,893	147	74,653	
Handweeded													
Red Wing	Red			109,560	587	440	2,933	15,253	55,440	5,133	293	76,120	
Handweeded													
Antarctica	White			100,613	880	1,027	1,027	2,053	32,413	24,493	12,613	71,573	
Handweeded													
White Cloud	White			118,213	2,787	1,907	2,493	2,053	37,400	30,507	12,907	82,867	
Handweeded													
SV4058NU	White			120,707	1,907	293	1,467	2,933	46,200	28,160	9,387	86,680	
Handweeded													
Variety LSD (0.05)				NS	NS	1,258	2,435	7,898	NS	8,879	2,784	NS	
Treatment (0.05)				NS	NS	NS	850	2,706	NS	5,750	2,899	NS	
Variety x Treatment (0.05)				NS	NS	NS	2,981	NS	NS	NS	4,515	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.

^bThe 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 for three red and three white onion cultivars in response to various Outlook^{®a} (dimethenamid-p) herbicide rates applied through drip irrigation at the Malheur Experiment Station, Ontario, OR, 2018.

Variety	Bulb color	Treatment fl oz/acre	Timing	Unmarketable ^b			Marketable yield by grade ^b					Total
				Neck rot	No.2s	<2¼ in	2¼-3 in	3-4 in	4-4¼ in	>4¼ in	cwt/acre	
Red Beret	Red			75.2	3.9	18.0	65.8	526.4	33.9	0.0	626.1	
Outlook		11	2 leaves (A)									
Outlook		10	14 d after A									
SV4643NT	Red			77.1	22.1	15.5	66.9	552.1	100.3	9.4	728.6	
Outlook		11	2 leaves (A)									
Outlook		10	14 d after A									
Red Wing	Red			142.4	6.2	32.2	106.8	550.7	18.1	0.0	675.6	
Outlook		11	2 leaves (A)									
Outlook		10	14 d after A									
Antarctica	White			23.7	8.2	3.9	14.9	522.0	429.1	136.6	1,102.5	
Outlook		11	2 leaves (A)									
Outlook		10	14 d after A									
White Cloud	White			33.0	36.8	28.1	237.5	382.9	307.8	245.5	1,173.6	
Outlook		11	2 leaves (A)									
Outlook		10	14 d after A									
SV4058NU	White			27.7	3.6	5.7	12.0	565.8	478.1	154.5	1,210.3	
Outlook		11	2 leaves (A)									
Outlook		10	14 d after A									

^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.

^bThe 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. **(Continued)** Onion yield for three red and three white onion cultivars in response to various Outlook^a (dimethenamid-p) herbicide rates applied through drip irrigation at the Malheur Experiment Station, Ontario, OR, 2018.

Variety	Bulb color	Treatment	Timing	Unmarketable ^b			Marketable yield by grade ^b				Total
				Neck rot	No.2s	<2¼ in	2¼-3 in	3-4 in	4-4¼ in	>4¼ in	
		fl oz/acre		----- cwt/acre -----							
Red Beret	Red			87.0	3.5	19.7	71.7	504.7	51.1	3.5	631.0
Outlook		7	2 leaves (A)								
Outlook		7	7 D after A								
Outlook		7	14 D after A								
SV4643NT	Red			43.5	31.7	7.7	44.9	504.9	142.9	30.7	723.4
Outlook		7	2 leaves (A)								
Outlook		7	7 D after A								
Outlook		7	14 D after A								
Red Wing	Red			112.8	4.8	22.4	94.7	534.0	16.3	2.4	647.4
Outlook		7	2 leaves (A)								
Outlook		7	7 D after A								
Outlook		7	14 D after A								
Antarctica	White			25.7	5.1	5.9	18.2	575.9	408.3	72.2	1,074.6
Outlook		7	2 leaves (A)								
Outlook		7	7 D after A								
Outlook		7	14 D after A								
White Cloud	White			41.5	30.7	8.9	26.8	516.8	411.1	191.0	1,145.8
Outlook		7	2 leaves (A)								
Outlook		7	7 D after A								
Outlook		7	14 D after A								
SV4058NU	White			29.7	7.0	6.5	24.8	588.8	366.0	142.3	1,121.9
Outlook		7	2 leaves (A)								
Outlook		7	7 D after A								
Outlook		7	14 D after A								

^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.

^bThe 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. **(Continued)** Onion yield for three red and three white onion cultivars in response to various Outlook^a (dimethenamid-p) herbicide rates applied through drip irrigation at the Malheur Experiment Station, Ontario, OR, 2018.

Variety	Bulb color	Treatment fl oz/acre	Timing	Unmarketable ^b			Marketable yield by grade ^b					Total
				Neck rot	No.2s	<2¼ in	2¼-3 in	3-4 in	4-4¼ in	>4¼ in		
Red Beret	Red			51.4	7.9	10.9	57.1	448.4	67.5	9.9	582.9	
Outlook		6	2 leaves (A)									
Outlook		5	7 D after A									
Outlook		5	14 D after A									
Outlook		5	21 D after A									
SV4643NT	Red			25.7	39.5	5.0	44.7	467.8	123.9	51.9	688.3	
Outlook		6	2 leaves (A)									
Outlook		5	7 D after A									
Outlook		5	14 D after A									
Outlook		5	21 D after A									
Red Wing	Red			55.4	6.4	11.2	71.0	619.7	60.8	5.2	756.7	
Outlook		6	2 leaves (A)									
Outlook		5	7 D after A									
Outlook		5	14 D after A									
Outlook		5	21 D after A									
Antarctica	White			23.7	24.3	4.7	16.0	425.1	465.0	200.3	1,106.4	
Outlook		6	2 leaves (A)									
Outlook		5	7 D after A									
Outlook		5	14 D after A									
Outlook		5	21 D after A									
White Cloud	White			39.6	21.8	8.2	21.9	514.1	434.4	266.1	1,236.4	
Outlook		6	2 leaves (A)									
Outlook		5	7 D after A									
Outlook		5	14 D after A									
Outlook		5	21 D after A									
SV4058NU	White			49.5	19.2	9.2	23.7	562.4	406.5	148.3	1,140.9	
Outlook		6	2 leaves (A)									
Outlook		5	7 D after A									
Outlook		5	14 D after A									
Outlook		5	21 D after A									

^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.

^bThe 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. **(Continued)** Onion yield for three red and three white onion cultivars in response to various Outlook^a (dimethenamid-p) herbicide rates applied through drip irrigation at the Malheur Experiment Station, Ontario, OR, 2018.

Variety	Bulb color	Treatment fl oz/acre	Timing	Unmarketable ^b			Marketable yield by grade ^b				Total
				Neck rot	U.S No.2	<2¼ in	2¼-3 in	3-4 in	4-4¼ in	>4¼ in	
Red Beret	Red			154.3	2.1	32.2	89.6	458.7	37.7	5.9	592.0
Outlook		21	2 leaves (A)								
Outlook		21	14 D after A								
SV4643NT	Red			91.0	24.5	18.6	89.3	472.4	76.0	19.9	657.6
Outlook		21	2 leaves (A)								
Outlook		21	14 D after A								
Red Wing	Red			110.8	13.1	25.4	106.4	433.7	28.1	3.4	571.5
Outlook		21	2 leaves (A)								
Outlook		21	14 D after A								
Antarctica	White			47.5	9.5	8.8	20.5	431.2	360.9	184.5	997.2
Outlook		21	2 leaves (A)								
Outlook		21	14 D after A								
White Cloud	White			63.3	29.2	13.2	35.0	462.2	409.3	226.4	1,132.8
Outlook		21	2 leaves (A)								
Outlook		21	14 D after A								
SV4058NU	White			59.3	7.6	13.0	24.2	525.0	405.2	171.9	1,126.2
Outlook		21	2 leaves (A)								
Outlook		21	14 D after A								

^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.

^bThe 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. (Continued) Onion yield for three red and three white onion cultivars in response to various Outlook^a (dimethenamid-p) herbicide rates applied through drip irrigation at the Malheur Experiment Station, Ontario, OR, 2018.

Variety	Bulb color	Treatment	Timing	Unmarketable ^b			Marketable yield by grade ^b				
				Neck Rot	No.2s	<2¼ in	2¼-3 in	3-4 in	4-4¼ in	>4¼ in	Total
fl oz/acre				cwt/acre							
Red Beret	Red			53.4	31.0	11.9	61.6	534.2	102.5	8.7	706.9
Outlook		21	2 lf-Broadcast								
SV4643NT	Red			53.4	52.8	10.5	51.6	492.3	168.9	62.7	775.6
Outlook		21	2 lf-Broadcast								
Red Wing	Red			43.5	16.6	14.6	57.2	637.1	109.2	0.0	803.5
Outlook		21	2 lf-Broadcast								
Antarctica	White			25.7	22.2	4.6	12.5	354.4	477.7	300.4	1,145.1
Outlook		21	2 lf-Broadcast								
White Cloud	White			17.8	33.9	3.7	13.3	306.2	462.3	529.7	1,311.6
Outlook		21	2 lf-Broadcast								
SV4058NU	White			37.6	8.9	7.3	29.2	469.9	485.8	315.4	1,300.3
Outlook		21	2 lf-Broadcast								
Red Beret	Red			57.4	8.6	12.7	80.9	559.9	67.7	6.4	714.8
Handweeded											
SV4643NT	Red			57.4	25.2	12.7	53.3	602.0	117.0	3.6	775.9
Handweeded											
Red Wing	Red			39.6	7.0	8.8	81.7	524.9	85.3	6.2	698.0
Handweeded											
Antarctica	White			13.8	22.5	1.8	10.7	400.0	440.5	296.7	1,147.8
Handweeded											
White Cloud	White			33.6	31.9	7.0	11.1	472.0	547.9	313.8	1,344.8
Handweeded											
SV4058NU	White			19.8	6.0	4.9	13.3	573.7	498.9	219.7	1,305.6
Handweeded											
Variety LSD (0.05)				32.8	NS	NS	NS	NS	139.1	71.4	192.7
Treatment (0.05)				11.5	NS	4.1	NS	NS	NS	76.9	34.6
Variety x Treatment (0.05)				40.2	NS	NS	NS	NS	NS	107.2	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.

^bThe 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).