

# RESPONSE OF RED AND WHITE ONION CULTIVARS TO OUTLOOK® APPLIED THROUGH DRIP IRRIGATION

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## Introduction

Application of dimethenamid-p (Outlook®) herbicide through drip irrigation systems to control yellow nutsedge in onion in the Treasure Valley of eastern Oregon and southwestern Idaho was authorized in 2016. The section 24C Special Local Need (SLN) registration is allowed only on yellow onions. 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 labels still limit 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 irrigation drip 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 that is needed in order to allow the use of Outlook through the irrigation drips to red and white onions. The study included six red varieties and four white varieties.

## Materials and Methods

A field study was conducted at the Malheur Experiment Station, Ontario, Oregon in 2017 to evaluate the response of six red and four white onion varieties to various Outlook herbicide rates applied through irrigation drips. Seeds of red varieties 'Red Wing', 'Red Carpet', 'Red Devil', 'Salsa', SV4643NT, and 'Purple Haze'; as well as white varieties 'Antarctica', 'White Cloud', SV4058NU, and 'Brundage' were planted on April 10, 2017 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. On April 17 each onion row received a 7-inch band of Lorsban® at 3.7 oz/1000 ft of row 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® H<sub>2</sub>O) at 2.0 pt/acre (0.95 lb ai/acre) late pre-emergence on April 19. 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 31, June 7, 13, and 22 (Tables 1-4). On July 20, 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. Fertilizer was applied through irrigation drip on May 8 (30 lb nitrogen (N)/acre), June 22, July 7, and 11 (50 lb N/acre each). All other operations followed recommended local production practices.

Plant tops were flailed and onion bulbs were lifted on September 6 and 7, respectively. Bulbs were hand-harvested from the two center beds on September 11 and graded on September 22. Bulbs were graded for yield and quality based on USDA standards as follows: bulbs without blemishes (U.S. No. 1), split bulbs (U.S. 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 >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 May 3, 2017. Data analysis indicated differences attributed to varietal differences but not herbicide rates and there was no interaction between variety and herbicide rates. Therefore, the data presented herein are averaged across herbicide rates (or across varieties to illustrate lack of herbicide effects).

Evaluations on July 20 (78 days after onion emergence) indicated variations in plant height that were attributed to variety difference and not herbicide or the interaction of herbicide by variety (Table 1). The average plant height for red varieties was 29.2 inches compared to 31.8 for white varieties. Plant stand on July 20 ranged from 73,853 to 114,345 plants/acre for reds and 68,040 to 100,766 plants/acre for whites. Differences in the number of harvested bulbs for each category varied widely for the red and white varieties. The variations were not attributed to herbicide rates or the interaction of herbicide by variety.

Data averaged across varieties revealed differences in the number of plants and height as well as the number of harvested bulbs attributable to variety difference, with no negative effects from any of the herbicide rates or the interaction of herbicide by varieties (Table 2).

Differences in onion yield for various bulb categories were also attributed to variety differences (Table 3). Onion bulb yield averages across varieties confirmed differences were due to varieties and there were no negative effects from herbicide rates (Table 4).

These results demonstrated that red and white onion varieties evaluated in this study were not negatively affected by any of the Outlook herbicide rates tested.

The study will be repeated in 2018 to confirm these results followed by a request to include red and white onions on the Outlook SLN labels in eastern Oregon and southwestern Idaho to apply Outlook through the irrigation drips to control yellow nutsedge in onions.

The current SLN label allowing the application of Outlook through the irrigation drips 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**

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Table 1. Onion plant stand and plant height (July 20), and number of harvested bulbs for six red and four white onion varieties averaged across various Outlook<sup>a</sup> (dimethenamid-p) herbicide rates applied through the irrigation drip at the Malheur Experiment Station, Ontario, OR, 2017. The average across herbicide rates includes the untreated hand-weeded control treatment.

| Type <sup>a</sup>          | Variety        | Plant stand<br>No./acre | Plant height<br>inches | Marketable                        |           |           |         |        |         |        | Total  |
|----------------------------|----------------|-------------------------|------------------------|-----------------------------------|-----------|-----------|---------|--------|---------|--------|--------|
|                            |                |                         |                        | <2¼ in                            | U.S No. 2 | Plate Rot | 2¼-3 in | 3-4 in | 4-4¼ in | >4¼ in |        |
|                            |                |                         |                        | Number of bulbs/acre <sup>b</sup> |           |           |         |        |         |        |        |
| Red                        | Red Wing       | 114,345                 | 29.7                   | 15,298                            | 231       | 165       | 29,014  | 70,325 | 659     | 0      | 99,998 |
| Red                        | Red Carpet     | 98,129                  | 29.7                   | 15,067                            | 659       | 198       | 30,036  | 51,137 | 1,616   | 66     | 82,854 |
| Red                        | Red Devil      | 79,201                  | 30.2                   | 10,979                            | 264       | 1,286     | 30,827  | 35,641 | 264     | 33     | 66,764 |
| Red                        | Salsa          | 77,638                  | 26.6                   | 16,947                            | 4,121     | 3,495     | 21,892  | 29,310 | 758     | 33     | 51,994 |
| Red                        | SV4643NT       | 88,555                  | 30.2                   | 16,518                            | 2,341     | 923       | 27,365  | 38,443 | 1,418   | 33     | 67,259 |
| Red                        | Purple Haze    | 73,853                  | 29.0                   | 9,528                             | 330       | 1,121     | 27,530  | 36,564 | 264     | 0      | 64,357 |
|                            | <i>Average</i> | 88,620                  | 29.2                   | 14,056                            | 1,324     | 1,198     | 27,777  | 43,570 | 830     | 28     | 72,204 |
| White                      | Antarctica     | 100,766                 | 33.8                   | 2,143                             | 1,187     | 429       | 6,001   | 73,128 | 19,254  | 1,220  | 99,602 |
| White                      | White Cloud    | 90,704                  | 30.4                   | 3,495                             | 6,660     | 6,627     | 5,836   | 52,554 | 15,133  | 1,714  | 75,238 |
| White                      | SV4058NU       | 99,423                  | 31.9                   | 2,769                             | 1,121     | 1,451     | 10,847  | 72,369 | 11,144  | 593    | 94,954 |
| White                      | Brundage       | 68,040                  | 31.1                   | 3,825                             | 1,484     | 725       | 10,023  | 44,477 | 6,825   | 429    | 61,753 |
|                            | <i>Average</i> | 89,733                  | 31.8                   | 3,058                             | 2,613     | 2,308     | 8,177   | 60,632 | 13,089  | 989    | 82,887 |
| LSD (0.05) Variety         |                | 19,349                  | 2.0                    | NS                                | 2,256     | 2,095     | 17,441  | 40,182 | 6,358   | 792    | 28,078 |
| LSD (0.05) Herbicide       |                | NS                      | NS                     | NS                                | NS        | NS        | NS      | NS     | NS      | NS     | NS     |
| LSD (0.05) Var x Herbicide |                | NS                      | NS                     | NS                                | NS        | NS        | NS      | NS     | NS      | NS     | NS     |

<sup>a</sup>Herbicide 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.

<sup>b</sup>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). Marketable yield is composed of medium, jumbo, colossal, and supercolossal grades. 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). Marketable yield consists of U.S. No.1 bulbs >2¼ inches.

Table 2. Onion plant stand and plant height (July 20), and number of harvested bulbs in response to various Outlook<sup>a</sup> (dimethenamid-p) herbicide treatments applied through the irrigation drip at the Malheur Experiment Station, Ontario, OR 2017. The number of bulbs are averaged across six red and four white onion varieties.

| Treatment                             | Rate <sup>a</sup><br>fl oz/acre | Timing <sup>b</sup> | Plant                              | Plant            | Plate  |          |       | Marketable <sup>c</sup> |        |         |        | Total  |
|---------------------------------------|---------------------------------|---------------------|------------------------------------|------------------|--------|----------|-------|-------------------------|--------|---------|--------|--------|
|                                       |                                 |                     | population<br>No./acre             | height<br>inches | <2¼ in | US No. 2 | rot   | 2¼-3 in                 | 3-4 in | 4-4¼ in | >4¼ in |        |
|                                       |                                 |                     | Number of bulbs /acre <sup>c</sup> |                  |        |          |       |                         |        |         |        |        |
| Outlook                               | 11                              | 2 leaves = A        | 89,459                             | 30.4             | 8,289  | 2,097    | 1,365 | 18,377                  | 52,917 | 6,667   | 475    | 78,436 |
| Outlook                               | 10                              | 14 days after A     |                                    |                  |        |          |       |                         |        |         |        |        |
| Outlook                               | 7                               | 2 leaves = A        | 87,847                             | 30.4             | 9,772  | 1,780    | 1,899 | 20,079                  | 51,117 | 5,440   | 475    | 77,110 |
| Outlook                               | 7                               | 7 days after A      |                                    |                  |        |          |       |                         |        |         |        |        |
| Outlook                               | 7                               | 14 days after A     |                                    |                  |        |          |       |                         |        |         |        |        |
| Outlook                               | 6                               | 2 leaves = A        | 90,587                             | 30.1             | 10,208 | 1,187    | 1,286 | 22,215                  | 51,374 | 3,996   | 178    | 77,763 |
| Outlook                               | 5                               | 7 days after A      |                                    |                  |        |          |       |                         |        |         |        |        |
| Outlook                               | 5                               | 14 days after A     |                                    |                  |        |          |       |                         |        |         |        |        |
| Outlook                               | 5                               | 21 days after A     |                                    |                  |        |          |       |                         |        |         |        |        |
| Outlook                               | 21                              | 2 leaves = A        | 91,349                             | 30.0             | 10,821 | 2,038    | 2,156 | 22,690                  | 47,952 | 5,302   | 415    | 76,359 |
| Outlook                               | 21                              | 14 days after A     |                                    |                  |        |          |       |                         |        |         |        |        |
| Outlook                               | 21                              | 2-leaf broadcast    | 86,645                             | 30.3             | 9,950  | 1,899    | 1,622 | 17,646                  | 49,435 | 6,014   | 495    | 73,589 |
| Hand-weeded                           |                                 |                     | 88,506                             | 30.4             | 8,902  | 2,038    | 1,523 | 18,615                  | 49,574 | 6,983   | 435    | 75,607 |
| <i>LSD (0.05) herbicide</i>           |                                 |                     | NS                                 | NS               | NS     | NS       | NS    | NS                      | NS     | NS      | NS     | NS     |
| <i>LSD (0.05) varieties</i>           |                                 |                     | 19,349                             | 2.0              | NS     | 2,256    | 2,095 | 17,441                  | NS     | 6,358   | 792    | 28,078 |
| <i>LSD (0.05) herbicide x variety</i> |                                 |                     | NS                                 | NS               | NS     | NS       | NS    | NS                      | NS     | NS      | NS     | NS     |

<sup>a</sup>Herbicide 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.

<sup>b</sup>Herbicide application timing; A = onions at 2-leaf stage (May 31, 2017); B = 7 days after A (Jun 7, 2017); C = 14 days after A (Jun 13, 2017); D = 21 days after A (Jun 21, 2017).

<sup>c</sup>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). Marketable yield is composed of medium, jumbo, colossal, and supercolossal grades. 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). Marketable yield consists of U.S. No.1 bulbs >2¼ inches.

Table 3. Onion plant stand (July 20), and harvested bulb yield for six red and four white onion varieties averaged across various Outlook<sup>a</sup> (dimethenamid-p) herbicide rates applied through the irrigation drip at the Malheur Experiment Station, Ontario, OR, 2017. The average across herbicide rates includes the untreated hand-weeded check treatment.

| Type                       | Variety        | Plant stand<br>No./acre | Unmarketable                      |         |           | Marketable |        |         |        | Total |
|----------------------------|----------------|-------------------------|-----------------------------------|---------|-----------|------------|--------|---------|--------|-------|
|                            |                |                         | <2¼ in                            | US No.2 | Plate Rot | 2¼-3 in    | 3-4 in | 4-4¼ in | >4¼ in |       |
|                            |                |                         | ----- cwt/acre <sup>b</sup> ----- |         |           |            |        |         |        |       |
| Red                        | Red Wing       | 114,345                 | 27.7                              | 1.3     | 0.6       | 106.3      | 481.3  | 6.8     | 0.0    | 594.4 |
| Red                        | Red Carpet     | 98,129                  | 30.8                              | 4.6     | 0.7       | 106.2      | 365.6  | 16.7    | 0.7    | 489.2 |
| Red                        | Red Devil      | 79,201                  | 23.1                              | 1.3     | 4.9       | 115.7      | 231.8  | 3.2     | 0.4    | 351.0 |
| Red                        | Salsa          | 77,638                  | 30.0                              | 20.8    | 7.7       | 77.4       | 210.6  | 9.2     | 0.6    | 297.9 |
| Red                        | SV4643NT       | 88,555                  | 30.6                              | 18.4    | 3.4       | 95.4       | 280.5  | 16.9    | 0.5    | 393.3 |
| Red                        | Purple Haze    | 73,853                  | 19.8                              | 1.2     | 5.5       | 103.7      | 229.6  | 3.1     | 0.0    | 336.4 |
|                            | <i>Average</i> | 88,620                  | 27                                | 7.9     | 3.8       | 100.8      | 299.9  | 9.3     | 0.4    | 410.4 |
| White                      | Antarctica     | 100,766                 | 4.3                               | 11.3    | 4.9       | 24.3       | 646.5  | 234.8   | 18.2   | 923.7 |
| White                      | White Cloud    | 90,704                  | 5.5                               | 45.4    | 55.6      | 22.4       | 462.3  | 199.0   | 29.0   | 712.7 |
| White                      | SV4058NU       | 99,423                  | 5.7                               | 6.2     | 10.0      | 42.4       | 590.0  | 136.7   | 9.0    | 778.1 |
| White                      | Brundage       | 68,040                  | 6.3                               | 7.8     | 4.4       | 37.3       | 355.6  | 82.5    | 6.2    | 481.6 |
|                            | <i>Average</i> | 89,733                  | 5.5                               | 17.7    | 18.7      | 31.6       | 513.6  | 163.3   | 15.6   | 724.0 |
| LSD (0.05) variety         |                | 19,349                  | NS                                | 17.7    | 15.4      | 55.5       | NS     | 81.6    | 13.2   | 311.5 |
| LSD (0.05) herbicide       |                | NS                      | NS                                | NS      | NS        | NS         | NS     | NS      | NS     | NS    |
| LSD (0.05) var x herbicide |                | NS                      | NS                                | NS      | NS        | NS         | NS     | NS      | NS     | NS    |

<sup>a</sup>Herbicide 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.

<sup>b</sup>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). Marketable yield is composed of medium, jumbo, colossal, and supercolossal grades. 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). Marketable yield consists of U.S. No.1 bulbs >2¼ inches.

Table 4. Onion plant stand on July 20 and harvested bulb yield averaged across six red and four white onion varieties various in response to Outlook<sup>a</sup> (dimethenamid-p) herbicide treatments applied through the irrigation drip at the Malheur Experiment Station, Ontario, OR, 2017.

| Treatment                               | Rate <sup>a</sup><br>fl oz/acre | Timing <sup>b</sup> | Plant stand<br>No./acre | Unmarketable          |          |           | Marketable |        |         |        | Total |
|---|---------------------------------|---------------------|-------------------------|-----------------------|----------|-----------|------------|--------|---------|--------|-------|
|   |                                 |                     |                         | <2¼ in <sup>c</sup>   | US No. 2 | Plate Rot | 2¼-3 in    | 3-4 in | 4-4¼ in | >4¼ in |       |
|   |                                 |                     |                         | cwt/acre <sup>c</sup> |          |           |            |        |         |        |       |
| Outlook                                 | 11                              | 2 leaves = A        | 89,459                  | 15.5                  | 13.6     | 7.6       | 69.7       | 414.4  | 82.7    | 7.5    | 574.3 |
| Outlook                                 | 10                              | 14 days after A     |                         |                       |          |           |            |        |         |        |       |
| Outlook                                 | 7                               | 2 leaves = A        | 87,847                  | 19.0                  | 11.2     | 12.2      | 73.7       | 388.5  | 67.5    | 7.4    | 537.1 |
| Outlook                                 | 7                               | 7 days after A      |                         |                       |          |           |            |        |         |        |       |
| Outlook                                 | 7                               | 14 days after A     |                         |                       |          |           |            |        |         |        |       |
| Outlook                                 | 6                               | 2 leaves = A        | 90,587                  | 20.1                  | 8.3      | 8.5       | 81.6       | 390.6  | 49.1    | 2.9    | 524.3 |
| Outlook                                 | 5                               | 7 days after A      |                         |                       |          |           |            |        |         |        |       |
| Outlook                                 | 5                               | 14 days after A     |                         |                       |          |           |            |        |         |        |       |
| Outlook                                 | 5                               | 21 days after A     |                         |                       |          |           |            |        |         |        |       |
| Outlook                                 | 21                              | 2 leaves = A        | 91,349                  | 20.7                  | 11.7     | 11.2      | 83.3       | 362.4  | 63.5    | 6.4    | 515.5 |
| Outlook                                 | 21                              | 14 days after A     |                         |                       |          |           |            |        |         |        |       |
| Outlook                                 | 21                              | 2-leaf broadcast    | 86,645                  | 18.3                  | 12.0     | 10.1      | 62.2       | 378.0  | 74.9    | 7.7    | 522.7 |
| Hand-weeded check                       |                                 |                     | 88,506                  | 16.7                  | 14.2     | 8.8       | 68.3       | 378.3  | 87.6    | 6.8    | 541.0 |
| <i>LSD (0.05) herbicide</i>             |                                 |                     | NS                      | NS                    | NS       | NS        | NS         | NS     | NS      | NS     | NS    |
| <i>LSD (0.05) varieties</i>             |                                 |                     | 19,349                  | NS                    | 17.7     | 15.4      | 55.5       | NS     | 81.6    | 13.2   | 311.5 |
| <i>LSD (0.05) herbicide x varieties</i> |                                 |                     | NS                      | NS                    | NS       | NS        | NS         | NS     | NS      | NS     | NS    |

<sup>a</sup>Herbicide 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.

<sup>b</sup>Herbicide application timing; A = onions at 2-leaf stage (May 31, 2017); B = 7 days after A (Jun 7, 2017); C = 14 days after A (Jun 13, 2017); D = 21 days after A (Jun 21, 2017).

<sup>c</sup>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). Marketable yield is composed of medium, jumbo, colossal, and supercolossal grades. 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). Marketable yield consists of U.S. No.1 bulbs >2¼ inches.