# ONION RESPONSE TO TALINOR® HERBICIDE RATE AND APPLICATION TIMING

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

## Introduction

Weed control is essential in order to realize favorable onion yield and bulb quality. However, herbicides registered for weed control in onion are limited, largely due to seedling sensitivity at the early growth stage. In order to guard against selection of herbicide-resistant weeds through repeated use of the few registered products, it is vital to evaluate new products on the market for their suitability to manage weeds in onion in order to broaden the tool kit. Also, growers lack an efficacious herbicide that is safe to use in onions at the early growth stage.

Talinor® herbicide is a premix of bromoxynil and bicyclopyrone, which is registered for weed control in cereals. We chose to evaluate this premix because bromoxynil is registered for weed control in onion, and we have previously observed onion tolerance to bicyclopyrone. The objective of this study was to evaluate onion response to Talinor herbicide applied at various rates to onions at the 1- or 2-leaf stages and the level of weed control achieved.

## Materials and Methods

A field study was initiated during spring 2020 at the Malheur Experiment Station to evaluate the response of direct-seeded onion variety 'Vaquero' to Talinor herbicide and the level of weed control at various application rates and timings. The predominant soil was an Owyhee silt loam with a pH of 7.8 and 2.78% soil organic matter. Land was prepared the previous fall by flailing wheat stubble; the field was then irrigated, disked, ripped, plowed, and groundhogged. Based on soil analysis, fertilizer was broadcast applied during fall 2019 at 100 lb nitrogen (N)/acre, 100 lb phosphorus/acre, 200 lb sulfur/acre, 9 lb manganese/acre, and 2 lb boron/acre.

The field was fumigated with K-Pam® at 15 gal/acre and beds were formed at 22-inch spacing on October 18, 2019. The beds were harrowed down and onion seed of Vaquero was planted on March 20, 2020, 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 2, 2020, each onion bed received a 7-inch band of Lorsban® 15G at 3.7 oz/1000 ft of row (chlorpyrifos 0.101 lb ai/acre) and the soil surface was rolled.

The study had a randomized complete-block design with four replicates. Individual plots were 7.33 ft wide (4 beds) by 27 ft long. Herbicide treatments were applied using a $CO_2$-pressurized backpack sprayer fitted with a boom equipped with 8002EVS TeeJet nozzles calibrated to deliver 20 gal/acre for delayed pre-emergence treatments or 35 gal/acre for post-emergence

treatments. Treatments with Talinor at the 1-leaf stage were preceded by a delayed pre-emergence application of glyphosate at 22 fl oz/acre, while Talinor treatments at the 2-leaf stage and the grower standard received a delayed pre-emergence application of glyphosate + Prowl® $H_2O$ at 2 pt/acre (pendimethalin 0.95 lb ai/acre). Untreated and hand-weeded checks were included.

Delayed pre-emergence treatments were applied on April 3, 2020. Talinor herbicide at 4, 8, or 10 fl oz/acre was applied to onions at the 1-leaf stage on May 1, 2020. Onion at the 2-leaf stage was sprayed with Talinor herbicide at 10, 12, 15, or 18 fl oz/acre on May 11, 2020 (Tables 1–4). Treatments with Talinor at the 2-leaf stage received a tank-mix of Brox® 2EC at 12 fl oz/acre (bromoxynil 0.188 lb ai/acre) plus GoalTender® at 4 fl oz/acre (oxyfluorfen 0.125 lb/ai acre) when onion plants were at the 4-leaf stage (June 2, 2020).

In-season fertilizer was applied according to soil and tissue test results. Fertilizer was applied through drip irrigation on May 30 and June 19 to supply 50 lb N/acre on each incident.

The following insecticide combinations were used on the indicated dates to control onion thrips:

- May 29 and June 5, 2020 — Movento® 5 fl oz/acre (spirotetramat 0.078 lb ai/acre) + Aza-Direct® 12 fl oz/acre (azadirachtin 0.0093 lb ai/acre) + Persist® Ultra 1% v/v (methyl esters of canola oil 85% + alkyl phenol ethoxylate 12%).

- June 18 and June 26, 2020 — Exirel® 20.5 fl oz/acre (cyantraniliprole 0.13 lb ai/acre) + Persist Ultra 1% v/v (methyl esters of canola oil 85% + alkyl phenol ethoxylate 12%).

- July 4 and 14, 2020 — Radiant® 10 fl oz/acre (spinetoram 0.078 lb ai/acre) + Dyne- Amic® adjuvant 0.25% v/v (methyl esters of C16-C18 fatty acids, polyalkyleneoxide modified polydimethylsiloxane, alkylphenol ethoxylate 99%).

All other operations followed recommended local production practices for drip-irrigated onion. Visible plant injury and weed control were assessed based on a scale of 0% (no onion injury or weed control) to 100% (complete onion plant kill or total weed control). Onion response to Talinor herbicide was assessed on May 8, May 18, May 26, June 1, and June 8, 2020). Weed control was assessed on May 8, May 18, May 26, and June 1.

The field was drip irrigated from April 20 to August 28, 2020. Plant tops were flailed on September 9, and onion bulbs were lifted and left in the field to cure. Bulbs were hand harvested from the two center beds on September 14, 2020, and placed in burlap bags. 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 super colossal (>4¼ inches). Marketable yield consisted of U.S. No.1 bulbs greater than 2¼ inches in diameter.

After harvest, bulbs from a section of two center rows in each plot were rated for single centers. Twenty-five 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. Onions were considered "functionally single centered" for processing if they were single centered (bullet) or had a small multiple center.

Data were subjected to analysis of variance and the treatment means were compared using protected LSD at the 0.05% level of confidence.

## Results and Conclusions

Onion emergence was observed on April 20, 2020. Evaluation on May 8 (7 days after application of Talinor at 1-leaf) indicated 0 to 1% visible injury (Table 1). Onion injury seems to have been related to the application rate. Evaluations on May 18 (17 days after 1-leaf and 7 days after 2-leaf stage applications) and May 26 (26 days after 1-leaf and 15 days after 2-leaf applications) indicated visible injury of 10% or less for the 1-leaf-stage application timing and 1 to 18% for the 2-leaf-stage application compared to 9 to 10% for the grower standard (Table 1).

Subsequent evaluations on June 1 showed visible onion injury of 3% or less for the 1-leaf-stage application timing and 28 to 65% for the 2-leaf application (Table 1). No visible onion injury was detected on June 8 for the 1-leaf application and 26 to 80% for the 2-leaf application. **It is important to note that the high level of injury to plants treated with Talinor at the 2-leaf stage (May 11) occurred following the first application of a tank-mixture of the insecticides Movento 5 fl oz/acre + Aza-Direct 12 fl oz/acre + Persist Ultra at 1% v/v on May 29, 2020, to control onion thrips.** Injury seems to have increased with Talinor rate, suggesting an interaction of herbicide residues in the plant with the combination of Movento and Aza-Direct or Persist adjuvant. A follow-up study will attempt to isolate the cause of the injury.

Weed control on May 8 and May 18, 2020, varied across herbicide treatments (Table 2). Control for common lambsquarters, hairy nightshade, and pigweed species ranged from 81 to 100% for plots treated with Talinor herbicide at 4, 8, or 10 fl oz/acre when onions were at the 1-leaf stage. Evaluations on May 8 indicated that Talinor applied at 10, 12, 15, or 18 fl oz/acre when onions were at the 2-leaf stage provided 34 to 41% for common lambsquarters and hairy nightshade. Corresponding control for common lambsquarters, hairy nightshade, and pigweed species on May 18 ranged from 80 to 100%. Control for the above-mentioned weeds ranged from 88 to 100% on May 26 and June 1, 2020 (Table 3).

The total number of weeds on June 18 ranged from 14 to 48 weed plants/99 $ft^2$ (two center rows) in plots treated with Talinor herbicide at 4 to 10 fl oz/acre (1-leaf stage) or 10 to 18 fl oz/acre (2-leaf stage) compared to 145 plants/99 $ft^2$ (two center rows) for the grower standard, which was composed of Prowl $H_2O$ followed by Brox 2EC plus GoalTender (Table 4).

Onion yield reflected the level of weed control and previously observed injury (Table 5). US No. 1 yield was generally higher for treatments that received Talinor herbicide at the 1-leaf

stage (1,154.9 to 1,284.5 cwt/acre) compared to 821.6 to 1,038.1 cwt/acre when Talinor was applied at the 2-leaf stage. The injury following application of Movento + Aza-Direct+ adjuvant likely contributed to the reduced yield in plots treated with Talinor at the 2-leaf stage.

Single-centered bulbs ranged from 54% to 71% for Talinor applied at the 1-leaf stage and 45% to 69% for Talinor applied at the 2-leaf growth stage compared to 69% for the grower standard and 56% for the hand-weeded check (Table 6).

These results suggested that Vaquero could tolerate Talinor herbicide applied as early as the 1-leaf stage. Therefore, there is potential to use Talinor at 4 to 10 fl oz/acre to manage weeds in direct-seeded onion. Further studies will be conducted to explore possible interactions between Talinor and the insecticides Movento and Aza-Direct plus the adjuvant Persist Ultra, which caused excessive onion injury when applied to control onion thrips.

## Acknowledgements

This project was funded by the Idaho-Eastern Oregon Onion Committee, cooperating chemical companies, Oregon State University, and the Malheur County Education Service District and supported by Formula Grant nos. 2020-31100-06041 and 2020-31200-06041 from the USDA National Institute of Food and Agriculture.

Table 1. Onion injury in response to Talinor herbicide application rate and timing, Malheur Experiment Station, Oregon State University, Ontario, OR, 2020.

| Treatment[1] | Rate | Growth stage | Application date | Onion injury[2] | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | May 8 | May 18 | May 26 | June 1 | June 8 |
| | fl oz/acre | | | % | | | | |
| Untreated | | | | 0 a | 0 b | 0 c | 0 d | 0 d |
| Hand weeded | | | | 0 a | 0 b | 0 c | 0 d | 0 d |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | 1 a | 10 ab | 10 a | 3 d | 0 d |
| Talinor | 4 | 1 leaf | May 1 | | | | | |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | 0 a | 9 ab | 8 ab | 3 d | 0 d |
| Talinor | 8 | 1 leaf | May 1 | | | | | |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | 1 a | 10 ab | 8 ab | 1 d | 0 d |
| Talinor | 10 | 1 leaf | May 1 | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 0 a | 3 b | 0 c | 28 c | 26 c |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | |
| Talinor | 10 | 2 leaf | May 11 | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 0 a | 3 b | 4 bc | 40 b | 48 b |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | |
| Talinor | 12 | 2 leaf | May 11 | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 0 a | 4 b | 3 c | 48 b | 46 b |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | |
| Talinor | 15 | 2 leaf | May 11 | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 0 a | 18 a | 1 c | 65 a | 80 a |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | |
| Talinor | 18 | 2 leaf | May 11 | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | |
| Prowl $H_2O$ (Grower std) | 32 | Delayed-PRE | April 3 | 0 a | 10 ab | 9 a | 4 d | 0 d |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | |
| Brox 2EC | 12 | 2 leaf | May 11 | | | | | |
| GoalTender | 4 | 2 leaf | May 11 | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | |
| LSD (P = 0.05) | | | | 1.5 | 10.4 | 4.5 | 9.0 | 11.6 |

NOTE: Onion injury (inset box) was observed starting on June 1 following the application of Movento 5 fl oz/acre (spirotetramat 0.078 lb ai/acre) + Aza-Direct 12 fl oz/acre (azadirachtin 0.0093 lb ai/acre) + Persist Ultra 1% v/v (methyl esters of canola oil 85% + alkyl phenol ethoxylate 12%) on May 29, 2020. Onion injury was exacerbated by successive application of Movento + Aza-Direct + Persist Ultra on June 5. Injury was observed only on onions sprayed with Talinor at the 2-leaf stage.

[1]Roundup PowerMax 22 fl oz/acre = glyphosate 0.77 lb ae/acre; Talinor 4 fl oz/acre = bicyclopyrone 0.0097 lb ai/acre + bromoxynil 0.0456 lb ai/acre; Talinor 8 fl oz/acre = bicyclopyrone 0.0194 lb ai/acre + bromoxynil 0.092 lb ai/acre; Talinor 10 fl oz/acre = bicyclopyrone 0.0242 lb ai/acre + bromoxynil 0.114 lb ai/acre; Talinor 12 fl oz/acre = bicyclopyrone 0.029 lb ai/acre + bromoxynil 0.137 lb ai/acre; Talinor 15 fl oz/acre = bicyclopyrone 0.0363 lb ai/acre + bromoxynil 0.17 lb ai/acre; Talinor 18 fl oz/acre = bicyclopyrone 0.044 lb ai/acre + bromoxynil 0.206 lb ai/acre; Brox 2EC 12 fl oz/acre = bromoxynil 0.188 lb ai/acre; GoalTender 4 fl oz/acre = oxyfluorfen 0.125 lb ai/acre; Prowl $H_2O$ 32 fl oz/acre = pendimethalin 0.95 lb ai/acre.
[2]Means within a column followed by same letter do not significantly differ (P = 0.05, LSD).

Table 2. Weed control in onion in response to Talinor herbicide application rate and timing, Malheur Experiment Station, Oregon State University, Ontario, OR, 2020.

| | | | | Weed control[2] | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | 5/8/2020 | | 5/18/2020 | | |
| Treatment[1] | Rate | Growth stage | Application date | Common lambsquarters | Hairy nightshade | Common lambsquarters | Hairy nightshade | Pigweeds |
| | fl oz/acre | | | % | | | | |
| Untreated | | | | 0 c | 0 c | 0 d | 0 c | 0 c |
| Hand weeded | | | | 100 a | 100 a | 100 a | 100 a | 100 a |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | 81 a | 88 a | 100 a | 100 a | 100 a |
| Talinor | 4 | 1 leaf | May 1 | | | | | |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | 95 a | 99 a | 100 a | 100 a | 100 a |
| Talinor | 8 | 1 leaf | May 1 | | | | | |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | 97 a | 100 a | 100 a | 100 a | 100 a |
| Talinor | 10 | 1 leaf | May 1 | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 39 b | 41 b | 80 c | 88 b | 95 b |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | |
| Talinor | 10 | 2 leaf | May 11 | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 38 b | 34 b | 85 bc | 95 ab | 96 b |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | |
| Talinor | 12 | 2 leaf | May 11 | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 43 b | 38 b | 93 ab | 100 a | 100 a |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | |
| Talinor | 15 | 2 leaf | May 11 | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 35 b | 35 b | 93 ab | 100 a | 100 a |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | |
| Talinor | 18 | 2 leaf | May 11 | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | |
| Prowl $H_2O$ (Grower std) | 32 | Delayed-PRE | April 3 | 35 b | 30 bc | 93 ab | 100 a | 100 a |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | |
| Brox 2EC | 12 | 2 leaf | May 11 | | | | | |
| GoalTender | 4 | 2 leaf | May 11 | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | |
| LSD (P = 0.05) | | | | 34 | 33 | 10 | 9 | 3 |

[1]Roundup PowerMax 22 fl oz/acre = glyphosate 0.77 lb ae/acre; Talinor 4 fl oz/acre = bicyclopyrone 0.0097 lb ai/acre + bromoxynil 0.0456 lb ai/acre; Talinor 8 fl oz/acre = bicyclopyrone 0.0194 lb ai/acre + bromoxynil 0.092 lb ai/acre; Talinor 10 fl oz/acre = bicyclopyrone 0.0242 lb ai/acre + bromoxynil 0.114 lb ai/acre; Talinor 12 fl oz/acre = bicyclopyrone 0.029 lb ai/acre + bromoxynil 0.137 lb ai/acre; Talinor 15 fl oz/acre = bicyclopyrone 0.0363 lb ai/acre + bromoxynil 0.17 lb ai/acre; Talinor 18 fl oz/acre = bicyclopyrone 0.044 lb ai/acre + bromoxynil 0.206 lb ai/acre; Brox 2EC 12 fl oz/acre = bromoxynil 0.188 lb ai/acre; GoalTender 4 fl oz/acre = oxyfluorfen 0.125 lb ai/acre; Prowl $H_2O$ 32 fl oz/acre = pendimethalin 0.95 lb ai/acre.

[2]Means within a column followed by same letter do not significantly differ (P = 0.05, LSD).

Table 3. Weed control in onion in response to Talinor herbicide application rate and timing, Malheur Experiment Station, Oregon State University, Ontario, OR, 2020.

| | | | | Weed control[2] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 5/26/2020 | | | | 6/1/2020 | | | | | |
| Treatment[1] | Rate | Growth stage | Application date | Common lambsquarters | | Hairy nightshade | Pigweeds | Common lambsquarters | | Hairy nightshade | Pigweeds | | |
| | fl oz/acre | | | % | | | | % | | | | | |
| Untreated | | | | 0 | d | 0 | 0 | 0 | e | 0 | 0 | | |
| Hand weeded | | | | 100 | a | 100 | a | 100 | a | 100 | a | 100 | a | 100 | a |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | 99 | a | 100 | a | 100 | a | 98 | ab | 100 | a | 100 | a |
| Talinor | 4 | 1 leaf | May 1 | | | | | | | | | | |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | 100 | a | 100 | a | 100 | a | 100 | a | 100 | a | 100 | a |
| Talinor | 8 | 1 leaf | May 1 | | | | | | | | | | |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | 100 | a | 100 | a | 100 | a | 100 | a | 100 | a | 100 | a |
| Talinor | 10 | 1 leaf | May 1 | | | | | | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 88 | c | 100 | a | 100 | a | 83 | d | 100 | a | 100 | a |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | | | | | | |
| Talinor | 10 | 2 leaf | May 11 | | | | | | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 91 | bc | 100 | a | 100 | a | 86 | cd | 100 | a | 100 | a |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | | | | | | |
| Talinor | 12 | 2 leaf | May 11 | | | | | | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 96 | ab | 100 | a | 100 | a | 93 | abc | 100 | a | 100 | a |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | | | | | | |
| Talinor | 15 | 2 leaf | May 11 | | | | | | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 99 | a | 100 | a | 100 | a | 95 | abc | 100 | a | 100 | a |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | | | | | | |
| Talinor | 18 | 2 leaf | May 11 | | | | | | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | | | | | | |
| Prowl $H_2O$ (Grower std) | 32 | Delayed-PRE | April 3 | 95 | ab | 100 | a | 100 | a | 90 | bcd | 100 | a | 100 | a |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | | | | | | |
| Brox 2EC | 12 | 2 leaf | May 11 | | | | | | | | | | |
| GoalTender | 4 | 2 leaf | May 11 | | | | | | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | | | | | | |
| LSD (P = 0.05) | | | | 6 | | NS | NS | 9 | | NS | NS | | |

[1]Roundup PowerMax 22 fl oz/acre = glyphosate 0.77 lb ae/acre; Talinor 4 fl oz/acre = bicyclopyrone 0.0097 lb ai/acre + bromoxynil 0.0456 lb ai/acre; Talinor 8 fl oz/acre = bicyclopyrone 0.0194 lb ai/acre + bromoxynil 0.092 lb ai/acre; Talinor 10 fl oz/acre = bicyclopyrone 0.0242 lb ai/acre + bromoxynil 0.114 lb ai/acre; Talinor 12 fl oz/acre = bicyclopyrone 0.029 lb ai/acre + bromoxynil 0.137 lb ai/acre; Talinor 15 fl oz/acre = bicyclopyrone 0.0363 lb ai/acre + bromoxynil 0.17 lb ai/acre; Talinor 18 fl oz/acre = bicyclopyrone 0.044 lb ai/acre + bromoxynil 0.206 lb ai/acre; Brox 2EC 12 fl oz/acre = bromoxynil 0.188 lb ai/acre; GoalTender 4 fl oz/acre = oxyfluorfen 0.125 lb ai/acre; Prowl $H_2O$ 32 fl oz/acre = pendimethalin 0.95 lb ai/acre.

[2]Means within a column followed by same letter do not significantly differ (P = 0.05, LSD).

Table 4. Number and weight of weeds on June 18 in response to Talinor herbicide application rate and timing, Malheur Experiment Station, Oregon State University, Ontario, OR, 2020.

| Treatment[1] | Rate | Growth stage | Application date | Number of weeds[2] Common lambsquarters | | Pigweeds | Hairy nightshade | Kochia | Total | | Total weed weight | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | fl oz/acre | | | ---------- Number per 99 ft$^2$ ---------- | | | | | | | lb/99 ft$^2$ | |
| Untreated[3] | | | | 2,676 | | 25 | 1,634 | 25 | 4,059 | | 337.10 | |
| Hand weeded[3] | | | | 0 | | 0 | 0 | 0 | 0 | | 0.00 | |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | 23 | bc | 1 a | 14 a | 0 a | 38 | b | 2.69 | c |
| Talinor | 4 | 1 leaf | May 1 | | | | | | | | | |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | 13 | bc | 2 a | 34 a | 0 a | 48 | b | 0.54 | c |
| Talinor | 8 | 1 leaf | May 1 | | | | | | | | | |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | 7 | c | 2 a | 5 a | 0 a | 14 | b | 0.24 | c |
| Talinor | 10 | 1 leaf | May 1 | | | | | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 51 | b | 0 a | 4 a | 0 a | 55 | b | 27.65 | a |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | | | | | |
| Talinor | 10 | 2 leaf | May 11 | | | | | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 42 | bc | 0 a | 4 a | 1 a | 47 | b | 23.28 | a |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | | | | | |
| Talinor | 12 | 2 leaf | May 11 | | | | | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 25 | bc | 0 a | 4 a | 0 a | 30 | b | 8.15 | bc |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | | | | | |
| Talinor | 15 | 2 leaf | May 11 | | | | | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 14 | bc | 0 a | 0 a | 0 a | 14 | b | 6.79 | bc |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | | | | | |
| Talinor | 18 | 2 leaf | May 11 | | | | | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | | | | | |
| Prowl$H_2O$ (Grower std) | 32 | Delayed-PRE | April 3 | 93 | a | 3 a | 50 a | 0 a | 145 | a | 19.66 | ab |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | | | | | |
| Brox 2EC | 12 | 2 leaf | May 11 | | | | | | | | | |
| GoalTender | 4 | 2 leaf | May 11 | | | | | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | | | | | |
| LSD (P = 0.05) | | | | 6 | | NS | NS | 9 | NS | | NS | |

[1]Roundup PowerMax 22 fl oz/acre = glyphosate 0.77 lb ae/acre; Talinor 4 fl oz/acre = bicyclopyrone 0.0097 lb ai/acre + bromoxynil 0.0456 lb ai/acre; Talinor 8 fl oz/acre = bicyclopyrone 0.0194 lb ai/acre + bromoxynil 0.092 lb ai/acre; Talinor 10 fl oz/acre = bicyclopyrone 0.0242 lb ai/acre + bromoxynil 0.114 lb ai/acre; Talinor 12 fl oz/acre = bicyclopyrone 0.029 lb ai/acre + bromoxynil 0.137 lb ai/acre; Talinor 15 fl oz/acre = bicyclopyrone 0.0363 lb ai/acre + bromoxynil 0.17 lb ai/acre; Talinor 18 fl oz/acre = bicyclopyrone 0.044 lb ai/acre + bromoxynil 0.206 lb ai/acre; Brox 2EC 12 fl oz/acre = bromoxynil 0.188 lb ai/acre; GoalTender 4 fl oz/acre = oxyfluorfen 0.125 lb ai/acre; Prowl $H_2O$ 32 fl oz/acre = pendimethalin 0.95 lb ai/acre.
[2]Means within a column followed by same letter do not significantly differ (P = 0.05, LSD).
[3]Untreated and hand-weeded checks were not included in statistical analysis.

Table 5. Onion yield in response to application of Talinor herbicide at various rates and timings, Malheur Experiment Station, Oregon State University, Ontario, OR, 2020.

| | | | | Onion yield[2] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Treatment[1] | Rate | Growth stage | Application date | Rot | US No. 2 | Small | Medium | Jumbo | Colossal | Super colossal | US No.1 |
| | fl oz/acre | | | cwt/acre | | | | | | | |
| Untreated | | | | 0.0 a | 0.0 a | 0.0 b | 0.0 a | 0.0 c | 0.0 c | 0.0 c | 0.0 g |
| Weed free (hand weeded) | | | | 0.0 a | 0.0 a | 3.2 b | 45.9 a | 330.6 ab | 535.3 a | 319.6 ab | 1231.4 ab |
| Talinor | 4 | 1 leaf | May 1 | 0.0 a | 0.0 a | 2.7 b | 9.2 a | 367.5 ab | 525.7 a | 382.1 a | 1284.5 a |
| Talinor | 8 | 1 leaf | May 1 | 1.0 a | 0.0 a | 5.5 b | 11.2 a | 286.0 b | 554.2 a | 393.8 a | 1245.2 ab |
| Talinor | 10 | 1 leaf | May 1 | 0.0 a | 1.6 a | 5.3 b | 15.9 a | 276.5 b | 545.9 a | 316.7 ab | 1154.9 abc |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 0.3 a | 0.6 a | 14.6 a | 22.5 a | 396.4 a | 352.6 b | 266.4 ab | 1038.1 cde |
| Talinor | 10 | 2 leaf | May 11 | | | | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 0.0 a | 0.9 a | 15.4 a | 24.9 a | 348.5 ab | 296.1 b | 299.1 ab | 968.7 e |
| Talinor | 12 | 2 leaf | May 11 | | | | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 0.0 a | 1.3 a | 18.6 a | 32.7 a | 358.3 ab | 295.9 b | 300.7 ab | 987.5 de |
| Talinor | 15 | 2 leaf | May 11 | | | | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 0.0 a | 0.0 a | 21.9 a | 34.1 a | 301.1 ab | 272.3 b | 214.1 b | 821.6 f |
| Talinor | 18 | 2 leaf | May 11 | | | | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | | | | |
| Prowl $H_2O$ (Grower std) | 32 | Delayed-PRE | April 3 | 0.0 a | 2.4 a | 6.6 b | 13.6 a | 276.1 b | 496.4 a | 324.6 ab | 1110.6 bcd |
| Brox 2EC | 12 | 2 leaf | May 11 | | | | | | | | |
| GoalTender | 4 | 2 leaf | May 11 | | | | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | | | | |
| LSD (P = 0.05) | | | | 0.96 | 2.82 | 7.64 | 30.46 | 97.80 | 118.28 | 129.70 | 137.30 |

[1]All delayed-pre-emergence treatments included Roundup PowerMax 22 fl oz/acre = glyphosate 0.77 lb ae/acre; Talinor 4 fl oz/acre = bicyclopyrone 0.0097 lb ai/acre + bromoxynil 0.0456 lb ai/acre; Talinor 8 fl oz/acre = bicyclopyrone 0.0194 lb ai/acre + bromoxynil 0.092 lb ai/acre; Talinor 10 fl oz/acre = bicyclopyrone 0.0242 lb ai/acre + bromoxynil 0.114 lb ai/acre; Talinor 12 fl oz/acre = bicyclopyrone 0.029 lb ai/acre + bromoxynil 0.137 lb ai/acre; Talinor 15 fl oz/acre = bicyclopyrone 0.0363 lb ai/acre + bromoxynil 0.17 lb ai/acre; Talinor 18 fl oz/acre = bicyclopyrone 0.044 lb ai/acre + bromoxynil 0.206 lb ai/acre; Brox 2EC 12 fl oz/acre = bromoxynil 0.188 lb ai/acre; GoalTender 4 fl oz/acre = oxyfluorfen 0.125 lb ai/acre; Prowl $H_2O$ 32 fl oz/acre = pendimethalin 0.95 lb ai/acre.
[2]Means within a column followed by same letter do not significantly differ (P = 0.05, LSD).

Table 6. Single and multiple-center bulb ratings in response to Talinor herbicide application rate and timing, Malheur Experiment Station, Oregon State University, Ontario, OR, 2020.

| Treatment[1] | Rate | Growth stage | Application date | Multiple centers[2,3] | | | Single center[2,3] | |
|---|---|---|---|---|---|---|---|---|
| | | | | Large | Medium | Small | Functional[4] | Bullet |
| | fl oz/acre | | | % | | | | |
| Hand weeded | | | | 17 bc | 27 a | 21 a | 56 a | 35 a |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | 19 bc | 27 a | 21 a | 54 a | 32 a |
| Talinor | 4 | 1 leaf | May 1 | | | | | |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | 18 bc | 22 a | 16 a | 60 a | 44 a |
| Talinor | 8 | 1 leaf | May 1 | | | | | |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | 13 cd | 16 a | 20 a | 71 a | 51 a |
| Talinor | 10 | 1 leaf | May 1 | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 31 a | 24 a | 7 a | 45 a | 38 a |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | |
| Talinor | 10 | 2 leaf | May 11 | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 25 ab | 19 a | 14 a | 56 a | 42 a |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | |
| Talinor | 12 | 2 leaf | May 11 | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 14 cd | 17 a | 21 a | 69 a | 47 a |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | |
| Talinor | 15 | 2 leaf | May 11 | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | |
| Prowl $H_2O$ | 32 | Delayed-PRE | April 3 | 15 bcd | 25 a | 15 a | 60 a | 45 a |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | |
| Talinor | 18 | 2 leaf | May 11 | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | |
| Prowl$H_2O$ (Grower std) | 32 | Delayed-PRE | April 3 | 6 d | 25 a | 20 a | 69 a | 49 a |
| Roundup PowerMax | 22 | Delayed-PRE | April 3 | | | | | |
| Brox 2EC | 12 | 2 leaf | May 11 | | | | | |
| GoalTender | 4 | 2 leaf | May 11 | | | | | |
| Brox 2EC | 12 | 4 leaf | June 2 | | | | | |
| GoalTender | 4 | 4 leaf | June 2 | | | | | |
| LSD (P = 0.05) | | | | NS | NS | NS | NS | NS |

[1]Roundup PowerMax 22 fl oz/acre = glyphosate 0.77 lb ae/acre; Talinor 4 fl oz/acre = bicyclopyrone 0.0097 lb ai/acre + bromoxynil 0.0456 lb ai/acre; Talinor 8 fl oz/acre = bicyclopyrone 0.0194 lb ai/acre + bromoxynil 0.092 lb ai/acre; Talinor 10 fl oz/acre = bicyclopyrone 0.0242 lb ai/acre + bromoxynil 0.114 lb ai/acre; Talinor 12 fl oz/acre = bicyclopyrone 0.029 lb ai/acre + bromoxynil 0.137 lb ai/acre; Talinor 15 fl oz/acre = bicyclopyrone 0.0363 lb ai/acre + bromoxynil 0.17 lb ai/acre; Talinor 18 fl oz/acre = bicyclopyrone 0.044 lb ai/acre + bromoxynil 0.206 lb ai/acre; Brox 2EC 12 fl oz/acre = bromoxynil 0.188 lb ai/acre; GoalTender 4 fl oz/acre = oxyfluorfen 0.125 lb ai/acre; Prowl $H_2O$ 32 fl oz/acre = pendimethalin 0.95 lb ai/acre.

[2]Means within a column followed by same letter do not significantly differ (P = 0.05, LSD).

[3]Multiple-centered onions were ranked according to the inside diameter of the first entire single ring: small <1½ inches, medium 1½ to 2¼ inches, and large >2¼ inches.

[4]"Functionally single centered" are the bullet or had a small multiple center.