

ONION RESPONSE TO TALINOR® HERBICIDE RATE AND APPLICATION TIMING

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Introduction

Timely control of weeds is essential in order to achieve better onion yield and bulb quality. Unfortunately, there are very few herbicides registered for weed management in onion largely due to seedling sensitivity at the early growth stage. Repeated use of the same few registered products could result in selection of herbicide-resistant weeds. Therefore, in order to broaden the tool kit, it is vital to evaluate new products on the market for suitability to manage weeds in onion. Additionally, growers lack an efficacious herbicide that is safe to use in onions at the early growth stage.

Talinor is a premix herbicide composed of bicyclopyrone and bromoxynil, which is registered for weed control in cereals. The choice of this herbicide premix was because bromoxynil is already 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 starting at the 1- or 2-leaf stages and the level of weed control achieved.

Materials and Methods

A field study was initiated during spring 2022 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 and irrigated. Once dry, the field was disked, ripped, plowed, and groundhogged. Based on soil analysis, fertilizer was broadcasted during fall 2021 at 100 lb nitrogen (N)/acre, 180 lb potassium/acre, 100 lb sulfur/acre, 3 lb zinc/acre, 13 lb manganese/acre, and 1 lb boron/acre. The field fumigated and beds were formed at 22-inch spacing.

The study area was sprayed with Roundup at 1 qt/acre (1.13 lb ae/acre) on March 7, 2022 to control all emerged weed prior to establishing the study. Beds were harrowed on March 21 and onion variety ‘Vaquero’ (Nunhems, Parma, ID) was seeded at about 125,000 seeds/acre (3.8 inches between seeds) on March 23, 2022. Onion seeds were planted in double rows spaced 3 inches apart on each 22-inch bed. Drip tape (with emitters spaced 8 inches apart and an emitter flow rate of 0.09 gal/hr (0.22 gal/min/100 ft, Toro Aqua-Traxx, Toro Co., El Cajon, CA) was laid at 2-inch depth between each pair of beds on March 22. The distance between the tape and the center of each double row of onions was 11 inches. Because of dry soil conditions, the study area was drip irrigated on March 28, 2022 to enable seed germination.

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 CO₂-pressurized

backpack sprayer fitted with a boom calibrated to deliver 20 gal/acre for delayed pre-emergence treatments or 35 gal/acre for post-emergence treatments. Treatments with Talinor applied at the 1-leaf onion growth stage were preceded by a delayed pre-emergence application of glyphosate at 22 fl oz/acre (glyphosate 0.77 lb ae/acre), whereas Talinor treatments applied at the 2-leaf stage and the grower standard received a delayed pre-emergence application of glyphosate 22 fl oz/acre + Prowl H2O at 2 pt/acre (pendimethalin 0.95 lb ai/acre). Untreated and hand-weeded checks were included (Tables 1-3).

Delayed pre-emergence herbicide treatments were applied on April 7, 2022. Talinor herbicide at 4, 8, or 10 fl oz/acre (bicyclopyrone 0.155 oz ai/acre + bromoxynil 0.73 oz ai/acre, bicyclopyrone 0.312 oz ai/acre + bromoxynil 1.47 oz ai/acre or bicyclopyrone 0.385 oz ai/acre + bromoxynil 1.81 oz ai/acre, respectively) was applied to onions at the 1-leaf stage on May 12, 2022. Onions at the 2-leaf stage were sprayed with Talinor herbicide at 10, 12, 15, or 18 fl oz/acre (bicyclopyrone 0.385 oz ai/acre + bromoxynil 1.81 oz ai/acre, bicyclopyrone 0.466 oz ai/acre + bromoxynil 2.2 oz ai/acre, bicyclopyrone 0.58 oz ai/acre + bromoxynil 2.72 oz ai/acre, or bicyclopyrone 0.7 oz ai/acre + bromoxynil 3.3 oz ai/acre, respectively) on May 23, 2022 (see details in Tables 1–3). Treatments sprayed with Talinor at the 1- or 2-leaf onion growth stages 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 7, 2022). On May 11, all treatments (except the hand-weeded and untreated control) were sprayed with Poast herbicide at 1.5 pt/acre (sethoxydim 0.287 lb ai/acre) plus COC at 1 pt/acre (0.41 % v/v) to control grassy weeds.

In-season fertilizer was applied according to soil and tissue test results. Fertilizer was applied through drip irrigation on June 5, June 21, and July 12 to supply 50 lb N/acre on each incident.

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

- June 3, 2022 – M-Pede 5.6 pt/acre + Aza-Direct 20 fl oz/acre (azadirachtin 0.0155 lb ai/acre) + BB5 NC 0.1% v/v (2.8 fl oz/100 gal).
- June 10, 2022 – Aza-Direct 20 fl oz/acre (azadirachtin 0.0155 lb ai/acre) + Movento 2.5 fl oz/acre (spirotetramat 0.039 lb ai/acre) + Dyne-Amic 0.25 v/v + 0.25 v/v + BB5 NC 4.25 fl oz/acre.
- June 17, 2022 – Movento 2.5 fl oz/acre (spirotetramat 0.039 lb ai/acre) + Aza-Direct 20 fl oz/acre (azadirachtin 0.0155 lb ai/acre) + Dyne-Amic 0.25 v/v + BB5 NC 4.25/100 gal.
- June 24, 2022 – Agri-Mek 3.5 fl oz/acre (abamectin 0.0191 lb ai/acre) + Persist Ultra 0.25% v/v (methyl esters of canola oil 85% + alkyl phenol ethoxylate 12%) + BB5 NC 4.25 fl oz/acre.
- July 1, 2022 – Agri-Mek 3.5 fl oz/acre (abamectin 0.0191 lb ai/acre) + Persist Ultra 0.25% v/v (methyl esters of canola oil 85% + alkyl phenol ethoxylate 12%) + BB5 NC 4.25 fl oz/acre.
- July 12, 2022 – Radiant 20 fl oz/acre + Persist Ultra 0.25% v/v (methyl esters of canola oil 85% + alkyl phenol ethoxylate 12%) + BB5 NC 1 fl oz/100 gal.
- July 19, 2022 – Radiant 20 fl oz/acre + Persist Ultra 0.25% v/v (methyl esters of canola oil 85% + alkyl phenol ethoxylate 12%) + BB5 NC 1 fl oz/100 gal.
- July 28, 2022 – Exirel 20 fl oz/acre (cyantraniliprole 0.13 lb ai/acre) + Persist Ultra 0.25% v/v (methyl esters of canola oil 85% + alkyl phenol ethoxylate 12%) + BB5 NC 4.25 fl oz/acre.

- August 2, 2022 – Exirel 20 fl oz/acre (cyantraniliprole 0.13 lb ai/acre) + Persist Ultra 0.25% v/v (methyl esters of canola oil 85% + alkyl phenol ethoxylate 12%) + BB5 NC 4.25 fl oz/acre.

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 killed or total weed control). Onion response to Talinor herbicide was assessed on May 25 and June 29, 2022. Weed control was assessed on May 25 and June 29, 2022 (Table 1). Plots were hand-weeded on July 23, 2022 (except for untreated control).

The field was drip irrigated from March 28 to August 22, 2022. Plant tops were flailed on September 2, and onion bulbs were lifted on September 6. Bulbs were hand harvested from 20 ft length of one bed on September 12, 2022, placed in burlap bags, and kept in the storage barn until graded. 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. 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 purposes 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

The lower Treasure Valley region experienced mild winter conditions in 2021 and was generally warm and dry at onion planting time in spring 2022. Therefore, the study was irrigated on March 28, which was only 5 days after seeding. Onion emergence was observed on April 18, 2022. Plant count on June 9 indicated variable plant population density ranging from 44,660 to 76,230 plants/acre across herbicide treatments (Table 1), which was well below the target rate of 125,000 plants/acre. It was not clear what caused the variability in plant stand, but likely weather conditions during spring played a role. Evaluation on May 25 (14 days after application of Talinor to onion at 1-leaf stage) indicated no visible onion injury (data not shown). Onion injury on May 30 (18 days after 1-leaf and 7 days after 2-leaf application timings) was 5% across

herbicide treatments. Subsequent evaluation on June 6 (25 days after 1-leaf and 14 days after 2-leaf applications) indicated onion injury ranged from 5 to 15% largely depending on the increase in herbicide rate. The injury was characterized by leaf tip burn and curling typical of Brox 2EC effect on onion. The injury was transitory with plants exhibiting no injury a few weeks later.

There was very little variation in weed control across herbicide treatments during ratings on June 6, 2022 (Table 1) suggesting superior weed control with Talinor applied to onion starting at the 1-leaf stage compared to the grower standard of delayed pre-emergence application of ProwlH2O plus Roundup herbicides. Control for common lambsquarters ranged from 92 to 99%. Hairy nightshade control ranged from 91 to 97% for Talinor treatments compared to 95% for the grower standard. Evaluations on June 29 indicated common lambsquarters control at $\geq 98\%$ across herbicide treatments (Table 1). Control for hairy nightshade on June 29 was similarly high. It is important to note that the warmer than normal spring weather may have influenced the results. Also, the silt-loam soil may have masked the onion injury and follow up studies should evaluate the response at light textured soils.

Onion yield reflected the plant stand (Table 2). The marketable yield (medium to super colossal grades) for Talinor treatments was generally comparable to the grower standard with similar plant stand. Marketable yield averaged 904.2 to 1,128.6 cwt/acre for treatments that received Talinor herbicide at the 1-leaf stage and 892.8 to 1,123.3 cwt/acre when Talinor was applied to onions starting at the 2-leaf stage compared to 1,141.9 cwt/acre for the grower standard herbicides and 985 cwt/acre for the hand-weeded control. Total onion yield (all grades combined) followed a similar trend.

Bulb single centeredness is very important for growers contracting with processors for production of onion rings. The percentage of functional single-centered bulbs (bullet plus small multiple center bulbs) was similar across herbicide treatments and ranged from 88 to 97% across Talinor treatments at either the 1-leaf or 2-leaf stage compared to 92% for the grower standard and 95% for the hand weeded control (Table 3).

These results suggested onion variety ‘Vaquero’ tolerance to Talinor herbicide applied as early as the 1-leaf stage. Given the weather conditions in 2022, further studies should be conducted to explore onion response in light textured soils.

Acknowledgements

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Table 1. Onion plant stand (June 9) and weed control in onion with Talinor herbicide applied at variable rate and timing, Malheur Experiment Station, Oregon State University, Ontario, OR, 2022.

Treatment ¹	Rate fl oz/a	Growth stage	Application date	Plant stand No./acre	Weed control ²			
					6/6/2022		6/29/2022	
					C lambs- quarters	Hairy nightshade	C Lambs- quarters	Hairy nightshade
Untreated*	--	--	--	48,400 ab	0 c	0 c	0 c	0 c
Hand weeded	--	--	--	62,260 ab	78 b	100 a	100 a	100 a
Roundup PowerMax	22	Delayed-PRE	April 7	36,520 b	92 ab	94 ab	89 c	99 ab
Talinor	4	1 leaf	May 12					
Brox 2EC	12	4 leaf	June 7					
GoalTender	4	4 leaf	June 7					
Roundup PowerMax	22	Delayed-PRE	April 7	44,660 b	99 a	97 ab	100 a	99 ab
Talinor	8	1 leaf	May 12					
Brox 2EC	12	4 leaf	June 7					
GoalTender	4	4 leaf	June 7					
Roundup PowerMax	22	Delayed-PRE	April 7	39,820 b	98 a	97 ab	98 ab	98 abc
Talinor	10	1 leaf	May 12					
Brox 2EC	12	4 leaf	June 7					
GoalTender	4	4 leaf	June 7					
Prowl H2O	32	Delayed-PRE	April 7	45,870 ab	98 a	95 ab	98 ab	94 c
Roundup PowerMax	22	Delayed-PRE	April 7					
Talinor	10	2 leaf	May 23					
Brox 2EC	12	4 leaf	June 7					
GoalTender	4	4 leaf	June 7					
Prowl H2O	32	Delayed-PRE	April 7	43,010 b	98 a	91 b	96 b	95 bc
Roundup PowerMax	22	Delayed-PRE	April 7					
Talinor	12	2 leaf	May 23					
Brox 2EC	12	4 leaf	June 7					
GoalTender	4	4 leaf	June 7					
Prowl H2O	32	Delayed-PRE	April 7	76,230 a	99 a	93 b	100 a	96 abc
Roundup PowerMax	22	Delayed-PRE	April 7					
Talinor	15	2 leaf	May 23					
Brox 2EC	12	4 leaf	June 7					
GoalTender	4	4 leaf	June 7					
Prowl H2O	32	Delayed-PRE	April 7	46,420 ab	99 a	94 ab	99 ab	98 abc
Roundup PowerMax	22	Delayed-PRE	April 7					
Talinor	18	2 leaf	May 23					
Brox 2EC	12	4 leaf	June 7					
GoalTender	4	4 leaf	June 7					
Prowl H2O (Grower standard)	32	Delayed-PRE	April 7	49,390 ab	99 a	95 ab	98 ab	98 ab
Roundup PowerMax	22	Delayed-PRE	April 7					
Brox 2EC	12	2 leaf	May 23					
GoalTender	4	2 leaf	May 23					
Brox 2EC	12	4 leaf	June 7					
GoalTender	4	4 leaf	June 7					
LSD (P = 0.05)				30,749	20	7	3	4

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 H2O 32 fl oz/acre = pendimethalin 0.95 lb ai/acre. *Untreated not included in statistical analysis, ²Means within a column followed by same letter do not significantly differ (P = 0.05, LSD).

Table 2. Onion yield in response to application of Talinor herbicide at various rates and timings, Malheur Experiment Station, Oregon State University, Ontario, OR, 2022.

Treatment ^a	Rate fl oz/acre	Growth stage	Application date	Marketable onion yield ^b								
				Rot	US No. 2	Small	Medium	Jumbo	Colossal	Super colossal	Total marketable	Total yield
Untreated				0.0 a	0.0 a	0.0 c	0.0 c	0.0 c	0.0 c	0.0 e	0.0 c	0.0 c
Weed free (hand weeded)				0.0 a	0.0 a	5.2 abc	41.7 a	367.0 a	349.0 ab	227.2 d	985.0 ab	990.3 ab
Talinor	4	1 leaf	May 12	0.0 a	0.0 a	7.7 ab	35.5 ab	294.6 ab	343.6 ab	372.6 bcd	1,046.3 ab	1,053.9 ab
Talinor	8	1 leaf	May 12	0.0 a	3.2 a	1.7 bc	31.8 ab	283.4 ab	339.4 ab	474.1 ab	1,128.6 a	1,133.5 a
Talinor	10	1 leaf	May 12	0.0 a	3.0 a	2.1 bc	15.4 abc	156.4 bc	270.9 b	461.5 abc	904.2 b	909.3 b
Prowl H2O	32	Delayed-PRE	April 7	2.0 a	4.4 a	4.7 abc	16.6 abc	255.0 ab	368.8 ab	453.7 abc	1,094.0 a	1,105.0 a
Talinor	10	2 leaf	May 23									
Brox 2EC	12	4 leaf	June 7									
GoalTender	4	4 leaf	June 7									
Prowl H2O	32	Delayed-PRE	April 7	4.5 a	2.7 a	4.8 abc	13.9 bc	163.8 bc	278.3 b	436.8 a-d	892.8 b	904.8 b
Talinor	12	2 leaf	May 23									
Brox 2EC	12	4 leaf	June 7									
GoalTender	4	4 leaf	June 7									
Prowl H2O	32	Delayed-PRE	April 7	0.0 a	0.0 a	9.0 a	41.6 a	420.4 a	304.2 b	240.1 cd	1,006.3 ab	1,015.3 ab
Talinor	15	2 leaf	May 23									
Brox 2EC	12	4 leaf	June 7									
GoalTender	4	4 leaf	June 7									
Prowl H2O	32	Delayed-PRE	April 7	4.9 a	0.0 a	2.8 bc	20.6 abc	142.7 bc	363.7 ab	596.4 a	1,123.3 a	1,131.1 a
Talinor	18	2 leaf	May 23									
Brox 2EC	12	4 leaf	June 7									
GoalTender	4	4 leaf	June 7									
Prowl H2O (Grower std)	32	Delayed-PRE	April 7	0.0 a	0.0 a	5.3 abc	22.6 abc	304.0 ab	437.7 a	377.5 a-d	1,141.9 a	1,147.2 a
Brox 2EC	12	2 leaf	May 23									
GoalTender	4	2 leaf	May 23									
Brox 2EC	12	4 leaf	June 7									
GoalTender	4	4 leaf	June 7									
LSD (P = 0.05)				6.59	6.11	6.15	27.44	198.44	126.86	221.92	159.35	160.40

^a 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 H2O 32 fl oz/acre = pendimethalin 0.95 lb ai/acre.

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

Table 3. Single and multiple-center bulb ratings in response to Talinor herbicide application rate and timing, Malheur Experiment Station, Oregon State University, Ontario, OR, 2022.

Treatment ¹	Rate fl oz/acre	Growth stage	Application date	Multiple centers ^{2 3}			Single center ²	
				Large	Medium	Small	Bullet	Functional ⁴
Hand weeded				4 a	1 a	16 ab	79 ab	95 a
Talinor	4	1 leaf	May 12	2 a	10 a	18 ab	70 ab	88 a
Brox 2EC	12	4 leaf	June 7					
GoalTender	4	4 leaf	June 7					
Talinor	8	1 leaf	May 12	3 a	9 a	15 ab	73 ab	88 a
Brox 2EC	12	4 leaf	June 7					
GoalTender	4	4 leaf	June 7					
Talinor	10	1 leaf	May 12	4 a	6 a	16 ab	74 ab	90 a
Brox 2EC	12	4 leaf	June 7					
GoalTender	4	4 leaf	June 7					
Prowl H2O	32	Delayed-PRE	April 7	1 a	6 a	17 ab	76 ab	93 a
Talinor	10	2 leaf	May 23					
Brox 2EC	12	4 leaf	June 7					
GoalTender	4	4 leaf	June 7					
Prowl H2O	32	Delayed-PRE	April 7	6 a	8 a	19 ab	67 b	86 a
Talinor	12	2 leaf	May 23					
Brox 2EC	12	4 leaf	June 7					
GoalTender	4	4 leaf	June 7					
Prowl H2O	32	Delayed-PRE	April 7	1 a	2 a	10 b	87 a	97 a
Talinor	15	2 leaf	May 23					
Brox 2EC	12	4 leaf	June 7					
GoalTender	4	4 leaf	June 7					
Prowl H2O	32	Delayed-PRE	April 7	4 a	8 a	16 ab	72 ab	88 a
Talinor	18	2 leaf	May 23					
Brox 2EC	12	4 leaf	June 7					
GoalTender	4	4 leaf	June 7					
Prowl H2O (Grower std)	32	Delayed-PRE	April 7	2 a	6 a	22 a	70 ab	92 a
Brox 2EC	12	2 leaf	May 23					
GoalTender	4	2 leaf	May 23					
Brox 2EC	12	4 leaf	June 7					
GoalTender	4	4 leaf	June 7					
LSD (P = 0.05)				6	11	11	17	12

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 H2O 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 and a small multiple center.