

EFFECT OF ETHOTRON™ APPLICATION RATE AND TIMING ON WEEDS AND ONION BULB SINGLE CENTERS

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Introduction

Ethotron™ herbicide provides selective control of weeds in onions and other crops. It is a group 16 herbicide and belongs to the benzofuran family of herbicides. The current label recommends pre-emergence and/or post-emergence applications to onions at the 2- to 8-leaf stage. The use rate varies depending on the application timing, soil texture, and organic matter. The label carries a caution that the herbicide may cause temporary leaf fusion, distortion, and stunting when used according to label directions and under normal growing conditions. Growers use this product to control kochia in onions.

Reports indicate that over 20% of the onions produced in the Treasure Valley of eastern Oregon and southwestern Idaho are processed for onion rings. In order to meet the needs of this market, onion packers and shippers in southwestern Idaho and eastern Oregon adopted a new bulb size class called “supercolossal” (>4¼ inches diameter) (Shock et al. 2005). It is reported that onion ring manufacturing efficiency is reduced when bulbs have multiple centers. Bulbs with single centers (called “bullets”) or bulbs with a small multiple center (called a “small double” with multiple center diameters <1½ inches) are preferred. Together the “bullets” and “small doubles” are called “functionally single-centered” onion bulbs (Shock et al. 2005). Incentives are paid for delivering onions that are more than 75% “functionally single-centered.” Onions with progressively larger multiple centers have fewer useable rings for processing. As a result, supercolossal bulbs have become important for the processing industry.

This study was conducted to evaluate onion response to Ethotron application rate and timing as well as weed control and onion bulb single centers.

Materials and Methods

A field study was conducted at the Malheur Experiment Station, Ontario, Oregon in 2018 to evaluate the response of onion variety ‘Vaquero’ to Ethotron herbicide application rate and timing as well as bulb centers. Onion seed was planted on March 26, 2018 in double rows on beds spaced 22 inches apart. The twin rows were spaced 3 inches apart with 4.75-inch seed spacing within each row. Immediately after planting, each onion row 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 1.25% organic matter. Drip irrigation was used to supply water and fertilizer.

The study had a factorial design and treatments were arranged in randomized complete blocks with three replicates. Herbicide application timing formed the main plot onto which herbicide

application rates 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.

Ethotron Application Timing

The herbicide was applied 1) prior to bed harrowing followed by harrowing the beds twice; 2) harrowing down the beds, spraying, and harrowing the second time; or 3) pre-emergence (after harrowing the beds twice and planting). Timing 3 would be the standard practice for the application of Ethotron in the fields planted to onion. Ethotron was applied at 12 fl oz/acre (0.375, lb ai/acre), 16 fl oz/acre (0.5 lb ai/acre), or 32 fl oz/acre (1 lb ai/acre) on each timing (Tables 1-4). Follow up post-emergence applications were when onions were at the 2 and 4 leaf stage (Tables 1-4).

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. All herbicide treatments were applied using a CO₂-pressurized backpack sprayer fitted with a boom equipped with four EVS8002 flat-fan nozzles at a spray volume of 20 gal/acre. Visual evaluations for onion injury and weed control were conducted on June 14 and June 22. Estimates were based on a 0-100% visual scale; where 0% = no injury or no weed control and 100% = total crop damage or complete weed control.

Fertilizer was applied through irrigation drip on May 29, June 13 and 29, and July 6 to supply 50 lb nitrogen (N)/acre at each application. All other operations including insect control followed recommended local production practices.

Single Center Assessment

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

Plant tops were flailed on September 11, 2018 and bulbs were hand-harvested from the two center beds on September 12.

Bulbs were graded on September 12, 2018 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.

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

Results

Onion emergence was observed on April 18, 2018. Evaluations on June 14 (57 days after onion emergence) indicated 0-11% onion injury (Table 1). The greatest injury was observed in plants growing in plots that received pre-emergence applications of Ethotron at 32 fl oz/acre. The injury was characterized by leaf fusion and overly green above-ground onion parts. The predominant weeds were common lambsquarters, redroot pigweed, and hairy nightshade. Weed control improved when Ethotron was applied pre-emergence at 12 to 32 fl oz/acre (Tables 1 and 2). Applications of Ethotron before bed harrowing or between the two harrowings resulted in reduced weed control regardless of the application rate.

Plant stand on May 29, 2018 ranged from 101,658 to 109,351 plants/acre across herbicide treatments and 99,460 plants/acre in the untreated control (Table 3). The number of harvested bulbs varied greatly across herbicide treatments, but tended to be higher in plots where Ethotron herbicide was applied pre-emergence.

The total marketable yield, which is comprised of medium (2¼-3 inches) to supercolossal (>4¼ inches) bulb categories, was greater when Ethotron was applied pre-emergence (1,031.9-1,123.2 cwt/acre) compared to before bed harrowing (806.5-859.4 cwt/acre) or in between two harrowings prior to planting (816.6-925.5 cwt/acre) (Table 4). The yield for small bulbs ranged from 4.2 to 14.3 cwt/acre across Ethotron rate and application timings.

Onion single-center results are presented in Table 5. The percentage of functionally single-centered onion bulbs was greater when Ethotron was applied pre-emergence (84-88%) compared to applications before planting (77-83%). Functionally single center for the hand weeded treatment was 82%.

The results suggested better weed control when Ethotron was applied pre-emergence compared to applications before bed harrowing or between the two harrowings. Similarly, onion single center was higher when Ethotron was applied pre-emergence. The study will be repeated in 2019 to confirm these results.

Acknowledgements

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References

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

Table 1. Onion response and weed control (6/14/2018) with Ethotron™ applied at different timings in direct-seeded onion variety ‘Vaquero’ at the Malheur Experiment Station, Ontario, OR 2018.

Treatment	Rate fl oz/acre	Application timing	Weed control*			
			Injury	Common lambsquarters	Redroot pigweed	Hairy nightshade
Timing 1			1 bc	83 bc	84 cd	86 c
Ethotron 4 SC	12	Before bed harrowing				
Brox 2 EC	12	2 & 4-Leaf				
GoalTender	4	2 & 4-Leaf				
Timing 1			3 bc	83 bc	86 cd	94 abc
Ethotron 4 SC	16	Before bed harrowing				
Brox 2 EC	12	2 & 4-Leaf				
GoalTender	4	2 & 4-Leaf				
Timing 1			3 bc	83 bc	89 bcd	91 abc
Ethotron 4 SC	32	Before bed harrowing				
Brox 2 EC	12	2 & 4-Leaf				
GoalTender	4	2 & 4-Leaf				
Timing 2			0 c	88 abc	89 bcd	89 bc
Ethotron 4 SC	12	Harrow-spray-harrow				
Brox 2 EC	12	2 & 4-Leaf				
GoalTender	4	2 & 4-Leaf				
Timing 2			0 c	84 bc	93 abc	91 abc
Ethotron 4 SC	16	Harrow-spray-harrow				
Brox 2 EC	12	2 & 4-Leaf				
GoalTender	4	2 & 4-Leaf				
Timing 2			5 b	75 c	82 d	88 c
Ethotron 4 SC	32	Harrow-spray-harrow				
Brox 2 EC	12	2 & 4-Leaf				
GoalTender	4	2 & 4-Leaf				
Timing 3			1 bc	92 ab	96 ab	98 ab
Ethotron 4 SC	12	PRE-emergence				
Ethotron 4 SC	8	2-Leaf				
Brox 2 EC	12	2-Leaf				
GoalTender	4	2-Leaf				
Ethotron 4 SC	12	4-Leaf				
Brox 2 EC	12	4-Leaf				
GoalTender	4	4-Leaf				
Timing 3			0 c	97 a	100 a	100 a
Ethotron 4 SC	16	PRE-emergence				
Ethotron 4 SC	16	2-Leaf				
Brox 2 EC	12	2-Leaf				
GoalTender	4	2-Leaf				
Ethotron 4 SC	12	4-Leaf				
Brox 2 EC	12	4-Leaf				
GoalTender	4	4-Leaf				
Timing 3			11 a	97 a	99 a	99 a
Ethotron 4 SC	32	PRE-emergence				
Ethotron 4 SC	16	2-Leaf				
Brox 2 EC	12	2-Leaf				
GoalTender	4	2-Leaf				
Ethotron 4 SC	12	4-Leaf				
Brox 2 EC	12	4-Leaf				
GoalTender	4	4-Leaf				
Untreated	--		0 c	0 d	0 e	0 d
Handweeded	--		0 c	100 a	100 a	100 a
LSD ($P = 0.05$)			4.0	13	9	9
Standard deviation			2.8	8.8	6.1	6.4

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

Table 2. Onion response and weed control (6/22/2018) with Ethotron™ applied at different timings in direct-seeded onions variety ‘Vaquero’ at the Malheur Experiment Station, Ontario, OR 2018.

Treatment	Rate fl oz/acre	Application timing	Weed control*			
			Injury	Common lambsquarters	Redroot pigweed	Hairy nightshade
Timing 1			0 b	70 cd	75 de	74 b
Ethotron 4 SC	12	Before bed harrowing				
Brox 2 EC	12	2 & 4-Leaf				
GoalTender	4	2 & 4-Leaf				
Timing 1			4 b	80 bc	81 b-e	85 ab
Ethotron 4 SC	16	Before bed harrowing				
Brox 2 EC	12	2 & 4-Leaf				
GoalTender	4	2 & 4-Leaf				
Timing 1			9 a	73 cd	79 cde	77 ab
Ethotron 4 SC	32	Before bed harrowing				
Brox 2 EC	12	2 & 4-Leaf				
GoalTender	4	2 & 4-Leaf				
Timing 2			1 b	78 bc	72 de	81 ab
Ethotron 4 SC	12	Harrow-spray-harrow				
Brox 2 EC	12	2 & 4-Leaf				
GoalTender	4	2 & 4-Leaf				
Timing 2			0 b	76 bc	88 a-d	83 ab
Ethotron 4 SC	16	Harrow-spray-harrow				
Brox 2 EC	12	2 & 4-Leaf				
GoalTender	4	2 & 4-Leaf				
Timing 2			11 a	56 d	67 e	80 ab
Ethotron 4SC	32	Harrow-spray-harrow				
Brox 2 EC	12	2 & 4-Leaf				
GoalTender	4	2 & 4-Leaf				
Timing 3			3 b	86 abc	95 abc	95 ab
Ethotron 4 SC	12	PRE-emergence				
Ethotron 4 SC	8	2-Leaf				
Brox 2 EC	12	2-Leaf				
GoalTender	4	2-Leaf				
Ethotron 4 SC	12	4-Leaf				
Brox 2 EC	12	4-Leaf				
GoalTender	4	4-Leaf				
Timing 3			0 b	95 ab	97 ab	99 a
Ethotron 4 SC	16	PRE-emergence				
Ethotron 4 SC	16	2-Leaf				
Brox 2 EC	12	2-Leaf				
GoalTender	4	2-Leaf				
Ethotron 4 SC	12	4-Leaf				
Brox 2 EC	12	4-Leaf				
GoalTender	4	4-Leaf				
Timing 3			11 a	95 ab	99 ab	99 a
Ethotron 4 SC	32	PRE-emergence				
Ethotron 4 SC	16	2-Leaf				
Brox 2 EC	12	2-Leaf				
GoalTender	4	2-Leaf				
Ethotron 4 SC	12	4-Leaf				
Brox 2 EC	12	4-Leaf				
GoalTender	4	4-Leaf				
Untreated			0 b	0 e	0 f	0 c
Handweeded			3 b	100 a	100 a	100 a
LSD ($P = 0.05$)			5	19	18	24
Standard deviation			3.4	13.2	12.2	16.7

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

Table 3. Onion plant stand (5/29/2018) and number of harvested bulbs in response to Ethotron™ rate and application timing at the Malheur Experiment Station, Ontario, OR 2018.

Treatment	Rate fl oz/acre	Application timing	Plant stand	Marketable bulb number by grade*					Small	No.2s	Neck rot
				Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in			
			No./acre								
Timing 1			101,658 ab	71,280 ab	2,970 abc	14,190 abc	45,430 a	8,690 abc	3,300 abc	110 b	110 a
Ethotron 4 SC	12	Before harrowing									
Brox 2EC	12	2 & 4-Leaf									
GoalTender	4	2 & 4-Leaf									
Timing 1			101,877 ab	68,640 b	2,970 abc	12,210 bc	43,780 a	9,680 ab	4,180 ab	220 ab	0 a
Ethotron 4 SC	16	Before harrowing									
Brox 2EC	12	2 & 4-Leaf									
GoalTender	4	2 & 4-Leaf									
Timing 1			103,196 ab	71,170 ab	1,870 bc	15,730 abc	43,010 a	10,560 a	5,390 a	220 ab	0 a
Ethotron 4 SC	32	Before harrowing									
Brox 2EC	12	2 & 4-Leaf									
GoalTender	4	2 & 4-Leaf									
Timing 2			105,394 ab	72,930 ab	1,210 bc	11,000 bcd	50,820 a	9,900 ab	4,840 ab	0 b	220 a
Ethotron 4 SC	12	Harrow-spray-harrow									
Brox 2EC	12	2 & 4-Leaf									
GoalTender	4	2 & 4-Leaf									
Timing 2			105,614 ab	73,700 ab	3,080 abc	16,610 abc	45,100 a	8,910 abc	4,290 ab	220 ab	0 a
Ethotron 4 SC	16	Harrow-spray-harrow									
Brox 2EC	12	2 & 4-Leaf									
GoalTender	4	2 & 4-Leaf									
Timing 2			105,284 ab	68,530 b	2,640 bc	8,360 cd	47,300 a	10,230 a	4,840 ab	110 b	0 a
Ethotron 4SC	32	Harrow-spray-harrow									
Brox 2EC	12	2 & 4-Leaf									
GoalTender	4	2 & 4-Leaf									
Timing 3			104,515 ab	76,010 ab	4,180 ab	22,770 ab	45,100 a	3,960 bcd	1,540 bc	330 ab	0 a
Ethotron 4 SC	12	PRE-emergence									
Ethotron 4 SC	8	2-Leaf									
2EC	12	2-Leaf									
GoalTender	4	2-Leaf									
Ethotron 4 SC	12	4-Leaf									
Brox 2EC	12	4-Leaf									
GoalTender	4	4-Leaf									
Timing 3			103,306 ab	73,920 ab	6,380 a	20,790 ab	42,680 a	4,070 bcd	1,650 bc	220 ab	220 a
Ethotron 4 SC	16	PRE-emergence									
Ethotron 4 SC	16	2-Leaf									
Brox 2EC	12	2-Leaf									
GoalTender	4	2-Leaf									
Ethotron 4 SC	12	4-Leaf									
Brox 2EC	12	4-Leaf									
GoalTender	4	4-Leaf									
Timing 3			109,351 a	78,540 a	4,620 ab	24,970 a	45,650 a	3,300 cd	1,870 abc	660 a	0 a
Ethotron 4 SC	32	PRE-emergence									
Ethotron 4 SC	16	2-Leaf									
Brox 2EC	12	2-Leaf									
GoalTender	4	2-Leaf									
Ethotron 4 SC	12	4-Leaf									
Brox 2EC	12	4-Leaf									
GoalTender	4	4-Leaf									
Untreated			99,460 b	0 c	0 c	0 d	0 b	0 d	0 c	0 b	0 a
Handweeded			108,471 ab	76,670 ab	3,740 ab	21,890 ab	48,950 a	2,090 d	2,310 abc	220 ab	0 a
LSD (P = 0.05)			9,053	8,798	3,561	11,771	10,024	5,946	3,689	467	236
Standard deviation			6269.6	6,093.2	2,466.0	8,151.9	6,942.4	4,117.6	2,554.8	323.2	163.4

*Means followed by same letter do not significantly differ (P = 0.05, LSD).

Table 4. Onion yield (9/29/2018) by grade in response to Ethotron™ rate and application timing at the Malheur Experiment Station, Ontario, OR 2018.

Treatment	Rate	Application timing	Marketable yield by grade*							Neck rot
			Total	>4¼ in	4-4¼ in	3-4 in	2¼-3 in	Small	No.2s	
fl oz/acre			cwt/acre							
Timing 1			838.6 bc	42.0 bc	249.5 a-d	501.0 a	46.1 ab	9.3 ab	1.4 b	1.5 ab
Ethotron 4 SC	12	Before bed harrowing								
Brox 2 EC	12	2 & 4-Leaf								
GoalTender	4	2 & 4-Leaf								
Timing 1			806.5 c	68.8 abc	210.5 bcd	479.3 a	47.9 ab	12.6 a	3.5 ab	0.0 b
Ethotron 4 SC	16	Before bed harrowing								
Brox 2 EC	12	2 & 4-Leaf								
GoalTender	4	2 & 4-Leaf								
Timing 1			859.4 abc	45.0 bc	270.7 a-d	491.7 a	52.0 a	13.4 a	2.4 b	0.0 b
Ethotron 4 SC	32	Before bed harrowing								
Brox 2 EC	12	2 & 4-Leaf								
GoalTender	4	2 & 4-Leaf								
Timing 2			816.6 bc	28.1 bc	185.8 cde	551.4 a	51.4 a	14.4 a	0.0 b	1.8 ab
Ethotron 4 SC	12	Harrow-spray-harrow								
Brox 2 EC	12	2 & 4-Leaf								
GoalTender	4	2 & 4-Leaf								
Timing 2			925.5 abc	70.9 abc	298.3 a-d	510.3 a	46.0 ab	11.4 a	2.4 b	0.0 b
Ethotron 4 SC	16	Harrow-spray-harrow								
Brox 2 EC	12	2 & 4-Leaf								
GoalTender	4	2 & 4-Leaf								
Timing 2			783.7 c	65.4 bc	145.1 de	519.0 a	54.3 a	14.3 a	1.5 b	0.0 b
Ethotron 4SC	32	Harrow-spray-harrow								
Brox 2 EC	12	2 & 4-Leaf								
GoalTender	4	2 & 4-Leaf								
Timing 3			1,077.3 ab	95.5 ab	408.9 ab	552.2 a	20.7 bc	4.2 ab	4.0 ab	0.0 b
Ethotron 4 SC	12	PRE-emergence								
Ethotron 4 SC	8	2-Leaf								
Brox 2 EC	12	2-Leaf								
GoalTender	4	2-Leaf								
Ethotron 4 SC	12	4-Leaf								
Brox 2 EC	12	4-Leaf								
GoalTender	4	4-Leaf								
Timing 3			1,031.9 abc	147.2 a	362.5 abc	501.8 a	20.4 bc	5.1 ab	2.9 ab	2.7 a
Ethotron 4 SC	16	PRE-emergence								
Ethotron 4 SC	16	2-Leaf								
Brox 2 EC	12	2-Leaf								
GoalTender	4	2-Leaf								
Ethotron 4 SC	12	4-Leaf								
Brox 2 EC	12	4-Leaf								
GoalTender	4	4-Leaf								
Timing 3			1,123.2 a	106.8 ab	438.7 a	561.1 a	16.6 c	5.5 ab	9.0 a	0.0 b
Ethotron 4 SC	32	PRE-emergence								
Ethotron 4 SC	16	2-Leaf								
Brox 2 EC	12	2-Leaf								
GoalTender	4	2-Leaf								
Ethotron 4 SC	12	4-Leaf								
Brox 2 EC	12	4-Leaf								
GoalTender	4	4-Leaf								
Untreated			0.0 d	0.0 c	0.0 e	0.0 b	0.0 c	0.0 b	0.0 b	0.0 b
Handweeded			1,080.0 ab	84.7 ab	385.3 abc	598.9 a	11.0 c	7.2 ab	1.8 b	0.0 b
LSD (P = 0.05)			265.16	81.75	206.92	125.65	29.38	10.37	6.16	2.44
Standard deviation			183.64	56.62	143.30	87.02	20.35	7.18	4.27	1.69

*Means followed by same letter do not significantly differ (P = 0.05, LSD).

Table 5. Single- and multiple-center onion bulb ratings in response to Ethotron™ rate and application timing at the Malheur Experiment Station, Oregon State University, Ontario, OR 2018.

Treatment	Rate	Application timing	Multiple center*			Single center	
			large >2.25 in	medium 1.5 - 2.25 in	small <1.5 in	bullet	functional ^a single
fl oz/acre			----- % -----				
Timing 1			9 ab	14 abc	19 a	58 a	77 ab
Ethotron 4 SC	12	Before bed harrowing					
Brox 2 EC	12	2 & 4-Leaf					
GoalTender	4	2 & 4-Leaf					
Timing 1			7 ab	20 ab	13 a	60 a	73 ab
Ethotron 4 SC	16	Before harrowing					
Brox 2 EC	12	2 & 4-Leaf					
GoalTender	4	2 & 4-Leaf					
Timing 1			5 ab	23 ab	19 a	53 a	72 b
Ethotron 4 SC	32	Before harrowing					
Brox 2 EC	12	2 & 4-Leaf					
GoalTender	4	2 & 4-Leaf					
Timing 2			3 ab	25 a	16 a	56 a	72 b
Ethotron 4 SC	12	Harrow-spray-harrow					
Brox 2 EC	12	2 & 4-Leaf					
GoalTender	4	2 & 4-Leaf					
Timing 2			7 ab	10 bc	16 a	67 a	83 ab
Ethotron 4 SC	16	Harrow-spray-harrow					
Brox 2 EC	12	2 & 4-Leaf					
GoalTender	4	2 & 4-Leaf					
Timing 2			11 a	18 abc	15 a	56 a	71 b
Ethotron 4SC	32	Harrow-spray-harrow					
Brox 2 EC	12	2 & 4-Leaf					
GoalTender	4	2 & 4-Leaf					
Timing 3			3 ab	13 abc	19 a	65 a	84 ab
Ethotron 4 SC	12	PRE-emergence					
Ethotron 4 SC	8	2-Leaf					
Brox 2 EC	12	2-Leaf					
GoalTender	4	2-Leaf					
Ethotron 4 SC	12	4-Leaf					
Brox 2 EC	12	4-Leaf					
GoalTender	4	4-Leaf					
Timing 3			9 ab	6 c	16 a	69 a	85 ab
Ethotron 4 SC	16	PRE-emergence					
Ethotron 4 SC	16	2-Leaf					
Brox 2 EC	12	2-Leaf					
GoalTender	4	2-Leaf					
Ethotron 4 SC	12	4-Leaf					
Brox 2 EC	12	4-Leaf					
GoalTender	4	4-Leaf					
Timing 3			2 b	10 bc	18 a	70 a	88 a
Ethotron 4 SC	32	PRE-emergence					
Ethotron 4 SC	16	2-Leaf					
Brox 2 EC	12	2-Leaf					
GoalTender	4	2-Leaf					
Ethotron 4 SC	12	4-Leaf					
Brox 2 EC	12	4-Leaf					
GoalTender	4	4-Leaf					
Untreated			--	--	--	--	--
Handweeded			5 ab	13 abc	16 a	66 a	82 ab
LSD ($P = 0.05$)			8	14	12	17	15
Standard Deviation			6	9.6	8.3	12	10.6

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

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