PREVIOUS YEAR MID-SUMMER SOIL INCORPORATION OF DUAL MAGNUM® AND EPTAM® TO CONTROL YELLOW NUTSEDGE IN ONION THE FOLLOWING YEAR

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Introduction

Onions are a valuable crop grown in the Treasure Valley of eastern Oregon and southwestern Idaho. However, onion production sustainability is challenged by the ever-expanding yellow nutsedge in most fields. The negative consequences of yellow nutsedge on onion production are extreme. Studies at the Malheur Experiment Station have shown that onion yield losses are between 23 and 63% in heavily infested fields. Yellow nutsedge is particularly hard to control because it emerges primarily from nutlets (tubers) throughout the growing season. Direct application of herbicides to manage yellow nutsedge in direct-seeded onion has proved to be a relatively ineffective strategy, mainly because of herbicide application timing. Current labels for Dual Magnum® (*S*-metolachlor) and Outlook® (dimethenamid-p) recommend applications only after onions have reached the 2-leaf stage. By the time onions reach the 2-leaf stage, yellow nutsedge has already emerged, and neither herbicide can control emerged weeds, including yellow nutsedge which continues to expand in infested fields. The objective of this study was to evaluate the effectiveness of Dual Magnum and Eptam® to control yellow nutsedge when applied and incorporated in the soil about mid-August of the year preceding onion.

Materials and Methods

A field study was conducted in 2014 and 2015 in a field known to contain yellow nutsedge near the Malheur Experiment Station, Ontario, Oregon to evaluate the response of direct-seeded onion to Dual Magnum and Eptam herbicides applied in mid-August of the preceding year to control yellow nutsedge. For the 2014 study, wheat stubble was flailed on July 29, 2013 and the field was irrigated on August 1. The field was disked twice and deep ripped on August 13 and 14, respectively. Herbicide treatments were applied on August 18 and the field disked twice and rototilled to incorporate the herbicides in the soil. Based on soil tests, fertilizer to supply 40 lbs nitrogen (N)/acre, 100 lbs phosphorus (P)/acre, 65 lbs potassium (K)/acre, 4 lbs zinc (Z)/acre, 1 lb manganese (Mn)/acre, and 1 lb boron (B)/acre was applied on August 22. The field was moldboard plowed on August 23, rototilled on August 26, and left undisturbed. The soil was fumigated using Telone® C-17 at 18 gal/acre (1,3 dichloropropene 81.2% plus chloropicrin 16.5%) and simultaneously bedded on a 22-inch spacing on October 18, 2013.

The beds were harrowed and flattened on March 24, 2014 and onion variety 'Vaquero' was planted on March 25.

The 2015 study was initiated on July 2, 2014 by irrigating and flailing the wheat stubble. The field was disked and ripped on August 11, 2014. Based on soil tests, fertilizer to supply 150 lbs N/acre, 100 lbs P/acre, 60 lbs K/acre, 3 lbs Z/acre, 1 lb Mn/acre, and 1 lb B/acre was applied on August 15. Herbicide treatments were applied on August 18, 2014 and the field disked twice. The field was rototilled on August 19 and plowed on August 20. The soil was fumigated using Telone-C17 at 18 gal/acre (1,3 dichloropropene 81.2% plus chloropicrin 16.5%) and simultaneously bedded on a 22-inch spacing on October 31, 2014.

The beds were harrowed and flattened on March 3, 2015 and onion variety Vaquero planted on March 18, 2015.

The studies were a randomized complete block design with four replications. Individual plots measured 22 ft wide by 50 ft long. Studies for both years had six treatments as presented in Table 2. The soil was a Greenleaf silt loam with a pH of 7.2 and 1.8% organic matter.

In each year, onion seed of the variety Vaquero was planted in double rows spaced 3 inches apart and 4.5-inch seed spacing within each row on the 22-inch beds. Planting was done with customized John Deere Flexi Planter units equipped with disc openers. Immediately after planting, the onion rows received a narrow band of Lorsban® 15G and the soil surface was rolled. The list of major field operations in 2014 and 2015 including planting date, in-season herbicides, fertilizers, and sprays to control thrips is presented in Table 1.

Drip irrigation was used each year and was set on April 23, 2014 and March 17, 2015. Irrigation started on May 9, 2014 and April 13, 2015 and was repeated as needed for the duration of the study. The number of onion plants was determined in May by counting all plant in the two center beds of each plot.

Onions were visually evaluated subjectively for crop injury and yellow nutsedge control on June 6 and July 7, 2014. In 2015, onion injury and yellow nutsedge control were evaluated on May 15 and July 21. Onion injury and yellow nutsedge control assessments were based on a scale of 0 to 100%; where 0% = no weed control or crop injury and 100% = complete weed control or complete crop kill.

Plant tops were flailed and onion bulbs were lifted on September 9, 2014 and September 8, 2015. Bulbs were hand-harvested from the two center rows on September 12 and graded on September 17, 2014 and September 9 and September 14, 2015. Bulbs were graded for quality and yield based on USDA standards. Onion 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). No.1 is comprised of medium, jumbo, colossal, and supercolossal. Marketable yield is composed of medium, jumbo, colossal, and supercolossal grades.

A different batch of onions was harvested on the same dates as above and the bags were placed in storage and graded on December 18, 2014. In 2015 stored onions were graded on December 11. The storage shed was ventilated to maintain air temperature as close to 34°F as possible. Stored onions were graded for quality and yield as described above as well as for internal bulb quality. Stored bulbs were subsequently cut longitudinally and evaluated for the presence of incomplete scales, internal bacterial rot, and internal rot caused by the fungus *Botrytis allii*, the fungi *Fusarium proliferatum* and *Aspergillus niger* (black mold), and bulbs infected with

unidentified bacteria in the external scales. Incomplete scales were characterized as those that had an internally dry length extending inward more than 0.25 inch from the neck. 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 Discussion

Onion plant stand, average plant height, onion injury, yellow nutsedge control, and total number of bulbs harvested in 2014 and 2015 are presented in Table 2. In 2014, early onion plant stand on May 6 ranged from 114,479 to 136,199 plants/acre. The corresponding plant stand on May 7, 2015 ranged from 89,678 to 101,086 plants/acre across herbicide treatments. The plant stand was generally similar across herbicide treatments indicating that onion emergence was not adversely affected by the herbicides.

Average plant height, 27 to 29 inches, was similar across herbicide treatments in 2014, and ranged between 34 and 35 inches/plant in 2015.

Onion injury was less than 18% and restricted only to plants in plots that were treated with Dual Magnum at 4 pt/acre. The injury was characterized by plant stunting.

Yellow nutsdge control in mid-July 2014 ranged between 68 and 96% for treatments that included Dual Magnum or Dual Magnum plus Eptam, while control with Eptam alone was 40%. These results indicated that Dual Magnum applied mid-summer provided superior yellow nutsedge control compared to plots that were fumigated only with Telone C-17 at 18 gal/acre (18%).

Yellow nutsedge control increased from 58% for Dual Magnum at 1.33 pt/acre to 93% for Dual Magnum at 4 pt/acre. Yellow nutsedge control with Dual Magnum at 1.33 pt/acre plus Eptam at 5 pt/acre was 75% compared to 28% for Eptam alone at 7 pt/acre. Yellow nutsedge control with fumigation only was 20%.

In 2014, small onion yield ranged from 25 to 40 cwt/acre for Dual Magnum and Eptam treatments incorporated in the soil in mid-August compared to 55 cwt/acre for fumigation only (Table 3). The yield for medium grade onions was similar across treatments and ranged from 134 to 177 cwt/acre. Yield for jumbo, colossal, and supercolossal onions was variable across herbicide treatments. Marketable onion yield ranged from 514 to 722 cwt/acre among soil-incorporated herbicide treatments compared to 449 cwt/acre for fumigation only. The total yield ranged from 551 to 750 cwt/acre across soil-incorporated herbicide treatments compared to 504 cwt/acre for the fumigation only. The number of bulbs for the different onion grades including marketable and total yield followed similar trends as the yields for different onion grades.

The 2014 onion yield out of storage for the different grades was variable across treatments (Table 4). It is noteworthy that there was no significant difference among treatments for the proportion of spoiled onions that ranged from 6 to 13 cwt/acre. The number of stored bulbs of the different grades including marketable and total yield followed similar trends as the yields for different onion grades.

In 2015, harvested onion yield varied across herbicide treatments (Table 5). Yield for small bulbs ranged from 0 to 7 cwt/acre across herbicide treatments compared to 15 cwt/acre for fumigation only. Similarly, the yield for medium grade bulbs was higher (89 cwt/acre) for fumigation only

compared to 11 to 38 cwt for the mid-August herbicide treatments. Jumbo onion yield was lower for fumigation only compared to herbicide treatments. The yield for colossal was higher with herbicide treatments compared to fumigation only. These results reflected the effects of yellow nutsedge competition on onion size and yield. The increased onion/yellow nutsedge competition reduced yields of onion bulbs over 4 inches and in turn increased yields of small and medium bulbs, which are of reduced economic value to the grower. The number of bulbs at harvest followed the onion yield trend.

Stored bulb yield and number were graded on December 11, 2015 (Table 6). The total marketable yield for stored bulbs was similar across treatments and ranged from 689 to 745 cwt/acre. The number of bulbs followed a similar trend as the yield.

The stored bulbs with incomplete scales in 2015 ranged from 34 to 58% across treatments (Table 7). Incomplete scale was similar for fumigation only and Dual Magnum or Eptam only. The total internal onion rot caused by bacteria and fungus was similar across treatments.

These results indicated improved yellow nutsedge control with Dual Magnum and Eptam applied and incorporated in the soil in mid-August of the year preceding onion.

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Table 1. List of major field operations for Dual Magnum and Eptam applied mid-summer to control yellow nutsedge in onions planted the following year at the Malheur Experiment Station, Ontario, OR, 2014 and 2015.

Operation	**2014**	**2015**
Onion variety 'Vaquero' planted	3/25	3/18
Lorsban 15G at 3.7 oz/1,000 ft of bed (0.82 lb ai/acre)	3/25	3/20
Pendimethalin 0.95 lb ai/acre (Prowl H_2O 32 fl oz/acre)	4/4	3/31
Pendimethalin 0.95 lb ai/acre (Prowl H_2O 32 fl oz/acre) + glyphosate 0.77 lb ae/acre	4/8	3/31
Onion emergence	4/11	4/6
Dimethenamid-p 0.98 lb ai/acre (Outlook 21 fl oz/acre)	5/8	--
Bromoxynil 0.187 lb ai/acre (Buctril 0.75 pt/acre) + oxyfluorfen 0.25 lb ai/acre (GoalTender 8 fl oz/acre)	5/21	5/12
Injected fertilizer to supply 50 lbs N/acre	6/5	--
Bromoxynil 0.125 lb ai/acre (Buctril 0.75 pt/acre) + oxyfluorfen 0.25 lb ai/acre (GoalTender 8 floz/acre) + Poast 16 oz/acre	--	6/1
Injected fertilizer to supply 100 lbs N/acre	--	6/16
Injected fertilizer to supply 50 lbs N/acre	7/3	--
Injected fertilizer to supply 70 lbs N/acre	--	7/8
Thrips control		
Movento 5 oz/acre (spirotetramat 0.078 lb ai/acre) plus Radiant 8 oz/acre (spinetoram 1 oz ai/acre) and Pierce (crop oil concentrate) 16 oz/100 gal of water.	5/29; 6/3	5/26*; 6/3
Agri-Mek 3.5 oz/acre plus NIS 10 oz/100 gal of water	6/12 & 6/17	6/17
Agri-Mek 3.5 oz/acre plus NIS 10 oz/100 gal of water	6/30	--
Lannate at 3 pt/acre (methomyl 0.9 lb ai/acre)	7/6 & 7/13	7/15
Radiant 10 oz/acre (spinetoram 1.25 oz ai/acre)	7/22 &27	--

*Only Movento at 5 oz/acre was used for the first application in 2015.

Table 2. Plant stand, average plant height, onion injury, and yellow nutsedge control in response Dual Magnum and Eptam incorporated in the soil in the mid-summer of the preceding year, Malheur Experiment Station, Ontario, OR, 2014 and 2015.

Mid-summer herbicide	Rate[a]	Plant stand[b]		Average plant[c] height		Onion injury[d]				Yellow nutsedge control[e]				Total number of bulbs[f]	
		2014	2015	2014	2015	2014		2015		2014		2015		2014	2015
	pt/acre	---- plants/acre ----		---- inches ----		---------- % ----------								----- number/acre ----	
Fumigation only		114,479 b	101,086 a	27 a	35 ab	0 b	0 b	0 b	0 b	16 d	18 d	15 c	20 d	121,659 b	93,767 a
Dual Magnum	1.33	136,199 a	95,349 a	28 a	35 ab	0 b	0 b	0 b	0 b	69 b	68 b	70 a	58 c	123,737 ab	95,547 a
Dual Magnum	2	120,176 ab	97,855 a	28 a	34 b	0 b	0 b	0 b	0 b	93 a	96 a	79 a	86 a	127,001 ab	98,811 a
Dual Magnum	4	121,541 ab	97,657 a	27 a	34 b	9 a	18 a	8 a	10 a	97 a	96 a	95 a	93 a	133,529 a	95,250 a
Eptam	7	117,268 ab	89,678 a	29 a	36 a	0 b	0 b	0 b	0 b	29 c	40 c	26 b	28 d	120,473 b	94,063 a
Dual Magnum Eptam	1.33 5	121,125 ab	96,800 a	27 a	35 ab	0 b	1 b	0 b	0 b	85 a	88 ab	89 a	75 b	126,110 ab	93,173 a
LSD (P = 0.05)		19,488.7	NS	NS	2	2	2	3	3	12	21	25	9	11,499	NS

[a]Herbicides were applied and incorporated in the soil on August 18 in both years.
[bc]Plant stand and average plant height were determined on May 6, 2014 and May 7, 2015.
[de]Onion injury and yellow nutsedge control (0-100%) were assessed on June 6 and July 7, 2014 and May 15 and July 21, 2015.
[f]Total number of bulbs harvested on September 11 and graded September 14 in both years.
Means followed by same letter do not significantly differ (P = 0.05, LSD).

Table 3. Onion yield and number of bulbs in response to previous year mid-summer (August 18, 2013) soil-incorporation of Dual Magnum and Eptam, Malheur Experiment Station, Ontario, OR, 2014.

	Mid-summer herbicide	Rate	Onion marketable yield[a] <2¼ Small		2¼-3 in Medium	3-4 in Jumbo	4-4¼ in Colossal	Total	Total yield
		pt/acre	---------- cwt/acre ----------						
1	Fumigation only		54.8	a	151.2 a	293.1 c	5.2 b	449.4 c	504.2 c
2	Dual Magnum	1.33	24.7	b	147.2 a	494.1 ab	9.9 ab	651.1 ab	675.8 ab
3	Dual Magnum	2	33.8	ab	168.7 a	430.7 abc	3.5 b	602.9 abc	636.7 abc
4	Dual Magnum	4	27.2	b	133.6 a	559.8 a	28.9 a	722.2 a	749.4 a
5	Eptam	7	37.0	ab	176.5 a	337.8 bc	0.0 b	514.3 bc	551.3 bc
6	Dual Magnum Eptam	1.33 5	39.6	ab	164.4 a	414.2 abc	7.2 ab	585.8 abc	625.4 abc
LSD (*P* = 0.05)			27.1		NS	194.0	23.2	166.6	144.4

			Number of onion bulbs/acre						
1	Fumigation only		33,234	a	42,432 a	45,400 b	593 ab	88,426 b	121,659 b
2	Dual Magnum	1.33	13,650	b	40,059 a	69,138 ab	890 ab	110,087 ab	123,737 ab
3	Dual Magnum	2	17,210	ab	46,290 a	63,204 ab	297 b	109,790 ab	127,001 ab
4	Dual Magnum	4	14,540	b	36,201 a	80,117 a	2,671 a	118,989 a	133,529 a
5	Eptam	7	19,881	ab	48,367 a	52,225 b	0 b	100,592 ab	120,473 b
6	Dual Magnum Eptam	1.33 5	21,365	ab	43,619 a	60,533 ab	593 ab	104,746 ab	126,110 ab
LSD (*P* = 0.05)			17,417		NS	27,066	2,156	23,562	11,499

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

Table 4. Stored onion yield in response to previous mid-summer (August 18, 2013) soil-incorporated Dual Magnum and Eptam, Malheur Experiment Station, Ontario, OR, 2014.

			Marketable onion yield by grade[a]									
			< 2¼		2¼-3 in		3-4 in	4-4¼ in				
	Mid-summer herbicide	Rate	Small		Medium		Jumbo	Colossal	Total		Rot	Total yield
		pt/acre	---------- cwt/acre ----------									
1	Fumigation only		26.5	a	98.5	a	361.2 b	4.3 a	464.0	c	5.7 a	490.4 c
2	Dual Magnum	1.33	15.1	ab	129.7	a	516.7 ab	22.1 a	668.5	ab	6.3 a	683.5 ab
3	Dual Magnum	2	10.0	b	169.4	a	513.2 ab	7.5 a	690.1	ab	8.1 a	700.1 ab
4	Dual Magnum	4	12.6	ab	100.3	a	594.8 a	7.4 a	702.4	a	12.7 a	715.1 a
5	Eptam	7	16.2	ab	153.4	a	366.5 b	14.6 a	534.5	bc	9.4 a	550.7 bc
6	Dual Magnum	1.33	12.2	ab	126.4	a	534.8 ab	20.4 a	681.6	ab	8.0 a	693.8 ab
	Eptam	5										
LSD (*P* = 0.05)			15.33		NS		188.2	NS	158.9		NS	151.7

			Number of marketable bulbs by grade[a]/acre									
1	Fumigation only		29,080	a	28,486	a	52,225 b	593 a	81,304	b	593 a	110,384 b
2	Dual Magnum	1.33	16,023	ab	33,827	a	75,369 ab	1,780 a	11,0977	a	1,187 a	127,001 ab
3	Dual Magnum	2	11,276	b	36,795	a	72,996 ab	593 a	11,0384	a	1,187 a	121,659 ab
4	Dual Magnum	4	14,243	ab	27,299	a	87,239 a	593 a	115,131	a	2,374 a	129,374 a
5	Eptam	7	18,991	ab	41,542	a	60,533 b	1,187 a	103,262	ab	1,780 a	122,253 ab
6	Dual Magnum	1.33	13,650	ab	34,421	a	75,963 ab	1,780 a	112,164	a	1,187 a	125,814 ab
	Eptam	5										
LSD (*P* = 0.05)			15,975		NS		25,923	NS	22,900		NS	17,630

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

Table 5. Onion yield and the number of bulbs in response to previous year mid-summer soil-incorporated Dual Magnum and Eptam, Malheur Experiment Station, Ontario, OR, 2015.

	Mid-summer herbicide	Rate[a]	Onion marketable yield[b] <2¼ Small	2¼-3 in Medium	3-4 in Jumbo	4-4¼ in Colossal	>4-4¼ in Super colossal	Total	Total yield
		pt/a	cwt/acre						
1	Fumigation only		14.6 a	89.3 a	519.3 b	30.3 d	0.0 a	639.0 c	653.6 c
2	Dual Magnum	1.33	3.2 b	28.9 b	646.6 ab	105.2 bc	4.6 a	785.3 abc	788.5 abc
3	Dual Magnum	2	7.2 ab	27.1 b	675.4 ab	171.5 ab	10.4 a	884.4 ab	891.7 a
4	Dual Magnum	4	0.9 b	10.9 b	686.5 a	189.4 a	12.6 a	899.4 a	900.3 a
5	Eptam	7	2.5 b	38.0 b	647.9 ab	50.8 cd	0.0 a	736.8 bc	739.3 bc
6	Dual Magnum	1.33	0.0 b	16.1 b	650.2 ab	181.4 a	4.4 a	852.0 ab	852.0 ab
	Eptam	5							
LSD (*P* = 0.05)			8.3	33.7	160.2	70.7	NS	155.2	149.6

			Number of onion bulbs/acre						
1	Fumigation only		6,231 a	22,255 a	62,907 a	2,374 d	0 a	87,535 a	93,767 a
2	Dual Magnum	1.33	1,484 bc	7,715 b	77,743 a	8,308 bc	297 a	94,063 a	95,547 a
3	Dual Magnum	2	3,561 ab	6,528 b	74,479 a	13,353 ab	890 a	95,250 a	98,811 a
4	Dual Magnum	4	297 bc	3,264 b	75,666 a	15,133 a	890 a	94,954 a	95,250 a
5	Eptam	7	1,484 bc	9,792 b	78,337 a	4,451 cd	0 a	92,580 a	94,063 a
6	Dual Magnum	1.33	0 c	4,451 b	74,776 a	13,946 a	0 a	93,173 a	93,173 a
	Eptam	5							
LSD (*P* = 0.05)			3,394	7,562	NS	5,506	NS	NS	NS

[a]Herbicides were applied on August 18, 2014 and onion planted on March 18, 2015.
[b]Means within a column and grouping followed by same letter do not significantly differ (*P* = 0.05, LSD).

Table 6. Stored onion yield in response to previous mid-summer soil-incorporated Dual Magnum and Eptam, Malheur Experiment Station, Ontario, OR, 2015.

	Mid-summer herbicide	Rate[a]	Stored onion marketable yield[b] <2¼ Small	2¼-3 in Medium	3-4 in Jumbo	4-4¼ in Colossal	>4-4¼ in Super colossal	Total	Total yield
		pt/a	cwt/acre						
1	Fumigation only		10.4 a	58.5 a	588.1 a	42.1 d	0.0 b	688.8 a	699.2 a
2	Dual Magnum	1.33	4.2 b	40.4 ab	587.1 a	169.5 ab	16.4 a	813.3 a	817.4 a
3	Dual Magnum	2	0.9 b	27.9 b	652.6 a	128.8 bc	9.4 ab	818.6 a	819.5 a
4	Dual Magnum	4	2.7 b	17.9 b	646.3 a	230.5 a	0.0 b	894.7 a	897.4 a
5	Eptam	7	0.7 b	24.9 b	663.1 a	57.0 cd	0.0 b	745.0 a	745.7 a
6	Dual Magnum Eptam	1.33 5	0.4 b	22.2 b	577.3 a	97.7 bcd	0.0 b	697.2 a	697.6 a
LSD (*P* = 0.05)			6.0	30.0	NS	85.6	15.9	NS	NS

			Number of onion bulbs/acre						
1	None								
2	Dual Magnum	1.33	8308 a	14,837 a	75,369 a	3,561 c	0 b	93,767 a	102,075 a
3	Dual Magnum	2	4,154 ab	10,682 ab	74,183 a	14,243 ab	1,187 a	100,295 a	104,449 a
4	Dual Magnum	4	593 b	7,122 ab	78,337 a	9,495 bc	593 ab	95,547 a	96,141 a
5	Eptam	7	1,780 b	5,341 b	73,589 a	19,584 a	0 b	98,514 a	100,295 a
6	Dual Magnum	1.33	593 b	5,935 b	82,491 a	5,341 c	0 b	93,767 a	94,360 a
	Eptam	5	593 b	5,935 b	65,281 a	8,308 bc	0 b	79,524 a	80,117 a
LSD (*P* = 0.05)			5,000	8,025	31,467	7,233	1,050	NS	NS

[a]Herbicides were applied on August 18, 2014 and onion planted on March 18, 2015.
[b]Means within a column and grouping followed by same letter do not significantly differ (*P* = 0.05, LSD).

Table 7. Incomplete scale and internal bulb decomposition for onions graded from storage in December, from the study to evaluate previous year mid-summer soil-incorporated Dual Magnum and Eptam, Malheur Experiment Station, Ontario, OR, 2015.

	Mid-summer herbicide	Rate[a]	Stored onion[bc]				
			Incomplete scale	Incomplete scale + int. bacterial rot	Incomplete scale + fusarium rot	Incomplete scale + neck rot	Total internal rot
		pt/acre	---------- percentage ----------				
1	Fumigation only		34 b	5 a	11 a	0 a	16 a
2	Dual Magnum	1.33	43 ab	6 a	8 a	1 a	15 a
3	Dual Magnum	2	39 ab	7 a	7 a	1 a	14 a
4	Dual Magnum	4	44 ab	5 a	7 a	2 a	13 a
5	Eptam	7	48 ab	5 a	6 a	0 a	10 a
6	Dual Magnum	1.33	58 a	4 a	15 a	1 a	20 a
	Eptam	5					
LSD (*P* = 0.05)			19	NS	NS	NS	NS

[a]Herbicides were applied on August 18, 2014 and onion planted on March 18, 2015.
[b]Means within a column and grouping followed by same letter do not significantly differ (*P* = 0.05, LSD).
[c]Onions were harvested on September 14, stored, and graded on December 11, 2015.