ONION RESPONSE TO MID-SUMMER SOIL INCORPORATION OF DUAL MAGNUM® AND EPTAM® TO CONTROL YELLOW NUTSEDGE IN DIRECT-SEEDED ONION

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Introduction

Yellow nutsedge (YNS) continues to be a problem weed in the Treasure Valley of eastern Oregon and southwestern Idaho. The negative consequences of YNS on onion production are extreme. Studies at the Malheur Experiment Station show that onion yield losses are between 23 and 63% in heavily infected fields. Yellow nutsedge is particularly hard to control as it emerges primarily from nutlets (tubers) throughout the growing season. Direct application of herbicides to manage YNS in direct-seeded onion has proved to be a relatively ineffective strategy, mainly because of the herbicide application timing. Current labels for Dual Magnum® (*S*-metolachlor) and Outlook® (dimethenamid-p) recommend applications only when onions have reached the 2-leaf stage. By the time onions reach the 2-leaf stage, YNS has already emerged, and the two herbicides lack the ability to control emerged weeds including YNS. Consequently, YNS continues to expand in infested fields. The objective of this study was to evaluate Dual Magnum applied and incorporated in the soil about mid-August of the year preceding onion.

Materials and Methods

A field study was conducted in 2014 near the Malheur Experiment Station, Ontario, Oregon in a neighboring field to evaluate the response of direct-seeded onion to Dual Magnum and Eptam® herbicides applied on August 18, 2013 to control YNS. The wheat stubble was flailed on July 29 and the field was irrigated on August 1, 2013. The field was disked twice and deep ripped on August 13 and 14, 2013, respectively. The study followed a randomized complete block design with four replications. Individual plots measured 22 ft wide by 50 ft length. The study had six treatments as presented in Table 1. On August 12, 2013, five core soil samples each measuring 4.25 inches in diameter and 12 inches deep were taken randomly from each plot to quantify YNS tubers at the beginning of the study. Core samples were taken again on March 26, 2014 following the same procedure. The soil was processed to recover YNS tubers using the washing and sieving procedure. Tubers from each plot were placed in a ziplock plastic bag and stored in the dark at 40°F until they were counted and weighed.

Herbicide treatments were sprayed on August 18, 2013 and the area was disked twice to incorporate the herbicides in the soil. The field was then groundhogged once to create a smooth

seedbed. Based on a soil test, the study area was fertilized on August 22, 2013 with 40 lb nitrogen (N)/acre, 100 lb phosphorus (P)/acre, 65 lb potassium (K)/acre, 4 lb zinc (Z)/acre, 1 lb manganese (Mn)/acre, and 1 lb boron (B)/acre. The field was moldboard plowed on August 23, 2013 and disked twice and left undisturbed. The field was fumigated on October 18, 2013 with Telone® C-17 at 18 gal/acre (1,3 dichloropropene 81.2% plus chloropicrin 16.5%) and simultaneously bedded on a 22-inch spacing. The soil was a Greenleaf silt loam with a pH 7.2 and 1.8% organic matter.

The beds were harrowed and flattened on March 24 and 25, 2014. Onion seed of the variety 'Vaquero' was planted on March 25 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 at 3.7 oz/1,000 ft of beds (0.82 lb ai/acre), and the soil surface was rolled.

On April 4, 2014 the entire study area was sprayed with glyphosate at 0.77 lb ae/acre (Roundup PowerMax® at 22 fl oz/acre) plus pendimethalin at 0.95 lb ai/acre (Prowl® H_2O at 32 fl oz/acre) to control all emerged weeds prior to onion emergence. Onion emergence started on April 8. A drip irrigation system was set on April 23, 2014 and irrigation started on May 9 and repeated every 3-4 days for the duration of the study. The number of onion plants was determined on May 6 by counting all plants in the two center beds of each plot.

On May 8, dimethenamid-p at 0.95 lb ai/acre (Outlook® at 21 fl oz/acre) was sprayed on the entire study area. On May 21, 2014, oxyfluorfen at 0.25 lb ai/acre (GoalTender® at 8 oz/acre) plus bromoxynil at 0.125 lb ai/acre (Buctril® at 8 oz/acre) plus sethoxydim at 0.28 lb ai/acre (Poast® at 1.5 pt/acre) were broadcast to control grassy and broadleaf weeds. All other activities followed the standard local onion production practices. Onion plants were fertilized with 50 lbs N/acre applied through the drip on June 5 and July 3, 2014 on each occurrence.

To control thrips, onions were sprayed with Movento® at 0.50 oz/acre (spirotetramat at 0.078 lb ai/acre) tank mixed with Radiant® at 8 oz/acre (spinetoram at 1 oz ai/acre) and Pierce (crop oil concentrate) at 16 oz/100 gal of water on May 29 and again on June 3, 2014. Onion plants were sprayed again on June 17 using Agri-Mek® at 3.5 oz/acre plus non-ionic surfactant (NIS) at 10 oz/100 gal of water to control thrips. Later sprays to control thrips were conducted aerially as follows: Agri-Mek at 3.5 oz/acre plus NIS at 10 oz/100 gal of water on June 30, Lannate® at 3 pt/acre (methomyl at 0.9 lb ai/acre) on July 6 and 13, Radiant at 10 oz/acre (spinetoram at 1.25 oz ai/acre) on July 22 and 27, 2014.

Onions were visually evaluated for crop injury on June 5 and July 7, 2014. Yellow nutsedge control was evaluated subjectively on June 5 and July 7, 2014. Onion injury and YNS control assessments were based on 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 4 and 9, 2014, respectively. Bulbs were hand-harvested from the two center rows on September 12 and graded on September 17, 2014. 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). U.S. No.1 and marketable yield are comprised of medium, jumbo, colossal and supercolossal.

Another batch of onions was harvested on the same day as above and the bags were placed in storage on September 10, 2014. The storage shed was ventilated to maintain air temperature as close to 34°F as possible. Stored onions were graded on December 18, 2014 following the procedure described above. Data were subjected to analysis of variance and the treatment means were compared using protected LSD at 0.05% level of confidence.

Results and Discussion

Onion plant stand on May 6 ranged from 114,479 to 136,199 plants/acre (Table 1). Evaluation indicated 0 to 9% onion injury on June 5 and 0 to 18% on July 7. The injury was restricted to the high rate of Dual Magnum (4 pt/acre) and was characterized by onion stunting. Yellow nutsedge control on June 5 ranged from 29 to 97% for the Dual Magnum and Eptam treated treatments compared to 16% for fumigation only. Yellow nutsedge control on July 7 for the mid-summer plow-down herbicide treatments ranged from 40 to 96% compared to 18% for the treatment without summer plow-down herbicides.

Small onion yield ranged from 25 to 40 cwt/acre for soil-incorporated herbicides treatments compared to 55 cwt/acre for fumigation only (Table 2). The yield for medium grade onions was similar across treatments ranging from 134 to 177 cwt/acre. Yield for jumbo, colossal, and supercolossal onion grades 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 no plow down herbicide. The total yield ranged from 551 to 750 cwt/acre across soil-incorporated herbicide treatments compared to 504 cwt/acre for the treatment without summer plow-down herbicides. The number of bulbs for the different onion grades including marketable and total yield followed similar trends as the yields for different onion grades.

Onion yield out of storage for the different grades was variable (Table 3). However, there was no significant difference among herbicide treatments for the proportion of rotten onion yield that ranged from 6 to 13 cwt/acre. The number of bulbs for the different grades including marketable and total yield followed similar trends as the yields for different onion grades.

These results indicate improved YNS control for Dual Magnum and Eptam applied and incorporated in the soil in mid-August of the year preceding onion.

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Table 1. Plant stand on May 6, onion injury, and yellow nutsedge control on June 5 and July 7, 2014 in response to soil incorporation of Dual Magnum and Eptam on August 18, 2013, Malheur Experiment Station, Ontario, OR.

					Onion injury[b]		Control[b] Yellow nutsedge	
	Mid-summer herbicide	Rate	Timing[a]	Plant stand	June 5	July 7	June 5	July 7
		pt/acre		plants/acre	---------- % ----------			
1	None			114,479 b	0 b	0 b	16 d	18 d
2	Dual Magnum	1.33	A	136,199 a	0 b	0 b	69 b	68 b
3	Dual Magnum	2	A	120,176 ab	0 b	0 b	93 a	96 a
4	Dual Magnum	4	A	121,541 ab	9 a	18 a	97 a	96 a
5	Eptam	7	A	117,268 ab	0 b	0 b	29 c	40 c
6	Dual Magnum	1.33	A	121,125 ab	0 b	1 b	85 a	88 ab
	Eptam	5	A					
LSD (*P* = 0.05)				19,489	2	35	12	21

[a] Herbicides were applied and incorporated in the soil on August 18, 2013.
[b] Means followed by same letter do not significantly differ (*P* = 0.05, LSD).

Table 2. Onion yield and the number of bulbs in 2014 in response to August 18, 2013 soil incorporation of Dual Magnum and Eptam, Malheur Experiment Station, Ontario, OR.

	Mid-summer herbicide	Rate	Timing[b]	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	None			54.8 a	151.2 a	293.1 c	5.2 b	449.4 c	504.2 c
2	Dual Magnum	1.33	A	24.7 b	147.2 a	494.1 ab	9.9 ab	651.1 ab	675.8 ab
3	Dual Magnum	2	A	33.8 ab	168.7 a	430.7 abc	3.5 b	602.9 abc	636.7 abc
4	Dual Magnum	4	A	27.2 b	133.6 a	559.8 a	28.9 a	722.2 a	749.4 a
5	Eptam	7	A	37.0 ab	176.5 a	337.8 bc	0.0 b	514.3 bc	551.3 bc
6	Dual Magnum	1.33	A	39.6 ab	164.4 a	414.2 abc	7.2 ab	585.8 abc	625.4 abc
	Eptam	5	A						
LSD (*P* = 0.05)				27.1	NS	194.0	23.2	166.6	144.4

				Number of onion bulbs					
				number/acre					
1	None			33,234 a	42,432 a	45,400 b	593 ab	8,8426 b	121,659 b
2	Dual Magnum	1.33	A	13,650 b	40,059 a	69,138 ab	890 ab	110,087 ab	123,737 ab
3	Dual Magnum	2	A	17,210 ab	46,290 a	63,204 ab	297 b	109,790 ab	127,001 ab
4	Dual Magnum	4	A	14,540 b	36,201 a	80,117 a	2,671 a	118,989 a	133,529 a
5	Eptam	7	A	19,881 ab	48,367 a	52,225 b	0 b	100,592 ab	120,473 b
6	Dual Magnum	1.33	A	21,365 ab	43,619 a	60,533 ab	593 ab	104,746 ab	126,110 ab
	Eptam	5	A						
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).
[b] Herbicides were applied on August 18, 2013.

Table 3. Stored onion yield in 2014 in response to August 18, 2013 incorporation of Dual Magnum and Eptam, Malheur Experiment Station, Ontario, OR, 2014.

					Marketable onion yield by grade[a]					
			Timing[b]	<2¼ in	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	None			26.5 a	98.5 a	361.2 b	4.3 a	464.0c	5.7 a	490.4 c
2	Dual Magnum	1.33	A	15.1 ab	129.7 a	516.7 ab	22.1 a	668.5ab	6.3 a	683.5 ab
3	Dual Magnum	2	A	10.0 b	169.4 a	513.2 ab	7.5 a	690.1ab	8.1 a	700.1 ab
4	Dual Magnum	4	A	12.6 ab	100.3 a	594.8 a	7.4 a	702.4a	12.7 a	715.1 a
5	Eptam	7	A	16.2 ab	153.4 a	366.5 b	14.6 a	534.5bc	9.4 a	550.7 bc
6	Dual Magnum	1.33	A	12.2 ab	126.4 a	534.8 ab	20.4 a	681.6ab	8.0 a	693.8 ab
	Eptam	5	A							
LSD (*P* = 0.05)				15.33	NS	188.2	NS	158.9	NS	151.7

				Number of marketable bulbs by grade[a]						
				---------- number/acre ----------						
1	None			29,080 a	28,486 a	52,225 b	593 a	81,304 b	593 a	110,384 b
2	Dual Magnum	1.33	A	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	A	11,276 b	36,795 a	72,996 ab	593 a	11,0384 a	1,187 a	121,659 ab
4	Dual Magnum	4	A	14,243 ab	27,299 a	87,239 a	593 a	115,131 a	2,374 a	129,374 a
5	Eptam	7	A	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	A	13,650 ab	34,421 a	75,963 ab	1,780 a	112,164 a	1,187 a	125,814 ab
	Eptam	5	A							
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).
[b] Herbicides were applied on August 18, 2013.