EVALUATION OF DUAL MAGNUM® AND OUTLOOK® USED PRE-EMERGENCE ON DIRECT-SEEDED DRY BULB ONIONS WITH ACTIVATED CHARCOAL

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Introduction

Yellow nutsedge has become an ever-growing threat to direct-seeded onions throughout the Treasure Valley of eastern Oregon and southwestern Idaho. A previous study indicated the effectiveness of activated charcoal to neutralize Dual Magnum® (*s*-metolachlor) and Outlook® (dimethenamid-p) in the onion row when applied pre-emergence (PRE) on direct-seeded onions (Felix and Ishida 2009). Dual Magnum and Outlook control yellow nutsedge best when applied prior to weed emergence. The objective of this study was to evaluate the potential use of activated charcoal to neutralize Dual Magnum and Outlook immediately within the onion row when applied PRE with and without simulated rain after herbicide application. **Dual Magnum and Outlook herbicides are not currently registered for pre-emergence application on direct-seeded dry bulb onions. Always read herbicide labels to ensure that the product is registered for the intended use.**

Materials and Methods

A field study was conducted in 2010 at the Malheur Experiment Station, Ontario, Oregon to evaluate the potential use of activated charcoal to neutralize Dual Magnum and Outlook within the onion row to protect emerging plants from the herbicide effects. The study also evaluated the effect of simulated rain (0.5 inches) shortly after herbicide application but before onion emergence. The beds formed during fall 2009 were harrowed and planted to onion variety 'Vaquero' on April 1, 2010. The study followed a split-plot design with simulated rain (with and without) forming the main blocks into which herbicide rates were imposed as subplots. The study had 4 replications and the plot size was 4 rows of 22-inch-wide beds by 22 ft long. Lorsban® 15G (chlorpyrifos at 0.125 lb ai/acre) was banded at 3.7 oz/1,000 ft of row over the entire field immediately after planting as a preventive measure against onion maggots. Activated charcoal was applied at the time of planting and herbicide treatments were applied on April 2, 2010.

The activated charcoal brand used was GRO-SAFE® (Norit Americas Inc., Atlanta, GA). Activated charcoal was applied using a modified planter fitted with a 25-gal Rear's NIFTY Tank Series (Rear's Manufacturing Co., Eugene, OR) and set to apply a 1-inch band of activated charcoal slurry directly over the onion row. Activated charcoal was applied at a rate of 25 lb/acre in 50 gal of water on the ground directly behind the onion planter's press wheel. Dual Magnum

was applied PRE at the rates of 1.00 pt/acre or 1.33 pt/acre (0.95 lb ai/acre or 1.27 lb ai/acre) and Outlook at 10.5 fl oz/acre PRE followed by 10.5 fl oz/acre (0.49 lb ai/acre) or 21 fl oz/acre (0.98 lb ai/acre) when onions were at the 2-leaf stage. The study also included a grower standard, which was treated with Prowl® H_2O at 2 pt/acre (pendimethalin at 1 lb ai/acre) before onion emergence, followed by Buctril® and Goal® 2XL herbicides at 0.5 pt/acre (bromoxynil and oxyfluorfen at 0.125 lb ai/acre). An untreated control treatment was also included.

Half of the main plots received a sprinkler irrigation on April 7, 2010 simulating 0.5 inches of rainfall in 1 hour. The entire trial was sprayed with Roundup® at 1 qt/acre (1.13 ae/acre) on April 13 to control volunteer wheat. The study area was furrow irrigated on April 26. Plants were sprayed with Lorsban® 4E at the rate of 1 qt/acre (chlorpyrifos at 1 lb ai/acre) on May 6 to control onion maggots. The study area was furrow irrigated on May 19 to incorporate the insecticide in the soil.

Plant stand evaluations were accomplished by counting plants in 15 ft of the center 2 rows of the plot on May 4 and June 9. The entire study area was sprayed with a tankmix of Buctril® at 16 oz/acre plus Goal® 2XL at 8 oz/acre plus Poast® at 1.5 pt/acre (bromoxynil at 0.25 lb ai/acre plus oxyfluorfen at 0.25 lb ai/acre and sethoxydim at 0.287 lb ai/acre) on May 25 to control emerged weeds. Plants were fertilized on June 8 to supply 250 lb/acre of nitrogen, 180 lb/acre of phosphorus, 90 lb/acre of potassium, 5 lb/acre of zinc, 4 lb/acre of manganese, and 1 lb/acre of boron.

Plants were sprayed with Movento® at 4 fl oz/acre plus Ad-wet® non-ionic surfactant at 1 qt/acre (spirotetramat at 1.25 oz ai/acre plus Ad-wet at 1.25% V/V) on June 23 to control onion thrips. Subsequent spray for thrips control on June 30 used Success® at 8 oz/acre plus Aza-Direct® at 16 oz/acre plus Ad-wet non-ionic surfactant at 1 qt/acre (spinosad at 0.125 lb ai/acre + azadirachtin at 0.0123 lb ai/acre + Ad-wet at 1.25% V/V). The trial was sprayed for thrips control again on July 15 and 27 using Lannate® at 3 pt/acre (methomyl at 0.9 lb ai/acre).

The beds were corrugated and the study irrigated on June 25. Otherwise irrigation was scheduled to maintain proper moisture levels in the top 12 inches of soil profile.

Onions were lifted on September 14 and hand harvested from 22 ft of the 2 center rows on September 17. The onions were graded on September 21. During grading, bulbs were separated according to quality: bulbs without blemishes (No. 1), split bulbs (No. 2), neck rot (bulbs infected with the fungus *Botrytis allii* in the neck or side), plate rot (bulbs infected with the fungus *Fusarium oxysporum*), and black mold (bulbs infected with the fungus *Aspergillus niger*). The No. 1 bulbs were graded according to diameter: small (<2.25 inches), medium (2.25-3 inches), jumbo (3-4 inches), colossal (4-4.25 inches), and supercolossal (>4.25 inches). The data collected were subjected to analysis of variance and means compared using LSD at $P = 0.05$.

Results and Discussion

The onion plants suffered a high incidence of onion maggot, which possibly contributed to the observed differences in plant stand among treatments. The analysis of variance indicated differences in plant stand for treatments with and without charcoal and irrigation (Table 1). Evaluations on May 4 indicated reduced plant stand in irrigated plots that were not sprayed with

charcoal. The plant stand was similar for plots treated with activated charcoal with or without irrigation. Plant count on June 9 indicated higher plant population density in treatments that received charcoal but no irrigation.

There also was a combined effect of herbicide and irrigation for onion plant stand (Table 2). Onion stand on May 4 ranged from 50,598 to 92,681 plants/acre across treatments. Onion stand was reduced when Dual Magnum was applied at 1 pt/acre and Outlook at 10.5 fl oz/acre followed by irrigation. Plant count on June 9 was greatly variable, likely due to onion maggot infestation experienced at the test site.

There were differences in onion yield attributed to the use of activated charcoal (Table 3). The marketable onion yield was 384 cwt/acre compared to 341 cwt/acre in plots treated with and without activated charcoal, respectively. Onion yield was also influenced by the combined effects of charcoal and irrigation (Table 4). The marketable onion yield was similar for plots treated with charcoal with and without irrigation. However, the yield was not significantly different from plots that were not treated with activated charcoal or irrigated. Again, the effect of onion maggot on plant stand may have contributed to the variability in onion plant stand, which in turn affected the final yield.

Onion yield was also affected by a combination of herbicide treatments and irrigation (Table 5). The onion marketable yield was generally low when herbicide treatments were followed by irrigation. The lowest yield was recorded in plots treated with Outlook at 21 fl oz/acre and irrigated. The highest yield was recorded in plots treated with Dual Magnum at 1 or 1.33 pt/acre and not irrigated. However, onion yields for Dual Magnum- treated plots were similar to the grower standard. These results lead us to believe that under ideal conditions the application of Dual Magnum and Outlook may not pose significant risk to the crop. However, in case of extreme conditions such as a rain incident after application of herbicides, there may be potential harm to direct-seeded onions when both herbicides are applied prior to onion emergence.

Yellow nutsedge control with Dual Magnum was not significantly different from the grower standard, mainly due to uneven distribution across the field. Outlook provided significantly less control at all treatment levels. The results may also have been influenced by the weather in 2010, which was cooler than normal. The study will be repeated in 2011 to further evaluate the treatments and refine the methodology for activated charcoal application. We are still convinced that yellow nutsedge control will be significantly better when Dual Magnum and/or Outlook herbicides are applied prior to nutsedge emergence.

References

Felix, J., and J. Ishida. 2009. Use of activated charcoal to detoxify Dual Magnum® and Outlook® applied pre-emergence on direct-seeded onions. Oregon State University Malheur Experiment Station Annual Report 2010:115-118.

Table 1. Onion plant population (plants/acre) in response to pre-emergence application of Dual Magnum and Outlook herbicides with and without activated charcoal and irrigation at Malheur Experiment Station, Ontario, OR 2010.

	Plant stand	
	May 4	Jun 9
Treatment[a]	---------- plants/acre ----------	
Charcoal, with irrigation	83,109 b[b]	75,551 b
Charcoal, without irrigation	88,225 b	82,482 a
No charcoal, with irrigation	66,408 c	51,456 c
No charcoal, no irrigation	89,314 a	81,855 a

[a] Charcoal was applied at 25 lb/acre in 50 gal of water. Irrigation was applied to supply an equivalent of 0.5 inch of rain immediately after planting and application of herbicides.
[b] Means within a column followed by the same letter are not significantly different (LSD, $P \leq 0.05$)

Table 2. Onion plant population (plants/acre) in response to pre-emergence application of Dual Magnum and Outlook herbicides with and without irrigation at Malheur Experiment Station, Ontario, OR 2010.

				Plant stand[b]	
				5/4/10	6/9/10
Treatment	Active rate	Product rate	Irrigation	Plants/acre	
Grower standard[a]			--	92,681 a	96,444 a
Dual Magnum	0.95 lb ai/a	1.00 pt/a	Yes	73,035 b	57,727 e
Dual Magnum	0.95 lb ai/a	1.00 pt/a	No	93671 a	87,334 a
Dual Magnum	1.27 lb ai/a	1.33 pt/a	Yes	79,610 ab	62,480 cde
Dual Magnum	1.27 lb ai/a	1.33 fl oz/a	No	88,621 a	82,680 ab
Outlook	0.49 lb ai/a	10.50 fl oz/a	Yes	72,877 b	60,599 de
Outlook	0.49 lb ai/a	10.50 fl oz/a	No	88,819 a	83,274 ab
Outlook	0.98 lb ai/a	21.00 fl oz/a	Yes	50,598 c	36,142 f
Outlook	0.98 lb ai/a	21.00 fl oz/a	No	87,532 ab	79,908 abc
Untreated			Yes	79,710 ab	67,629 bcd
Untreated			No	81,294 ab	63,372 cde

[a] Grower standard treatment received pre-emergence Prowl H_2O at 2 pt/acre (0.95 lb ai/acre) followed by Goal Tender at 0.25 pt/acre (0.125 la ai/acre) when onions were at the 2-leaf stage. Dual Magnum was also applied to grower standard when onions were at the 2-leaf stage.
[b] Means within a column followed by the same letter are not significantly different (LSD, $P \leq 0.05$).

Table 3. Dry bulb onion yield in response to activated charcoal application at Malheur Experiment Station, Ontario, OR, 2010.

Treatment	Charcoal rate	Onion yield[a]					
		Small	Medium	Jumbo	Colossal	Super-colossal	Marketable yield
		cwt/acre					
Charcoal	25 lb/a	21 a	106 a	275 a	3 a	0	384 a
No charcoal	-- --	16 b	84 b	250 a	7 a	0	341 b

[a] Means within a column followed by the same letter are not significantly different (LSD, $P \leq 0.05$).

Table 4. Dry bulb onion yield in response to the application of activated charcoal and irrigation (0.5 inch) at Malheur Experiment Station, Ontario, OR, 2010.

Treatment	Charcoal rate	Onion yield[a]					
		Small	Medium	Jumbo	Colossal	Super-colossal	Marketable yield
		cwt/acre					
Charcoal, with irrigation	25 lb/a	19.1 a	99.5 a	254.8 a	2.5 a	0	356.8 a
Charcoal, no irrigation	25 lb/a	23.6 a	112.8 a	294.6 a	3.6 a	0	411.0 a
No charcoal, with irrigation	-- --	14.7 a	68.4 b	185.1 b	9.6 a	0	263.4 b
No charcoal, no irrigation	-- --	18.2 a	98.7 b	314.0 a	4.9 a	0	417.8 a

[a] Means within a column followed by the same letter are not significantly different (LSD, $P \leq 0.05$)

Table 5. Dry bulb onion yield in response to pre-emergence application of Dual Magnum and Outlook with or without irrigation (0.5 inch) at Malheur Experiment Station, Ontario, OR, 2010.

Treatment	Rate	Irrigation	Onion yield[a]					
			Small	Medium	Jumbo	Colossal	Super-colossal	Marketable yield
			cwt/acre					
Grower standard[b]		--	21 a	162.3 a	301.7 bcd	0.0 a	0.0 a	464.0 a
Dual Magnum	1.0 pt/a	Yes	18 a	82.6 a	249.9 cd	17.0 a	1.2 a	350.6 bc
Dual Magnum	1.0 pt/a	No	17 a	103.6 a	412.1 a	7.4 a	0.8 a	523.8 a
Dual Magnum	1.33 pt/a	Yes	9 a	49.6 a	259.7 cd	10.3 a	0.0 a	350.6 bc
Dual Magnum	1.33 pt/a	No	17 a	75.5 a	367.1 ab	6.3 a	0.0 a	449.0 a
Outlook	10.5 fl oz/a	Yes	15 a	69.0 a	235.2 de	6.5 a	0.0 a	310.7 c
Outlook	10.5 fl oz/a	No	14 a	98.0 a	344.9 ab	5.5 a	0.0 a	448.5 a
Outlook	21.0 fl oz/a	Yes	9 a	43.3 a	153.4 ef	2.3 a	0.0 a	198.9 e
Outlook	21.0 fl oz/a	No	15 a	93.3 a	319.5 bc	6.4 a	0.0 a	419.2 b
Untreated		Yes	30 a	97.0 a	119.8 f	0.0 a	0.0 a	216.8 de
Untreated		No	42 a	101.8 a	80.2 f	0.0 a	0.0 a	182.1 e

[a]Means with a column followed by the same letter are not significantly different (LSD, $P \leq 0.05$).
[b]Grower standard was treated with Prowl H_2O at 2 pt/acre pre-emergence followed by Goal Tender at 0.25 pt/a when onions were at the 2-leaf stage. Dual Magnum was also applied to grower standard when onions were at the 2-leaf stage.

Table 6. Yellow nutsedge control with Dual Magnum and Outlook applied prior to onion emergence using activated carbon at Malheur Experiment Station, Ontario, OR, 2010.

Treatment	Rate	Yellow nutsedge control (%)
Grower standard[a]		84.8 a[b]
Dual Magnum	1.33 pt/a	92.2 ab
Dual Magnum	1.00 pt/a	89 ab
Outlook	21.00 fl oz/a	83.9 bc
Outlook	10.50 fl oz/a	78.1 c
Untreated		0 d

[a] The grower standard was treated with Prowl® H_2O at 2 pt/acre (pendimethalin at 1 lb ai/acre) before onion emergence, followed by Buctril® and Goal® 2XL herbicides at 0.5pt/acre (bromoxynil and oxyfluorfen at 0.125 lb ai/acre).
[b] Means within a column followed by the same letter are not significantly different (LSD, $P \leq 0.05$)