

ONION RESPONSE TO CHATEAU[®] AND FIERCE[®] HERBICIDES APPLIED LATE PRE-EMERGENCE ON MINERAL SOIL

Joel Felix and Joey Ishida, Malheur Experiment Station, Oregon State University, Ontario, OR, 2017

Introduction

Weed control in marketable onions is essential in order to minimize yield losses from weed competition and realize acceptable bulb size. Weed control in onions is difficult compared to many crops because of the lack of a complete crop canopy and limited herbicide options. The herbicide Chateau[®] (flumioxazin) is also marketed as Valor[®] by Valent Corporation to manage weeds in various specialty crops. Initially it was evaluated for suitability as a postemergence weed control in direct-seeded onions, but injury proved to be too high for the company to proceed with registration in the Treasure Valley. Currently there are labels for Chateau use to control weeds in onions in Michigan and New York. This trial was initiated to evaluate the potential use of Chateau as a late pre-emergence-applied product similar to the timing of Prowl[®] H₂O in onions grown in the Treasure Valley of eastern Oregon and southwestern Idaho.

Materials and Methods

A field study was conducted at the Malheur Experiment Station, Ontario, Oregon in 2017 to evaluate the response of onion variety ‘Vaquero’ to Chateau (flumioxazin) and Fierce[®] (premix of Chateau plus Zidua[®] (pyroxasulfone)), when applied late pre-emergence at reduced rates. Onion seeds of variety Vaquero were planted on April 7, 2017 in double rows spaced 3 inches apart with 4-inch seed spacing within each row. Each double row was planted on beds spaced 22 inches apart. Immediately after planting, onion rows received a 7-inch band of Lorsban[®] at 3.7 oz/1000 ft of row (chlorpyrifos at 0.206 lb ai/acre) and the soil surface was rolled. The soil was an Owyhee silt loam with a pH 7.2 and 1.83% organic matter.

The study had a randomized complete block design with three replicates. Individual plots were 7.33 ft wide (4 beds) by 27 ft long. Plots for respective treatments (except untreated check plots) were treated with pendimethalin (Prowl H₂O) at 2.0 pt/acre (0.95 lb ai/acre) or Chateau or Fierce late pre-emergence on April 19 (Table 1). Postemergence application of Buctril[®] at 12 fl oz/acre (bromoxynil at 0.188 lb ai/acre) plus GoalTender[®] at 4 fl oz/acre (oxyfluorfen at 0.125 lb/ ai acre) was made when onion seedlings were at the 2-leaf stage on May 23 and at the 4- to 6-leaf stages on June 5. The study plots were sprayed with Poast[®] herbicide at 1.5 pt/acre (sethoxydim at 0.287 lb ai/acre) on June 4 to control grassy weeds.

The plants were fertilized on May 4 (30 lb nitrogen (N)/acre), June 16 (50 lb N/acre), July 3 and 14 (50 lb N/acre each date). On June 23, all weeds within the two center rows were counted and plots hand weeded. All other operations including insect control followed recommended local production practices.

Plant tops were flailed and onion bulbs were lifted on September 6 and 7, respectively. Bulbs were hand-harvested from the two center beds on September 13 and graded on September 25. Bulbs were graded for yield and quality based on USDA standards as follows: bulbs without blemishes (U.S. No. 1), split bulbs (U.S. 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 >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 May 3, 2017. Generally, the plant population was low during the 2017 cropping season, possibly due to uncharacteristically high moisture from winter snow and spring precipitation. Evaluations on May 23 (34 days after application of late pre-emergence treatments) indicated plant injury ranging from 10 to 15% for plants growing in plots treated with Chateau or Fierce (Table 1). Common lambsquarters control ranged from 90 to 98% for Chateau and Fierce treatments compared to 94 to 97% for plots treated with Prowl H₂O. A similar trend was observed for redroot pigweed, kochia, hairy nightshade, and barnyardgrass.

Evaluations on May 30 (41 days after late pre-emergence and 7 days after postemergence treatments) indicated onion injury in plots treated with Chateau and Fierce ranging from 5 to 10% compared to 0% for those treated with Prowl H₂O (Table 2). Control for common lambsquarters, redroot pigweed, kochia, and hairy nightshade was still high, ranging from 80 to 79% compared to 100% for plots treated with Prowl H₂O. However, weed control in plots treated with Prowl H₂O late pre-emergence followed by Chateau at 0.5 oz/acre when onions were at the 2- and 4-leaf stage was ≤23% for common lambsquarters, redroot pigweed, kochia, and hairy nightshade. These results suggested that Chateau would not be a good choice as a standalone product to control weeds postemergence.

Average number of weeds in the two center rows on June 20 (31 days after late pre-emergence and 7 days after postemergence treatments) is presented in Table 3. Common lambsquarters control ranged from 2 to 14 plants for plots treated with Chateau or Fierce late pre-emergence compared to 18 plants for Chateau applied postemergence and 1 to 5 plants for plots treated with Prowl H₂O. Generally, plots treated with Chateau or Fierce late pre-emergence had fewer weeds compared to plots treated with Prowl H₂O at the same timing.

Plant stand on May 30 and marketable onion yield is presented in Table 4. Counts on May 30 indicated reduced plant stand in plots treated with Fierce at 1.25 oz/acre (0.0594 lb ai/acre) and Chateau at 1 oz/acre (0.032 lb ai/acre), which was 80,960 and 83,600 plants/acre, respectively. Yield for U.S. No. 2 onions was similar across treatments ranging from 0 to 5.5 cwt/acre. Yield for bulbs exhibiting plate rot was higher in plots treated with Chateau or Fierce late pre-emergence. Total marketable yield was similar across herbicide treatments and ranged from 862.2 to 988.4 cwt/acre compared to 1002.6 cwt/acre for the grower standard.

Acknowledgements

This project was funded by the Idaho-Eastern Oregon Onion Committee, cooperating onion seed companies, Oregon State University, the Malheur County Education Service District, and supported by Formula Grant nos. 2017-31100-06041 and 2017-31200-06041 from the USDA National Institute of Food and Agriculture.

Table 1. Onion response and weed control on May 23 (34 days after late pre-emergence treatments) to application of various herbicides at the Malheur Experiment Station, Ontario, OR, 2017.

Treatment	Rate ^a	Timing ^b	Onion injury	Weed control ^c				
				Common lambsquarters	Redroot pigweed	Kochia	Hairy nightshade	Common barnyardgrass
			----- % -----					
Untreated check	per acre		0 d	0 d	0 e	0 d	0 c	0 b
Chateau	0.5 oz	LPRE	10 ab	90 c	95 d	92 c	94 ab	97 a
Buctril	12 fl oz	2-leaf						
GoalTender	4 fl oz	2-leaf						
Buctril	12 fl oz	4-6 leaf						
GoalTender	4 fl oz	4-6 leaf						
Chateau	1.0 oz	LPRE	13 a	98 a	99 a	99 a	99 a	98 a
Buctril	12 fl oz	2-leaf						
GoalTender	4 fl oz	2-leaf						
Buctril	12 fl oz	4-6 leaf						
GoalTender	4 fl oz	4-6 leaf						
Fierce (Chateau + Zidua)	1.25 oz	LPRE	15 a	97 ab	98 abc	98 ab	98 ab	98 a
Buctril	12 fl oz	2-leaf						
GoalTender	4 fl oz	2-leaf						
Buctril	12 fl oz	4-6 leaf						
GoalTender	4 fl oz	4-6 leaf						
Prowl H ₂ O	2.0 pt	LPRE	3 cd	96 ab	96 cd	93 c	94 ab	96 a
Fierce (Chateau + Zidua)	1.25 oz	2-leaf						
Buctril	12 fl oz	4-6 leaf						
GoalTender	4 fl oz	4-6 leaf						
Prowl H ₂ O	2.0 pt	LPRE	3 cd	97 ab	99 ab	99 ab	96 ab	94 a
Fierce (Chateau + Zidua)	1.5 oz	2-leaf						
Buctril	12 fl oz	4-6 leaf						
GoalTender	4 fl oz	4-6 leaf						
Prowl H ₂ O	2.0 pt	LPRE	5 bcd	94 b	97 bcd	92 c	93 b	96 a
Chateau	0.5 oz	2-leaf						
Chateau	0.5 oz	4-6 leaf						
Prowl H ₂ O (Grower standard)	2.0 pt	LPRE	7 bc	96 ab	98 abc	95 bc	95 ab	98 a
Buctril	12 fl oz	2-leaf						
GoalTender	4 fl oz	2-leaf						
Buctril	12 fl oz	4-6 leaf						
GoalTender	4 fl oz	4-6 leaf						
LSD (<i>P</i> = 0.05)			5.8	3.4	2.3	4.2	5.2	4.0
Standard Deviation			3.3	1.9	1.3	2.4	3.0	2.3
CV			46.53	2.32	1.52	2.86	3.54	2.7

^aChateau 0.5 oz/acre = flumioxazin 0.016 lb/acre; Buctril 12 fl oz/acre = bromoxynil 0.188 lb ai/acre; GoalTender 4 fl oz/acre = oxyfluorfen 0.125 lb ai/acre; Fierce 1.25 oz/acre = flumioxazin 0.0262 + pyroxasulfone 0.0332 lb ai/acre; Prowl H₂O 2 pt/acre = pendimethalin 0.95 lb ai/acre.

^bTiming LPRE-late pre-emergence (75% of seeds have germinated but no emergence); 2-leaf = onion seedlings at 2-leaf stage; 4-6 leaf = onion seedling at 4- to 6-leaf stage.

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

Table 2. Onion response and weed control on May 30 (41 days after late pre-emergence) and 7 days after postemergence application of various herbicides at the Malheur Experiment Station, Ontario, OR, 2017.

Treatment	Rate ^a	Timing ^b	Onion injury	Weed control ^c				
				Common lambsquarters	Redroot pigweed	Kochia	Hairy nightshade	Common barnyardgrass
Untreated check	per acre		0.0 c	0 e	0 d	0 e	0 e	0 f
Chateau	0.5 oz	LPRE	5.0 b	93 b	97 a	95 b	95 b	80 b
Buctril	12 fl oz	2-leaf						
GoalTender	4 fl oz	2-leaf						
Buctril	12 fl oz	4-6 leaf						
GoalTender	4 fl oz	4-6 leaf						
Chateau	1.0 oz	LPRE	10.0 a	97 ab	97 a	95 b	97 b	20 e
Buctril	12 fl oz	2-leaf						
GoalTender	4 fl oz	2-leaf						
Buctril	12 fl oz	4-6 leaf						
GoalTender	4 fl oz	4-6 leaf						
Fierce (Chateau + Zidua)	1.25 oz	LPRE	6.7 b	97 ab	97 a	97 ab	95 b	72 d
Buctril	12 fl oz	2-leaf						
GoalTender	4 fl oz	2-leaf						
Buctril	12 fl oz	4-6 leaf						
GoalTender	4 fl oz	4-6 leaf						
Prowl H ₂ O	2.0 pt	LPRE	0.0 c	85 c	87 b	78 c	80 c	77 c
Fierce (Chateau + Zidua)	1.25 oz	2-leaf						
Buctril	12 fl oz	4-6 leaf						
GoalTender	4 fl oz	4-6 leaf						
Prowl H ₂ O	2.0 pt	LPRE	5.0 b	96 ab	97 a	97 ab	97 b	80 b
Fierce (Chateau + Zidua)	1.5 oz	2-leaf						
Buctril	12 fl oz	4-6 leaf						
GoalTender	4 fl oz	4-6 leaf						
Prowl H ₂ O	2.0 pt	LPRE	0.0 c	22 d	23 c	22 d	22 d	2 f
Chateau	0.5 oz	2-leaf						
Chateau	0.5 oz	4-6 leaf						
Prowl H ₂ O (Grower standard)	2.0 pt	LPRE	0.0 c	100 a	100 a	100 a	100 a	100 a
Buctril	12 fl oz	2-leaf						
GoalTender	4 fl oz	2-leaf						
Buctril	12 fl oz	4-6 leaf						
GoalTender	4 fl oz	4-6 leaf						
LSD (<i>P</i> = 0.05)			1.79	4.7	3.4	4.3	2.4	3
Standard Deviation			1.02	2.7	1.9	2.4	1.4	1.89
CV			30.62	3.62	2.58	3.35	1.9	3.52

^aChateau 0.5 oz/acre = flumioxazin 0.016 lb/acre; Buctril 12 fl oz/acre = bromoxynil 0.188 lb ai/acre; GoalTender 4 fl oz/acre = oxyfluorfen 0.125 lb ai/acre; Fierce 1.25 oz/acre = flumioxazin 0.0262 + pyroxasulfone 0.0332 lb ai/acre; Prowl H₂O 2 pt/acre = pendimethalin 0.95 lb ai/acre.

^bTiming LPRE-late pre-emergence (75% of seeds have germinated but no emergence); 2-leaf = onion seedlings at 2-leaf stage; 4-6 leaf = onion seedling at 4- to 6- leaf stage.

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

Table 3. Average number of weeds in two center rows (3.67 x 27ft) of the onion plot on June 20 (31 days after late pre-emergence and 14 days after the last postemergence herbicide application) at the Malheur Experiment Station, Ontario, OR, 2017.

Treatment	Rate ^a per acre	Timing ^b	Number of weeds ^c					Total count
			Common lambsquarters	Redroot pigweed	Kochia	Hairy nightshade	Lady's- thumb	
Untreated check			694 a	958 a	132 a	1,949 a	1,354 a	5,087 a
Chateau	0.5 oz	LPRE	14 b	14 b	3 b	1 b	22 b	53 b
Buctril	12 fl oz	2-leaf						
GoalTender	4 fl oz	2-leaf						
Buctril	12 fl oz	4-6 leaf						
GoalTender	4 fl oz	4-6 leaf						
Chateau	1.0 oz	LPRE	2 b	1 b	0 b	0 b	2 b	5 b
Buctril	12 fl oz	2-leaf						
GoalTender	4 fl oz	2-leaf						
Buctril	12 fl oz	4-6 leaf						
GoalTender	4 fl oz	4-6 leaf						
Fierce (Chateau + Zidua)	1.25 oz	LPRE	5 b	1 b	1 b	0 b	3 b	10 b
Buctril	12 fl oz	2-leaf						
GoalTender	4 fl oz	2-leaf						
Buctril	12 fl oz	4-6 leaf						
GoalTender	4 fl oz	4-6 leaf						
Prowl H ₂ O	2.0 pt	LPRE	5 b	22 b	2 b	54 b	27 b	111 b
Fierce (Chateau + Zidua)	1.25 oz	2-Leaf						
Buctril	12 fl oz	4-6 leaf						
GoalTender	4 fl oz	4-6 leaf						
Prowl H ₂ O	2.0 pt	LPRE	8 b	12 b	1 b	63 b	31 b	116 b
Fierce (Chateau + Zidua)	1.5 oz	2-Leaf						
Buctril	12 fl oz	4-6 leaf						
GoalTender	4 fl oz	4-6 leaf						
Prowl H ₂ O	2.0 pt	LPRE	18 b	58 b	2 b	77 b	29 b	185 b
Chateau	0.5 oz	2-leaf						
Chateau	0.5 oz	4-6 leaf						
Prowl H ₂ O (Grower standard)	2.0 pt	LPRE	1 b	5 b	1 b	55 b	12 b	73 b
Buctril	12 fl oz	2-leaf						
GoalTender	4 fl oz	2-leaf						
Buctril	12 fl oz	4-6 leaf						
GoalTender	4 fl oz	4-6 leaf						
LSD ($P = 0.05$)			65.13	457.6	93.7	372.9	99.7	724.8
Standard Deviation			37.19	261.3	53.5	212.9	56.9	413.8
CV			39.83	195.42	299.16	77.44	30.75	58.7

^aChateau 0.5 oz/acre = flumioxazin 0.016 lb/acre; Buctril 12 fl oz/acre = bromoxynil 0.188 lb ai/acre; GoalTender 4 fl oz/acre = oxyfluorfen 0.125 lb ai/acre; Fierce 1.25 oz/acre = flumioxazin 0.0262 + pyroxasulfone 0.0332 lb ai/acre; Prowl H₂O 2 pt/acre = pendimethalin 0.95 lb ai/acre.

^bTiming LPRE-late pre-emergence (75% of seeds have germinated but no emergence); 2-leaf = onion seedlings at 2-leaf stage; 4-6 leaf = onion seedling at 4- to 6-leaf stage.

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

Table 4. Onion plant stand and bulb yield in response to Chateau and Fierce herbicides applied late pre-emergence at the Malheur Experiment Station, Ontario, OR, 2017.

Treatment	Rate ^a per acre	Timing ^b	Plant stand No./acre	Unmarketable			Marketable yield ^d				Total
				US No. 2	Plate Rot	<2¼ in ^c	2¼-3 in cwt/acre ^d	3-4 in	4-4¼ in	>4¼ in	
Untreated check			73,480 d	0.0 a	0.0 b	0.0 b	0.0 c	0.0 d	0.0 b	0.0 c	0.0 b
Chateau	0.5 oz	LPRE	91,520 ab	0.0 a	3.1 ab	2.3 ab	17.7 abc	475.4 ab	376.4 a	57.3 bc	926.8 a
Buctril	12 fl oz	2-leaf									
GoalTender	4 fl oz	2-leaf									
Buctril	12 fl oz	4-6 leaf									
GoalTender	4 fl oz	4-6 leaf									
Chateau	1.0 oz	LPRE	83,600 bc	1.6 a	7.3 a	2.7 ab	9.4 bc	368.1 c	379.6 a	145.4 a	902.5 a
Buctril	12 fl oz	2-leaf									
GoalTender	4 fl oz	2-leaf									
Buctril	12 fl oz	4-6 leaf									
GoalTender	4 fl oz	4-6 leaf									
Fierce (Chateau + Zidua)	1.25 oz	LPRE	80,960 cd	0.0 a	5.0 ab	3.1 ab	18.8 abc	431.6 bc	345.4 a	66.3 bc	862.2 a
Buctril	12 fl oz	2-leaf									
GoalTender	4 fl oz	2-leaf									
Buctril	12 fl oz	4-6 leaf									
GoalTender	4 fl oz	4-6 leaf									
Prowl H ₂ O	2.0 pt	LPRE	88,733 abc	0.0 a	0.0 b	5.7 ab	22.0 ab	484.7 ab	403.1 a	78.6 ab	988.4 a
Fierce (Chateau + Zidua)	1.25 oz	2-leaf									
Buctril	12 fl oz	4-6 leaf									
GoalTender	4 fl oz	4-6 leaf									
Prowl H ₂ O	2.0 pt	LPRE	94,013 a	3.3 a	0.8 b	6.3 a	18.1 abc	524.8 a	297.4 a	69.9 bc	910.3 a
Fierce (Chateau + Zidua)	1.5 oz	2-leaf									
Buctril	12 fl oz	4-6 leaf									
GoalTender	4 fl oz	4-6 leaf									
Prowl H ₂ O	2.0 pt	LPRE	97,093 a	0.0 a	0.0 b	5.5 ab	36.4 a	542.7 a	292.8 a	42.9 bc	914.7 a
Chateau	0.5 oz	2-leaf									
Chateau	0.5 oz	4-6 leaf									
Prowl H ₂ O (Grower standard)	2.0 pt	LPRE	95,333 a	5.5 a	0.4 b	1.5 ab	24.2 ab	465.1 ab	439.0 a	74.4 b	1,002.6 a
Buctril	12 fl oz	2-leaf									
GoalTender	4 fl oz	2-leaf									
Buctril	12 fl oz	4-6 leaf									
GoalTender	4 fl oz	4-6 leaf									
LSD (<i>P</i> = 0.05)			9,393.7	5.48	5.68	5.71	19.13	88.41	198.22	70.68	200.36
Standard Deviation			5,363.6	3.13	3.24	3.26	10.92	50.48	113.18	40.36	114.40
CV			6.09	240.56	155.7	96.26	59.6	12.27	35.74	60.36	14.06

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

^b Chateau 0.5 oz/acre = flumioxazin 0.016 lb/acre; Buctril 12 fl oz/acre = bromoxynil 0.188 lb ai/acre; GoalTender 4 fl oz/acre = oxyfluorfen 0.125 lb ai/acre; Fierce 1.25 oz/acre = flumioxazin 0.0262 + pyroxasulfone 0.0332 lb ai/acre; Prowl H₂O 2pt/acre = pendimethalin 0.95 lb ai/acre.

^c Timing LPRE-late pre-emergence (75% of seeds have germinated but no emergence); 2-leaf = onion seedlings at 2-leaf stage; 4-6 leaf = onion seedling at 4- to 6-leaf stage.

^d The 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 is composed of medium, jumbo, colossal, and supercolossal grades. Split bulbs (No. 2s), bulbs infected with the fungus *Botrytis allii* in the neck or side, bulbs infected with the fungus *Fusarium oxysporum* (plate rot). Marketable yield consists of U.S. No.1 bulbs >2¼ inches.