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2009 Chemigation Weed Control Trials in Processing Onions

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Introduction

Weed control in onions is particularly problematic. Onions are slow to emerge after planting and slow to grow after emergence. Weeds on the other hand often emerge early and grow quickly, effectively competing for moisture, nutrients and sunlight. Typically, such competition results in severely reduced onion yields, so early season weed control is critical. Broadleaf herbicides available for post-emergence use in onions are marginally selective and are most effective if applied when weeds are small. Unfortunately, crop injury is more likely when these herbicides are applied to small onions. Thus, onion producers are faced with troubling questions. Should they apply herbicides early to slow the weeds and risk crop injury from the herbicides? Or, would it be better to wait for the onions to get bigger and risk crop yield loss from early weed competition or the weeds getting too large to control?

Two herbicide experiments were conducted at the Intermountain Research and Extension Center in 2009. One trial (4569A) evaluated varying rates of Goal + Outlook + Prowl H_20 tank-mixes in an attempt to determine the effects of 1/2x to 2x rates on weed control and crop injury. Another trial (4569B) evaluated herbicide treatments with pre-emergent, loop, and/or post-emergent applications to identify treatments that maximize weed control with little or no crop injury.

Methods

Onions were planted April 20, 2009 on 36 inch beds with 4 rows per bed. The onions reached the 1-, early 2-, and 3 to 4- true leaf stages on May 21, May 29, and June 11, respectfully. Broadleaf weeds (mostly redroot pigweed, lambsquarter, kochia, clover, and spiny sowthistle) began germinating 7 to 14 days after planting. Broadleaf weeds were 0.5 to 1.5 inches in diameter by May 21st. On May 29th, weeds were 2 to 4 inches tall in the untreated plots, and weeds started to green-up and push new leaves in plots treated with herbicides. On June 11th, weeds were 3 to 7 inches tall in the untreated plots.

Herbicides were applied in a randomized complete block with four replications. Plot size was 18 ft x 30 ft. Treatments for trials are listed on page 2 and 7. All treatments were chemigated via ABI, a small-plot linear move irrigation apparatus pulled through the field with a reel system (same reel system used for big-gun sprinklers).

Onions were grown using irrigation, fertilizer, and pest management practices typical of commercial dehydrator onion production in the Klamath Basin. Weed control evaluations were made May 26, June 8, June 18, July 6, and August 3. Weed density was evaluated by counting the number of weeds in a 6 x 10 ft sub-plot in the middle of each plot. Hand-weeded plots were weeded on a weekly basis starting at the 1-leaf stage throughout the growing season to prevent weed establishment.

Immediately following the July 6 evaluation, all treated plots were hand-weeded to estimate hand-weeding costs and prevent excessive weed growth and seed production. Treated plots were hand-weeded a second time immediately after the August 3 evaluation. Plots were hand-weeded in August to manage weeds that re-grew or emerged after the first hand-weeding event. Weeds in the untreated plots were managed by cutting the weeds 1 to 3 inches tall on July 6 and August 3. All plots were mechanically harvested on October 1. Total bulb weight was measured from a 180 ft^2 sub-plot in the middle of each plot.

Results

Varying rates of Goal/Outlook/Prowl H_20 tank-mixes

Weed Stand Counts

Weed stand counts are presented in Table 1. All treatments reduced total weed density compared to the non-weeded control. The ½x and ¾x rate of Goal/Outlook/Prowl H_20 provided reduced weed control compared to the 1x, 1.5x, and 2x rates. Weed control was also reduced when the first Goal application was delayed until the 2^{nd} true leaf stage in a Goal/Outlook/Prowl H_20 program and when Goal/Prowl H_20 was applied without Outlook.

Hand-weeding Costs

Hand-weeding costs are presented in Table 2. Treatments with the lowest total hand-weeding cost were the 2x, 1.5x, and 1x rate of Goal/Outlook/Prowl H_20 at $63, $78, and $81 per acre respectively. Treatments with the highest total hand-weeding costs were the ½x and ¾x rate of Goal/Outlook/Prowl H_20 along with treatments where the 1^{st} application of Goal was delayed until the onion 2-leaf stage. These treatments' hand-weeding costs ranged from $130 to $190 per acre.

Onion Injury, Stand, and Yield

Onion injury, stand, and yield data are presented in Table 2. The 1.5x and 2x rates of Goal/Outlook/Prowl H_20 caused significant onion injury (stunting, curling, and chlorosis). Onions in all treatments did not display herbicide injury at the July evaluation. None of the treatments reduced onion stand. Onion yield did not differ significantly between treatments, but onion yield in non-weeded plots was significantly lower than the yield in herbicide-treated plots. This trend suggests early-season weed competition decreased yield.

Pre-emergent, Loop, and/or Post-emergent Herbicide Treatments

Weed Stand Counts

Weed stand counts are presented in Table 3. All treatments reduced total weed cover compared to the non-weeded control. The primary weed species in the plots were kochia and clover. For pre-emergent herbicides, the addition of Nortron to Prowl H_20 applied pre-emergent or at loop stage provided over 95% control of kochia and clover. For post-emergent treatments, adding Buctril to Goal improved kochia and clover control compared to Goal alone. The high rate of Buctril + Goal gave similar weed control compared to the Nortron treatments. Adding Starane to Goal gave excellent control of kochia, but Starane did not improve control of clover compared to Goal alone. Differences in weed control from Goal formulations (Tender vs. 2XL) applied at the 1- and 2-leaf stage were not evident. When comparing treatments with and without Goal applied at the 3-4 leaf stage, there was no statistical difference. The vast majority of weed control appeared to occur during 1- and 2-leaf treatments (visual observations).

Hand-weeding Costs

Hand-weeding costs are presented in Table 4. Not surprisingly, treatments' hand-weeding costs were closely related to weed stand counts. Treatments with the lowest hand-weeding costs included those with Goal plus Buctril or Starane applied at the 2-leaf stage and treatments with Nortron applied pre-emergent or at loop. Hand-weeding costs for these treatments ranged from $58 to $105 per acre. Hand-weeding costs for Goal/Outlook/Prowl H_20 treatments without Buctril, Starane, or Norton ranged from $170 to $215 per acre due to extra time required to remove kochia and clover escapes.

Onion Injury, Stand, and Yield

Onion injury, stand, and yield data are presented in Table 4. None of the treatments reduced onion stand compared to the control. Broadcast applied Goal + Starane and Goal + Buctril (high rate) applied at the 2-leaf stage caused significant onion injury (stunting, curling, and chlorosis) on 6/8/09 at 2.63 and 0.75 respectively on a 1-10 injury scale. Interestingly, onion injury from Goal + Starane applied via chemigation in a border area (unreplicated) was 0.5 (field notes) suggesting chemigation may be a safer method of applying Starane. None of the treatments show significant visual herbicide injury at the July evaluation.

Treatments with the lowest weed density tended to have the highest onion yield . Goal/Outlook/Prowl H_20 treatments without Buctril or Nortron had reduced onion yields (3.6 to 4 tons/acre) compared to the top-yielding treatment (trt 8- Goal + Buctril). The hand-weeded control yield was 4.9 tons/acre lower than the top-yielding treatment, and the non-weeded control had the lowest yield (10.3 tons/acre lower than the top-yielding treatment). The yield decrease in the hand-weeded plots was likely due to regular field disturbance from hand-weeding on a weekly basis. Goal + Starane broadcast applied reduced onion yield by 4 tons/acre compared to the top-yielding treatment; this yield reduction was likely related to early-season herbicide injury.

4569A Treatment List

4569A Varying rates of Goal/Outlook/Prowl H_20 Trial

Trt #	Herbicide	1 Leaf (5-21-09)	2 Leaf (5-29-09)	3-4 Leaf (6-12-09)
1	Goal 2xL	2 oz/a	6 oz/a	6 oz/a
2	Goal 2xL		6 oz/a	6 oz/a
3	Goal 2xL Outlook Prowl H20	1 oz/a 5.25 oz/a 2 pt/a	3 oz/a 5.25 oz/a	6 oz/a
4	Goal 2xL Outlook Prowl H20	1.5 oz/a 7.9 oz/a 3 pt/a	4.5 oz/a 7.9 oz/a	6 oz/a
5	Goal 2xL Outlook Prowl H20	2 oz/a 10.5 oz/a 4 pt/a	6 oz/a 10.5 oz/a	6 oz/a
6	Goal 2xL Outlook Prowl H20	3 oz/a 15.7 oz/a 6 pt/a	9 oz/a 15.7 oz/a	6 oz/a
7	Goal 2xL Outlook Prowl H20	4 oz/a 21 oz/a 8 pt/a	12 oz/a 21 oz/a	6 oz/a
8	Goal 2xL Outlook	2 oz/a 4 pt/a	6 oz/a	6 oz/a
9	Goal 2xL Prowl H20	2 oz/a 4 pt/a	6 oz/a	6 oz/a
10	Goal 2xL Outlook Prowl H20	 4 pt/a	6 oz/a 21 oz/a	6 oz/a

[1] All herbicide rates are product rate per acre.

Table 1. The influence of varying rates of Goal/Outlook/Prowl H_20 on weed density on 7/8/09 and 8/3/09.

Trt #	Herbicide	1 true leaf	2 true leaf	Follow up application 3-4 true leaf	Clover stand count	Pigweed stand count	Lambs-quarter stand count	Spiny sowthistle stand count	Total Weed Stand Count	
					7/8/09	7/8/09	7/8/09	7/8/09	7/8/09	8/3/09[1]
1	Goal 2XL	goal@2 oz	goal@6 oz	goal@6 oz	8	0.5	4.75	0.25	17	5.8
2	Goal 2XL		goal@6 oz	goal@6 oz	9	0	5.6	1.75	19	6.2
3	Goal 2XL (1/2 X rate) Outlook Prowl H20	goal@1 oz outlook@5.25 oz prowl@2 pt	goal@3 oz outlook@5.25 oz	goal@6 oz	11.3	0	3	1.25	20.7	8
4	Goal 2XL (3/4 X rate) Outlook Prowl H20	goal@1.5 oz outlook@7.9 oz prowl@3 pt	goal@4.5 oz outlook@7.9 oz	goal@6 oz	11.3	1.25	5.25	1.25	19.8	8.5
5	Goal 2XL (1 X rate) Outlook Prowl H20	goal@2 oz outlook@10.5 oz prowl@4 pt	goal@6 oz outlook@10.5 oz	goal@6 oz	4.7	0.33	2.33	0.33	9.3	6.5
6	Goal 2XL (1.5 X rate) Outlook Prowl H20	goal@3 oz outlook@15.75 oz prowl@6 pt	goal@9 oz outlook@15.75 oz	goal@6 oz	3.8	0	1.5	0	5.8	3.25
7	Goal 2XL (2 X rate) Outlook Prowl H20	goal@4 oz outlook@21 oz prowl@8 pt	goal@12 oz outlook@21 oz	goal@6 oz	1.8	0	2.25	0	4	1.5
8	Goal 2XL Outlook	goal@2 oz outlook@10.5 oz	goal@6 oz outlook@10.5 oz	goal@6 oz	3.3	0.667	3.67	0.33	8.7	6.25
9	Goal 2XL Prowl H20	goal@2 oz prowl@4 pt	goal@6 oz	goal@6 oz	8.8	0	5	1.5	19	5.5
10	Goal 2XL Outlook Prowl H20	 prowl@4 pt	goal@6 oz outlook@21 oz	goal@6 oz	9.3	3	9.75	0.75	26.5	6
11	Hand Weeded Control				0	0	0	0	0	0
12	Non-weeded Control				31	70	8.25	2.5	114.3	15.5
	LSD (P=0.05)				6	3.1	4.2	1.5	16	6.6

[1]Weed stand counts taken on 8/3/09 occurred after the first hand-weeding event. Pigweed, clover, lambsquarter, and kochia were the predominat weed species in most plots.

Table 2. The influence of varying rates of Goal/Outlook/Prowl H_20 on onion injury, stand, yield, and hand-weeding costs

Trt #	Herbicide	1 true leaf	2 true leaf	Follow up application 3-4 true leaf	Onion injury (0-10) scale 6/8/09[1]	Onion Stand Count 7/6/09	Hand Weeding Cost $/acre 7/8/09[2]	Hand Weeding Cost $/acre 8/4/09[3]	Hand Weeding Cost $/acre Total[4]	Onion Yield 10/6/09 ton/acre
1	Goal 2XL	goal@2 oz	goal@6 oz	goal@6 oz	0.75	62	$70	$36	$106	30
2	Goal 2XL		goal@6 oz	goal@6 oz	0.38	63	$82	$48	$130	29.9
3	Goal 2XL (1/2 X rate) Outlook Prowl H20	goal@1 oz outlook@5.25 oz prowl@2 pt	goal@3 oz outlook@5.25 oz	goal@6 oz	0	63	$121	$31	$152	30.7
4	Goal 2XL (3/4 X rate) Outlook Prowl H20	goal@1.5 oz outlook@7.9 oz prowl@3 pt	goal@4.5 oz outlook@7.9 oz	goal@6 oz	0	59	$108	$45	$153	31.6
5	Goal 2XL (1 X rate) Outlook Prowl H20	goal@2 oz outlook@10.5 oz prowl@4 pt	goal@6 oz outlook@10.5 oz	goal@6 oz	0.38	58	$66	$15	$81	31.3
6	Goal 2XL (1.5 X rate) Outlook Prowl H20	goal@3 oz outlook@15.75 oz prowl@6 pt	goal@9 oz outlook@15.75 oz	goal@6 oz	1.13	62	$44	$34	$78	28.9
7	Goal 2XL (2 X rate) Outlook Prowl H20	goal@4 oz outlook@21 oz prowl@8 pt	goal@12 oz outlook@21 oz	goal@6 oz	1	57	$40	$23	$63	31.1
8	Goal 2XL Outlook	goal@2 oz outlook@10.5 oz	goal@6 oz outlook@10.5 oz	goal@6 oz	0.75	60	$76	$43	$119	30.7
9	Goal 2XL Prowl H20	goal@2 oz prowl@4 pt	goal@6 oz	goal@6 oz	0	60	$100	$22	$122	30.9
10	Goal 2XL Outlook Prowl H20	 prowl@4 pt	goal@6 oz outlook@21 oz	goal@6 oz	0.38	56	$157	$33	$190	31.8
11	Hand Weeded Control[5]				0	61	$$$	$$$	$$$	31.1
12	Non-weeded Control[6]				*	60	*	*	*	25.4
	LSD (P=0.05)				0.8	NS	$41	$26	$41	3.1

[1]Onion injury rating on 6/8/09 was taken 9 days after the 2-leaf stage herbicide trt. (1 to 10 scale; 10=plant death)

[2]Weeding labor costs were calculated using $8 per hour per worker, 8 workers

[3]Plots were hand-weeded on 8/3/09 to remove weeds that germinated or re-grew after the 7/8/09 hand-weeding

[4]Total hand weed cost is the sum of the 7/8/09 & 8/3/09 hand weeding events

[5] Hand-weeded plots were weeded on a weekly basis throughout the season

[6] Weeds in the non-weeded plots were cut 1-3 inchest tall during hand weeding dates to minimize weed seed

4569B Treatment List

Comparison of Pre-emergent, Loop, and/or Post-emergent Herbicide Combinations

Trt #	Herbicide[a]	Pre-Emergent	Loop (5-11-09)	1 Leaf (5-21-09)	2 Leaf (5-29-09)	3-4 Leaf (6-12-09)
1	Nortron	32oz/a				
	Goal 2xL			3fl. oz/a	3fl. oz/a	6 oz/a
	Prowl H20			1.5 pt/a	1.5 pt/a	
	Outlook			10fl. oz/a	10fl. oz/a	
2	Nortron	32oz/a				
	Prowl H20	1.5 pt/a		1.5 pt/a		
	Goal 2xL			3fl. oz/a	3fl. oz/a	6 oz/a
	Outlook			10fl. oz/a	10fl. oz/a	
3	Prowl H20		1.5 pt/a	1.5 pt/a		
	Goal 2xL			3fl. oz/a	3fl. oz/a	6 oz/a
	Outlook			10fl. oz/a	10fl. oz/a	
4	Goal 2xL			3fl. oz/a	3fl. oz/a	6 oz/a
	Prowl H20			1.5 pt/a	1.5 pt/a	
	Outlook			10fl. oz/a	10fl. oz/a	
5	Goal Tender			4fl. oz/a	4fl. oz/a	6 oz/a
	Prowl H20			1.5 pt/a	1.5 pt/a	
	Outlook			10fl. oz/a	10fl. oz/a	
6	Goal Tender			4fl. oz/a		
	Goal 2xL				4fl. oz/a	6 oz/a
	Buctril (4EC)				4fl. oz/a	
	Prowl H20			1.5 pt/a	1.5 pt/a	
	Outlook			10fl. oz/a	10fl. oz/a	
7	Goal Tender			4fl. oz/a		
	Goal 2xL				4fl. oz/a	6 oz/a
	Buctril (4EC)				4fl. oz/a	
	Nortron				6fl. oz/a	
	Prowl H20			1.5 pt/a	1.5 pt/a	
	Outlook			10fl. oz/a	10fl. oz/a	
8	Goal Tender			4fl. oz/a		
	Goal 2xL				4fl. oz/a	
	Buctril (4EC)				12fl. oz/a	
	Prowl H20			1.5 pt/a	1.5 pt/a	
	Outlook			10fl. oz/a	10fl. oz/a	
9	Goal Tender			4fl. oz/a	4fl. oz/a	6 oz/a
	Nortron			16 fl. oz/a	16 fl. oz/a	
	Prowl H20			1.5 pt/a	1.5 pt/a	
	Outlook			10fl. oz/a	10fl. oz/a	
10	Goal Tender			4fl. oz/a		
	Goal 2xL				6fl. oz/a	6 oz/a
	Prowl H20				3 pt/a	
	Outlook				21fl oz/a	
11[b]	Goal 2xL			3fl. oz/a	3fl. oz/a	6 oz/a
	Starane				10fl. oz/a	
	Prowl H20			1.5 pt/a	1.5 pt/a	
	Outlook			10fl. oz/a	10fl. oz/a	
12	Nortron		32 oz/a			
	Prowl H20		1.5 pt/a	1.5 pt/a	1.5 pt/a	
	Goal Tender			4fl. oz/a	4fl. oz/a	6 oz/a
	Outlook			10fl. oz/a	10fl. oz/a	

a:All herbicide rate is in product rate per acre b: Treatment 11 was broadcasted

Table 4. The influence of herbicides on weed density on 7/8/09 and 8/3/09.

Goal 2XL at 6 fl. oz/A was applied at the 3-4 leaf stage for all goal trts.

Trt #	Herbicide	Product Rate	Treatment Timing			Kochia stand ct. w/o 3-4 leaf[1]	Kochia stand ct. w 3-4 leaf[2]	Clover stand ct. w/o 3-4 leaf[1]	Clover stand ct. w 3-4 leaf[2]	Total Weed Stand Count w 3-4 leaf	
										7/8/2009[3]	8/3/2009[4]
1	Nortron	32 oz/A	pre			3.5	5	0	0	6	1.5
1	Goal 2XL	3 fl. oz/A	1 leaf	2 leaf	3-4 leaf						
1	Prowl H20	1.5 pt/A	1 leaf	2 leaf							
1	Outlook	10 fl. oz/A	1 leaf	2 leaf							
2	Nortron	32 oz/A	pre			5.3	2.5	0	0	3	0
2	Prowl H20	1.5 pt/A	pre								
2	Goal 2XL	3 fl. oz/A	1 leaf	2 leaf	3-4 leaf						
2	Prowl H20	1.5 pt/A	1 leaf								
2	Outlook	10 fl. oz/A	1 leaf	2 leaf							
3	Prowl H20	1.5 pt/A	loop			10.5	16	7	3.5	20	5.5
3	Goal 2XL	3 fl. oz/A	1 leaf	2 leaf	3-4 leaf						
3	Prowl H20	1.5 pt/A	1 leaf								
3	Outlook	10 fl. oz/A	1 leaf	2 leaf							
4	Goal 2XL	3 fl. oz/A	1 leaf	2 leaf	3-4 leaf	20.5	13	5.75	5	18	3.5
4	Prowl H20	1.5 pt/A	1 leaf	2 leaf							
4	Outlook	10 fl. oz/A	1 leaf	2 leaf							
5	GoalTender	4 fl. oz/A	1 leaf	2 leaf	3-4 leaf	11	11	4.75	5.6	19	8
5	Prowl H20	1.5 pt/A	1 leaf	2 leaf							
5	Outlook	10 fl. oz/A	1 leaf	2 leaf							
6	GoalTender	4 fl. oz/A	1 leaf			9.5	2.5	2.5	0.5	4	1.5
6	Goal 2XL	4 fl. oz/A		2 leaf	3-4 leaf						
6	Buctril (4EC)	4 fl. oz/A		2 leaf							
6	Prowl H20	1.5 pt/A	1 leaf	2 leaf							
6	Outlook	10 fl. oz/A	1 leaf	2 leaf							
7	GoalTender	4 fl. oz/A	1 leaf			4	3.3	2	0.5	6	3.5
7	Goal 2XL	4 fl. oz/A		2 leaf	3-4 leaf						
7	Buctril (4EC)	4 fl. oz/A		2 leaf							
7	Nortron	6 fl. oz/A		2 leaf							
7	Prowl H20	1.5 pt/A	1 leaf	2 leaf							
7	Outlook	10 fl. oz/A	1 leaf	2 leaf							

Table 4. Continued

8	GoalTender	4 fl. oz/A	1 leaf			0	0	0	1	1	1
8	Goal 2XL	4 fl. oz/A		2 leaf							
8	Buctril (4EC)	12 fl. oz/A		2 leaf							
8	Prowl H20	1.5 pt/A	1 leaf	2 leaf							
8	Outlook	10 fl. oz/A	1 leaf	2 leaf							
9	GoalTender	4 fl. oz/A	1 leaf	2 leaf	3-4 leaf	2.5	8	0	0	8	1
9	Nortron	16 fl. oz/A	1 leaf	2 leaf							
9	Prowl H20	1.5 pt/A	1 leaf	2 leaf							
9	Outlook	10 fl. oz/A	1 leaf	2 leaf							
10	GoalTender	4 fl.oz/A	1 leaf			7	6	9	6.5	12.5	7
10	Goal 2xl	6 fl. oz/A		2 leaf	3-4 leaf						
10	Prowl H20	3 pt/A		2 leaf							
10	Outlook	21 fl. oz/A		2 leaf							
11	Goal2XL[5]	3 fl. oz/A	1 leaf	2 leaf	3-4 leaf	0	0	3	3	3.5	1
11	Starane	10 fl. oz/A		2 leaf							
11	Prowl H20	1.5 pt/A	1 leaf	2 leaf							
11	Outlook	10 fl. oz/A	1 leaf	2 leaf							
12	Nortron	32 oz/A	loop			6	2	0	0	2	0
12	Prowl H20	1.5 pt/A	loop								
12	GoalTender	4 fl. oz/A	1 leaf	2 leaf	3-4 leaf						
12	Prowl H20	1.5 pt/A	1 leaf	2 leaf							
12	Outlook	10 fl. oz/A	1 leaf	2 leaf							
13	Hand-Weeded Control					0	0	0	0	0	16
14	Non-Weeded Control					44	44	15.8	15.8	91	10.5
	LSD (P=0.05)					14.5	16.3	2.8	10.6	14.8	NS

Weed stand counts reflect the # of weeds in a 6x10 ft sub-plot.

[1] Half of the plot received the Goal 2XL treatment at 3-4 leaf stage; this half of the plot did not. Evaluation on 7/8/09

[2] This half of the plot did receive Goal at 6 oz/A at the 3-4 leaf stage. Evaluation on 7/8/09

[3] Weed stand counts on 7/8/09 were taken immediately before plots were hand-weeded for the first time

[4] Weed stand counts on 8/3/09 reflect weeds that emerged or regrew after the hand-weeding event on 7/8/09

[5] The Goal + Starane + Prowl + Outlook treatment at the 2 leaf stage was broadcast applied.

Table 5. The influence of herbicides on hand-weeding costs, onion stand, onion injury, and onion yield.

Goal 2XL at 6 fl. oz/A was applied at the 3-4 leaf stage for all goal trts.

Trt #	Herbicide	Product Rate	Treatment Timing			1st Hand Weeding[1] 7/9/2009	2nd Hand Weeding[2] 8/3/2009	Hand Weeding Total	Onion stand 7/7/2009	Onion injury (0-10) 6/8/2009[3]	Yield ton/acre 10/7/09
1	Nortron	32 oz/A	pre			$63	$37	$100	53	0.38	29.3
1	Goal 2XL	3 fl. oz/A	1 leaf	2 leaf	3-4 leaf						
1	Prowl H20	1.5 pt/A	1 leaf	2 leaf							
1	Outlook	10 fl. oz/A	1 leaf	2 leaf							
2	Nortron	32 oz/A	pre			$54	$52	$105	57	0	29.3
2	Prowl H20	1.5 pt/A	pre								
2	Goal 2XL	3 fl. oz/A	1 leaf	2 leaf	3-4 leaf						
2	Prowl H20	1.5 pt/A	1 leaf								
2	Outlook	10 fl. oz/A	1 leaf	2 leaf							
3	Prowl H20	1.5 pt/A	loop			$111	$59	$170	54	0	28.6
3	Goal 2XL	3 fl. oz/A	1 leaf	2 leaf	3-4 leaf						
3	Prowl H20	1.5 pt/A	1 leaf								
3	Outlook	10 fl. oz/A	1 leaf	2 leaf							
4	Goal 2XL	3 fl. oz/A	1 leaf	2 leaf	3-4 leaf	$126	$65	$190	57	0	28.4
4	Prowl H20	1.5 pt/A	1 leaf	2 leaf							
4	Outlook	10 fl. oz/A	1 leaf	2 leaf							
5	GoalTender	4 fl. oz/A	1 leaf	2 leaf	3-4 leaf	$129	$86	$215	62	0	29.7
5	Prowl H20	1.5 pt/A	1 leaf	2 leaf							
5	Outlook	10 fl. oz/A	1 leaf	2 leaf							
6	GoalTender	4 fl. oz/A	1 leaf			$48	$45	$94	59	0.38	28.1
6	Goal 2XL	4 fl. oz/A		2 leaf	3-4 leaf						
6	Buctril (4EC)	4 fl. oz/A		2 leaf							
6	Prowl H20	1.5 pt/A	1 leaf	2 leaf							
6	Outlook	10 fl. oz/A	1 leaf	2 leaf							
7	GoalTender	4 fl. oz/A	1 leaf			$56	$42	$98	57	0	30.3
7	Goal 2XL	4 fl. oz/A		2 leaf	3-4 leaf						
7	Buctril (4EC)	4 fl. oz/A		2 leaf							
7	Nortron	6 fl. oz/A		2 leaf							
7	Prowl H20	1.5 pt/A	1 leaf	2 leaf							
7	Outlook	10 fl. oz/A	1 leaf	2 leaf							

Table 5. Continued

8	GoalTender	4 fl. oz/A	1 leaf			$51	$25	$75	62	0.75	32.2
8	Goal 2XL	4 fl. oz/A		2 leaf							
8	Buctril (4EC)	12 fl. oz/A		2 leaf							
8	Prowl H20	1.5 pt/A	1 leaf	2 leaf							
8	Outlook	10 fl. oz/A	1 leaf	2 leaf							
9	GoalTender	4 fl. oz/A	1 leaf	2 leaf	3-4 leaf	$79	$37	$116	60	0.38	30.2
9	Nortron	16 fl. oz/A	1 leaf	2 leaf							
9	Prowl H20	1.5 pt/A	1 leaf	2 leaf							
9	Outlook	10 fl. oz/A	1 leaf	2 leaf							
10	GoalTender	4 fl.oz/A	1 leaf			$133	$52	$185	58	0	30.8
10	Goal 2xl	6 fl. oz/A		2 leaf	3-4 leaf						
10	Prowl H20	3 pt/A		2 leaf							
10	Outlook	21 fl. oz/A		2 leaf							
11	Goal2XL[4]	3 fl. oz/A	1 leaf	2 leaf	3-4 leaf	$42	$16	$58	53	2.63	28.1
11	Starane	10 fl. oz/A		2 leaf							
11	Prowl H20	1.5 pt/A	1 leaf	2 leaf							
11	Outlook	10 fl. oz/A	1 leaf	2 leaf							
12	Nortron	32 oz/A	loop			$42	$26	$68	61	0.38	30.3
12	Prowl H20	1.5 pt/A	loop								
12	GoalTender	4 fl. oz/A	1 leaf	2 leaf	3-4 leaf						
12	Prowl H20	1.5 pt/A	1 leaf	2 leaf							
12	Outlook	10 fl. oz/A	1 leaf	2 leaf							
13	Hand-Weeded Control[5]					*	*	*	50	0	27.3
14	Non-Weeded Control [6]					*	*	*	54	0	21.9
	LSD (P=0.05)					$77	$27	$70	NS	0.72	3.3

[1] Weeding labor costs were $8 per hour per worker, 8 workers IREC personel

[2] Second hand-weeding occurred after the first one to control new weeds

[3] Onion injury rating on 6/8/09 was taken 9 days after the 2-leaf stage herbicide trt.

[4] The Goal + Starane + Prowl + Outlook treatment at the 2 leaf stage was broadcast applied.

[5] Hand weeded were weeded on a weekly basis starting at 1-leaf stage

[6] Non-Weeded had the weeds cut back to prevent seed production during hand-weeding dates