WEED CONTROL AND ONION TOLERANCE WITH SOIL ACTIVE AND POSTEMERGENCE HERBICIDES

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Introduction

Weed control is essential for the production of marketable onions. Weed control in onions is difficult compared to many crops because of the lack of a complete crop canopy. Often combinations of postemergence and soil-active herbicides are required to improve overall weed control. Weed control research is important in identifying potential herbicides and management strategies to improve weed control in onions.

Methods

General Procedures

Trials were conducted at the Malheur Experiment Station to evaluate experimental and registered herbicides, and postemergence urea ammonium nitrate (32 percent N) solution applications for weed control and onion tolerance. The effect of spray volume on weed control and onion tolerance was also evaluated. Trials were conducted under furrow irrigation. All herbicide treatments were applied with a CO_2-pressurized backpack sprayer calibrated to deliver 20 gal/acre at 30 psi.

On March 29, onions (cv. 'Vision', Petoseed, Payette, ID) were planted at a 3.7-inch spacing in double rows on 22-inch beds. Plots were four rows wide and 27 ft long and arranged in a randomized complete block design with three or four replications. Lorsban was applied in a 6-inch band over each row at 3.7 oz/1,000 ft of row. Onions were sidedressed with 150 lb N/acre as urea on May 23. Registered insecticides and fungicides were applied for thrips and downy mildew control. Weed control and onion injury were evaluated throughout the season. Onions were harvested September 18 and graded by size on September 19 and 20.

Data were analyzed using analysis of variance and means were separated using a protected least significant difference (LSD) at the 5 percent level (0.05).

Soil-Active Herbicides for Weed Control in Onions

The soil-active herbicides Prowl, Dacthal, Dual Magnum, and Outlook were evaluated for crop injury and weed control applied either preemergence, to two-leaf onions, or as a lay-by treatment. Preemergence applications of Roundup (0.375 lb ai/acre) plus Prowl (0.75 or 1.0 lb ai/acre) or Dacthal (8.0 or 10.0 lb ai/acre) followed by sequential postemergence herbicide applications were compared to treatments where Prowl, Dacthal, Dual Magnum, and Outlook were applied in combination with the

postemergence herbicides or as a lay-by application. In several treatments Prowl (0.63 or 1.0 lb ai/acre) was applied to flag leaf onions instead of preemergence with Roundup. Postemergence treatments of Buctril (0.15 lb ai/acre) plus Poast (0.1 lb ai/acre) were applied on May 19 to two-leaf onions, followed by Buctril (0.25 lb ai/acre) and Goal (0.125 lb ai/acre) applied on May 31 to four-leaf onions. Dacthal (6.0 lb ai/acre), Outlook (0.64, 0.33, 0.66 lb ai/acre), and Prowl (0.63 lb ai/acre) were added to the two-leaf application in several treatments to compare residual control with these products at various rates in combination with the postemergence herbicides. Lay-by treatments applied on June 15 consisted of Goal (0.25 or 0.125 lb ai/acre) alone or in combination with Prowl (0.75 lb ai/acre), Dacthal (6, 8, or 12 lb ai/acre), Dual Magnum (1.3 lb ai/acre), or Outlook (0.33, 0.64 lb ai/acre).

Onion Tolerance to Valor Combinations

Onions were evaluated for tolerance to postemergence applications of Valor herbicide. All plots received Roundup (0.375 lb ai/acre) preemergence on April 17 and Select (0.125 lb ai/acre) applied postemergence on May 18. Treatments applied May 19 to two-leaf onions included Valor (0.063, 0.094, or 0.125 lb ai/acre) applied either with a non-ionic surfactant (NIS) (0.25 percent v/v) or Buctril (0.15 lb ai/acre), Goal (0.125 lb ai/acre), and Goal plus Buctril. On June 15, Valor or Goal were applied to six-leaf onions. Plots were hand weeded on June 1, July 5 and 16, and August 7 to eliminate competition from escaped weeds.

Weed Control with Postemergence Nitrogen Applications

A trial was conducted to evaluate weed control from postemergence 32 percent N applications in onions. Treatments consisted of 32 percent N applied in a separate application as part of a postemergence herbicide program. Thirty-two percent N was applied at 20 or 30 gal/acre to flag leaf or one-leaf onions on April 26 or May 7, respectively. Treatments using preemergence applications of either Roundup (0.375 lb ai/acre) plus Prowl (1.0 lb ai/acre) or Roundup plus Dacthal (8.0 lb ai/acre) were applied on April 16. Following 32 percent N application, various combinations of Buctril (0.05, 0.15, or 0.25 lb ai/acre), Poast (0.1 lb ai/acre), and Goal (0.125 or 0.25 lb ai/acre) were applied to onions beginning at the two-leaf stage with final application at the six-leaf stage.

Spray Volume Effects on Weed Control and Onion Injury

Weed control and onion injury were evaluated with postemergence applications of Buctril and/or Goal at various rates and with spray volumes of 35 or 100 gal/acre. Treatments included Goal at 0.125 and 0.25 lb ai/acre in both 35 and 100 gal/acre spray volumes. Other treatments were Buctril (0.25 lb ai/acre) applied at both spray volumes; Buctril plus Goal (0.25 lb ai/acre) applied in 100 gal/acre spray volume; and an untreated check. All treatments were applied twice, with the first application made to two-leaf onions (May 19) and the second application applied to four-leaf onions (May 31). The entire experimental area received Roundup (0.375 lb ai/acre) applied preemergence on April 17 and Select (0.125 lb ai/acre) plus crop oil concentrate (1 percent v/v) on May 18. Weed and onion biomass samples were collected from 5-ft

sections of the second row in each plot on July 16. These samples were used to evaluate weed competition effect on onion yield.

Results and Discussion

Soil-Active Herbicides for Weed Control in Onions

All treated plots exhibited injury (7 to 28 percent on May 24 and 13 to 18 percent on June 27) (Table 1). Injury was greatest on May 24 in plots receiving postemergence applications including Buctril applied to two-leaf onions followed by Buctril plus Goal applied to four-leaf onions. Treatments including preemergence and lay-by applications of Prowl or Dacthal provided similar control of redroot pigweed, common lambsquarters, and hairy nightshade (Table 1). The split application of Dacthal (6.0 lb ai/acre) applied at the two-leaf timing and as a lay-by provided greater hairy nightshade control compared to Dacthal (12.0 lb ai/acre) applied only as a lay-by. Dacthal (6.0 lb ai/acre) applied to two-leaf onions and as a lay-by provided greater control of redroot pigweed than Dacthal (8.0 lb ai/acre) preemergence in combination with Dual Magnum or Outlook applied as a lay-by. All treatments gave 90 percent or better control of common lambsquarters; however, Dual Magnum lay-by gave significantly better control of common lambsquarters than did Outlook. Outlook plus Buctril (0.15 lb ai/acre) applied at the two-leaf timing increased hairy nightshade control over Outlook alone and Outlook plus Goal applied to two-leaf onions. Small onion yields were similar among treatments and were greatest for the untreated check (Table 1). Medium onion yields were not significantly different among treatments. In general, plots receiving soil-active herbicide applications included with Buctril plus Poast at the two-leaf application timing produced the greatest onion yields in terms of jumbo, colossal, and total onion yield (Table 1).

Onion Tolerance to Valor Combinations

On May 24, 5 days after the two-leaf application, injury associated with herbicide treatment was significantly greater than the untreated check (Table 2). Crop injury associated with Valor plus NIS treatments ranged from 44 to 49 percent and were similar regardless of application rate. Valor plus NIS produced significantly greater crop injury than all other treatments on May 24. Twelve days after the six-leaf application (June 27) all treatments except Valor (0.063 lb ai/acre) plus Buctril caused significant injury (5 to 11 percent). Injury was not significant for any treatment on July 11. Despite substantial early season injury, onion yields were not different among treatments (Table 2). Although the experimental data show no differences in onion yield, the visual injury associated with Valor treatment was not commercially acceptable.

Weed Control with Postemergence Nitrogen Applications

Late season (September 11) redroot pigweed, common lambsquarters, and hairy nightshade control were highest when Roundup plus Prowl were followed by Buctril (0.05 lb ai/acre) applied to one-leaf onions (Table 3). Total postemergence treatments including 32 percent N provided similar weed control regardless of the number of 32 percent N applications or the application rate. In plots receiving postemergence treatments only, Buctril (0.05 lb ai/acre) applied at the one-leaf timing provided greater

hairy nightshade control at both evaluation dates than 32 percent N applied at the same timing. Onion injury from 32 percent N and/or herbicide treatment was higher than the untreated check 5 days after two-leaf application (May 24) and 12 days after six-leaf application (June 27) (Table 4). There were only slight differences in injury among treatments ranging from 13 to 20 percent on May 24 and 13 to 19 percent on June 27. Small and medium onion yields were highest among the untreated plots and those receiving postemergence applications of 32 percent N at 30 gal/acre applied to one-leaf onions and split applications of 32 percent N at 20 gal/acre applied to flag leaf and one-leaf onions (Table 4). Jumbo onion yields were greatest in plots that received preemergence applications of Roundup plus Prowl with and without buctril applied to one-leaf onions, and those receiving Buctril at the one-leaf timing. Colossal as well as total onion yields were significantly higher with treatments including preemergence applications of Roundup plus Prowl.

Spray Volume Effects on Weed Control and Onion Injury

Onion injury associated with herbicide treatment was significantly greater than the untreated check 5 days after two-leaf application on May 24 (Table 5). Injury ranging from 12 to 26 percent was generally similar among treatments with the highest injury in plots treated with Goal (0.25 lb ai/acre) and Buctril plus Goal each applied in 100 gal/acre spray volume. On June 27, visible injury ranged from 0 to 9 percent and was observed in plots treated with Goal (0.25 lb ai/acre), Buctril (0.25 lb ai/acre) and Buctril plus Goal, all applied in 100 gal/acre spray volume. Redroot pigweed control on both evaluation dates was greatest with treatments including Goal at 0.25 lb ai/acre alone and in combination with Buctril and was not affected by spray volume. Goal applied at 0.25 lb ai/acre provided greater redroot pigweed control on July 17 compared to Goal at 0.125 lb ai/acre regardless of spray volume. Common lambsquarters control was greatest in plots receiving Buctril at 0.25 lb ai/acre and with the tank-mix of Buctril plus Goal (Table 5). Common lambsquarters control on July 11 with Buctril (0.25 lb ai/acre) was 93 percent when applied in 35 gal/acre spray volume compared to 70 percent applied in 100 gal/acre spray volume. Goal provided greater common lambsquarters control when applied at the higher rate regardless of spray volume. All treatments that included Buctril provided greater than 88 and 84 percent hairy nightshade control on June 27 and July 11, respectively (Table 5). Hairy nightshade control with Goal treatments ranged from 34 to 61 percent on June 27 and from 0 to 27 percent on July 11. Total dry weed biomass correlated well with total dry onion yield (Fig. 1).

Table 1. Onion injury, weed control, and yield response to soil-active herbicides, Malheur Experiment Station, Oregon State University, Ontario, OR, 2001.

Treatment	Rate	Timing*	Injury		Weed control†			Onion yield				
			5-24	6-27	Redroot pigweed	Common lambsquarters	Hairy nightshade	Small	Medium	Jumbo	Colossal	Total
	lb ai/acre	Leaf	%					cwt/acre				
Untreated	--	--	0	0	0	0	0	34	0	0	0	34
Hand-Weeded	--	--	0	0	95	98	93	12	57	588	171	837
Roundup + Prowl Buctril + Poast Buctril + Goal Goal + Prowl	0.375 + 0.75 0.15 + 0.1 0.25 + 0.125 0.25 + 0.75	PRE 2-leaf 4-leaf Lay-by	23	17	68	100	72	10	49	634	120	818
Roundup + Dacthal Buctril + Poast Buctril + Goal Goal + Dacthal	0.375 + 8.0 0.15 + 0.1 0.25 + 0.125 0.25 + 8.0	PRE 2-leaf 4-leaf Lay-by	22	15	69	98	73	19	81	598	84	789
Roundup + Dacthal Buctril + Poast Buctril + Goal Goal + Dacthal	0.375 + 10.0 0.15 + 0.1 0.25 + 0.125 0.25 + 12.0	PRE 2-leaf 4-leaf Lay-by	28	15	76	96	73	14	89	669	61	839
Roundup + Prowl Buctril + Poast Buctril + Goal Goal + Dacthal	0.375 + 1.0 0.15 + 0.1 0.25 + 0.125 0.25 + 8.0	PRE 2-leaf 4-leaf Lay-by	22	15	75	100	87	13	64	677	198	960
Roundup + Prowl Buctril + Poast + Dacthal Buctril + Goal Goal + Dacthal	0.375 + 1.0 0.15 + 0.1 + 6.0 0.25 + 0.125 0.25 + 6.0	PRE 2-leaf 4-leaf Lay-by	15	15	85	100	78	13	62	756	209	1047
Roundup + Prowl Buctril + Poast Buctril + Goal Goal + Dacthal	0.375 + 1.0 0.15 + 0.1 0.25 + 0.125 0.25 + 12.0	PRE 2-leaf 4-leaf Lay-by	18	18	73	100	93	11	64	696	152	926
Roundup + Dacthal Buctril + Poast Buctril + Goal Goal + Dacthal	0.375 + 8.0 0.15 + 0.1 0.25 + 0.125 0.25 + 12.0	PRE 2-leaf 4-leaf Lay-by	23	14	73	100	74	18	75	620	125	838

Table 1. *(continued)* Onion injury, weed control, and yield response to soil-active herbicides.

			Injury		Weed control†			Onion yield				
Treatment	Rate	Timing*	5-24	6-27	Redroot pigweed	Common lambsquarters	Hairy nightshade	Small	Medium	Jumbo	Colossal	Total
Roundup + Dacthal Buctril + Poast Buctril + Goal Goal + Dual Magnum	0.375 + 8.0 0.15 + 0.1 0.25 + 0.125 0.25 + 1.3	PRE 2-leaf 4-leaf Lay-by	23	18	73	98	69	11	67	535	64	691
Roundup + Dacthal Buctril + Poast Buctril + Goal Goal + Outlook	0.375 + 8.0 0.15 + 0.1 0.25 + 0.125 0.25 + 0.64	PRE 2-leaf 4-leaf Lay-by	17	15	69	90	70	12	89	611	86	804
Roundup + Prowl Buctril + Poast + Outlook Buctril + Goal Goal	0.375 + 1.0 0.15 + 0.1 + 0.64 0.25 + 0.125 0.25	PRE 2-leaf 4-leaf Lay-by	21	13	75	98	88	9	63	702	156	935
Roundup Prowl Buctril + Poast + Outlook + Prowl Buctril + Goal Goal + Outlook	0.375 0.63 0.15 + 0.3 + 0.33 + 0.63 0.25 + 0.125 0.25 + 0.33	PRE flag leaf 2-leaf 4-leaf Lay-by	27	15	83	100	86	8	37	773	238	1065
Roundup Prowl Outlook Buctril + Goal Goal	0.375 1.0 0.66 0.25 + 0.125 0.25	PRE flag leaf 2-leaf 4-leaf Lay-by	7	15	59	92	64	21	87	562	76	751
Roundup Prowl Buctril + Poast + Outlook Buctril + Goal Goal	0.375 1.0 0.15 + 0.66 + 0.38 0.25 + 0.125 0.25	PRE flag leaf 2-leaf 4-leaf Lay-by	27	15	69	100	98	9	42	734	214	1009
Roundup Prowl Poast + Outlook + Goal Buctril + Goal Goal	0.375 1.0 0.38 + 0.66 + 0.125 0.25 + 0.125 0.25	PRE flag leaf 2-leaf 4-leaf Lay-by	21	15	85	100	73	10	57	712	191	977
LSD (0.05)			6	4	12	6	13	12	NS	100	123	142

*Preemergence (PRE) treatment applied on April 16, flag leaf on April 23, two-leaf (2-leaf) on May 19, four-leaf (4-leaf) on May 31, and lay-by on June 15.
†Weed control ratings were taken June 27.

Table 2. Onion tolerance to Valor combinations, Malheur Experiment Station, Oregon State University, Ontario, OR, 2001.

			Onion injury			Onion yield‡				
Treatment*	Rate	Timing†	5-24	6-27	7-11	Small	Medium	Jumbo	Colossal	Total
	lb ai/acre	Leaf	%			cwt/acre				
Untreated	--	--	4	0	4	11	71	679	122	892
Valor + NIS Valor	0.063 0.063	2-leaf 6-leaf	49	10	0	11	45	738	236	1049
Valor + NIS Valor	0.094 0.094	2-leaf 6-leaf	46	9	5	11	59	734	140	959
Valor + NIS Valor	0.125 0.125	2-leaf 6-leaf	44	11	0	7	45	701	276	1041
Buctril + Valor Valor	0.15 + 0.063 0.063	2-leaf 6-leaf	32	5	3	6	47	786	199	1051
Buctril + Valor Valor	0.15 + 0.094 0.094	2-leaf 6-leaf	30	10	1	6	52	738	192	1001
Goal Goal	0.125 0.125	2-leaf 6-leaf	18	11	0	10	49	718	234	1029
Buctril + Goal Goal	0.15 + 0.125 0.125	2-leaf 6-leaf	28	8	0	7	57	717	200	987
LSD (0.05)			11	5	NS	NS	NS	NS	NS	NS

*All plots except the untreated received Roundup preemergence on April 17. Non-ionic surfactant (NIS) applied at 0.25 percent v/v.
†Treatments were applied on May 19 and June 15 to two-leaf (2-leaf) and six-leaf (6-leaf) onions, respectively.
‡Onions were harvested September 18.

Table 3. Weed control with postemergence nitrogen applications, Malheur Experiment Station, Oregon State University, Ontario, OR, 2001.

			Weed control					
			Redroot pigweed		Common lambsquarters		Hairy nightshade	
Treatment	Rate	Timing*	6-27	9-11	6-27	9-11	6-27	9-11
	lb ai/acre	Leaf	%					
Untreated	--	--	0	0	0	0	0	0
32% N Buctril + Poast Goal Buctril + Goal Goal	20 gal/acre 0.15 + 0.1 0.125 0.25 + 0.125 0.25	1-leaf 2-leaf 3-leaf 4-leaf 6-leaf	94	55	86	86	62	8
Roundup + Prowl 32% N Buctril + Poast Goal Buctril + Goal Goal	0.375 + 1.0 20 gal/acre 0.15 + 0.1 0.125 0.25 + 0.125 0.25	PRE 1-leaf 2-leaf 3-leaf 4-leaf 6-leaf	98	69	100	100	97	68
Roundup + Dacthal 32% N Buctril + Poast Goal Buctril + Goal Goal	0.375 + 8.0 20 gal/acre 0.15 + 0.1 0.125 0.25 + 0.125 0.25	PRE 1-leaf 2-leaf 3-leaf 4-leaf 6-leaf	92	56	91	84	78	10
Buctril Buctril + Poast Goal Buctril + Goal Goal	0.05 0.15 + 0.1 0.125 0.25 + 0.125 0.25	1-leaf 2-leaf 3-leaf 4-leaf 6-leaf	98	60	86	80	86	36
Roundup + Prowl Buctril Buctril + Poast Goal Buctril + Goal Goal	0.375 + 1.0 0.05 0.15 + 0.1 0.125 0.25 + 0.125 0.25	PRE 1-leaf 2-leaf 3-leaf 4-leaf 6-leaf	99	87	100	100	99	93
32% N 32% N Buctril + Poast Goal Buctril + Goal Goal	20 gal/acre 20 gal/acre 0.15 + 0.1 0.125 0.25 + 0.125 0.25	flag 1-leaf 2-leaf 3-leaf 4-leaf 6-leaf	100	58	74	66	62	8
32% N Buctril + Poast Goal Buctril + Goal Goal	30 gal/acre 0.15 + 0.1 0.125 0.25 + 0.125 0.25	1-leaf 2-leaf 3-leaf 4-leaf 6-leaf	97	58	81	56	64	5
LSD (0.05)			4	27	12	25	8	20

*Treatments were applied preemergence (PRE) on April 16, flag leaf on April 26, one-leaf (1-leaf) on May 7, two-leaf (2-leaf) on May 19, three-leaf (3-leaf) on May 24, four-leaf (4-leaf) on May 31, and six-leaf (6-leaf) on June 15, 2001.

Table 4. Onion injury and yield with postemergence nitrogen applications, Malheur Experiment Station, Oregon State University, Ontario, OR, 2001.

			Onion injury		Onion yield†				
Treatment	Rate	Timing*	5-24	6-27	Small	Medium	Jumbo	Colossal	Total
	lb ai/acre	Leaf	%		cwt/acre				
Untreated	--	--	0	0	42	5	0	0	47
32% N	20 gal/acre	1-leaf	13	15	18	141	488	27	682
Buctril + Poast	0.15 + 0.1	2-leaf							
Goal	0.125	3-leaf							
Buctril + Goal	0.25 + 0.125	4-leaf							
Goal	0.25	6-leaf							
Roundup + Prowl	0.375 + 1.0	PRE	20	17	10	61	741	249	1074
32% N	20 gal/acre	1-leaf							
Buctril + Poast	0.15 + 0.1	2-leaf							
Goal	0.125	3-leaf							
Buctril + Goal	0.25 + 0.125	4-leaf							
Goal	0.25	6-leaf							
Roundup + Dacthal	0.375 + 8.0	PRE	20	15	12	90	636	94	838
32% N	20 gal/acre	1-leaf							
Buctril + Poast	0.15 + 0.1	2-leaf							
Goal	0.125	3-leaf							
Bucril + Goal	0.25 + 0.125	4-leaf							
Goal	0.25	6-leaf							
Buctril	0.05	1-leaf	20	17	16	84	699	105	911
Buctril + Poast	0.15 + 0.1	2-leaf							
Goal	0.125	3-leaf							
Buctril + Goal	0.25 + 0.125	4-leaf							
Goal	0.25	6-leaf							
Roundup + Prowl	0.375 + 1.0	PRE	18	19	12	59	767	255	1107
Buctril	0.05	1-leaf							
Buctril + Poast	0.15 + 0.1	2-leaf							
Goal	0.125	3-leaf							
Buctril + Goal	0.25 + 0.125	4-leaf							
Goal	0.25	6-leaf							
32% N	20 gal/acre	flag	16	13	37	179	384	11	613
32% N	20 gal/acre	1-leaf							
Buctril + Poast	0.15 + 0.1	2-leaf							
Goal	0.125	3-leaf							
Buctril + Goal	0.25 + 0.125	4-leaf							
Goal	0.25	6-leaf							
32% N	30 gal/acre	1-leaf	18	15	29	163	419	22	635
Buctril + Poast	0.15 + 0.1	2-leaf							
Goal	0.125	3-leaf							
Buctril + Goal	0.25 + 0.125	4-leaf							
Goal	0.25	6-leaf							
LSD (0.05)			6	3	15	41	112	70	110

*Treatments were applied preemergence (PRE) on April 16, flag leaf on April 26, one-leaf (1-leaf) on May 7, two-leaf (2-leaf) on May 19, three-leaf (3-leaf) on May 24, four-leaf (4-leaf) on May 31, and six-leaf (6-leaf) on June 15, 2001.
†Onions were harvested September 18.

Table 5. Spray volume effects on weed control and onion injury, Malheur Experiment Station, Oregon State University, Ontario, OR, 2001.

						Weed control					
				Onion injury		Redroot pigweed		Common lambsquarters		Hairy nightshade	
Treatment*	Rate	Spray Volume	Timing†	5-24	6-27	6-27	7-11	6-27	7-11	6-27	7-11
	lb ai/acre	gal/acre	Leaf	%							
Untreated	--	--	--	0	0	0	0	0	0	0	0
Goal	0.125	35	2-lf & 4-lf	17	0	54	49	51	41	48	27
Goal	0.25	35	2-lf & 4-lf	20	0	83	85	83	82	34	0
Goal	0.125	100	2-lf & 4-lf	21	0	62	60	63	53	56	15
Goal	0.25	100	2-lf & 4-lf	26	4	83	81	81	79	61	22
Buctril	0.25	35	2-lf & 4-lf	12	0	34	15	100	93	88	84
Buctril	0.25	100	2-lf & 4-lf	18	2	39	28	74	70	97	93
Buctril + Goal	0.25 + 0.25	100	2-lf & 4-lf	23	9	97	91	96	96	88	91
LSD (0.05)				10	3	16	20	14	21	19	32

*All plots received Roundup (0.375 lb ai/acre) preemergence on April 14 and Select (0.125 lb ai/acre) plus Crop Oil Concentrate (1 percent v/v) on May 18.
†Applications were made to two-leaf (2-lf) onions May 19 and to four-leaf (4-lf) onions on May 31.

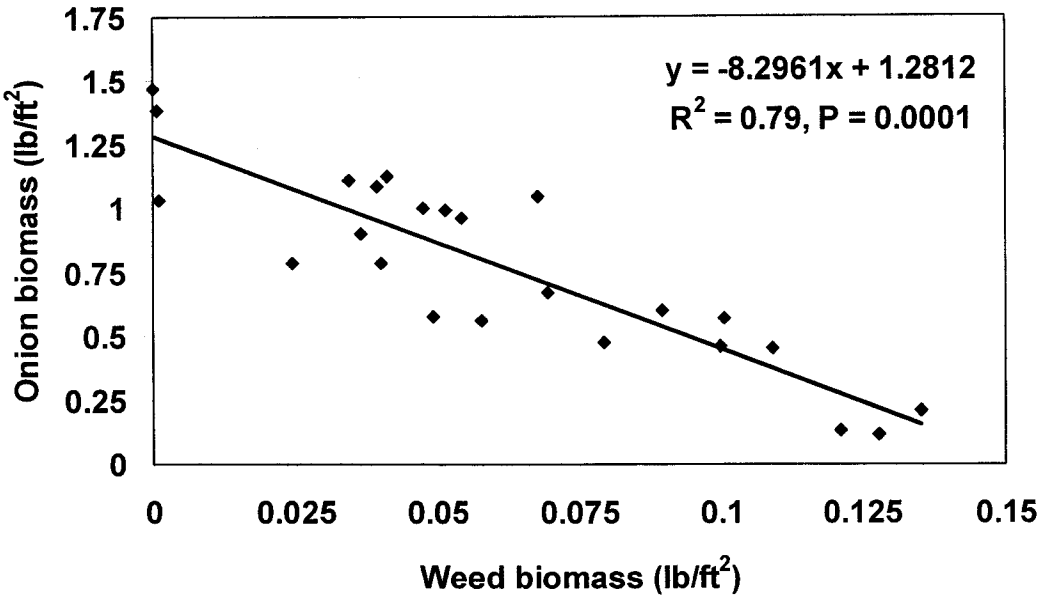

Figure 1. Relationship of total dry weed biomass versus total dry onion biomass in spray volume study, Malheur Experiment Station, Oregon State University, Ontario, OR, 2001.