

## HERBICIDE EVALUATION FOR WEED CONTROL IN ROUNDUP READY® SUGAR BEET

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Ontario, OR, 2009

### Introduction

The introduction of Roundup Ready® sugar beets presents an opportunity for growers to employ a total postemergence (POST) weed management program. If root yields are to be maximized, the total POST weed management program will require diligent monitoring of weed cohorts that emerge in succession. Use of soil-applied herbicides is a practical way to minimize selection of glyphosate-resistant weed biotypes and a viable practice to provide sustainable weed control. The objective of this study was to determine crop response to tank mixtures of soil-residual herbicides in combination with glyphosate to control weeds in Roundup Ready sugar beets.

### Materials and Methods

A field experiment was conducted in 2009 at the Malheur Experiment Station, Ontario, Oregon to evaluate glyphosate tank mixtures with soil-active herbicides for crop injury and weed control in Roundup Ready® sugar beet. Treatments were arranged in a randomized complete block design with four replications. Individual plots were 7.33 ft wide (4 rows) by 30 ft. Soil type was Owyhee silt loam (pH 7.4, 1.74 percent organic matter, and cation exchange capacity [CEC] 14 meq/kg). Roundup Ready sugar beet variety 'BTS 26R14' was planted on April 4, 2009, using tractor-mounted flexi-planter units with double-disc furrow openers and cone seeders fed from a spinner divider that uniformly distributed the seeds within the row. Sugar beet seeds were dropped at the rate of 4 seeds/ft of row and later thinned to 8-inch spacing between plants within a row. Terbufos 1.11 lb ai/acre (Counter® 15G at 7.4 lb/acre) was applied on April 17 and aldicarb 1.5 lb ai/acre (Temik® 15G at 10 lb/acre) on June 4, 2009. Sugar beets were fertilized on June 10 using a custom blended fertilizer to supply 175 lb urea (nitrogen)/acre and 2 lb zinc/acre. The study was irrigated on a calendar schedule to maintain moisture in the top 12 inches of the soil profile. Herbicide treatments were applied using a CO<sub>2</sub>-pressurized backpack sprayer with a boom equipped with four 8002EVS Teejet nozzles calibrated to deliver 12 gal/acre at 35 psi at 3 mph.

Early POST treatments (sugar beet at 2-leaf stage) were applied on May 13, while POST treatments (sugar beet at 4-leaf stage) were applied on May 27 followed by a second POST application (sugar beet at 8-leaf stage) on June 8. Plants within each plot were visually evaluated for crop injury and weed control starting on June at 7 and 14 days after the last POST herbicide application using a scale of 0 percent (no crop injury

or no weed control) to 100 percent (complete crop kill or complete weed control). Sugar beets were harvested on October 20 from 30 ft of the two center rows using a beet harvester. Sugar beet weight from each plot was multiplied by a factor of 0.90 to correct for tare. Sugar content and other sugar yield variables were determined in a laboratory at the Amalgamated Sugar Factory in Nampa, Idaho. Sugar concentrations were determined by multiplying the measured sucrose by 0.98 to estimate the sugar that would have been lost to respiration if the beets had been stored in a pile. The percent sugar extraction was calculated using the formula:

$$Ext = \frac{250 + [(1,255.2 * Cond) - (15,000 * Sug) - 6,185]}{Sug * (98.66 - 7.845 * Cond)}$$

Where *Ext* is percent sugar extraction, *Cond* is the electrical conductivity in mmho, and *Sug* is the percent sucrose concentration. The data were subjected to analysis of variance and means compared using the least significant difference (LSD, P = 0.05).

## Results and Discussion

The herbicides tested caused very little or no injury to glyphosate-tolerant sugar beet (Tables 1 and 3). A single glyphosate application had the lowest overall weed control (Tables 1 and 2). Evaluations on June 15 indicated 86 to 94 percent control for common lambsquarters, 95 to 100 percent for hairy nightshade, and 99 to 100 percent for redroot pigweed (Table 1). Weed control on June 22 was still excellent for common lambsquarters, hairy nightshade, barnyardgrass, and redroot pigweed (Table 2). However, control for black medic was 63 to 90 percent and poorest when glyphosate was applied alone and sugar beets were at the 2-leaf stage. Late season visual evaluations on August 11 indicated 98 to 100 percent control for common lambsquarters and redroot pigweed (Table 3), while control for hairy nightshade ranged from 78 to 100 percent. Late season control for barnyardgrass was 75 to 100 percent. Overall, the best weed control was obtained when glyphosate was applied multiple times, with the intermediate application including a soil-residual herbicide.

The highest root yield was obtained when glyphosate was applied at the 2-leaf and 6-leaf sugar beet growth stage (Table 4). A single application of glyphosate at 0.75 lb ae/acre (Roundup PowerMax<sup>®</sup> at 22 fl oz/acre) tank mixed with s-metolachlor at 1.25 lb ai/acre (Dual Magnum<sup>®</sup> at 1.31 pt/acre), cycloate at 3 lb ai/acre (Ro-Neet<sup>®</sup> at 4 pt/acre), or clopyralid at 0.25 lb ai/acre (Stinger<sup>®</sup> at 10.7 fl oz/acre) provided root yield similar to two or three applications of glyphosate alone. Application of glyphosate alone when sugar beets were at the 2-leaf stage followed by glyphosate mixed with either dimethenamid-p at 0.98 lb ai/acre (Outlook<sup>®</sup> at 21 fl oz/acre), EPTC at 3 lb ai/acre (Eptam<sup>®</sup> at 3.43 pt/acre), cycloate, or clopyralid provided similar yield as three applications of glyphosate with the terminal timing including a soil-residual herbicide. There was no clear response pattern for percent root sugar content. Consequently, the estimated recoverable sugar was largely influenced by the observed root yield.

Use of soil-residual herbicides is encouraged as a strategy against selection of glyphosate-resistant weeds.

Table 1. Weed control on June 15 and sugar beet response to different herbicides at the Malheur Experiment Station, Ontario, OR, 2009.

Treatment	Rate	Timing <sup>a</sup>	Sugar beet injury <sup>b</sup>	Weed control <sup>b</sup>		
				Common lambsquarters	Hairy nightshade	Redroot pigweed
Glyphosate	22 fl oz/a	2-leaf	0 c	88 def	93 c	90 b
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	2-leaf	0 c	88 def	100 a	100 a
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	6-leaf				
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	2-leaf	0 c	89 c-f	100 a	100 a
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	6-leaf				
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	10-leaf				
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	2-leaf	0 c	90 b-e	99 a	99 a
Ammonium sulfate	2.4 pt/a					
Outlook	21 fl oz/a					
Glyphosate	22 fl oz/a	2-leaf	0 c	91 a-d	100 a	100 a
Ammonium sulfate	2.4 pt/a					
Outlook	21 fl oz/a	6-leaf				
Glyphosate	22 fl oz/a					
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	2-leaf	0 c	95 a	100 a	100 a
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	6-leaf				
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	10-leaf				
Ammonium sulfate	2.4 pt/a					
Outlook	21 fl oz/a					
Glyphosate	22 fl oz/a	2-leaf	0 c	89 c-f	95 bc	98 a
Ammonium sulfate	2.4 pt/a					
Nortron	32 fl oz/a					
Glyphosate	22 fl oz/a		0 c	90 b-e	99 a	100 a
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	6-leaf				
Ammonium sulfate	2.4 pt/a					
Nortron	32 fl oz/a					
Glyphosate	22 fl oz/a	2-leaf	0 c	90 b-e	100 a	100 a
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	6-leaf				
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	10-leaf				
Ammonium sulfate	2.4 pt/a					
Nortron	32 fl oz/a					
Glyphosate	22 fl oz/a	2-leaf	0 c	85 f	99 a	100 a
Ammonium sulfate	2.4 pt/a					
Dual Magnum	1.31 pt/a					
Glyphosate	22 fl oz/a	2-leaf	0 c	91 a-d	100 a	100 a
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	6-leaf				
Ammonium sulfate	2.4 pt/a					
Dual Magnum	1.31 pt/a					

Table 1 continued.....

Treatment	Rate	Timing <sup>a</sup>	Sugar beet injury <sup>b</sup>	Weed control <sup>b</sup>		
				Common lambsquarters	Hairy nightshade	Redroot pigweed
				%		
Glyphosate	22 fl oz/a	2-leaf	0 c	94 ab	100 a	100 a
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	6-leaf				
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	10-leaf				
Ammonium sulfate	2.4 pt/a					
Dual Magnum	1.31 pt/a					
Glyphosate	22 fl oz/a	2-leaf	0 c	86 ef	98 ab	100 a
Ammonium sulfate	2.4 pt/a					
Eptam	55 fl oz/a					
Glyphosate	22 fl oz/a	2-leaf	0 c	90 b-e	100 a	100 a
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	6-leaf				
Ammonium sulfate	2.4 pt/a					
Eptam	55 fl oz/a					
Glyphosate	22 fl oz/a	2-leaf	0 c	93 abc	100 a	100 a
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	6-leaf				
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	10-leaf				
Ammonium sulfate	2.4 pt/a					
Eptam	55 fl oz/a					
Glyphosate	22 fl oz/a	2-leaf	0 c	91 a-d	98 ab	99 a
Ammonium sulfate	2.4 pt/a					
Ro-Neet	64 fl oz/a					
Glyphosate	22 fl oz/a	2-leaf	4 b	93 abc	100 a	100 a
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	6-leaf				
Ammonium sulfate	2.4 pt/a					
Ro-Neet	64 fl oz/a					
Glyphosate	22 fl oz/a	2-leaf	7 a	93 abc	100 a	100 a
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	6-leaf				
Ammonium sulfate	2.4 pt/a					
Glyphosate	22 fl oz/a	10-leaf				
Ammonium sulfate	2.4 pt/a					
Ro-Neet	64 fl oz/a					
Glyphosate	22 fl oz/a	2-leaf	0 c	90 b-e	100 a	100 a
Ammonium sulfate	2.4 pt/a					
Stinger	10.7 fl oz/a					
Ammonium sulfate	2.4 pt/a	2-leaf	3 b	91 a-d	100 a	100 a
Glyphosate	22 fl oz/a					
Ammonium sulfate	2.4 pt/a	6-leaf				
Glyphosate	22 fl oz/a					
Stinger	10.7 fl oz/a					
Ammonium sulfate	2.4 pt/a	2-leaf	3 b	93 abc	100 a	100 a
Glyphosate	22 fl oz/a					
Ammonium sulfate	2.4 pt/a	6-leaf				
Glyphosate	22 fl oz/a					
Ammonium sulfate	2.4 pt/a	10-leaf				
Glyphosate	22 fl oz/a					
Stinger	10.7 fl oz/a					
Untreated check			0 c	0 g	0 d	0 c

<sup>a</sup>2-leaf = sugar beet at two leaf stage; 6-leaf = sugar beet at six leaf stage; 10-leaf = sugar beet at ten leaf stage.

<sup>b</sup>Means within a column followed by same letter do not significantly differ (P = 0.05, LSD).

Table 2. Weed control in sugar beet on June 22 in response to different herbicides at the Malheur Experiment Station, Ontario, OR, 2009.

Treatment	Rate	Timing <sup>a</sup>	Weed control <sup>b</sup>				
			Common lambquarters	Hairy nightshade	Barnyard- grass	Redroot pigweed	Black medic
Glyphosate	22 fl oz/a	2-leaf	95 c	95 b	91 b	93 c	60 h
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	2-leaf	98 abc	100 a	98 a	100 a	76 c-f
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	2-leaf	100 a	100 a	100 a	100 a	86 abc
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	10-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	2-leaf	98 abc	99 a	100 a	99 ab	73 efg
Ammonium sulfate	2.4 pt/a						
Outlook	21 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	100 a	100 a	100 a	100 a	84 a-e
Ammonium sulfate	2.4 pt/a						
Outlook	21 fl oz/a	6-leaf					
Glyphosate	22 fl oz/a						
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	2-leaf	100 a	100 a	100 a	100 a	90 a
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	10-leaf					
Ammonium sulfate	2.4 pt/a						
Outlook	21 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	95 c	95 b	96 a	98 b	74 d-g
Ammonium sulfate	2.4 pt/a						
Nortron	32 fl oz/a						
Glyphosate	22 fl oz/a		99 ab	99 a	100 a	100 a	83 a-e
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Nortron	32 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	100 a	100 a	100 a	100 a	85 a-d
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	10-leaf					
Ammonium sulfate	2.4 pt/a						
Nortron	32 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	98 abc	99 a	96 a	100 a	66 fgh
Ammonium sulfate	2.4 pt/a						
Dual Magnum	1.31 pt/a						
Glyphosate	22 fl oz/a	2-leaf	100 a	100 a	100 a	100 a	88 abc
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Dual Magnum	1.31 pt/a						

Table 2 Continued.....

Treatment	Rate	Timing <sup>a</sup>	Weed control <sup>b</sup>				
			Common lambquarters	Hairy nightshade	Barnyard- grass	Redroot pigweed	Black medic
Glyphosate	22 fl oz/a	2-leaf	100 a	100 a	100 a	100 a	90 a
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	10-leaf					
Ammonium sulfate	2.4 pt/a						
Dual Magnum	1.31 pt/a						
Glyphosate	22 fl oz/a	2-leaf	95 c	98 ab	98 a	100 a	60 h
Ammonium sulfate	2.4 pt/a						
Eptam	55 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	99 ab	100 a	100 a	100 a	78 b-f
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Eptam	55 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	99 ab	100 a	100 a	100 a	84 a-e
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	10-leaf					
Ammonium sulfate	2.4 pt/a						
Eptam	55 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	96 bc	98 ab	98 a	99 ab	63 gh
Ammonium sulfate	2.4 pt/a						
Ro-Neet	64 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	100 a	100 a	99 a	100 a	82 a-e
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Ro-Neet	64 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	100 a	100 a	100 a	100 a	89 ab
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	10-leaf					
Ammonium sulfate	2.4 pt/a						
Ro-Neet	64 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	99 ab	100 a	98 a	100 a	89 ab
Ammonium sulfate	2.4 pt/a						
Stinger	10.7 fl oz/a						
Ammonium sulfate	2.4 pt/a	2-leaf	100 a	100 a	100 a	100 a	91 a
Glyphosate	22 fl oz/a						
Ammonium sulfate	2.4 pt/a	6-leaf					
Glyphosate	22 fl oz/a						
Stinger	10.7 fl oz/a						
Ammonium sulfate	2.4 pt/a	2-leaf	100 a	100 a	100 a	100 a	90 a
Glyphosate	22 fl oz/a						
Ammonium sulfate	2.4 pt/a	6-leaf					
Glyphosate	22 fl oz/a						
Ammonium sulfate	2.4 pt/a	10-leaf					
Glyphosate	22 fl oz/a						
Stinger	10.7 fl oz/a						
Untreated check			0 d	0 c	0 c	0 d	0 i

<sup>a</sup>2-leaf = sugar beet at two leaf stage; 6-leaf = sugar beet at six leaf stage; 10-leaf = sugar beet at ten leaf stage.

<sup>b</sup>Means within a column followed by same letter do not significantly differ (P = 0.05, LSD).

Table 3. Weed control on August 11 and sugar beet response to different herbicides at the Malheur Experiment Station, Ontario, OR, 2009.

Treatment	Rate	Timing <sup>a</sup>	Sugar beet injury <sup>b</sup>	Weed control <sup>b</sup>			
				Common lambsquarters	Hairy nightshade	Barnyard-grass	Redroot pigweed
Glyphosate	22 fl oz/a	2-leaf	0 b	100 a	100 a	78 b	100 a
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	2-leaf	0 b	100 a	100 a	98 a	100 a
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	2-leaf	0 b	100 a	100 a	100 a	100 a
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	10-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	2-leaf	0 b	100 a	98 a	100 a	99 b
Ammonium sulfate	2.4 pt/a						
Outlook	21 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	0 b	100 a	100 a	100 a	100 a
Ammonium sulfate	2.4 pt/a						
Outlook	21 fl oz/a	6-leaf					
Glyphosate	22 fl oz/a						
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	2-leaf	0 b	100 a	100 a	100 a	100 a
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	10-leaf					
Ammonium sulfate	2.4 pt/a						
Outlook	21 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	0 b	100 a	78 c	75 b	100 a
Ammonium sulfate	2.4 pt/a						
Nortron	32 fl oz/a						
Glyphosate	22 fl oz/a		0 b	100 a	100 a	100 a	100 a
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Nortron	32 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	0 b	100 a	100 a	100 a	100 a
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	10-leaf					
Ammonium sulfate	2.4 pt/a						
Nortron	32 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	0 b	100 a	80 bc	98 a	100 a
Ammonium sulfate	2.4 pt/a						
Dual Magnum	1.31 pt/a						
Glyphosate	22 fl oz/a	2-leaf	0 b	100 a	100 a	100 a	100 a
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Dual Magnum	1.31 pt/a						

Table 3 Continued.....

Treatment	Rate	Timing <sup>a</sup>	Sugar beet	Weed control <sup>b</sup>			
			injury <sup>b</sup>	Common lambsquarters	Hairy nightshade	Barnyard- grass	Redroot pigweed
				%			
Glyphosate	22 fl oz/a	2-leaf	0 b	100 a	100 a	100 a	100 a
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	10-leaf					
Ammonium sulfate	2.4 pt/a						
Dual Magnum	1.31 pt/a						
Glyphosate	22 fl oz/a	2-leaf	0 b	96 b	91 ab	96 a	100 a
Ammonium sulfate	2.4 pt/a						
Eptam	55 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	0 b	100 a	100 a	100 a	100 a
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Eptam	55 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	0 b	100 a	100 a	100 a	100 a
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	10-leaf					
Ammonium sulfate	2.4 pt/a						
Eptam	55 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	0 b	98 b	98 a	95 a	100 a
Ammonium sulfate	2.4 pt/a						
Ro-Neet	64 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	0 b	100 a	100 a	100 a	100 a
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Ro-Neet	64 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	0 b	100 a	100 a	100 a	100 a
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	10-leaf					
Ammonium sulfate	2.4 pt/a						
Ro-Neet	64 fl oz/a						
Ammonium sulfate	2.4 pt/a	2-leaf	0 b	98 b	99 a	86 ab	99 b
Glyphosate	22 fl oz/a						
Stinger	10.7 fl oz/a						
Ammonium sulfate	2.4 pt/a	2-leaf	0 b	100 a	100 a	99 a	100 a
Glyphosate	22 fl oz/a						
Ammonium sulfate	2.4 pt/a	6-leaf					
Glyphosate	22 fl oz/a						
Stinger	10.7 fl oz/a						
Ammonium sulfate	2.4 pt/a	2-leaf	0 b	100 a	100 a	100 a	100 a
Glyphosate	22 fl oz/a						
Ammonium sulfate	2.4 pt/a	6-leaf					
Glyphosate	22 fl oz/a						
Ammonium sulfate	2.4 pt/a	10-leaf					
Glyphosate	22 fl oz/a						
Stinger	10.7 fl oz/a						
Untreated check			38 a	0 c	0 d	0 c	0 c

<sup>a</sup>2-leaf = sugar beet at two leaf stage; 6-leaf = sugar beet at six leaf stage; 10-leaf = sugar beet at ten leaf stage.

<sup>b</sup>Means within a column followed by same letter do not significantly differ (P = 0.05, LSD).



Table 4. Sugar beet yield and sugar components in response to different herbicides at the Malheur Experiment Station, Ontario, OR, 2009.

Treatment	Rate	Timing <sup>a</sup>	Sugar beet yield <sup>b</sup> t/acre	Sugar components <sup>b</sup>			
				Sugar content %	Conductivity mmhos	Extractable sugar %	Estimated Rec. sugar lbs/acre
Glyphosate	22 fl oz/a	2-leaf	48.1 bcd	15.15 ab	0.923 a-e	82.3 a-f	12002 a-d
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	2-leaf	54.4 a	14.93 abc	0.913 a-e	82.4 a-f	13360 a
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	2-leaf	51.4 abc	15.17 ab	0.938 a-d	82.1 a-f	12806 abc
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	10-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	2-leaf	48.8 bcd	15.41 a	0.905 a-e	82.6 a-e	12412 a-d
Ammonium sulfate	2.4 pt/a						
Outlook	21 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	49.5 a-d	14.63 abc	1.003 a	81.1 ef	11739 bcd
Ammonium sulfate	2.4 pt/a						
Outlook	21 fl oz/a	6-leaf					
Glyphosate	22 fl oz/a						
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	2-leaf	51.9 ab	15.20 ab	0.870 cde	83.0 abc	13084 ab
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	10-leaf					
Ammonium sulfate	2.4 pt/a						
Outlook	21 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	49.2 bcd	14.78 abc	0.893 b-e	82.6 a-e	11992 a-d
Ammonium sulfate	2.4 pt/a						
Nortron	32 fl oz/a						
Glyphosate	22 fl oz/a		45.0 d	15.18 ab	0.915 a-e	82.4 a-f	11345 cd
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Nortron	32 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	50.5 abc	15.01 ab	0.890 b-e	82.7 a-d	12548 a-d
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	10-leaf					
Ammonium sulfate	2.4 pt/a						
Nortron	32 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	51.2 abc	14.66 abc	0.963 abc	81.6 c-f	12282 a-d
Ammonium sulfate	2.4 pt/a						
Dual Magnum	1.31 pt/a						
Glyphosate	22 fl oz/a	2-leaf	49.6 a-d	14.82 abc	0.930 a-e	82.1 a-f	12044 a-d
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Dual Magnum	1.31 pt/a						

Table 4 Continued.....

Treatment	Rate	Timing <sup>a</sup>	Sugar beet yield <sup>b</sup> t/acre	Sugar components <sup>b</sup>			
				Sugar content %	Conductivity mmhos	Extractable sugar %	Estimated Rec. sugar lbs/acre
Glyphosate	22 fl oz/a	2-leaf	50.7 abc	15.17 ab	0.825 e	83.6 a	12851.9 ab
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	10-leaf					
Ammonium sulfate	2.4 pt/a						
Dual Magnum	1.31 pt/a						
Glyphosate	22 fl oz/a	2-leaf	46.5 cd	14.76 abc	0.948 a-d	81.8 b-f	11216.7 d
Ammonium sulfate	2.4 pt/a						
Eptam	55 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	49.6 a-d	15.27 a	0.860 cde	83.2 abc	12581.9 a-d
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Eptam	55 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	50.5 abc	15.15 ab	0.940 a-d	82.1 a-f	12554.9 a-d
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	10-leaf					
Ammonium sulfate	2.4 pt/a						
Eptam	55 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	50.1 a-d	15.00 ab	0.910 a-e	82.4 a-f	12379.8 a-d
Ammonium sulfate	2.4 pt/a						
Ro-Neet	64 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	49.9 a-d	15.31 a	0.850 de	83.3 ab	12715.6 a-d
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Ro-Neet	64 fl oz/a						
Glyphosate	22 fl oz/a	2-leaf	49.9 a-d	15.18 ab	0.880 b-e	82.9 a-d	12556.2 a-d
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	6-leaf					
Ammonium sulfate	2.4 pt/a						
Glyphosate	22 fl oz/a	10-leaf					
Ammonium sulfate	2.4 pt/a						
Ro-Neet	64 fl oz/a						
Ammonium sulfate	2.4 pt/a	2-leaf	49.5 a-d	14.13 c	1.005 a	80.9 f	11320.2 cd
Glyphosate	22 fl oz/a						
Stinger	10.7 fl oz/a						
Ammonium sulfate	2.4 pt/a	2-leaf	50.8 abc	14.40 bc	0.945 a-d	81.8 b-f	11959.7 a-d
Glyphosate	22 fl oz/a						
Ammonium sulfate	2.4 pt/a	6-leaf					
Glyphosate	22 fl oz/a						
Stinger	10.7 fl oz/a						
Ammonium sulfate	2.4 pt/a	2-leaf	51.3 abc	14.86 abc	0.960 abc	81.7 c-f	12462.8 a-d
Glyphosate	22 fl oz/a						
Ammonium sulfate	2.4 pt/a	6-leaf					
Glyphosate	22 fl oz/a						
Ammonium sulfate	2.4 pt/a	10-leaf					
Glyphosate	22 fl oz/a						
Stinger	10.7 fl oz/a						
Untreated check			9.3 e	14.79 abc	0.985 ab	81.4 def	2234.2 e

<sup>a</sup>2-leaf = sugar beet at two leaf stage; 6-leaf = sugar beet at six leaf stage; 10-leaf = sugar beet at ten leaf stage.

<sup>b</sup>Means within a column followed by same letter do not significantly differ (P = 0.05, LSD).