

INFLUENCE OF SOIL-ACTIVE HERBICIDES ON WEED CONTROL WITH MICRO-RATE HERBICIDE PROGRAMS IN SUGAR BEET

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Introduction

Trials were initiated to examine weed control and crop response associated with soil-active herbicides applied postemergence as part of a three- or four-application micro-rate program. The soil-active herbicides evaluated were Outlook (dimethenamid-P), Dual Magnum (s-metolachlor), and Nortron (ethofumesate). Nortron can be applied pre-plant incorporated (PPI), preemergence (PRE), or postemergence (POST) in sugar beet. Outlook is labeled in sugar beet for POST applications only to two-leaf or larger beets. Dual Magnum received a sugar beet label in 2003 for PPI, PRE, and POST applications but due to injury concerns the future status of PPI and PRE applications are uncertain.

Methods

This trial was established at the Malheur Experiment Station under furrow irrigation on April 4, 2003. Sugar beets (Hilleshog 'PM-21') were planted in 22-inch rows at a 2-inch seed spacing. On April 3, kochia, pigweed, and hairy nightshade seed was spread over the entire experimental area to promote an even weed distribution. After planting, the trial was corrugated and Counter 20 CR was applied in a 7-inch band over the row at 6 oz/1,000 ft of row. Sugar beets were thinned to 8-inch spacing on May 13. Plots were sidedressed on June 3 with 176 lb nitrogen (urea), 96 lb phosphate, 100 lb potash, 38 lb sulfates, 62 lb elemental sulfur, 2 lb zinc, and 1 lb/acre boron. All plots were treated with Roundup (0.75 lb ai/acre) prior to sugar beet emergence on April 11. On May 16, Temik 15G (14 lb/acre) was applied for sugar beet root maggot control. For powdery mildew control, Headline (12 fl oz/acre) was applied on June 17 and again on July 2 with Super Six liquid sulfur (16 pt/acre) and Topsin M (0.5 lb prod/acre) was applied on August 4. All fungicide treatments were applied by air. Herbicide treatments were broadcast-applied with a CO₂-pressurized backpack sprayer calibrated to deliver 20 gal/acre at 30 psi. Plots were four rows wide and 27 ft long and treatments were arranged in a randomized complete block design with four replicates.

Micro-rate treatments were applied three or four times. Dual Magnum (21 oz ai/acre), Nortron (16 oz ai/acre), or Outlook (10 oz ai/acre) were applied in the second application to provide residual control of later germinating weeds. All treatments were compared to the micro-rate applied three or four times and to a standard herbicide treatment applied three times. Micro-rate and standard rate treatments were applied broadcast. Micro-rate treatments contained Progress (1.3 oz ai/acre), UpBeet (0.063 oz ai/acre), Stinger (0.5 oz ai/acre), Select (0.5 oz ai/acre), and a methylated seed oil

(MSO) at 1.5 percent v/v. Micro-rate applications were made on April 19, April 30, May 1, and May 12. The standard rate applications were made on April 26, May 1, and May 12. The micro-rate treatments were initiated when sugar beets were in the cotyledon stage. The standard rate treatment was initiated when the cotyledons were fully expanded and the first true leaves had emerged.

Sugar beet injury and weed control were evaluated throughout the season. Sugar beet yields were determined by harvesting the center two rows of each plot on October 6 and 7. Root yields were adjusted to account for a 5 percent tare. One sample of 16 beets was taken from each plot for quality analysis. The samples were coded and sent to Hillehog Mono-Hy Research Station in Nyssa, Oregon, to determine beet pulp sucrose content and purity. Sucrose content and recoverable sucrose were estimated using empirical equations. Data were analyzed using analysis of variance procedures and means were separated using protected LSD at the 95 percent confidence interval ($P = 0.05$). The untreated control was not included in the analysis of variance for weed control or crop response.

Results and Discussion

Pigweed control on June 30 (35 days after treatment [DAT]) was greater with three applications of the micro-rate with Outlook or Dual Magnum in the second application versus the micro-rate applied four times (Table 1). The addition of Outlook or Dual Magnum to the micro-rate applied three times increased pigweed control by 6 percent. Nortron did not significantly improve pigweed control when added to the micro-rate applied either three or four times. Pigweed control was similar among all treatments where the micro-rate was applied four times or when Outlook, Dual Magnum, or Nortron were added to the micro-rate applied three times. There were no differences in control among treatments for common lambsquarters or hairy nightshade. The addition of Outlook or Dual Magnum, but not Nortron, increased kochia control on July 21 (70 DAT) compared to three applications of the micro-rate alone. Similar kochia control was obtained with the standard rate treatment, all four application treatments of the micro-rate, and when Outlook or Dual Magnum were included in the three application micro-rate treatment. All treatments provided 100 percent barnyardgrass control except the micro-rate applied three times or the micro-rate applied three times with either Dual Magnum or Nortron in the second application.

Sugar beet injury on May 5 was greater in treatments with postemergence Outlook, Dual Magnum, or Nortron applications compared to the micro-rate treatments without these herbicides and the standard rate treatment (Table 2). Micro-rate treatments where Nortron was applied injured sugar beets less than micro-rate treatments where Dual Magnum was applied. Sugar beet injury on June 2 was similar among herbicide treatments. Sugar beet root yields were similar among herbicide treatments ranging from 46.7 to 49.2 tons/acre (Table 2). Estimated recoverable sucrose yields ranged from 13,077 to 14,300 lbs/acre and were not different among herbicide treatments. All treatments had greater root and estimated recoverable sucrose yields than the untreated control. There were no differences in percent sucrose content or percent extraction among treatments.

Table 1. Weed control with micro-rate herbicide treatments applied a different number of times and in various combinations in sugar beet, Malheur Experiment Station, Oregon State University, Ontario, OR, 2003.

Treatment	Rate	Timing*	Weed control [‡]					
			Pigweed spp [†]	Lambs-quarters	Hairy nightshade	Kochia		Barnyard-grass
			6-30	7-21	7-21	6-16	7-21	6-16
	oz ai/acre		----- % -----					
Progress + Upbeet + Stinger + Select + MSO	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v	1,3,5,6	89	100	99	100	94	100
Progress + Upbeet + Stinger + Select + MSO	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v	1,3,5	92	94	98	93	85	96
Progress + Upbeet + Stinger + Select + MSO	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v	1,5	98	95	99	98	96	100
Progress + Upbeet + Stinger + Select + MSO + Outlook	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v + 10.0	3						
Progress + Upbeet + Stinger + Select + MSO	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v	1,5	98	98	100	94	94	99
Progress + Upbeet + Stinger + Select + MSO + Dual Magnum	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v + 21.0	3						
Progress + Upbeet + Stinger + Select + MSO	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v	1,5	95	100	98	97	86	96
Progress + Upbeet + Stinger + Select + MSO + Nortron	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v + 16.0	3						
Progress + Upbeet + Stinger	4.0 + 0.25 + 1.5	2,4	100	100	100	100	96	100
Progress + Upbeet + Stinger + Select	4.0 + 0.25 + 1.5 + 2.0	6						
Progress + Upbeet + Stinger + Select + MSO	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v	1,5	98	100	100	99	94	100
Progress + Upbeet + Stinger + Select + MSO + Outlook	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v + 10.0	3						
Progress + Upbeet + Stinger + Select + MSO	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v	6						
Progress + Upbeet + Stinger + Select + MSO	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v	1,5	98	100	100	95	95	100
Progress + Upbeet + Stinger + Select + MSO + Dual Magnum	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v + 21.0	3						
Progress + Upbeet + Stinger + Select + MSO	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v	6						
Progress + Upbeet + Stinger + Select + MSO	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v	1,5	96	100	100	100	98	100
Progress + Upbeet + Stinger + Select + MSO + Nortron	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v + 16.0	3						
Progress + Upbeet + Stinger + Select + MSO	2.0 + 0.063 + 0.5 + 0.5 + 1.5% v/v	6						
Untreated control	--	--	--	--	--	--	--	--
LSD (0.05)			6	5	NS	NS	7	3

*Application timings were (1) April 19 to cotyledon beets, (2) April 23 to cotyledon beets, (3) April 26 to cotyledon to 2-leaf beets, (4) April 30 to 2-leaf beets, (5) May 1 to 2-leaf beets, and (6) May 12 to 8-leaf beets.

[†]Pigweed species included Powell amaranth and redroot pigweed.

[‡]The untreated control was not included in the weed control analysis.

Table 2. Sugar beet injury and yield with micro-rate herbicide treatments applied a different number of times and in various combinations in sugar beet, Malheur Experiment Station, Oregon State University, Ontario, OR, 2003.

Treatment	Rate oz ai/acre	Timing*	Sugar beet					
			Injury [†]		Yield [‡]			ERS [§] lb/acre
			5-5 ----- % -----	6-2	Root yield ton/acre	Sucrose ----- % -----	Extraction	
Progress + Upbeet + Stinger + Select + MSO	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v	1,3,5,6	17	8	47.9	15.5	92	13,669
Progress + Upbeet + Stinger + Select + MSO	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v	1,3,5	17	5	47	15.1	92.2	13,077
Progress + Upbeet + Stinger + Select + MSO	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v	1,5	31	14	49.2	14.7	92.1	13,290
Progress + Upbeet + Stinger + Select + MSO + Outlook	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v + 10.0	3						
Progress + Upbeet + Stinger + Select + MSO	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v	1,5	32	9	47.3	15.5	92	13,500
Progress + Upbeet + Stinger + Select + MSO + Dual Magnum	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v + 21.0	3						
Progress + Upbeet + Stinger + Select + MSO	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v	1,5	28	16	46.7	15.2	92	13,143
Progress + Upbeet + Stinger + Select + MSO + Nortron	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v + 16.0	3						
Progress + Upbeet + Stinger	4.0 + 0.25 + 1.5	2,4	9	11	47.4	15.8	92.7	13,925
Progress + Upbeet + Stinger + Select	4.0 + 0.25 + 1.5 + 2.0	6						
Progress + Upbeet + Stinger + Select + MSO	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v	1,5	33	10	48.9	15.6	91.8	14,004
Progress + Upbeet + Stinger + Select + MSO + Outlook	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v + 10.0	3						
Progress + Upbeet + Stinger + Select + MSO	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v	6						
Progress + Upbeet + Stinger + Select + MSO	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v	1,5	35	6	48.9	15	92.3	13,560
Progress + Upbeet + Stinger + Select + MSO + Dual Magnum	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v + 21.0	3						
Progress + Upbeet + Stinger + Select + MSO	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v	6						
Progress + Upbeet + Stinger + Select + MSO	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v	1,5	28	14	49.1	15.8	91.9	14,300
Progress + Upbeet + Stinger + Select + MSO + Nortron	1.3 + 0.063 + 0.5 + 0.5 + 1.5% v/v + 16.0	3						
Progress + Upbeet + Stinger + Select + MSO	2.0 + 0.063 + 0.5 + 0.5 + 1.5% v/v	6						
Untreated control	--	--	--	--	16.4	16.5	92.8	5,003
LSD (0.05)			4	9	3.4	NS	NS	1,630

*Application timings were (1) April 19 to cotyledon beets, (2) April 23 to cotyledon beets, (3) April 26 to cotyledon to 2-leaf beets, (4) April 30 to 2-leaf beets, (5) May 1 to 2-leaf beets, and (6) May 12 to 8-leaf beets.

[†]The untreated control was not included in the sugar beet injury analysis.

[‡]Sugar beets were harvested on October 6-7, 2003.

[§]ERS = Estimated recoverable sucrose.