

KOCHIA CONTROL WITH PREEMERGENCE NORTRON® IN STANDARD AND MICRO-RATE HERBICIDE PROGRAMS IN SUGAR BEET

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Introduction

The distribution of kochia resistant to UpBeet® (triflurosulfuron) herbicide and other acetolactate synthase (ALS) inhibitors (i.e., sulfonylureas, imidazolinones, and triazolopyrimidines) has increased in recent years and poses a serious problem in sugar beet production, as none of the currently registered postemergence herbicides effectively control ALS-resistant kochia. In this trial, Nortron® (ethofumesate) was evaluated for preemergence control of kochia in sugar beet. Nortron is a soil-active herbicide used preemergence or early postemergence to control annual grasses and broadleaf weeds.

Methods

This trial was established at the Malheur Experiment Station under furrow irrigation on April 8, 2004. Sugar beets (Hilleshog 'PM-21') were planted in 22-inch rows at a 2-inch seed spacing. On April 9, 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 10 to 13. Plots were sidedressed on June 2 with 175 lb nitrogen (urea), 30 lb potash (K₂O), 35 lb sulfates (SO₄), 38 lb elemental sulfur (S), 3 lb manganese (Mn), 2 lb zinc (Zn), and 1 lb/acre boron (B). All plots were treated with Roundup® (0.75 lb ai/acre) on April 13 prior to sugar beet emergence. On May 26, Temik 15G® (14 lb prod/acre) was applied for sugar beet root maggot control. For powdery mildew control, Headline® (12 fl oz/acre) was applied on June 25, Topsin M® (20 oz prod/acre) plus S at 6 lb/acre, phosphate (P₂O₅) at 1.5 lb/acre, and Zn at 0.2 lb/acre were applied August 4, and Headline (12 fl oz/acre) plus S at 6 lb/acre were applied August 8. 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 4 rows wide and 27 ft long and treatments were arranged in a randomized complete block design with 4 replicates.

The treatments in this trial consisted of both standard and micro-rate postemergence weed control programs applied with or without a preemergence application of Nortron at either 16, 24, or 32 oz ai/acre with and without postemergence UpBeet. For the micro-rate treatment without UpBeet, Nortron was also applied preemergence at 48 oz ai/acre. UpBeet was omitted from selected treatments to simulate ALS resistance and to better evaluate preemergence Nortron efficacy on kochia. Nortron was applied preemergence

on April 13. The standard rate program included three applications, with the first applied to full cotyledon sugar beets on April 26, the second to two- to four-leaf sugar beets on May 3, and the third application to six- to eight-leaf sugar beets on May 14. Progress (ethofumesate + phenmedipham + desmedipham) was applied at 4.0, 5.4, and 6.7 oz ai/acre in the first, second, and third applications, respectively. UpBeet was applied at 0.25 oz ai/acre in all three applications (excluding treatments where UpBeet was omitted). Stinger[®] (clopyralid) was applied in the second and third applications at 1.5 oz ai/acre. The micro-rate program consisted of four applications with the first applied to cotyledon sugar beets on April 23, the second to cotyledon to 2-leaf sugar beets on April 30, the third application was inadvertently delayed and was applied to 8- to 10-leaf sugar beets on May 15, and the fourth to 8- to 12-leaf sugar beets on May 20. In the micro-rate program, Progress[®] was applied at 1.3 oz ai/acre in the first two applications and at 2.0 oz ai/acre in the last two applications. All four micro-rate applications included UpBeet at 0.08 oz ai/acre (excluding treatments where UpBeet was omitted), Stinger at 0.5 oz ai/acre, and a methylated seed oil (MSO) at 1.5 percent v/v.

Sugar beet injury was evaluated May 10 and June 9 and weed control was evaluated September 3. Sugar beet yields were determined by harvesting the center two rows of each plot on October 8 and 9. 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 Syngenta Seeds 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

Postemergence herbicides were very effective this year. Kochia control was greater than 98 percent with either the standard rate or micro-rate treatments containing UpBeet regardless of whether preemergence Nortron was applied (Table 1). Removing UpBeet from the standard rate and the micro-rate resulted in a respective 18 and 58 percent decrease in kochia control on July 17. For the standard rate treatments without UpBeet, the addition of Nortron at any rate provided kochia control similar to the standard rate with UpBeet. For micro-rate treatments without UpBeet, the addition of preemergence Nortron, regardless of the rate, did not control kochia as well as the micro-rate with UpBeet. Increasing Nortron rates increased kochia control. Pigweed control also was reduced when UpBeet was omitted from the micro-rate. The addition of Nortron at 16 or 24 oz ai/acre improved kochia control, but the 32- or 48- oz ai/acre rates were required to control kochia equal to the micro-rate with UpBeet. There were no differences among treatments for common lambsquarters, hairy nightshade, or barnyardgrass control. Common lambsquarters and hairy nightshade control was 98 percent or higher while barnyardgrass control ranged from 87 to 99 percent.

Injury on May 10 was significantly higher for standard rate treatments with UpBeet compared to standard rate treatments without UpBeet or compared to any of the micro-rate treatments (Table 2). Within the micro-rate treatments, the 48- oz ai/acre rate of Nortron caused greater injury (23 vs 5-14 percent) than any of the other micro-rate treatments with or without Nortron preemergence. On June 9, injury was similar among all treatments. Sugar beet yields were not significantly different among any of the standard rate treatments. Sugar beet yields were lowest with the micro-rate applied without UpBeet. The addition of preemergence Nortron at 32 oz ai/acre to the micro-rate without UpBeet was the only treatment that produced yields similar to the micro-rate with UpBeet. The lower Nortron rates had lower yields and the 48- oz ai/acre Nortron treatment also yielded less than the micro-rate with UpBeet. The lower yield with the high rate of Nortron may have been related to the increased sugar beet injury.

In areas where kochia has become resistant to UpBeet, a preemergence application of Nortron followed by postemergence herbicides at standard rates should provide effective control. Removing UpBeet from the spray mixture may not be advisable since UpBeet would still be effective in controlling non-UpBeet-resistant kochia and also helps control other weeds. The micro-rate should not be used in areas with UpBeet resistant kochia because even with high rates of preemergence Nortron, acceptable kochia control cannot be achieved.

Table 1. Kochia control with preemergence Nortron® in standard and micro-rate herbicide programs, Malheur Experiment Station, Oregon State University, Ontario, OR, 2004.

Treatment*	Rate	Timing†	Weed control					
			Kochia		Pigweed‡	Lambs- quarters	Hairy nightshade	Barnyard- grass
			7-27	9-3	7-27	7-27	7-27	7-27
	oz ai/acre & % v/v		----- %-----					
Untreated control	--	--	--	--	--	--	--	--
<i>Standard Rate Program</i>								
Progress + UpBeet	4.0 + 0.25	3	100	100	100	100	99	95
Progress + UpBeet + Stinger	5.4 + 0.25 + 1.5	5						
Progress + UpBeet + Stinger	6.7 + 0.25 + 1.5	6						
<i>Micro-Rate Program</i>								
Progress + UpBeet + Stinger + MSO	1.3 + 0.083 + 0.5 + 1.5% v/v	2,4	98	98	97	100	100	97
Progress + UpBeet + Stinger + MSO	2.0 + 0.083 + 0.5 + 1.5% v/v	7,8						
Nortron fb	16.0	1	100	100	99	100	100	97
Standard with Upbeet	---	3,5,6						
Nortron fb	24.0	1	100	100	100	100	100	98
Standard with UpBeet	---	3,5,6						
Nortron fb	32.0	1	100	100	100	100	100	99
Standard with UpBeet	---	3,5,6						
Nortron fb	16.0	1	100	100	100	100	100	93
Standard w/out UpBeet	---	3,5,6						
Nortron fb	24.0	1	94	96	98	100	100	93
Standard w/out UpBeet	---	3,5,6						
Nortron fb	32.0	1	98	98	100	100	100	97
Standard w/out UpBeet	---	3,5,6						
Nortron fb	16.0	1	100	100	100	99	100	91
Micro with UpBeet	---	2,4,7,8						
Nortron fb	24.0	1	99	99	100	100	100	97
Micro with UpBeet	---	2,4,7,8						
Nortron fb	32.0	1	100	100	100	100	100	95
Micro with UpBeet	---							
Nortron fb	16.0	1	62	58	91	100	100	93
Micro w/out UpBeet	---	2,4,7,8						
Nortron fb	24.0	1	66	65	91	100	100	92
Micro w/out UpBeet	---	2,4,7,8						
Nortron fb	32.0	1	75	73	98	100	100	92
Micro w/out UpBeet	---	2,4,7,8						
Standard w/out UpBeet	---	3,5,6	82	88	95	100	100	95
Micro w/out UpBeet	---	2,4,7,8	40	48	80	100	100	87
Nortron fb	48.0	1	84	86	98	98	100	97
Micro w/out UpBeet	---	2,4,7,8						
LSD (0.05)	--		8	8	6	NS	NS	NS

*fb = Followed by.

†Application timings were (1) April 13 preemergence, (2) April 23 to cotyledon beets, (3) April 26 to full cotyledon beets, (4) April 30 to 2-leaf beets, (5) May 3 to 2- to 4-leaf beets, (6) May 14 to 6- to 8-leaf beets, (7) May 15 to 8- to 10-leaf beets, and (8) May 20 to 8- to 12-leaf beets.

‡Pigweed species included Powell amaranth and redroot pigweed.

Table 2. Sugar beet injury and yield with preemergence Nortron® in standard and micro-rate herbicide programs, Malheur Experiment Station, Oregon State University, Ontario, OR, 2004.

Treatment*	Rate	Timing†	Sugar beet					
			Injury		Yield‡			
			5-10	6-9	Root yield	Sucrose	Extraction	ERS§
oz ai/acre and % v/v	----- % -----	ton/acre	----- % -----	lbs/acre				
Untreated control	--	--	--	--	6.1	16.6	93.5	1,958
<i>Standard Rate Program</i>								
Progress + UpBeet	4.0 + 0.25	3	33	21	41.1	16.7	93.6	12,802
Progress + UpBeet + Stinger	5.4 + 0.25 + 1.5	5						
Progress + UpBeet + Stinger	6.7 + 0.25 + 1.5	6						
<i>Micro-Rate Program</i>								
Progress + UpBeet + Stinger + MSO	1.3 + 0.083 + 0.5 + 1.5% v/v	2,4	9	9	44.3	16.5	93.0	13,614
Progress + UpBeet + Stinger + MSO	2.0 + 0.083 + 0.5 + 1.5% v/v	7,8						
Nortron fb	16.0	1	30	18	42.7	17.1	93.4	13,616
Standard with UpBeet	---	3,5,6						
Nortron fb	24.0	1	30	15	39.8	17.1	93.2	12,653
Standard with UpBeet	---	3,5,6						
Nortron fb	32.0	1	32	20	40.9	16.9	93.3	12,940
Standard with UpBeet	---	3,5,6						
Nortron fb	16.0	1	13	11	40.6	16.9	93.1	12,770
Standard w/out UpBeet	---	3,5,6						
Nortron fb	24.0	1	15	21	39.6	16.4	93.0	12,067
Standard w/out UpBeet	---	3,5,6						
Nortron fb	32.0	1	18	14	42.1	16.1	93.9	12,613
Standard w/out UpBeet	---	3,5,6						
Nortron fb	16.0	1	11	18	42.2	16.5	93.7	13,025
Micro with UpBeet	---	2,4,7,8						
Nortron fb	24.0	1	10	11	42.2	16.3	93.1	12,792
Micro with UpBeet	---	2,4,7,8						
Nortron fb	32.0	1	13	14	40.5	17.1	93.5	12,918
Micro with UpBeet	---							
Nortron fb	16.0	1	11	18	29.4	17.4	93.3	9,509
Micro w/out UpBeet	---	2,4,7,8						
Nortron fb	24.0	1	14	15	34.5	17.6	93.6	11,386
Micro w/out UpBeet	---	2,4,7,8						
Nortron fb	32.0	1	5	13	38.0	17.3	93.5	12,300
Micro w/out UpBeet	---	2,4,7,8						
Standard w/out UpBeet	---	3,5,6	19	13	38.8	17.0	93.4	12,345
Micro w/out UpBeet	---	2,4,7,8	6	6	29.3	17.7	93.9	9,786
Nortron fb	48.0	1	23	26	35.2	17.5	93.4	11,490
Micro w/out UpBeet	---	2,4,7,8						
LSD (0.05)	--		8	13	6.1	0.8	NS	1,937

*fb = Followed by

†Application timings were (1) April 13 preemergence, (2) April 23 to cotyledon beets, (3) April 26 to full cotyledon beets, (4) April 30 to 2-leaf beets, (5) May 3 to 2 to 4-leaf beets, (6) May 14 to 6 to 8-leaf beets, (7) May 15 to 8 to 10-leaf beets, and (8) May 20 to 8 to 12-leaf beets.

‡Sugar beets were harvested October 8 and 9.

§ERS = estimated recoverable sucrose.