

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.

Materials and Methods

This trial was established at the Malheur Experiment Station under furrow irrigation on April 6, 2005. Sugar beets (Hilleshog 'PM-90') were planted in 22-inch rows at a 2-inch seed spacing. On April 7, 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 12 and 13. Plots were sidedressed on June 8 with 150 lb nitrogen (urea), 50 lb phosphate (P₂O₅), 30 lb potash (K₂O), 30 lb sulfates (SO₄), 5 lb manganese (Mn), 8 lb zinc (Zn), 1 lb copper (Cu), and 2 lb/acre boron (B). All plots were treated with Roundup® (0.75 lb ai/acre) on April 11 prior to sugar beet emergence. On April 28, 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 14, Dithane® (2 lb prod/acre) plus sulfur (6 lb/acre) were applied June 28, sulfur (6 lb/acre) was applied August 20, and Gem® (7 fl oz/acre) was applied August 25. 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 standard and micro-rate postemergence weed control programs applied with or without a preemergence application of Nortron at 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 11. The standard rate program included three applications, with the first applied to full cotyledon sugar beets on April 22, the second to two- to four-leaf sugar beets on May 2, and the third application to four- to eight-leaf sugar beets on May 13. 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[®] (clopypalid) 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 22, the second to cotyledon to two-leaf sugar beets on April 29, the third application was applied to two- to six-leaf sugar beets on May 7, and the fourth to four- to eight-leaf sugar beets on May 12. 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 12 and June 7 and weed control was evaluated July 27 and September 13. 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 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, likely because of frequent rainfall during April and May. All herbicide treatments effectively controlled common lambsquarters, hairy nightshade, and barnyardgrass (Table 1). On July 6 and August 17, the micro-rate without Upbeet provided the least kochia control of all the treatments. On August 17, Powell amaranth and redroot pigweed control was less with the micro-rate without Upbeet compared to all other treatments. Removing Upbeet from the standard postemergence treatment did not significantly affect kochia control compared to all other standard rate treatments. When the micro-rate was applied following Nortron (4 pt/acre) the removal of Upbeet reduced kochia control compared to the same treatment with Upbeet included.

Sugar beet yields were related to the level of kochia control provided by each herbicide treatment (Fig. 1). The micro-rate without Upbeet had the lowest sugar beet root yield and estimated recoverable sugar of any herbicide treatment (Table 2). When Nortron was applied preemergence at 3.0 or 4.0 pt/acre, removing Upbeet from postemergence micro-rate applications reduced yield compared to the same treatments with Upbeet. Estimated recoverable sugar was also reduced when Upbeet was

removed from the micro-rate following preemergence Nortron (3.0 pt/acre). In locations where Upbeet-resistant kochia is present, the use of preemergence Nortron can be used to provide additional control of ALS kochia that are not susceptible to Upbeet. When ALS-resistant kochia are present, it is recommended that producers apply standard herbicide rates as they are more effective than micro-rates for controlling kochia.

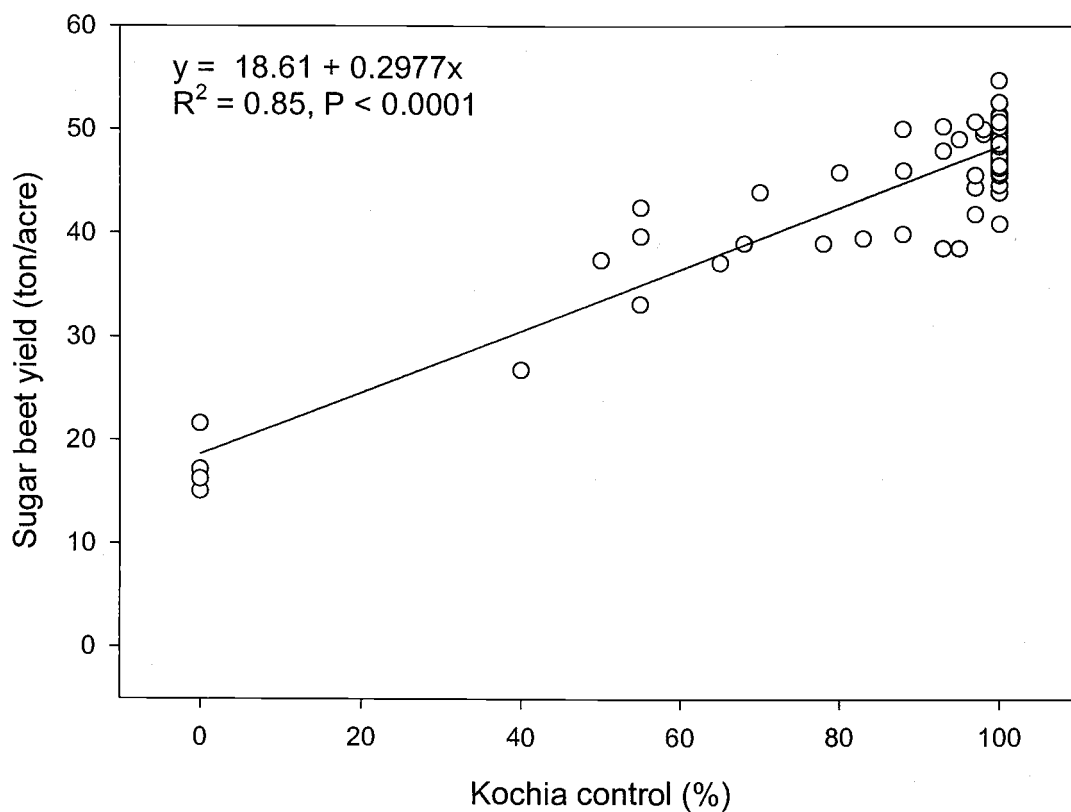


Figure 1. Relationship of sugar beet yield and visual kochia control ratings, Malheur Experiment Station, Oregon State University, Ontario, OR, 2005.

Table 1. Kochia control with preemergence Nortron® in standard and micro-rate herbicide programs, Malheur Experiment Station, Oregon State University, Ontario, OR, 2005.

Treatment*	Rate oz ai/acre & % v/v	Timing†	Weed control					
			Kochia		Pigweed‡	Lambs- quarters	Hairy nightshade	Barnyard- grass
			7-6	8-17	8-17	8-17	8-17	8-17
Untreated control	--	--	--	--	--	--	--	--
<i>Standard Rate Program</i>			99	99	100	100	100	100
Progress + UpBeet	4.0 + 0.25	2						
Progress + UpBeet + Stinger	5.4 + 0.25 + 1.5	4						
Progress + UpBeet + Stinger	6.7 + 0.25 + 1.5	7						
<i>Micro-Rate Program</i>			92	93	95	100	100	100
Progress + UpBeet + Stinger + MSO	1.3 + 0.083 + 0.5 + 1.5% v/v	2,3						
Progress + UpBeet + Stinger + MSO	2.0 + 0.083 + 0.5 + 1.5% v/v	5,6						
Nortron fb	16.0	1	100	100	100	100	100	100
Standard with Upbeet	---	2,4,7						
Nortron fb	24.0	1	100	100	100	100	100	100
Standard with UpBeet	---	2,4,7						
Nortron fb	32.0	1	100	100	100	100	100	100
Standard with UpBeet	---	2,4,7						
Nortron fb	16.0	1	100	100	100	100	100	100
Standard w/out UpBeet	---	2,4,7						
Nortron fb	24.0	1	100	99	100	100	100	100
Standard w/out UpBeet	---	2,4,7						
Nortron fb	32.0	1	100	100	95	100	100	100
Standard w/out UpBeet	---	2,4,7						
Nortron fb	16.0	1	97	95	100	100	100	100
Micro with UpBeet	---	2,3,5,6						
Nortron fb	24.0	1	100	100	100	100	100	100
Micro with UpBeet	---	2,3,5,6						
Nortron fb	32.0	1	100	100	100	100	100	100
Micro with UpBeet	---	2,3,5,6						
Nortron fb	16.0	1	76	83	100	100	100	100
Micro w/out UpBeet	---	2,3,5,6						
Nortron fb	24.0	1	86	88	95	100	100	100
Micro w/out UpBeet	---	2,3,5,6						
Nortron fb	32.0	1	82	83	98	100	100	100
Micro w/out UpBeet	---	2,3,5,6						
Standard w/out UpBeet	---	2,4,7	89	88	95	100	100	100
Micro w/out UpBeet	---	2,3,5,6	39	39	78	100	100	100
Nortron fb	48.0	1	99	97	100	100	100	100
Micro w/out UpBeet	---	2,3,5,6						
LSD (0.05)	--		15	14	8	NS	NS	NS

*fb = followed by.

†Application timings were (1) April 11 preemergence, (2) April 22 to cotyledon beets, (3) April 29 to full cotyledon beets, (4) May 2 to 2- to 4-leaf beets, (5) May 7 to 2- to 6-leaf beets, (6) May 12 to 4- to 8-leaf beets, and (7) May 13 to 4- to 8-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, 2005.

Treatment*	Rate oz ai/acre and % v/v	Timing†	Sugar beet					
			Injury		Yield‡			
			5-12	6-7	Root yield	Sucrose	Extraction	ERS§
			%	ton/acre	%	%	lbs/acre	
Untreated control	--	--	--	--	17.5	15.6	92.6	5,076
<i>Standard Rate Program</i>			25	14	48.2	15.0	91.9	13,266
Progress + UpBeet	4.0 + 0.25	2						
Progress + UpBeet + Stinger	5.4 + 0.25 + 1.5	4						
Progress + UpBeet + Stinger	6.7 + 0.25 + 1.5	7						
<i>Micro-Rate Program</i>			20	9	45.2	14.7	91.6	12,182
Progress + UpBeet + Stinger + MSO	1.3 + 0.083 + 0.5 + 1.5% v/v	2,3						
Progress + UpBeet + Stinger + MSO	2.0 + 0.083 + 0.5 + 1.5% v/v	5,6						
Nortron fb	16.0	1	31	12	48.8	14.7	91.5	13,111
Standard with UpBeet	---	2,4,7						
Nortron fb	24.0	1	24	13	49.3	14.7	91.2	13,227
Standard with UpBeet	---	2,4,7						
Nortron fb	32.0	1	25	13	49.9	15.2	91.7	13,889
Standard with UpBeet	---	2,4,7						
Nortron fb	16.0	1	21	15	48.5	14.9	91.4	13,174
Standard w/out UpBeet	---	2,4,7						
Nortron fb	24.0	1	15	14	47.6	15.1	91.9	13,249
Standard w/out UpBeet	---	2,4,7						
Nortron fb	32.0	1	22	17	46.1	14.9	91.6	12,560
Standard w/out UpBeet	---	2,4,7						
Nortron fb	16.0	1	20	11	48.9	14.8	91.6	13,234
Micro with UpBeet	---	2,3,5,6						
Nortron fb	24.0	1	20	14	47.6	14.7	91.4	12,867
Micro with UpBeet	---	2,3,5,6						
Nortron fb	32.0	1	20	12	50.8	14.6	91.2	13,518
Micro with UpBeet	---	2,3,5,6						
Nortron fb	16.0	1	18	11	45.2	14.5	91.6	12,020
Micro w/out UpBeet	---	2,3,5,6						
Nortron fb	24.0	1	18	14	41.8	14.3	91.3	10,910
Micro w/out UpBeet	---	2,3,5,6						
Nortron fb	32.0	1	22	10	45.2	14.6	91.9	12,120
Micro w/out UpBeet	---	2,3,5,6						
Standard w/out UpBeet	---	2,4,7	15	13	45.0	14.8	91.9	12,231
Micro w/out UpBeet	---	2,3,5,6	11	8	37.4	14.9	91.7	10,258
Nortron fb	48.0	1	22	12	47.1	14.5	91.9	12,622
Micro w/out UpBeet	---	2,3,5,6						
LSD (0.05)	--		6.7	NS	5.4	NS	0.7	1,666

*fb = followed by.

†Application timings were (1) April 11 preemergence, (2) April 22 to cotyledon beets, (3) April 29 to full cotyledon beets, (4) May 2 to 2- to 4-leaf beets, (5) May 7 to 2- to 6-leaf beets, (6) May 12 to 4- to 8-leaf beets, and (7) May 13 to 4- to 8-leaf beets.

‡Sugar beets were harvested October 6 and 7.

§ERS = estimated recoverable sucrose.