

KOCHIA CONTROL WITH VARIABLE NORTRON® RATES IN STANDARD AND MICRO-RATE HERBICIDES PROGRAMS

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Introduction

The distribution of kochia resistant to acetolactate synthase (ALS) inhibitors (i.e., sulfonyl ureas, imidazolinones) 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 these trials, Nortron was evaluated for postemergence control of ALS-resistant kochia in sugar beets. Nortron is a soil-active herbicide used preemergence or early postemergence to control annual grasses and broadleaf weeds.

Methods

Trials were established at the Malheur Experiment Station under furrow irrigation on April 12, 2001. Sugar beets (Hillehog 'WS PM-21') were planted in 22-inch rows at a 2-inch seed spacing. Sugar beets were thinned to 8-inch spacings on May 16. Plots were sidedressed on May 23 with 200 lbs N/acre as urea. Herbicide treatments were applied with a CO₂-pressurized backpack sprayer calibrated to deliver 20 gal/acre at 30 psi. Plots four rows wide and 27 ft long were arranged in a randomized complete block design. Roundup (0.75 lb ai/acre) was applied preemergence to all trials. 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 2.

On April 11, kochia seed was spread over the entire experimental area to provide an even weed distribution. UpBeet was omitted from selected treatments to simulate ALS resistance and to better evaluate Nortron efficacy on kochia. Nortron was applied postemergence in various tank-mix combinations at 0.063, 0.125, 0.04, and 0.027 lb ai/acre to sugar beets ranging from cotyledon up to the eight-leaf stage. Standard rate tank-mix combinations with Nortron included Progress (0.25, and 0.33 lb ai/acre), UpBeet (0.016 lb ai/acre), and Stinger (0.098 lb ai/acre) applied three times at 7- to 10-day intervals. Micro-rate treatments consisted of various combinations of Progress (0.08 lb ai/acre), Betamix (0.053 and 0.08 lb ai/acre), UpBeet (0.005 lb ai/acre), Stinger (0.031 lb ai/acre), and methylated seed oil (MSO) (1.5 percent v/v), with and without Nortron, applied a total of four times at 7-day intervals. Weed control and injury were evaluated periodically throughout the growing season. In addition to sugar beet root yield, 16 sugar beets from each plot were sent to the Hillehog Mono-Hy Research Station in Nyssa, Oregon, to determine beet pulp sucrose content and purity.

Results and Discussion

On June 25, common lambsquarters control was excellent (97 to 100 percent) with all treatments (Table 1). Redroot pigweed control was greater with the micro-rate when Stinger was included in the tank-mix. Redroot pigweed control on August 22 was generally greater for those treatments containing UpBeet except for the micro-rate when Stinger was not included in the tank-mix. Hairy nightshade control ranged from 83 to 100 percent on June 25. On August 22, hairy nightshade control was

generally good to excellent (82 to 98 percent) with all treatments except those not containing Stinger. On both June 25 and August 22, kochia control was significantly greater with treatments including UpBeet than without regardless of UpBeet rate or whether the treatment was applied as a standard or micro-rate. Treatments with Nortron applied postemergence without UpBeet provided poor (34 to 66 percent) kochia control on June 25. The addition of Nortron at both 0.063 and 0.125 lb ai/acre to the micro-rate treatment of Progress (0.08 lb ai/acre), UpBeet (0.005 lb ai/acre), Stinger (0.031 lb ai/acre), and MSO significantly increased kochia control evaluated on August 22 (Table 1). For all other treatments the addition of Nortron did not increase kochia control.

Sugar beet injury from standard rate treatments where Progress (0.25 or 0.33 lb ai/acre) and UpBeet (0.016 lb ai/acre) were applied together produced injury ranging from 35 to 42 percent on May 12 (Table 2). Generally, injury from these treatments remained higher than other treatments on May 24 and June 4. Visual injury was not significant for any treatment on June 25 (data not shown). Sugar beet injury was greater on May 24 and June 4, when Nortron (0.053 lb ai/acre) was applied in applications 1 and 2, and when Nortron (0.04 lb ai/acre) in applications 3 and 4 was added to Betamix (0.08 lb ai/acre) plus UpBeet (0.005 lb ai/acre) plus Stinger (0.031 lb ai/acre) and MSO.

Sugar beet root yields were different among treatments and were generally related to weed control. Root and estimated recoverable sucrose (ERS) yields were significantly higher with treatments containing UpBeet (Table 2). There was a positive correlation between ERS yields and kochia control (Fig. 1). Nortron applied postemergence did not increase root or extractable sucrose yields for any treatment. In general percent sucrose and percent extraction were similar among treatments ranging from 15.19 to 16.93 percent and 92.63 to 93.46 percent, respectively (Table 2).

Table 1. Weed control with standard and micro-rate treatments with and without various Nortron rates, Malheur Experiment Station, Oregon State University, Ontario, OR, 2001.

Treatment	Rate	Timin g*	Weed control							
			Pigweed		H. nightshade		Kochia		Lambsquarters	
			6-25	8-22	6-25	8-22	6-25	8-22	6-25	8-22
Untreated	--	--	0	0	0	0	0	0	0	0
Progress + UpBeet Progress + UpBeet + Stinger	0.25 + 0.016 0.33 + 0.016 + 0.098	1 2, 3	98	85	98	95	93	84	100	
Progress Progress + Stinger	0.25 0.33 + 0.098	1 2, 3	76	40	89	39	34	13	100	
Progress + UpBeet + Stinger + MSO	0.08 + 0.005 + 0.031 + 1.5%	1,2,3, 4	95	89	98	92	87	69	100	
Progress + UpBeet + Stinger + Nortron + MSO	0.08 + 0.005 + 0.031 + 0.063 + 1.5%	1,2,3, 4	95	89	100	91	94	91	100	
Progress + UpBeet + Stinger + Nortron + MSO	0.08 + 0.005 + 0.031 + 0.125 + 1.5%	1,2,3, 4	89	76	99	94	95	92	97	
Progress Progress	0.25 0.33	1 2,3	82	0	93	0	36	0	100	
Progress + Nortron Progress + Nortron	0.25 + 0.063 0.33 + 0.063	1 2,3	92	82	85	85	47	18	100	
Progress + Nortron Progress + Nortron Progress	0.25 + 0.125 0.33 + 0.125 0.33	1 2 3	85	45	96	--	37	7	100	
Progress + UpBeet Progress + UpBeet	0.25 + 0.016 0.33 + 0.016	1 2,3	92	77	83	62	97	93	98	
Progress + UpBeet + Nortron Progress + UpBeet + Nortron	0.25 + 0.016 + 0.063 0.33 + 0.016 + 0.063	1 2,3	93	83	96	87	95	89	100	
Progress + UpBeet + Nortron	0.25 + 0.016 + 0.125	1 2	98	93	98	95	97	91	100	

Progress + UpBeet + Nortron	0.33 + 0.016 + 0.125	3							
Progress + UpBeet	0.33 + 0.016								
Progress + UpBeet + MSO	0.08 + 0.005 + 1.5%	1,2,3, 80 4	57	91	53	96	88	100	
Progress + UpBeet + Nortron + MSO	0.08 + 0.005 + 0.063 + 1.5%	1,2,3, 79 4	63	87	60	92	84	100	
Progress + UpBeet + MSO	0.08 + 0.005 + 1.5%	1,2,3, 85 4	53	95	50	92	89	100	
Nortron	0.125	1,2							
Progress + UpBeet + MSO	0.08 + 0.005 + 1.5%	1,2,3, 86 4	66	92	82	91	78	100	
Nortron	0.063	1,2							
Nortron	0.125	3							

Table 1 (continued). Weed control with standard and micro-rate treatments with and without various Nortron rates, Malheur Experiment Station, Oregon State University, Ontario, OR, 2001.

Treatment	Rate	Timin g*	Weed control							
			Pigweed		H. nightshade		Kochia		Lambsquarters	
			6-25	8-22	6-25	8-22	6-25	8-22	6-25	8-22
	lb ai/acre % v/v		-----%-----							
Progress + Nortron	0.25 + 0.063	1	69	53	83	55	66	20	100	
Progress + Nortron	0.33 + 0.063	2								
Progress + Nortron	0.33 + 0.125	3								
Betamix + UpBeet + Stinger + MSO	0.08 + 0.005 + 0.031 + 1.5%	1,2,3, 4	88	72	100	83	95	88	100	
Betamix + Nortron + Upbeet + Stinger + MSO	0.053 + 0.027 + 0.005 + 0.031 + 1.5%	1,2 3,4	96	85	100	98	97	95	100	
Betamix + Nortron + Upbeet + Stinger + MSO	0.08 + 0.04 + 0.005 + 0.031 + 1.5%	1,2 3,4	99	81	100	92	94	93	100	
Betamix + Nortron + Upbeet + Stinger + MSO	0.12 + 0.04 + 0.005 + 0.031 + 1.5%	1,2 3,4	98	78	100	86	97	94	100	
Betamix + Nortron + Upbeet + Stinger + MSO	0.08 + 0.04 + 0.005 + 0.031 + 1.5%	1 2	99	76	97	95	94	86	99	
Betamix + Nortron + Upbeet + Stinger + MSO	0.08 + 0.081 + 0.005 + 0.031 + 1.5%	3								
Betamix + Nortron + Upbeet + Stinger +	0.12 + 0.081 + 0.005 + 0.031 +	4								

MSO	1.5%									
Betamix + Upbeet + Stinger + MSO	0.12 + 0.005 + 0.031 + 1.5%									
Betamix + Nortron + UpBeet + Stinger + MSO	0.08 + 0.081 + 0.005 + 0.031 + 1.5%	1	96	78	100	98	94	92	100	
Betamix + Nortron + UpBeet + Stinger + MSO	0.12 + 0.12 + 0.005 + 0.031 + 1.5%	3								
Betamix + UpBeet + Stinger + MSO	0.12 + 0.005 + 0.031 + 1.5%									
Hand-weeded	--	--	73	63	94	87	87	67	98	
LSD (0.05)			13.8	25	13	28	13	19	2	

*Application timings were (1) April 26 to cotyledon sugar beets, (2) May 3 to two-leaf sugar beets, (3) May 8 to four-leaf sugar beets, and (4) May 17 to eight-leaf sugar beet.

Table 2. Sugar beet injury and yield with standard and micro-rate treatments with and without various Nortron rates, Malheur Experiment Station, Oregon State University, Ontario, OR, 2001.

Treatment	Rate lb ai/acre % v/v	Timin	Injury			Sugar beet yield			ERS†
			5-12	5-24	6-4	Root ton/ac re	Sucros %-----	Extract -----	
			----- % -----						
Untreated	--	--	0	0	0	8.7	16.81	93.23	2,706
Progress + UpBeet	0.25 + 0.016	1	42	45	27	40.4	16.37	93.45	12,363
Progress + UpBeet + Stinger	0.33 + 0.016 + 0.098	2, 3							
Progress	0.25	1	15	18	6	21.9	16.93	93.15	6,862
Progress + Stinger	0.33 + 0.098	2, 3							
Progress + UpBeet + Stinger + MSO	0.08 + 0.005 + 0.031 + 1.5%	1,2,3, 4	17	17	12	41.6	16.59	93.16	12,849
Progress + UpBeet + Stinger + Nortron + MSO	0.08 + 0.005 + 0.031 + 0.063 + 1.5%	1,2,3, 4	22	22	8	42.7	15.19	92.65	11,962
Progress + UpBeet + Stinger + Nortron + MSO	0.08 + 0.005 + 0.031 + 0.125 + 1.5%	1,2,3, 4	22	19	14	42.4	16.38	93.02	12,936
Progress	0.25	1	28	25	15	22.6	16.19	93.15	6,888
Progress	0.33	2,3							
Progress + Nortron	0.25 + 0.063	1	20	21	9	24.5	16.80	92.96	7,676
Progress + Nortron	0.33 + 0.063	2,3							
Progress + Nortron	0.25 + 0.125	1	23	24	18	22.9	16.26	93.24	6,982
Progress + Nortron	0.33 + 0.125	2							
Progress	0.33	3							
Progress + UpBeet	0.25 + 0.016	1	35	40	29	40.0	16.59	93.33	12,372
Progress + UpBeet	0.33 + 0.016	2,3							
Progress + UpBeet + Nortron	0.25 + 0.016 + 0.063	1	42	44	31	40.8	16.49	93.11	12,517
Progress + UpBeet + Nortron	0.33 + 0.016 + 0.063	2,3							
Progress + UpBeet + Nortron	0.25 + 0.016 + 0.125	1	40	41	27	41.3	16.39	93.03	12,613
Progress + UpBeet + Nortron	0.33 + 0.016 + 0.125	2							
Progress + UpBeet + Nortron	0.33 + 0.016 + 0.125	3							

Nortron	0.125								
Progress + UpBeet	0.33 + 0.016								
Progress + UpBeet + MSO	0.08 + 0.005 + 1.5%	1,2,3, 4	19	12	11	38.0	16.27	93.11	11,534
Progress + UpBeet + Nortron + MSO	0.08 + 0.005 + 0.063 + 1.5%	1,2,3, 4	14	17	21	38.9	16.62	93.34	12,082
Progress + UpBeet + MSO	0.08 + 0.005 + 1.5%	1,2,3, 4	23	15	11	40.3	16.07	93.20	12,067
Nortron	0.125	1,2							
Progress + UpBeet + MSO	0.08 + 0.005 + 1.5%	1,2,3, 4	15	17	12	42.0	16.13	92.92	12,612
Nortron	0.063	1,2							
Nortron	0.125	3							

Table 2 (continued). Sugar beet injury and yield with standard and micro-rate treatments with and without various Nortron rates, Malheur Experiment Station, Oregon State University, Ontario, OR, 2001.

*Application timings were (1) April 26 to cotyledon sugar beets, (2) May 3 to two-leaf sugar beets, (3) May 8 to four-leaf sugar beets and (4) May 17 to eight-leaf sugar beets.

†Estimated recoverable sucrose.



Figure 1. Response of sugar beet estimated recoverable sucrose yields to percent kochia control.