Control of Kochia With Starane in Sugarbeet

Donald L. Vincent III, Alan G. Dexter, and John L. Luecke

Graduate Research Assistant, Extension Sugarbeet Specialist, and Sugarbeet Research Specialist, Department of Plant Sciences, North Dakota State University - University of Minnesota, Fargo, ND

Introduction

Kochia is a common, widespread weed in North Dakota and Minnesota. It produces large quantities of seed, but the seed survives only one to two years in the soil before a dramatic decrease in germination is observed. Kochia is highly variable in terms of morphology and response to herbicides. University researchers observed variable kochia response to plant growth regulator herbicides, over 30 years ago. More recently, kochia resistance to triazine and ALS-inhibitor herbicides has been documented at many sites in the western United States.

Herbicides that inhibit the ALS enzyme such as Harmony, Express, Matrix, Raptor, and UpBeet, have been extensively used in the Red River Valley for several years and kochia resistant to these herbicides has developed in several different crops. Several herbicides that inhibit the ALS enzyme are commonly used in a sugarbeet rotation. This increased selection pressure for resistant plants has created a population of ALS resistant kochia.

The micro-rate herbicide program is widely used to control weeds in sugarbeet throughout the Red River Valley, representing over 95% of the sugarbeet growers in 2000. The micro-rate program uses low rates of herbicides in combination applied three or more times at a 5 to 7 day interval, starting when sugarbeet plants are in the cotyledon stage. The most common micro-rate treatment is Betamix plus UpBeet plus Stinger plus Scoil (methylated seed oil) adjuvant at 0.5 pt/A plus 0.125 oz/A plus 1.3 fl oz/A plus 1.5% v/v. This treatment would be applied 3 to 7 times on a 5-day interval. The primary herbicide for controlling kochia in the micro-rate program is UpBeet. UpBeet is a sulfonylurea, and its mode of action is to inhibit the ALS enzyme. When ALS-resistant kochia is present in a field, UpBeet and the micro-rate system will not adequately control those resistant plants.

Sugarbeet growers and researchers are searching for a new herbicide with a different mode of action that will control kochia in sugarbeet. One herbicide being investigated is Starane (fluroxypyr). Starane provides excellent control of kochia including ALS- and dicamba-resistant types. The mode of action of Starane is plant growth regulation. Starane at 0.5 pt/A controls kochia less than 4 inches tall, but this rate usually injures sugarbeet. Starane at 0.5 to 0.67 pt/A is labeled for use in small grains. The objective of these experiments was to use Starane at reduced rates in conjunction with the micro-rate program to control ALS-resistant kochia and reduce the injury to sugarbeet.

Materials and Methods

Experiments were conducted in the Red River Valley of Minnesota and North Dakota in 2000 at Felton and Humboldt, MN, and Hillsboro and St. Thomas, ND. Experiments were located in 2001 at Felton, MN, Glasston, Manvel, and St. Thomas, ND. All experiments were conducted using a randomized complete block design with four replicates. Sugarbeet cultivars 'Beta 2081' in 2000 and 'Beta 660' in 2001 were planted 1 inch deep in 22 inch spaced rows and thinned to an 8-inch final plant spacing. Herbicide treatments were applied to the center four rows of six row plots with a bicycle-wheel-type sprayer with 'TeeJet' 8002 flat-fan nozzles, traveling 3 miles/hr, delivering 17 GPA at 40 psi. Crop injury and weed control evaluations were taken 14 and 28 days after the last herbicide application. Weed control and sugarbeet injury ratings of 0 to 100 were a visual estimate of biomass reduction in the treated four rows compared to the two adjacent untreated rows. Yield was determined in 2000 and 2001 at St. Thomas, ND, from plots that were hand weeded to ensure that any yield effects observed between treatments could be attributed to herbicide phytotxicity and not to competition from uncontrolled weeds.

The standard micro-rate treatment in 2000 and 2001 was Betamix + UpBeet + Scoil at 0.5 pt/A + 0.125 oz/A + 1.5 % v/v applied four times. Starane was added in either the second, third, or fourth application of the micro-rate. Starane was applied at 0.08 pt/A (1/8 labeled rate), 0.17 pt/A (1/4 labeled rate), 0.33 pt/A (1/2 labeled rate), or 0.67 pt/A (full labeled rate).

Results and Discussion

Kochia control varied between years (Table 1). Kochia control overall was substantially higher in 2000 than 2001 ranging from 82 to 98% in 2000 and from 42 to 87% in 2001. The micro-rate plus Starane at any rate tested in 2000 gave greater than 90% kochia control, but 2001, the highest level of kochia control was 87% with the highest Starane rate. This may be due to a higher observed kochia population at each of the three locations evaluated for weed control in 2001 compared to the three locations evaluated for weed control in 2000, and/or a higher percentage of ALS-resistant may have neen present kochia in 2001fields. Addition of Starane to the micro-rate gave a greater increase in kochia control in 2001 than in 2000. For example, in 2001, the micro-rate plus 0.08 pt/A Starane provided 68% kochia control compared to 42% kochia control from the micro-rate alone, a 26% increase in kochia control. For the same comparison in 2000 the micro-rate plus Starane at 0.08 pt/A gave 92% kochia control in 2000 compared to 82% from the micro-rate alone, or a 10% increase in kochia control (Table 1).

Table 1. Kochia control with Starane in 2000 and 2001, averaged across three locations.

Treatment	Starane rate	2000	2001
	pt/A	----------%----------	
Betamix+UpBeet+Scoil			
0.5 pt/A + 0.125 oz/A + 1.5 % v/v (Micro-rate)		82	42
Micro-rate + Starane	0.08	92	68
	0.17	97	75
	0.33	98	81
	0.67	98	87
LSD (0.05)		2	4

Sugarbeet injury was similar in 2000 and 2001. Significant sugarbeet injury was observed in both 2000 and 2001 when Starane was added at any rate or timing to the micro-rate (Table 2). Sugarbeet injury was greater than 25% both years when Starane was added at the lowest tested rate of 0.08 pt/A. In 2000 and 2001, sugarbeet injury increased as the Starane rate increased.

Table 2. Sugarbeet injury in weed free sugarbeet at St. Thomas, ND, in 2000 and 2001.

Treatment	Starane rate	2000	2001
	pt/A	----------%----------	
Betamix+UpBeet+Scoil			
0.5 pt/A + 0.125 oz/A + 1.5 % v/v (Micro-rate)		1	11
Micro-rate + Starane	0.08	28	26
	0.17	40	31
	0.33	63	50
	0.67	69	67
LSD (0.05)		9	7

Sugarbeet treated with Starane at 0.17 pt/A or greater yielded less extractable sucrose/A than when treated with the micro-rate alone (Table 3). Usually, as the rate of Starane increased, the amount of extractable sucrose/A decreased. This was true in both years except for Starane at 0.33 pt/A in 2000. Plots treated with Starane at 0.33 pt/A in 2000 yielded less but not significantly less than plots not treated with Starane. The reason for the lack of a significant response is not known. Starane at 0.08 pt/A added to the micro-rate did not cause a significant yield loss in 2000 or 2001, although yield was numerically less in 2001 from plots treated with Starane at 0.08 pt/A.

Table 3. Sugarbeet yield, expressed as extractable sucrose per acre, at St. Thomas, ND, in 2000 and 2001.

		----------Extractable sucrose----------	
Treatment	Starane rate	2000	2001
	pt/A	----------lb/A----------	
Betamix+UpBeet+Scoil			
0.5 pt/A + 0.125 oz/A + 1.5 % v/v (Micro-rate)		4090	6125
Micro-rate + Starane	0.08	4150	5760
	0.17	3450	5250
	0.33	3670	4880
	0.67	2640	3420
LSD (0.05)		340	710

Betamix at 1.5 pt/A was applied three times (3X) to represent a conventional rate in other field experiments conducted in 2000. Starane at 0.08 pt/A (1/8 labeled rate), 0.17 pt/A (1/4 labeled rate), 0.33 pt/A (1/2 labeled rate), or 0.67 pt/A (full labeled rate) was applied alone 7 days after the last Betamix treatment (DALT). Starane applied alone 7 DALT caused less injury and less yield loss compared to Starane plus Betamix (Table 4). Starane at rates up to 0.33 pt/A did not cause a significant yield loss. The only tested rate of Starane that caused a yield loss when applied 7 days after a conventional rate of Betamix was the full-labeled rate for small grains (0.67 pt/A). The highest level of sugarbeet injury from Starane alone at 0.67 pt/A was 33% (Table 4), as compared to 67 and 69% injury from Starane at 0.67 pt/A plus the micro-rate (Table 2).

Table 4. Yield of sugarbeet when treated with Starane 7 days after the last Betamix application in 2000.

Treatment	Starane Rate	Extractable sucrose/A	Injury
	pt/A	---lb/A---	---%---
Betamix 1.5 pt/A (3X)		4720	1
Betamix 1.5 pt/A (3X) + Starane 7 DALT	0.08	4550	1
	0.17	4040	9
	0.33	4540	10
	0.67	3910	33
LSD (0.05)		790	7

Experiments for 2001 were designed to test of Starane applied alone, after other herbicide treatments were completed because of the encouraging results that occurred in 2000 from Starane alone (Table 4). Betamix + UpBeet + Scoil at 0.5 pt/A + 0.125 oz/A + 1.5 % v/v was the standard micro-rate treatment applied four times. Starane was applied 7 or 14 days after the last micro-rate treatment (DALT). Starane was applied at 0.08 pt/A (1/8 labeled rate), 0.17 pt/A (1/4 labeled rate), 0.33 pt/A (1/2 labeled rate), or 0.67 pt/A (Full labeled rate). The results with Starane alone in 2001 were not similar to results in 2000. Yield loss was observed when Starane was applied at 0.17 pt/A or higher (Table 5). The 0.08 pt/A rate of Starane was the only tested rate that did not cause a significant yield loss. This was true when Starane was applied 7 or 14 DALT (Table 5, 6). Sugarbeet injury and yield loss was similar when Starane was applied at 7 or 14 DALT.

Table 5. Yield of sugarbeet treated with Starane 7 DALT in 2001 at St. Thomas, ND

Treatment	Starane rate	Extractable sucrose	Injury
	pt/A	---lb/A---	---%---
Betamix+UpBeet+Scoil			
0.5 pt/A + 0.125 oz/A + 1.5 % v/v (Micro-rate)		6130	11
Micro-rate + Starane	0.08	5050	22
	0.17	4740	31
	0.33	3470	37
	0.67	2900	55
LSD (0.05)		1210	11

Table 6. Sugarbeet yield treated with Starane 14 days after the last micro-rate treatment in 2001 at St. Thomas, ND

Treatment	Starane rate	Extractable sucrose	Injury
	pt/A	---lb/A---	---%---
Betamix+UpBeet+Scoil		6130	11
0.5 pt/A + 0.125 oz/A + 1.5 % v/v (Micro-Rate)			
Micro-rate + Starane	0.08	5290	18
	0.17	3100	23
	0.33	3010	44
	0.67	2400	52
LSD (0.05)		1210	11

Summary

Hand-weeded sugarbeet treated with the micro-rate plus 0.08 pt/A Starane produced extractable sucrose/A similar to sugarbeet treated with the micro-rate alone. Hand-weeded sugarbeet treated with micro-rate plus 0.017, 0.33, or 0.67 pt/A Starane yielded less extractable sucrose than sugarbeet treated with the micro-rate alone. The micro-rate alone gave 82% kochia control in 2000 and 42% kochia control in 2001. The micro-rate plus 0.08 pt/A Starane gave 92% kochia control in 2000 and 68% kochia control in 2001. Micro-rate plus 0.08 pt/A Starane increased kochia control by 10% in 2000 and 26% in 2001 compared to the micro-rate alone.

Sugarbeet treated with Starane 7 DALT in 2000 showed no significant injury from Starane rates up to 0.33 pt/A. In similar experiments conducted in 2001, Starane rates of 0.17 pt/A and higher caused a significant yield loss in 2001.

Conclusion

The micro-rate plus 0.08 pt/A Starane did not cause yield loss and gave increased kochia control compared to the micro-rate alone. However, obvious visible sugarbeet injury and variability in kochia control from the micro-rate plus 0.08 pt/A Starane would be a concern to sugarbeet growers and a potential registrant. Future experiments will focus on using Starane and other herbicides with an over-the-top wick application technique to control kochia in sugarbeet.