

KOCHIA CONTROL IN SUGARBEET - A PROGRESS REPORT

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Summary

1. Ethofumesate (Nortron) should be soil-applied at 7 to 7.5 pt/A in sugarbeet fields with known kochia history.
2. Scout fields with known or suspected kochia history and spray with a tank-mixture including Betamix, ethofumesate and UpBeet when kochia is 1-inch tall and sugarbeet is at the 2-leaf stage.
3. Make two or three repeat applications of UpBeet at 0.5 to 0.75 oz/A plus ethofumesate and glyphosate beginning when kochia is 2 inches tall and sugarbeet are at the 2 to 4 leaf stage.

Introduction

Kochia is an annual broadleaf weed in the Chenopodium family. Kochia is one of the first weeds to emerge in the spring and can withstand early-season frost. Kochia grows erect and is highly branched from the central stem. Kochia is a bush style plant that, at harvest, averages three to five feet tall. Kochia is extremely competitive with crops such as soybean, dry bean, or sugarbeet. In sugarbeet, Schweizer found that five kochia plants per 100 feet of row reduced yield by 10%. Kochia produces approximately 14,000 seed per plant. However, kochia seed viability is short, usually two years or less. There has been confirmed resistance to multiple herbicide families including ALS (Site of Action (SOA) 2), triazine (SOA 5) and glyphosate (SOA 9) chemical family herbicides.

Kochia historically was found in pastures, road ditches, and waste areas on farms but has evolved to flourish in cultivated fields. Kochia is extremely deep rooted and can grow in places that do not receive much rainfall. Kochia also is able to tolerate high salinity soils. Kochia leaves are alternate on the stem and are long and narrow, up to two inches long and less than half inch wide. Leaves are usually without petioles (leaf stems) and often have hairy margins. The young shoots are usually very hairy.

Kochia is associated with arid environments. However, it, along with many tough-to-control weeds, seems to be adapting to many different environments. While waterhemp may currently be receiving more attention in the media, kochia might have greater long-term impacts on sugarbeet farmers, primarily because there are very few herbicide options in sugarbeet. The purpose and objective for the research was to investigate control of glyphosate tolerant kochia in sugarbeet.

Materials and Methods

An experiment was conducted on natural populations of kochia near Barney, ND. Experimental area was prepared using a Kongskilde s-tine field cultivator with rolling baskets on April 23, 2015. The experiment was planted into corn stalks residue. Hillehog 'HM4022RR' sugarbeet seed treated with Cruiser 5FS at 60 gm ai, Apron XL at 15 gm ai, and Maxim 4FS at 2.5 gm a.i., respectively, per 100,000 seeds was planted on April 23, 2015, 1.25 inches deep in 22-inch rows at 60,825 seeds per acre. Herbicide treatments were applied at 17 gallons per acre spray solution through 8002 XR flat fan nozzles pressurized with CO₂ at 40 pounds per square inch to the center four rows of six-row plots 30 feet in length (Table 1). Ammonium sulfate (AMS) in all treatments was a liquid formulation from Winfield Solutions marketed as 'N-Pak' AMS. The Barney, ND, location contained moderate levels of glyphosate-resistant kochia. Sequential herbicide applications corresponded to kochia size and were made on April 23, May 21, May 27, June 4, and June 29, 2015. Assure II was applied across the experimental area for controlling volunteer corn. Experiment was randomized complete block design with four replications. Sugarbeet injury and kochia control were evaluated June 8, June 19, July 7, and August 4, 2015. All evaluations were a visual estimate of fresh weight reduction in the four treated rows compared to the adjacent untreated strip. Data was analyzed with the ANOVA procedure of Agricultural Research Manager (ARM), version 2015.6 software package.

Table 1. Application information for kochia control in sugarbeet experiment, Barney, ND, 2015.

Application code	A	B	C	D	E
Date	April 23	May 21	May 27	June 4	June 29
Time of Day	2:00 PM	1:15 PM	4:00 PM	6:00 PM	1:00 PM
Air Temperature (F)	51	66	85	86	77
Relative Humidity (%)	20	29	50	35	63
Wind Velocity (mph)	6	2.5	3	15	4.5
Wind Direction	E	NW	NE	NW	N
Soil Temp. (F at 6")	45	56	72	74	68
Soil Moisture	Good	Good	Good	Good	Good
Cloud Cover (%)	25	0	50	0	100
Sugarbeet stage (avg)	PRE	2 lf	4 lf	6 lf	10 lf
Kochia (untreated avg)	-	1.0"	1.5"	1.75"	12"

Results and Discussion

There was early season sugarbeet injury in this experiment (Table 2). Sugarbeet injury was greatest at the June 8 and June 19 evaluations and was less in July and generally negligible in August (July and August data not presented). Sugarbeet injury numerically was greatest at 30% from preemergence (PRE) ethofumesate at 7 pt/A followed by (fb) Betamix at 10 fl oz/A + UpBeet at 1 oz/A + ethofumesate at 4 fl oz/A at the 2-leaf sugarbeet stage fb Roundup PowerMax + ethofumesate at 4 fl oz/A + Betamix at 12, 24, and 32 fl oz/A. Roundup PowerMax + ethofumesate at 4 fl oz/A + Betamix at 16, 24, and 32 fl oz/A gave 19% injury compared to 24% injury from the same treatment following PRE ethofumesate at 7.5 pt/A. Three applications of PowerMax + Stinger at 2 fl oz/A + UpBeet at 0.5 oz/A gave 20% injury.

At evaluation timings, the experiment contained a heavy infestation of lambsquarters and kochia and a light infestation of redroot pigweed, barnyardgrass and foxtail species. Lambsquarters control with all treatments in the experiment was near perfect throughout the growing season (data not presented). All treatments contained Roundup PowerMax plus surfactant (either Prefer 90 non-ionic surfactant (NIS) or Destiny HC high surfactant methylated oil concentrate (HSMOC) and N-Pak AMS). Environmental conditions at application were ideal to maximize herbicide efficacy and all weeds were actively growing.

Two applications of Roundup PowerMax at 28 fl oz/A at the 4- and 6-leaf sugarbeet stage fb PowerMax at 22 fl oz/A at the 10-leaf stage gave only 70% kochia control when averaged across four evaluations, indicating there was glyphosate-resistant kochia at the Barney, ND location (Table 2). Increasing the PowerMax rate from 28 to 32 fl oz/A or addition of ethofumesate at 4 fl oz/A did not improve kochia control. Applying Betamix sequentially at 8, 12, 16 or 16, 24 or 32 fl oz/A + Roundup Power Max + ethofumesate improved kochia control but also caused more sugarbeet injury.

Ethofumesate applied PRE at 7.5 pt/A fb three applications of PowerMax + ethofumesate did not improve control. Poor kochia control may be due to lack of precipitation following planting. Precipitation during the 14 days following PRE ethofumesate application totaled only 0.25 inches and the first significant rainfall event (0.92 inches) occurred 18 days after planting. By this time, kochia had already emerged and was actively growing.

Kochia control numerically was greatest across evaluations from PRE ethofumesate at 7 pt/A fb Betamix at 10 fl oz/A + UpBeet at 1 oz/A + ethofumesate at 4 fl oz/A at the 2-leaf stage fb three applications of Roundup PowerMax + ethofumesate at 4 fl oz/A + Betamix at 12, 24 and 32 fl oz/A. However, this treatment caused 30% sugarbeet injury which is unacceptable to most growers and would be very costly.

A better compromise between crop safety and kochia control was from PRE ethofumesate at 7 pt/A fb ethofumesate at 12 fl oz/A + Betamix at 10 fl oz/A + UpBeet at 1 oz/A at the 2-leaf stage fb three applications of Roundup PowerMax. Three applications of Roundup PowerMax + ethofumesate at 4 fl oz/A + UpBeet at 0.5 oz/A also gave very good control, especially as the season progressed. Growers, however, will need to accept some sugarbeet injury to achieve acceptable kochia control.

Table 2. Sugarbeet injury and kochia control from soil-applied and postemergence herbicide treatments, Barney, ND, 2015.

Treatment ¹	Rate pt/A, fl oz/A or oz/A	Application Code ²	Sgbt injury		Kochia control			
			Jun 8	Jun 19	Jun 8	Jun 19	Jul 7	Aug 4
PMax ³ / PMax / PMax	28 / 28 / 22	C / D / E	9	0	65	63	78	75
PMax / PMax / PMax	32 / 24 / 22	C / D / E	0	4	63	58	68	70
PMax+Etho / PMax+Etho / PMax+Etho	28+4 / 28+4 / 22+4	C / D / E	3	10	58	63	75	70
PMax+Etho+Bmix / PMax+Etho+Bmix / PMax+Etho+Bmix	28+4+8 / 28+4+12 / 22+4+16	C / D / E	8	14	74	76	78	76
PMax+Etho+Bmix/ PMax+Etho+Bmix/ PMax+Etho+Bmix	28+4+16 / 28+4+24 / 22+4+32	C / D / E	19	18	68	79	86	78
Etho / PMax+Etho / PMax+Etho / PMax+Etho	7/ 28+4 / 28+4 / 22+4	A / C / D / E	9	5	85	70	73	70
Etho / PMax+Etho+Bmix / PMax+Etho+Bmix / PMax+Etho+Bmix	7 / 28+4+10 / 28+4+16 / 22+4+24	A / C / D / E	24	23	76	81	83	83
PMax+Sting+UpB / PMax+Sting+UpB / PMax+Sting+UpB	28+2+0.5 / 28+2+0.5 / 22+2+0.5	C / D / E	20	23	78	73	73	73
PMax+Etho+UpB / PMax+Etho+UpB / PMax+Etho+UpB	28+4+0.5 / 28+4+0.5 / 22+4+0.5	C / D / E	4	11	81	89	86	84
Etho / Etho+Bmix+UpB / PMax/ PMax / PMax	7 / 12+10+1 / 28 / 28 / 22	A / B / C / D / E	11	10	91	88	88	85
Etho / Etho +Bmix+UpB / PMax+Etho+Bmix / PMax+Etho+Bmix / PMax+Etho+Bmix	7 / 3+10+1 / 28+3 +12 / 28+3+24 / 22+3+34	A / B / C / D / E	30	29	90	91	93	86
LSD (0.10)			11	11	9	11	11	10

¹Treatments of Roundup PowerMax contained Prefer 90 NIS at 0.25% v/v plus N-Pak AMS at 2.5% v/v. All other treatments contained Destiny HC at 1.5 pt/A plus N-Pak AMS at 2.5% v/v.

²Application codes refer to the information in Table 1.

³PMax=Roundup PowerMax; Etho=Ethofumesate 4SC; Bmix=Des&Phen 8+8; UpB=UpBeet; Sting=Stinger.

Preemergence ethofumesate and/ or three applications of Roundup Power Max + ethofumesate + UpBeet seemed to be the best treatment to control kochia without causing sugarbeet injury. Treatments containing Betamix gave more sugarbeet injury when following PRE ethofumesate.

Future Research

We will continue to conduct experiments with kochia in sugarbeet in 2016. Plant early if the goal is to improved kochia research or consider delaying planting until after the first flush of kochia if the goal is sugarbeet production. We learned that timely rainfall for ethofumesate activation is critical to kochia management in 2015. Our 2016 experiments will continue to develop a kochia management system in sugarbeet and crops grown in sequence with sugarbeet including corn and soybean.

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