ROUNDUP READY PLUS®
CROP MANAGEMENT SOLUTIONS

Managing Kochia in a Corn and Sugarbeet Rotation

What You'll Learn...

- With the presence of glyphosate-resistant kochia in some areas, a proactive approach is needed for weed management in cropping systems.
- Crop rotation is a solid strategy that helps to break a weed's reproductive cycle through management of a separate cropping system.
- Kochia should be controlled aggressively in corn where more effective herbicide options are available.
- Proactive management utilizing herbicides with multiple modes of action with overlapping applications throughout the growing season is the most effect management approach in Roundup Ready® sugarbeets.

Weed Biology

Kochia is a resilient, competitive weed throughout the Great Plains and western United States. Kochia is extremely competitive with sugarbeets. A single kochia plant per 100 feet of row has been shown to reduce sugarbeet yield by 5%.[1] Research designed to predict sugarbeet root losses found that for every 10% decrease in kochia control growers could lose 2 to 3 tons/acre.[1]

Understanding the biology of kochia helps in developing management strategies for the weed. The bulk of kochia seed germinates in very early spring, and continues throughout the growing season. Kochia seeds are typically found on the soil surface or at very shallow depths in the soil and generally survive only 1 to 2 years in the soil.[2] Kochia produces large quantities of seed that can spread rapidly over long distances. The plants are tolerant of drought and saline soils, and do well under growing conditions considered poor for most crops.

Kochia has an imperfect flower that allows cross-pollination and reserves the right to self-pollinate. Its prolific seed production and ability to disperse seed widely has important implications for the spread of herbicide resistance. Populations of kochia have resistance to triazine (Group 5), ALS-inhibitor (Group 2), growth regulator (Group 4), and glyphosate (Group 9) herbicides in areas throughout the West. Kochia resistance to sulfonylurea herbicides is widespread. Populations of kochia resistant to auxin herbicides have also been reported in limited areas. Recently, glyphosate-resistant populations of kochia have been reported. Long-term kochia management will require integrated weed management tactics.

Kochia seed biology can be exploited to help keep kochia populations in check. Most new kochia seed does not survive longer than 1 year in the soil and only about 5% survives into the second year.[3] Crop rotation, planting date, crop competiveness, and light tillage are cultural practices that can be used to deplete kochia seed viability and persistence and create a competitive advantage for crops. Early emergence provides kochia with a competitive advantage by utilizing spring moisture in semi-arid areas. For this reason, spring burndown and early season herbicide applications can reduce kochia competition with the crop. Using diverse herbicide sites of action in preceding crops is an important tool to manage kochia, particularly in crops where herbicide options are limited.

Table 1. Kochia emergence from various depths.

Emergence depth - inches	% Emergence
0.08	52
0.39	41
0.79	27
1.60	7
3.15	0
LSD (0.05)	5

Adapted from Schwinghammer, T.D. and Van Acker, R.C. 2008.[2]

Management Recommendations

Producers need to be proactive and develop a comprehensive plan that targets kochia during all phases of the cropping system. Crop rotation allows the use of multiple management tactics and herbicide systems with multiple sites of action to help manage kochia. The benefits of longer sugarbeet rotations include: lower incidence and severity of Rhizoctonia root rot and Cercospora leaf spot, reduction of allelopathic affects, and better nitrogen management. Kochia and other weeds can be easier to control in corn because there are more effective herbicide options. Corn in a crop rotation can help improve weed control in sugarbeets because there are more effective herbicides available for use in corn. To control glyphosate-resistant kochia, tank mixtures of Roundup® agricultural herbicides and herbicides with other sites of action need to be used.

Figure 1. Seedling kochia plant.

Technology Development & Agronomy by MONSANTO

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Roundup Ready® Corn 2 and Corn with Roundup Ready® 2 Technology

⇒ Start clean with a burndown herbicide or tillage. Spray early, target 3 to 4 inch kochia. Tank mix dicamba with a Roundup® agricultural herbicide.

⇒ Use a pre-emergence (PRE) herbicide or tank mixtures at planting for residual control of kochia (Table 1).

⇒ Manage later emerging kochia with a post-emergence (POST) application of a Roundup® agricultural herbicide plus dicamba or Status®. Warrant® Herbicide applied alone does not control kochia but can provide extended residual control of annual grass and broadleaf weeds, including pigweed, to the tank mixture.

Table 1. Corn herbicide options for kochia.

Herbicide	Site of Action	Rotation Interval to Sugarbeets (months*)
Pre-emergence herbicide options		
Clarity®	4	4
Harness®[1]	15	Next cropping season
Sharpen®	14	4 to 9
Verdict®	14, 15	Next cropping season
Post-emergence herbicide options		
Buctril®	6	1
Clarity®	4	4
Status®	4, 19	4
WideMatch®	4	4

[1] Harness - reduced competition of kochia.
*** Herbicide use rate can influence duration of interval. Consult individual product labels for specific instructions.**

Atrazine, Balance® Flexx, Degree Xtra®, Harness® Xtra, Harness® Xtra 5.6L, Lumax® can be used PRE and atrazine, Impact®, Callisto® Xtra, and Capreno® can be used POST for kochia in corn, while effective, these products have rotation intervals that prevent planting sugarbeets immediately after corn in the rotation.

Genuity® Roundup Ready® Sugarbeets

Adding diversity to your weed management programs, especially early in the season, is important for kochia control in sugarbeets. Use multiple sites of action herbicides that are effective for kochia control, instead of using only glyphosate in the program.

⇒ Start clean with a burndown herbicide or tillage.

⇒ Use PRE soil residual herbicides at planting for kochia. Nortron® SC herbicide or other labeled soil residual herbicides can be applied preplant incorporated or PRE.

⇒ Follow-up with POST applications of a Roundup® agricultural herbicide tank mixture. Nortron® SC plus Betamix® herbicides can provide fair to good control of kochia. Sequential applications should be made at least 10 days apart. The addition of Warrant® Herbicide to the tank mixtures can provide extended residual control of other annual grass and broadleaf weeds, including pigweed. Apply soil residual herbicides when sugarbeets are between the 2 to 4-leaf growth stage to help reduce weed emergence prior to canopy closure.

⇒ Cultivate or hand weed if necessary to prevent any kochia escapes from producing seed.

Diverse crop rotations, multiple herbicide sites of action, soil residual herbicides, and the use of tillage, where needed, are the best strategies for managing kochia and other weeds.

Sources: [1] 2006. Soil-applied herbicide. American Crystal Sugar Company Fact sheet. https://www.crystalsugar.com. [2] Schwinghammer, T.D. and Van Acker, R.C. 2008. Emergence timing and persistence of kochia (kochia scoparia). Weed Science 56:37 - 41. [3] Zollinger, R. 2015. North Dakota Weed Control Guide W-253. North Dakota State University.