Evaluating the Relative Contributions of Crop Rotation, Tillage, and Herbicide Diversity for Proactive Herbicide Resistant Weed Management

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Introduction

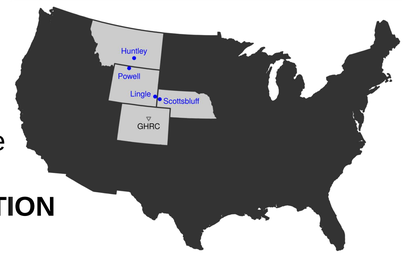
- Combinations of cultural, mechanical, and chemical practices are often recommended in agronomic settings in order to combat the buildup of various pests, including weeds.
- Kochia (*Kochia scoparia*) has become one of western United States most problematic weeds, in part, because of evolved resistance to many common herbicides.
- In Wyoming, Nebraska, and Montana, kochia has developed resistance to:
  - ALS-inhibitors
  - Photosystem II inhibitors
  - EPSP synthase inhibitors
  - Synthetic auxins
- It is critical to find alternative, sustainable methods to control herbicide-resistant kochia.

OBJECTIVE:

- Examine interactions between crop rotation diversity, tillage, and herbicide application on kochia density.

Methods

- Field studies were initiated in 2014 and are continuing through 2017 at 4 sites in Wyoming, Nebraska, and Montana.
- Kochia seed with known ALS R:S ratio (5:95%) was spread at 2,000 g/ha at study initiation.
- Split-split-plot RCBD
  - 4 blocks per site
  - Whole-plot: TILLAGE
    - Annual intensive tillage
    - Minimum tillage
  - Split-plot: CROP ROTATION
    - Continuous corn
    - Corn-sugarbeet
    - Corn-bean-corn-sugarbeet
    - Corn-bean-wheat-sugarbeet
  - Split-split-plot: HERBICIDE:
    - Continuous, exclusive use of ALS-inhibitors
    - Mixtures including ALS-inhibitors
    - Annual rotation of ALS-inhibitor herbicides



- Kochia density and seed production was assessed at crop maturity.
- Statistical Data Analysis: Generalized linear mixed-effects model

Results & Discussion

- Crop by herbicide interaction was significant for kochia density and seed production per plant in 2014, the first year of the study (*p<0.01).*
- Kochia density was multiplied by seed production per plant to estimate seed production per m^2 in 2014 (Table 1). The effect of herbicide on kochia seed production differed by crop; but wheat consistently allowed the least seed production.
- Tillage, crop rotation, and herbicide treatment had a significant interaction effect on kochia density in 2016, the third year of the study (*p<0.01).*
- Tillage and diverse crop rotations mitigated the effect of reliance on ALS herbicides (Table 2).
- Diverse crop rotations (corn-bean-corn-sugarbeet and corn-bean-wheat-sugarbeet) treated with ALS Mixtures that were intensively tilled were associated with the lowest kochia density on average (Table 2).
- R:S ratio of seedbank and surviving plants will be quantified at the completion of the study.

Table 1. Average kochia seed/m^2 produced within each crop and herbicide treatment in 2014

Crop	Herbicide treatment		
	ALS only	ALS mix	Non-ALS
Corn	4,268	7,935	133
Dry bean	1,544	1,531	1,111
Spring wheat	80	0	0
Sugarbeet	24,331	0	91

Table 2. Average kochia plants/m^2 within each tillage practice, crop rotation, and herbicide treatment in 2016, the 3rd year of the study

Crop Rotation	Herbicide Treatment					
	ALS only	ALS mixture	ALS rotation	ALS only	ALS mixture	ALS rotation
	Minimum Tillage			Intensive Tillage		
Continuous corn	67	3	2	37	1	2
Corn-Sugarbeet	481	4	56	296	11	43
Corn-Dry bean-Corn-Sugarbeet	64	4	65	31	3	7
Corn-Dry bean-Wheat-Sugarbeet	28	2	3	8	1	1

References

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Future Research

One more year of treatments will take place in the 2017 field season. Combined data will be used to model the long term effects of crop rotation diversity, tillage, and herbicide application on kochia populations in the High Plains region.

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Herbicide treatments included in this study

	Corn	Sugarbeet	Dry bean	Wheat
Non- ALS (every other year of ALS rotation treatment)	Roundup PowerMax (glyphosate) 1260g ae/ha	Roundup PowerMax (glyphosate) 1260g ae/ha	Prowl H2O (pendimethalin) 1330g ai/ha	Huskie (pyrasulfatole + bromoxynil) 253g ai/ha
	Clarity (dicamba) 280g ae/ha	Ammonium Sulfate 1.9g/100ml	Basagran (bentazon) 1120g ai/ha	MCPA-Ester 280 g ae/ha
	Warrant (acetochlor) 1050g ai/ha	Warrant (acetochlor 1050g ai/ha	COC 1% v/v	Ammonium Sulfate 1.9g/100ml
ALS only	Resolve Q (thifensulfuron + rimsulfuron) 19.6g ai/ha	UpBeet (triflusulfuron) 35g ai/ha	Eptam (EPTC) 3920g ai/ha	Affinity Broadspec (thifensulfuron + tribenuron) 35g ai/ha
	COC 2% v/v	COC 1% v/v	Raptor (imazamox) 35g ai/ha	NIS 0.25% v/v
	UAN (28-0-0) 2.98% v/v	Warrant (acetochlor) 1050g ai/ha	NIS 0.25% v/v	UAN (28-0-0) 2.5% v/v
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