MINNESOTA – Alfalfa in Rotations to Manage Herbicide-Resistant Giant Ragweed

Jared Goplen, Lisa Behnken, Fritz Breitenbach, Jeffrey Gunsolus, University of Minnesota

Weeds resistant to herbicides continue to become more widespread across Minnesota. Weeds with resistance to multiple herbicides reduce the utility of existing herbicides, but they also necessitate the use of alternative weed control strategies. From 2012-2015, near Rochester, MN, we determined the effect of six three-year crop rotations containing corn (C), soybean (S), alfalfa (A), and wheat (W): (CCC, SCC, CSC, SWC, SAC, AAC) on herbicide-resistant giant ragweed seed bank depletion and emergence patterns. Crop rotation had no effect on the amount of seed bank depletion when weed seed production was prevented through the use of alternative herbicides and manual weeding. Averaged across all rotations, the giant ragweed seed bank was depleted 96% within two years (Table 1).

Table 1. Total giant ragweed emergence in each year, percentage of seed bank depletion, and percentage of depletion accounted for by emergence in each crop rotation system, across both experimental locations in 2012-2015. Means with different letters indicate a significant difference at the 0.05 probability level using Fisher's protected LSD.

Crop rotation system‡	Emergence†			Seed bank§	
	Year 1	Year 2	Year 3	Depletion	Emergence
	Seedlings ft^{-2}			%	
CCC	0.32 ns	0.52 ab	0.10 ab	97.7 ns	100 ab
SCC	0.65	0.98 a	0.01 c	95.7	100 a
CSC	0.44	0.45 b	0.14 a	90.6	96 bc
SWC	0.60	0.38 b	0.05 abc	94.7	61 bc
SAC	0.66	0.43 b	0.05 bc	98.4	74 bc
AAC	0.41	0.07 c	0.03 bc	99.0	41 c

† Total seedling emergence in each year are corrected means from the seed bank density covariate.
§ Seed bank depletion represents percentage of seeds depleted between the first and third year of the crop rotation systems, while emergence represents percentage of the seed bank depletion accounted for by emergence during the same time period.
‡ C, S, W, and A represent the sequence of corn, soybean, wheat, and alfalfa in each 3-year crop rotation system.
ns = means numbers within columns are not significantly different

Multiple years of alfalfa allowed less seedling emergence while maintaining a high level of seed bank depletion (Table 1). Total emergence of giant ragweed was 58% less when two years of alfalfa were included in the rotation compared to rotations containing just corn or soybean. These results indicate corn and soybean rotations are more conducive to giant ragweed emergence than rotations containing alfalfa, and preventing giant ragweed seed production can quickly deplete the weed seed bank.

The economic net return of each crop rotation was also evaluated. The AAC rotation was the most profitable rotation, with an average net return of \$372 ac^{-1} yr^{-1}, which was at least \$223 ac^{-1} yr^{-1} more profitable than all other rotations. Rotations with alfalfa also had less financial risk, largely due to relatively stable alfalfa prices over the study period coupled with above-average yield and decreased production costs. Overall, these results confirm alfalfa can be used as an effective tool to mitigate the risk of herbicide-resistant giant ragweed infestations while providing substantial economic net return.