Fate of *Amaranthus palmeri* (Palmer amaranth) and *A. tuberculatus* (waterhemp) Seeds Under Cereal Rye Cover Crop Across the North Central Region

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Introduction

Palmer amaranth and Waterhemp

Are ranked atop the most troublesome weeds in American cropping systems[1]

Cause economic damage if left uncontrolled in agricultural fields[2]

Control is difficult with multiple SOA resistance[3]

Cereal Rye

Is a popular in the North Central Region due to its cold hardiness and drought tolerance

It increases microbial activity, especially after decomposition[3]

Microbial activity can result in seedbank decay, but results are species dependent[4]

Objective

Determine if the increase in microbial activity within cereal rye treatments affect amaranth species seedbank viability over time.

Hypothesis

There will be fewer viable seeds in plots with cereal rye cover crop.

Materials and Methods

Seven experiment sites across five states (Fig. 1)

1. Manhattan, KS (KS-1)
2. Rossville, KS (KS-2)
3. Columbia, MO
4. Brooklyn, WI (WI-1)
5. Fargo, ND
6. Lafayette, IN
7. Janesville, WI (WI-2)

Species from each location collected are listed in Table 1

A randomized complete block design was utilized under strip plots with two treatments and four replications

- Cover crop (cereal rye seeded at 67 kg ha $^{-1}$)
- No cover crop

Figure 1. Stars represent experiment sites

50 seeds were placed within fine (120 mm) wire mesh packets (transient barrier)

Packets were buried fall 2021 (Fig.2)

- Packets buried at each site were:
  - Local population
  - KS waterhemp (KSWH)
  - KS Palmer amaranth (KSPA)
- Rossville, KS included all populations

Seed packets were removed

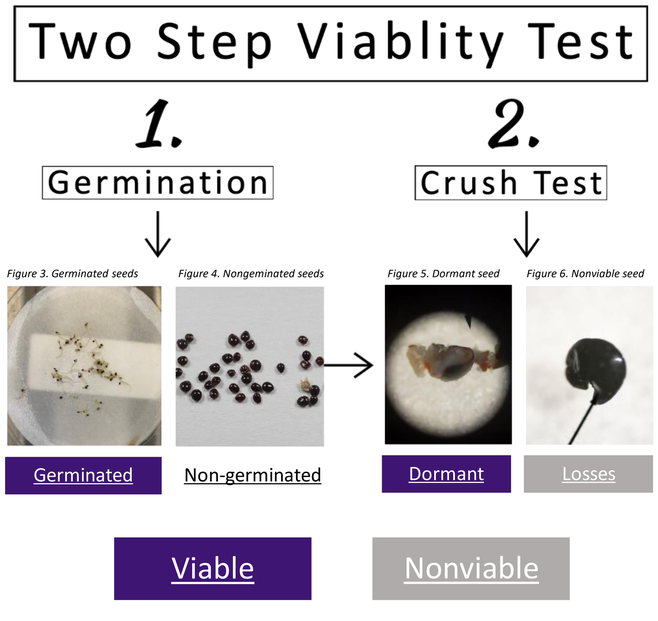
- Soybean planting 2022 (seven months)
- Soybean harvest 2022 (twelve months)

State	Species
Kansas	*A. palmeri*
Kansas	*A. tuberculatus*
North Dakota	*A. palmeri*
North Dakota	*A. tuberculatus*
Wisconsin	*A. tuberculatus*
Missouri	*A. tuberculatus*
Indiana	*A. tuberculatus*

Table 1. Each experiment state and populations

Figure 2. Seed packets buried at ~5cm

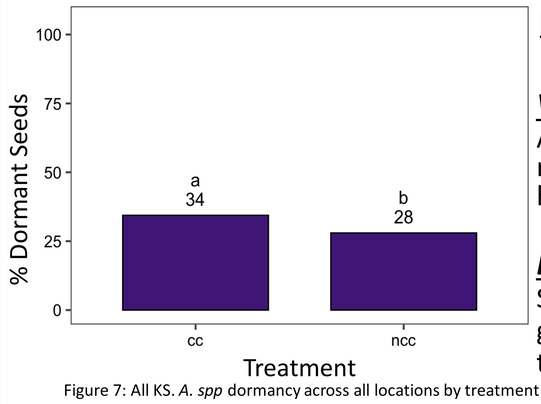
At Manhattan, KS a two-step viability test was conducted (Fig. 3,4, 5 & 6)



Statistical Analysis

- All data were analyzed in R and models were built using lmer() in package lme4
- Each subset was analyzed with an ANOVA using Anova() in R package car
- Means were separated with Tukey's HSD test ($\alpha = 0.05$) with R package emmeans
- Figures were built using ggplot2

Results



Kansas Palmer amaranth and waterhemp across all locations

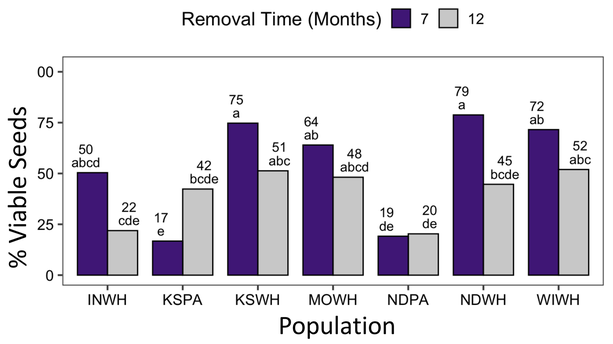
Viability

An interaction between location, species, and removal time occurred. However, treatment had no effect.

Dormancy

Seeds placed within cover crops incurred greater levels of dormancy than no cover crop treatments (Fig. 7)

Figure 7: All KS. A. spp dormancy across all locations by treatment



All Populations at Rossville, Kansas

Viability

An interaction between population and removal timing occurred (Fig.8). Only NDWH viability was less after twelve months compared to seven months.

Figure 8: All A. spp viability at Rossville, KS by removal time

Individual Populations

Viability

Missouri and Indiana waterhemp under cover crop exhibited greater viability than no cover crop at twelve months after burial when analyzed individually (Fig. 9 & 10)

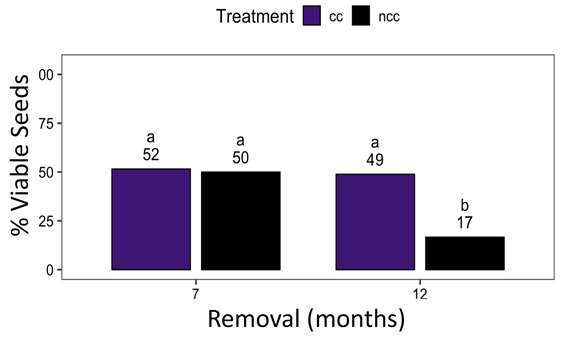


Figure 9. Indiana waterhemp at Kansas and Indiana

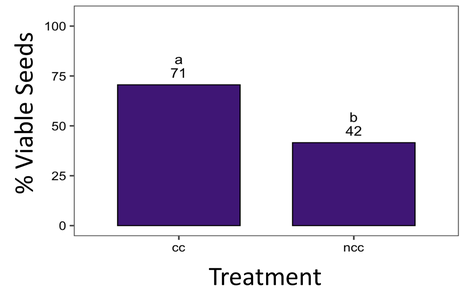


Figure 10. Missouri waterhemp at Rossville, KS

Discussion and Conclusion

Cover crops are changing the weed seedbank

Cereal rye increased dormancy of amaranth. This may mean a prolonged germination period for farmers.

Cereal rye increased viability of two waterhemp populations. Further research is needed to identify contributing genetic and environmental factors.

References

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