



Developing a Soil Bioassay for Alfalfa Autotoxicity

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RATIONALE & OBJECTIVES

- Autotoxicity impedes alfalfa rotations and is poorly understood.

Objectives:

Develop a commercial soil bioassay for autotoxicity.

Compare autotoxicity in soils obtained from alfalfa stands varying in environmental, genetic, and management factors.

Evaluate ability of bioassay to identify autotoxicity response to alfalfa termination date.

STUDY DESCRIPTION

Locations:

East Lansing, Michigan.

Development of Bioassay:

- Growth chamber.
- More than 50 trials.
- Bioassay used seedling root length and diameter as markers of autotoxicity in a 4-day test.

Field Study:

Plot layout: Randomized complete block with split block arrangement.

Factors:

- Rotation interval: 3 vs 14 weeks after termination of previous alfalfa.
- Alfalfa variety.

Analyses:

- Pre-planting bioassay.
- Seedling height.
- Seedling count.
- Dry matter yield.

RESULTS

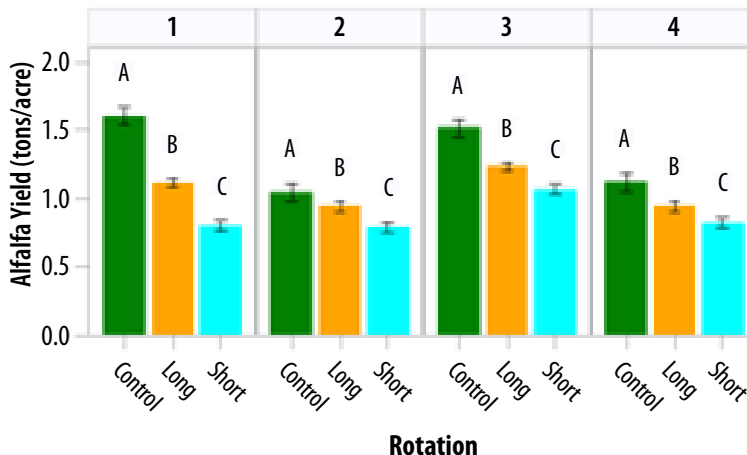
- Refinements to the bioassay protocol include improved growth medium, control growth medium, container, standardization of soil moisture, and best sample storage practices (Figure 1).

Figure 1. Alfalfa seedlings growing in potting soil (left) and all soil (right) bioassays. Photo: Paige Baisley



- No autotoxicity differences were detected among the alfalfa varieties tested. Longer rotation intervals generally resulted in better performance of reseeded alfalfa (Figure 2). Soil fertility was identified as a factor in reseeded success.

Figure 2. 2022 field trial alfalfa yield during year 1 harvest by treatment for each cut.



Letters indicate difference between treatments ($P < 0.05$). Error bars represent standard error of the ls-means.

- Seedling growth in field plots was accurately predicted when reseeded bioassays were positive for autotoxicity, but the bioassay had an unacceptable rate of false negative results and is not yet suitable for commercial use.

MANAGEMENT SUGGESTIONS/CONCLUSIONS

- The soil bioassay is a useful research tool because we can be confident of the existence of autotoxicity as a binary yes/no choice if the bioassay gives a positive result.
- We cannot be confident that we do *not* have autotoxicity if the bioassay results are negative; therefore, the bioassay is not yet suitable for commercial use by producers.
- More validation work is needed to determine if this false negative obstacle can be overcome.
- No variety differences in autotoxicity were detected.
- Our serendipitous finding on involvement of soil fertility suggested a new line of investigation on the possible interaction of soil fertility with autotoxicity. This will be explored in our new NIFA-ASAFA project leveraged by this funding.