



Developing a Soil Bioassay for Alfalfa Autotoxicity

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RATIONALE & OBJECTIVES

- Alfalfa contains an unidentified water-soluble compound or compounds that are autotoxic to new alfalfa seedlings, causing direct failure of germination and seedling establishment in some cases. The most damaging effect is permanent damage to surviving root systems that causes reduced persistence and lifetime yield for the stand.
- The duration and extent of autotoxicity is influenced by a complex mix of environmental, genetic, and management factors.
- Best management practices are based on waiting two weeks to two years after stand termination before planting a new stand.

Objectives:

To develop a bioassay that could be conducted with field soil samples to predict whether it is safe to replant and reduce the waiting period for replanting.

STUDY DESCRIPTION

- This is a laboratory study that uses soils from alfalfa variety test plots across Michigan.
- One method is to conduct germination tests with water extracts from suspect soils.
- A second method grew alfalfa seedlings for 4 days in a layer of soil on top of agar (soil-on-agar, SOA). This allows root structure to be observed during early growth.
- The third method grew alfalfa seedlings in soils in a greenhouse to begin validating bioassay results.

RESULTS

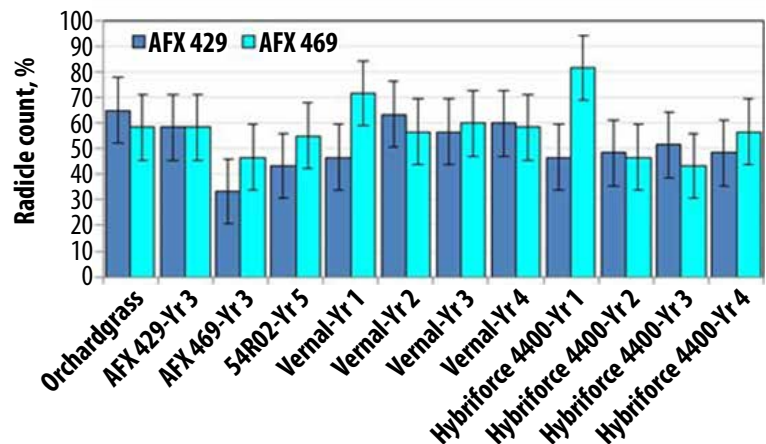
- Germination assays using simple water extracts from soil were not sensitive enough to detect differences.
- The SOA assay was able to detect soil-based differences in root development of alfalfa seedlings.

- The SOA bioassay was able to detect differences in root development between alfalfa varieties grown in the field soil, seed varieties used in the bioassay, stand age, and time since termination.
- Greenhouse-grown plants confirmed root development trends predicted by SOA assay.

Figure 1. Many seedlings exhibited abnormal growth orientation and this may be an indicator of the problems in autotoxic soils. Photo: Kim Cassida.



Figure 2. Seed by soil treatment interaction for radicle emergence four days after planting in soil from two alfalfa varieties of differing stand ages. Error bars represent LSD such that values with no overlap between bars are different ($P < 0.05$).



CONCLUSIONS/SUGGESTIONS

- This project provides proof-of-concept that the soil-on-agar method can rapidly detect alfalfa autotoxicity in field soils. This concept needs further refinement and validation before it is reliable for commercial deployment.



Alfalfa seedlings growing in the soil from grass (control) or alfalfa plots in Task 4.
Photo: Kim Cassida