Alfalfa Autotoxicity Soil Bioassay

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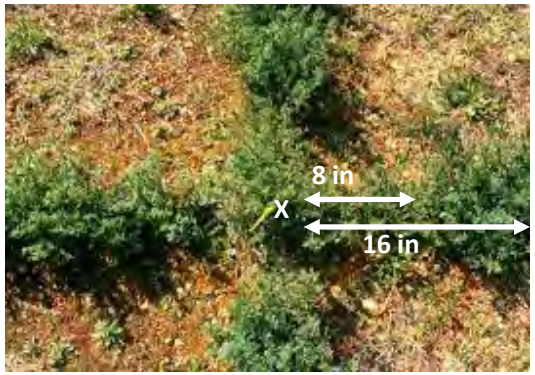
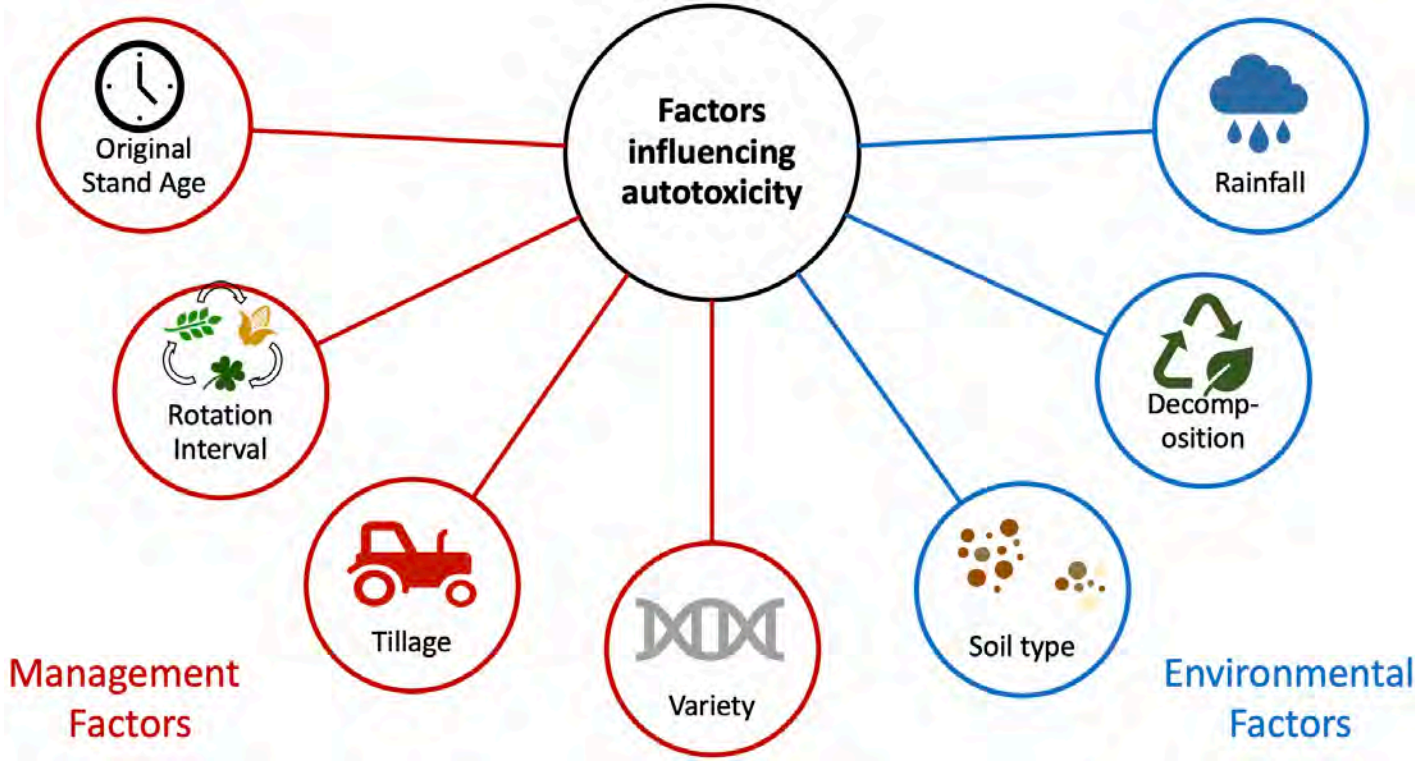
Photos: John Jennings



Compounds from one plant inhibit growth of other plants

- Reduced or failed establishment
- Damage taproots
- Reduced stand productivity

Specific compounds unconfirmed

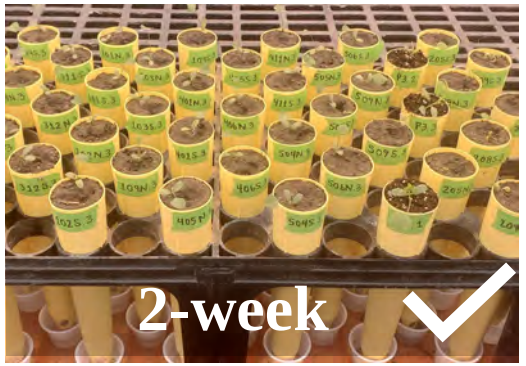


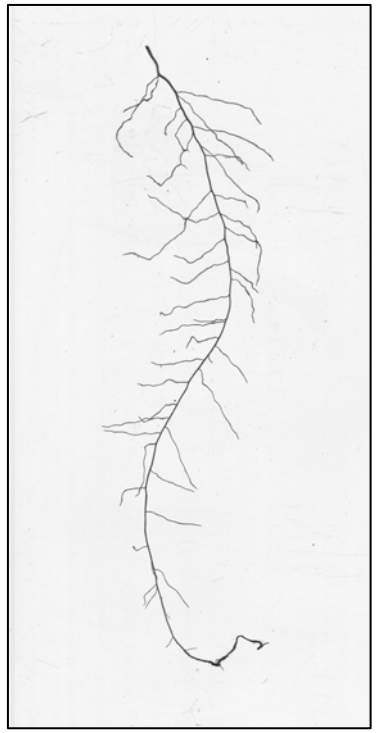
Diagnostic Test: Soil Bioassay for Detecting Autotoxicity

2-week bioassay more reliable than 4-day bioassay

Root length most reliable predictor of yield

- Potting soil as a control
- Report length as percent of length in potting soil





Validation

1. Validate predictions with soil from autotoxicity plot experiment
2. Validate predictions with soil from production fields – TBD
3. Test alfalfa and non-alfalfa sites to identify site characteristics influencing performance

2-week Soil Bioassay Predicts Alfalfa Yield in Plot Trial

1. Induce autotoxicity in plots
    - No previous alfalfa
    - Alfalfa terminated 12 wks before replant
    - Alfalfa terminated 4 wks before replant
2. Test soils in the bioassay
3. Root length in bioassay correlates to yield in 1st cut

Root Length Predicts Stem Counts

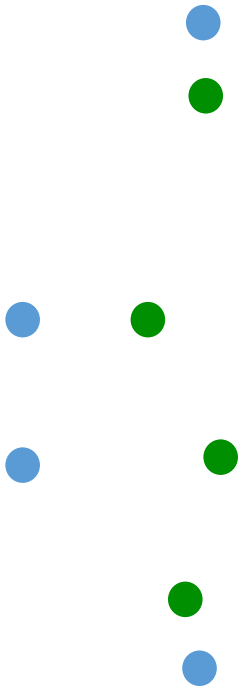
A)

B)

A) Bioassay predicts stem counts at 60 days after planting (DAP)

B) Stem counts at 60 DAP predict 1st cut yield

Alfalfa Bioassay Performance in Soil from Non-Alfalfa and Alfalfa Sites



- Roots are ~ 20 percentage points shorter in alfalfa soils than in non-alfalfa soils.
- Roots are shorter in field soils than potting soil

Predictors of Root Length (Non-Alfalfa Soils)

Model

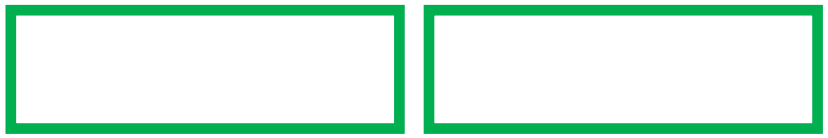
- Marginal $R^2 = 0.26$
- Conditional $R^2 = 0.42$

Random effects:

Set + Field in Set

Soil properties weakly affect root length

Predictors of Root Length (Alfalfa Soils)



Model

- Marginal $R^2 = 0.30$
- Conditional $R^2 = 0.50$

Stand density affects root length as expected

Random effects:

Set + Field in Set

Soil properties variable affects on root growth

Bioassay: Current Status and Future Directions

2-week soil bioassay has potential as a commercial test

- Next step: Beta testing phase in Michigan
- ”Alfalfa Replant Test”

Ongoing research:

- Autotoxin identification
- Role of root exudates, soil microbes, fertility, genetics

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