Targeting Plant-Microbe Interactions: Continued Development and Testing of an Alternative *Phragmites* Management Strategy

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USGS science for a changing world

US. Department of the Interior
U.S. Geological Survey

Phragmites australis
(common reed)


Photo credit: USGS


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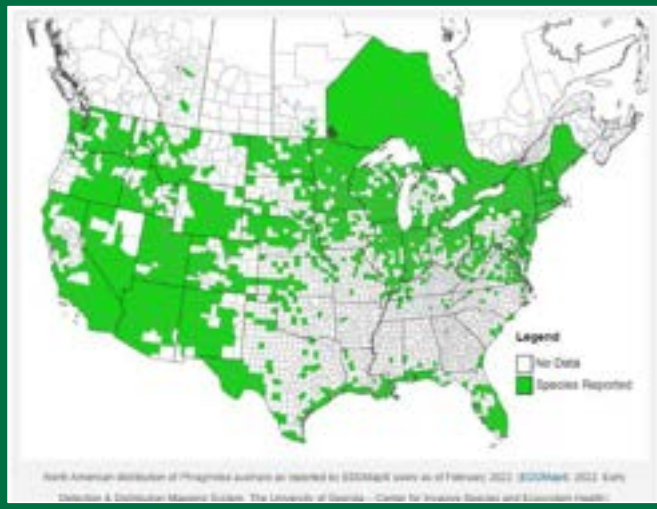
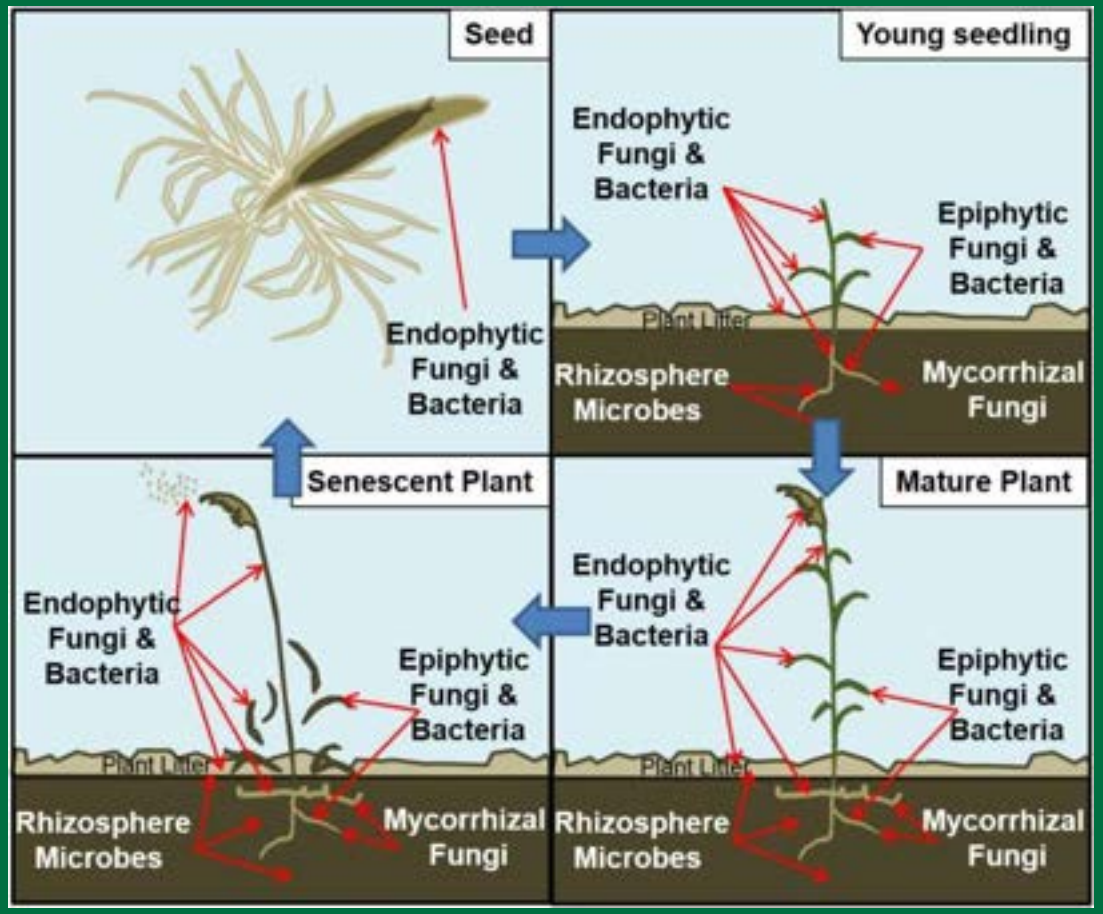


Phragmites Management

The Role of Microbes in *Phragmites* Growth



Kowalski et al. 2015

Fig. 6. Effect of *Stagonospora* spp. on growth of *Phragmites australis* in microcosms. Plants shown were from the first microcosm experiment (commercial source of seeds). A, Control (no inoculum), B, inoculation with *Stagonospora* sp. strain 4/99-1.

Ernst et al. 2003

Phragmites Symbiosis Collaborative

frontiers in MICROBIOLOGY

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Advancing the science of microbial symbiosis to support invasive species management: a case study on *Phragmites* in the Great Lakes

Kurt P. Kowalski[1], Charles Bacon[2], Wesley Bickford[1], Heather Braun[3], Keith Clay[4], Michèle Leduc-Lapierre[3], Elizabeth Lillard[3], Melissa K. McCormick[5], Eric Nelson[6], Monica Torres[7], James White[7] and Douglas A. Wilcox[8]*

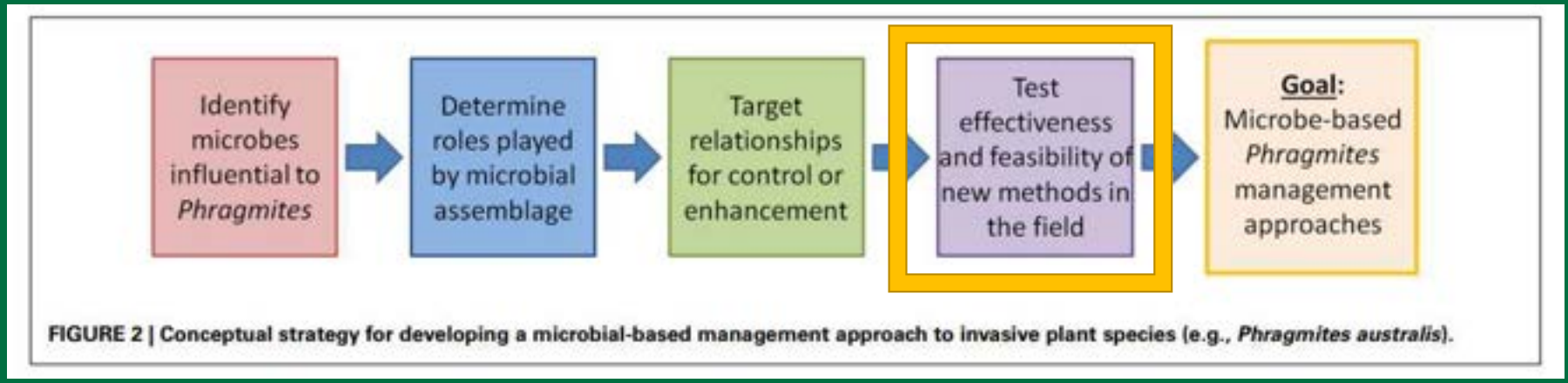
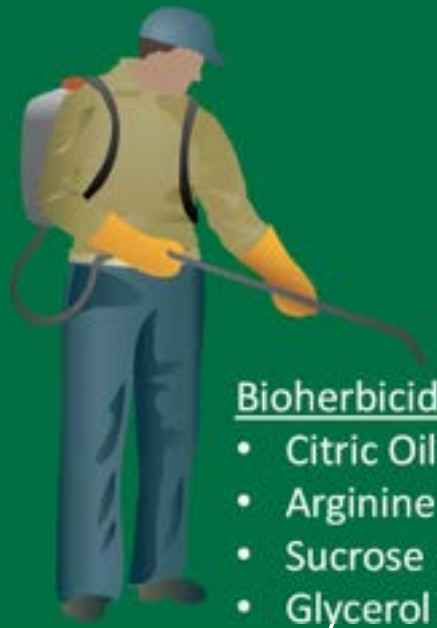


FIGURE 2 | Conceptual strategy for developing a microbial-based management approach to invasive plant species (e.g., *Phragmites australis*).

Bioherbicide Development for Targeting Microbial Relationships



Bioherbicide Formula*

- Citric Oil
- Arginine
- Sucrose
- Glycerol
- Yeast
- Water Solvent

*US Patent # 20230067609-A1

Citric Oil- strips waxy cuticle from leaf to allow penetration

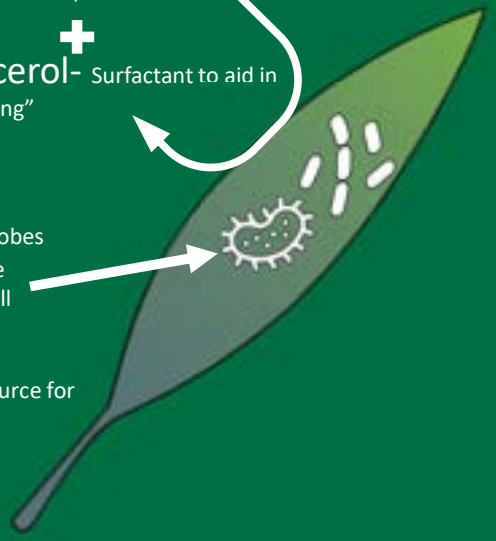
+

Glycerol- Surfactant to aid in "wetting"

Arginine- causes microbes to create excessive ethylene which leads to stress and cell death

+

Sucrose food source for microbial bloom



USGS Microbial Control of *Phragmites*

Apply Non-Toxic Bioherbicide

Stimulate Microbial Response in Plant

Monitor Plant Response

Analyze Results

Refine Formulation

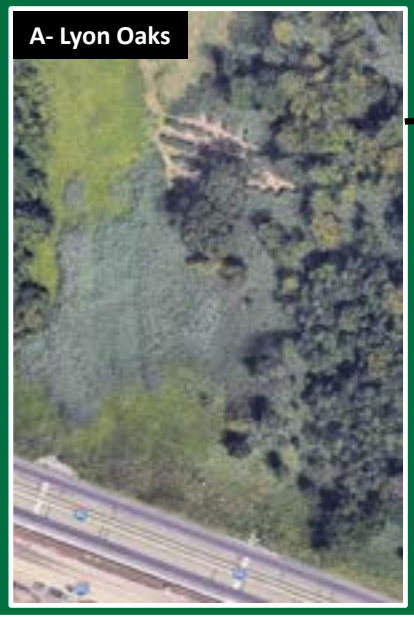
Year 1:

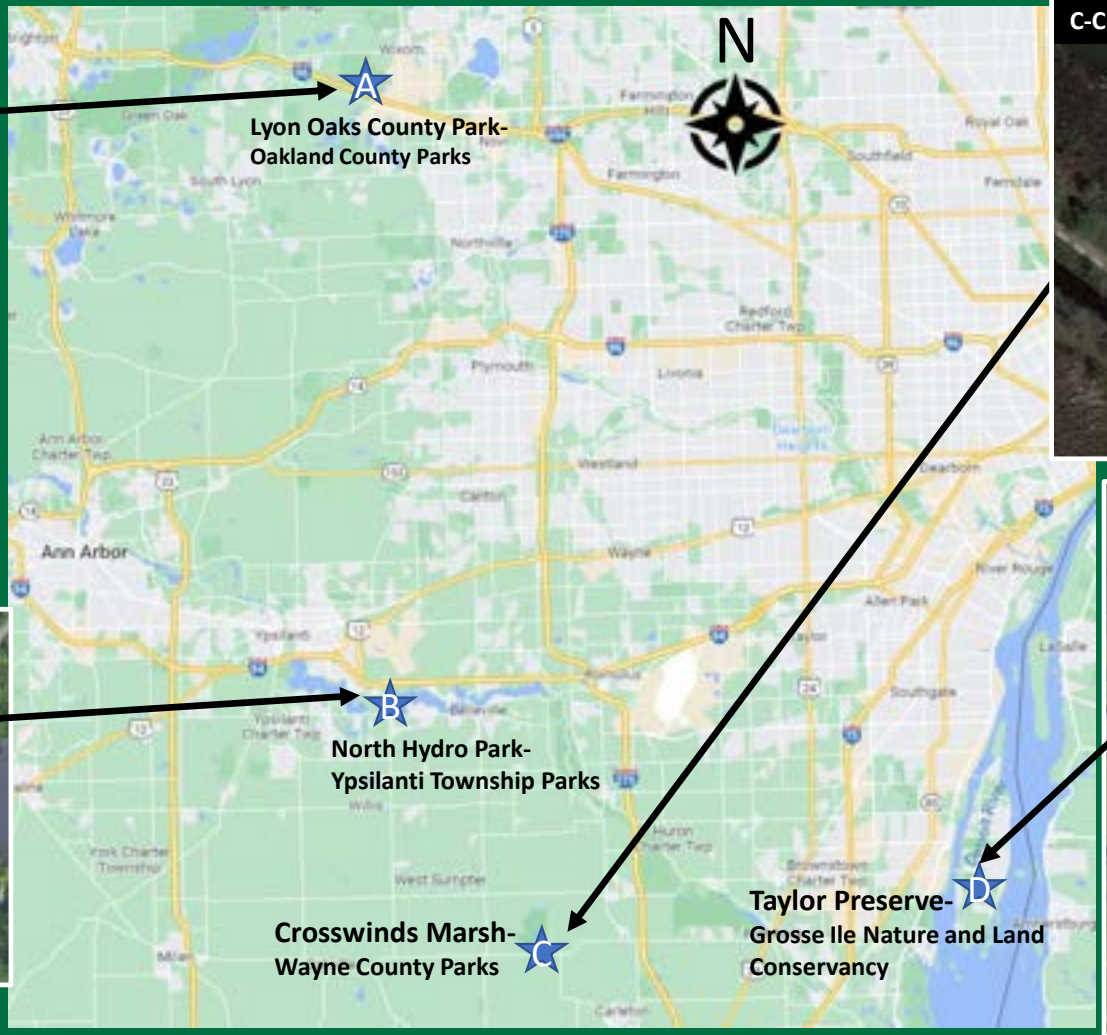
- Initial Field Test
- 2 Sites
- 3 Treatment Groups, 10 replicates per site (60 total plots)
  - 2-week application interval
  - 4-Week application interval
  - Water only application

Year 2:

- Year 1 sites + 2 new sites
- 4 Treatment Groups, 10 replicates
  - 4-Week application interval starting late Spring
  - 4-Week Application interval starting Late Summer
  - Water only application
- Bioherbicide refine: adjusted concentration + addition of Yeast and Glycerol

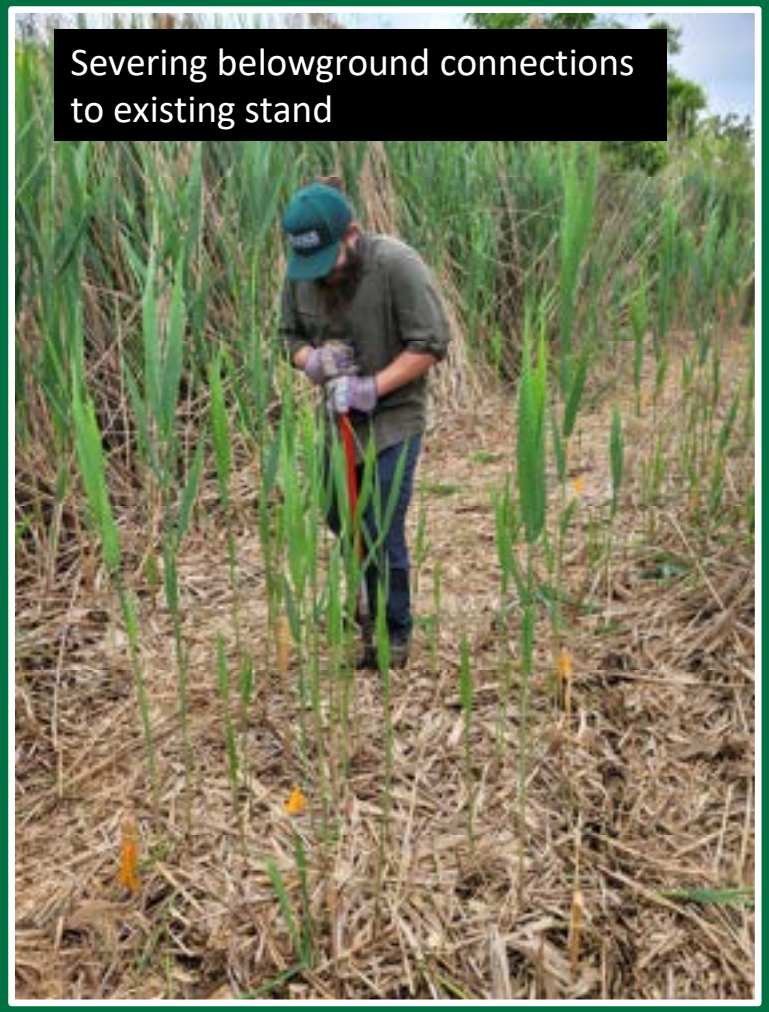
USGS Bioherbicide Experiment: Study Area





USGS Preliminary Information-Subject to Revision.
Not for Citation or Distribution.

USGS Bioherbicide Experiment Initiation



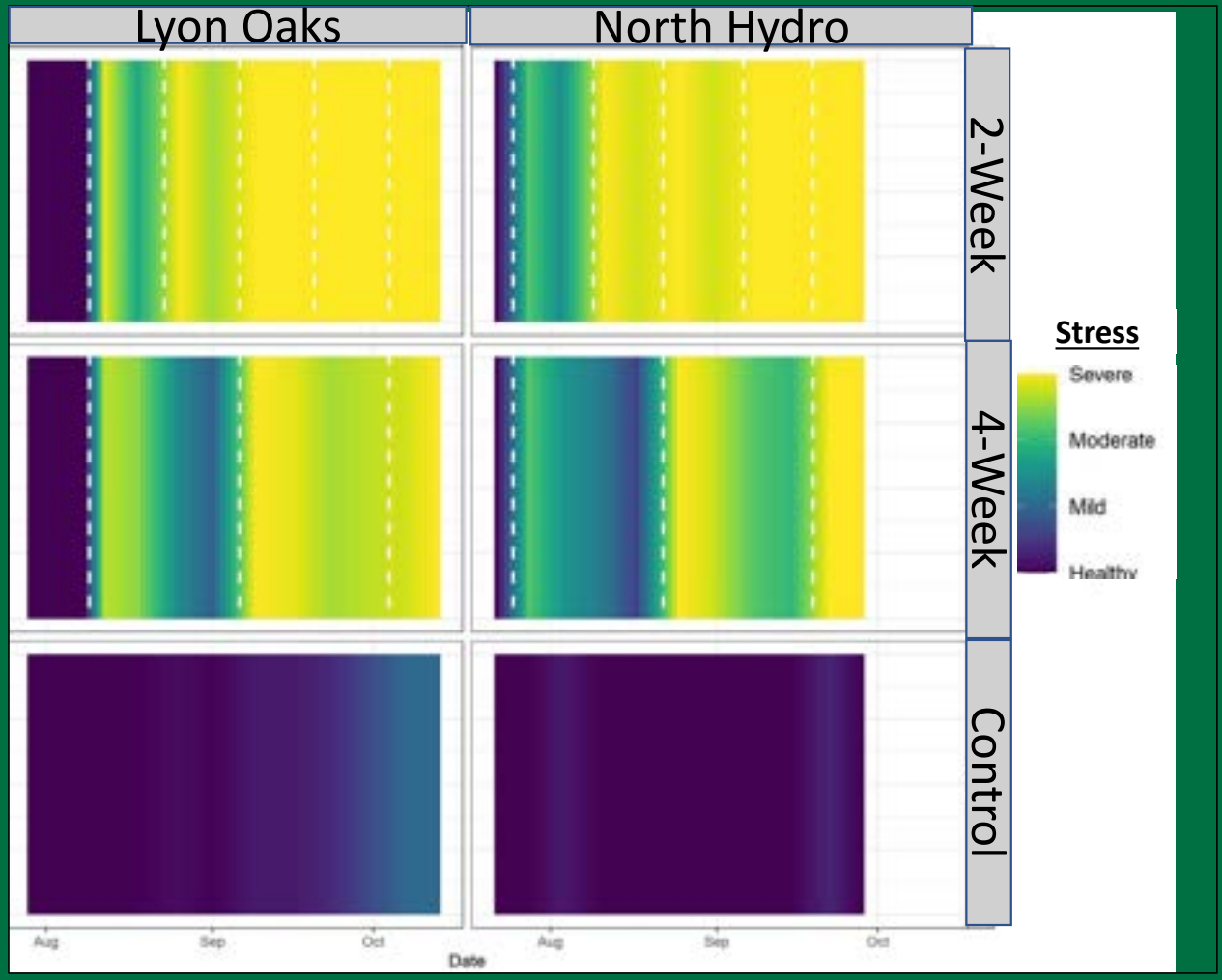
Bioherbicide Treatment Effects: Within 1 week

Bioherbicide Treatment Effects: Within 2 weeks

Bioherbicide Treatment Effects: Within 3-4 weeks

Year 1 Results: *Phragmites* Growth Stress

- Post treatment cycle of tissues death and regrowth
- Regrowth occurred less after successive treatments



North Hydro
July 22, 2022
Pre-treatment

Control

2-Week

4-Week

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North Hydro
July 28, 2022
3 days after 1st treatment

Control

2-Week

4-Week

North Hydro
August 25, 2022
3 days after 3rd '2-Week Treatment' & 2nd '4-Week Treatment'

Control

2-Week

4-Week

North Hydro
Sept 28, 2022
5th '2-Week Treatment' & 3rd '4 Week Treatment'

Control

2-Week

4-Week

USGS

North Hydro Park 4 Week Treatment Timelapse

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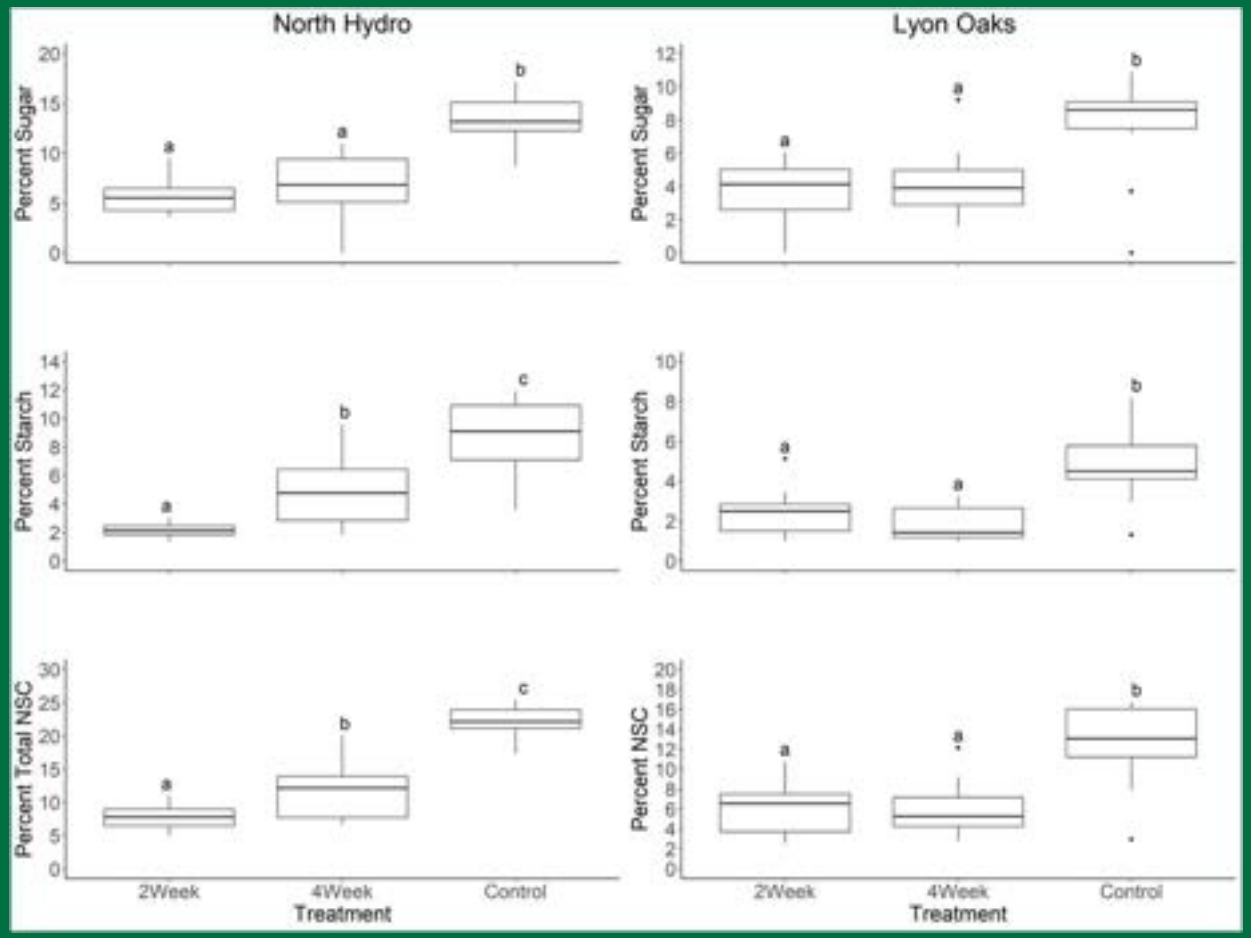
Year 1 Results: Belowground Resource Reserves

- Bioherbicide treatments reduced belowground reserves
- Little to no difference between 2-week and 4-week treatments



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  - Water only application

Year 2:

- Year 1 sites + 2 new sites
- 4 Treatment Groups, 10 replicates
  - 4-Week application interval starting late Spring
  - 4-Week Application interval starting Late Summer
  - Water only application

Year 2 Observations: Pre-Treatment May 24, 2023
Lyon Oaks

Control

Early Application

Cut + Treat

Late Application

Year 2 Observations: Mid-Season Pre-Late Application July 18th 2023 Lyon Oaks

Control

Early Application

Cut + Treat

Late Application

Year 2 Observations: Mid-Season Post-Late Application Aug 8th 2023
Lyon Oaks

Control

Early Application

Cut + Treat

Late Application

USGS

Year 2 Observations: End of Season Sept 7th, 2023
Lyon Oaks

Control

Early Application

Cut + Treat

Late Application

Conclusions

- Effective at killing aboveground biomass
- Likely stimulate some “microbial blooms”
  - Appears to be contact effect vs systemic
- Belowground rhizomes seem to remain viable, but with less reserves
- Potential for compounding effects after multiple seasons of treatments
  - Pending results from 2023 season
- Continuing to look into additional microbes to add to mix

Thank You!

Partners

Rutgers

Wayne County parks

Oakland County Parks

Grosse Ile Nature & Land Conservancy

ytownREC

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