Building a centralized database of watermilfoil strain geographic distribution and herbicide response for use in management decision-making

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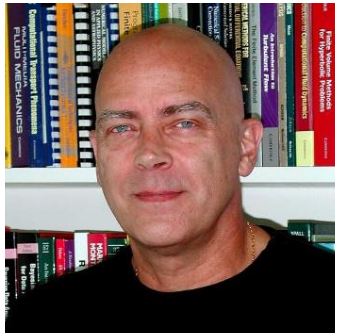


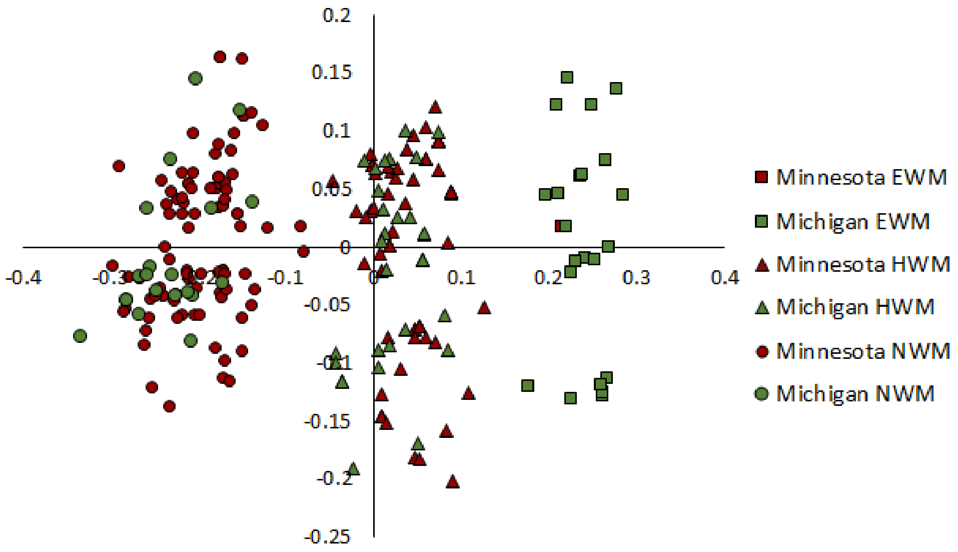
Introduction, Background, & Problem

- Genetic variation can influence management outcomes
- Genetic information can be used to predict management response, and thus improve management outcomes.

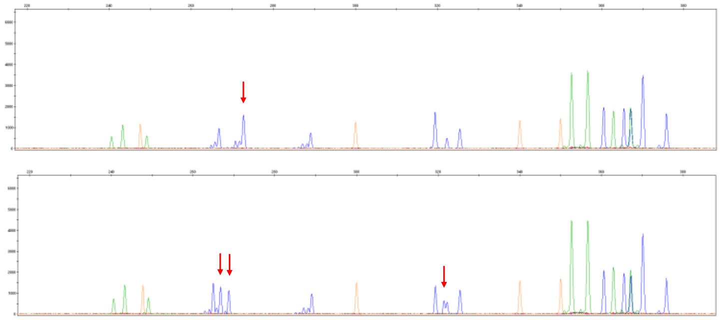
1. Health predisposition (how your genes influence your chance of having certain health conditions)
2. Carrier status (are you a carrier for certain inherited conditions)

Introduction, Background, & Problem

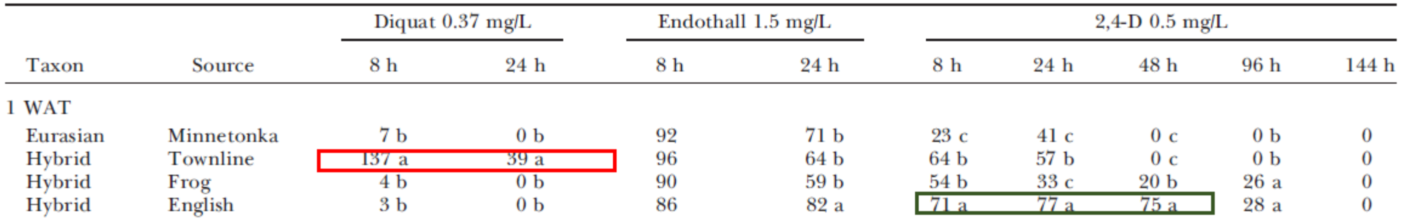
- Aquatic plant stakeholders increasingly recognize that Eurasian watermilfoil (including hybrids) is genetically diverse



Thum et al. (2020)
Invasive Plant Science & Management



DNA “Fingerprints”



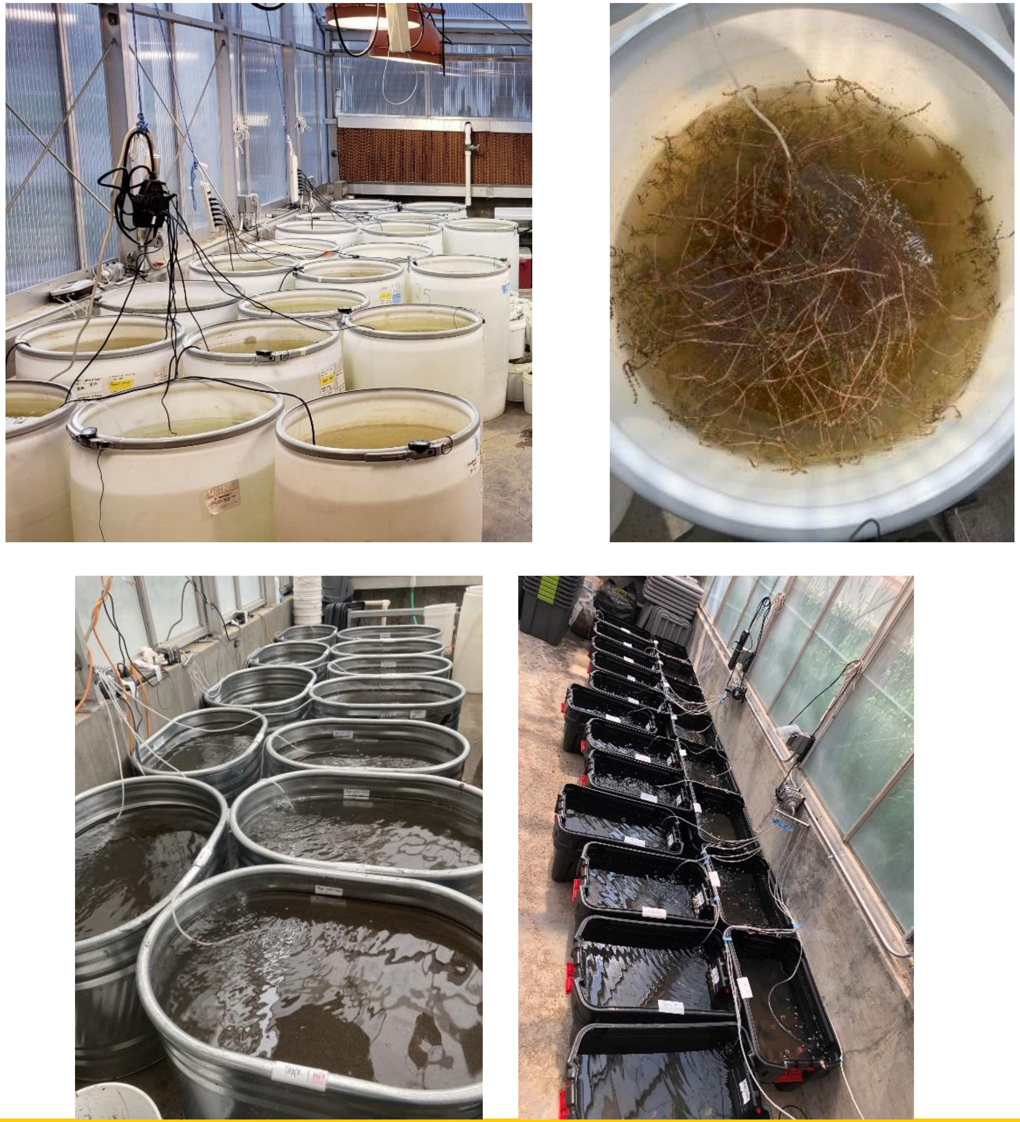
		Diquat 0.37 mg/L		Endothall 1.5 mg/L		2,4-D 0.5 mg/L				
Taxon	Source	8 h	24 h	8 h	24 h	8 h	24 h	48 h	96 h	144 h
1 WAT										
Eurasian	Minnetonka	7 b	0 b	92	71 b	23 c	41 c	0 c	0 b	0
Hybrid	Townline	137 a	39 a	96	64 b	64 b	57 b	0 c	0 b	0
Hybrid	Frog	4 b	0 b	90	59 b	54 b	33 c	20 b	26 a	0
Hybrid	English	3 b	0 b	86	82 a	71 a	77 a	75 a	28 a	0

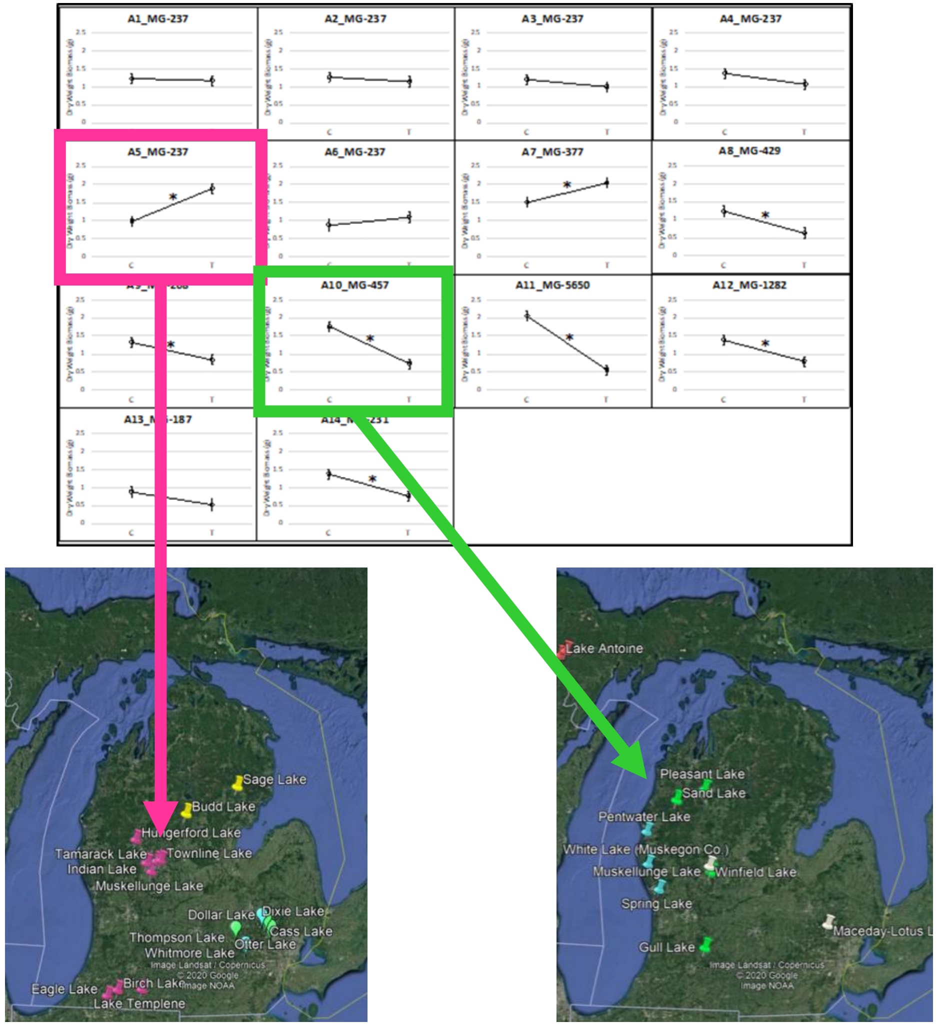
Netherland and Willey (2017)
J. Aquatic Plant Mgmt.

Introduction, Background, & Problem

- Our primary goal is to use genetic information to predict herbicide response, and thus improve management outcomes.
- Our research includes both short and long term approaches to relate control efficacy to genetic variation.

SHORT-TERM: database creation and management





GLRI-IJ Project Components

- Coordinate with state agencies to collect watermilfoil strain information from additional locations across the basin
    - Build a bioinformatics pipeline to integrate this new genetic strain data into a central database capable of real-time updates (similar to COVID variant tracking).
- Use simulations to identify best methods to estimate in-field response to herbicides for different strains to identify strains for herbicide resistance testing.
- Characterize herbicide response for several Minnesota strains.
- Explore options to interface the centralized database with a stakeholder-facing dashboard that can be used to inform herbicide management options and permitting.

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APMS
The Aquatic Plant Management Society

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Michigan Invasive Species

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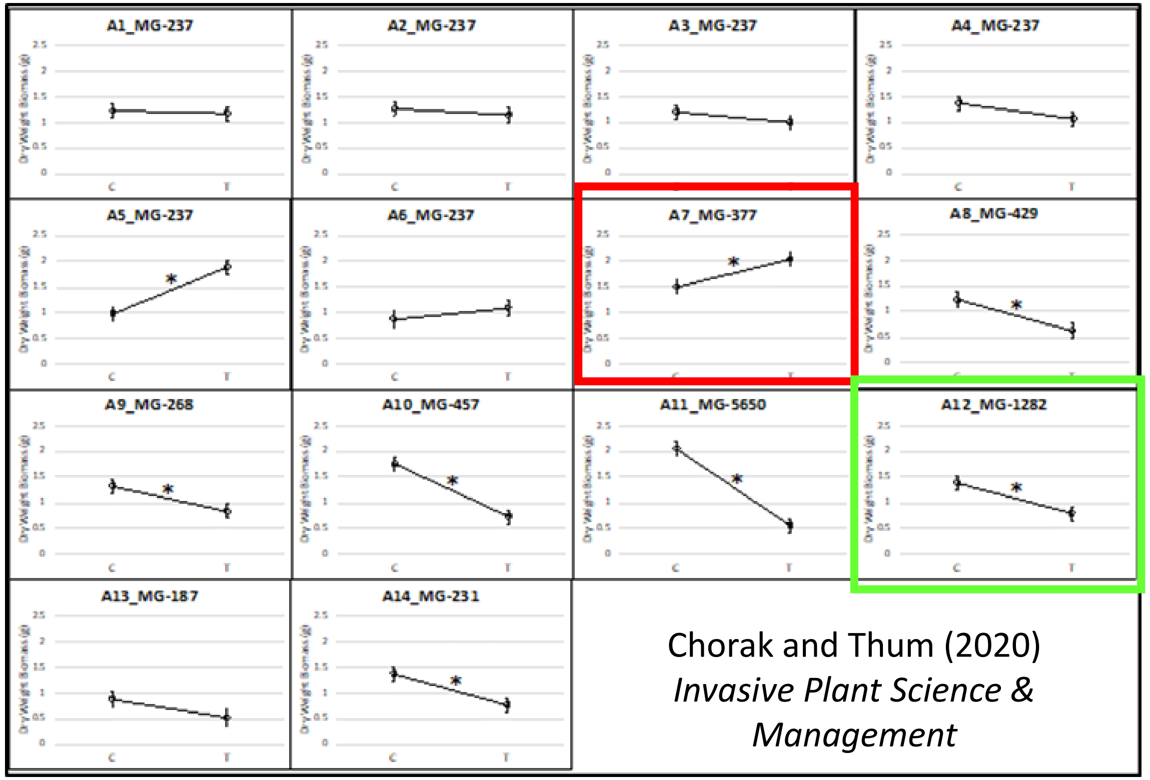
Objectives

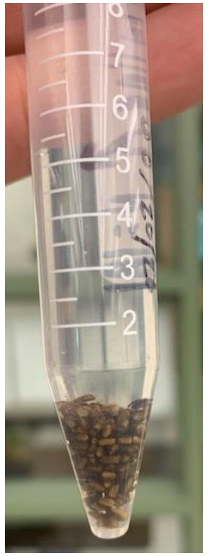
- Short-term – Build a catalog of watermilfoil strain herbicide response and geographic distribution information
  - Identifying genotypes for characterization
  - Characterizing herbicide response
  - Molecular characterization
  - Database creation and management

- Long-term – Identify the specific genes for resistance, and develop genetic tests for those genes
  - Genetic crosses to produce herbicide resistance mapping populations
  - Herbicide selection experiments of herbicide resistance mapping populations
  - Next-generation sequencing of herbicide resistance mapping populations
  - Data analysis

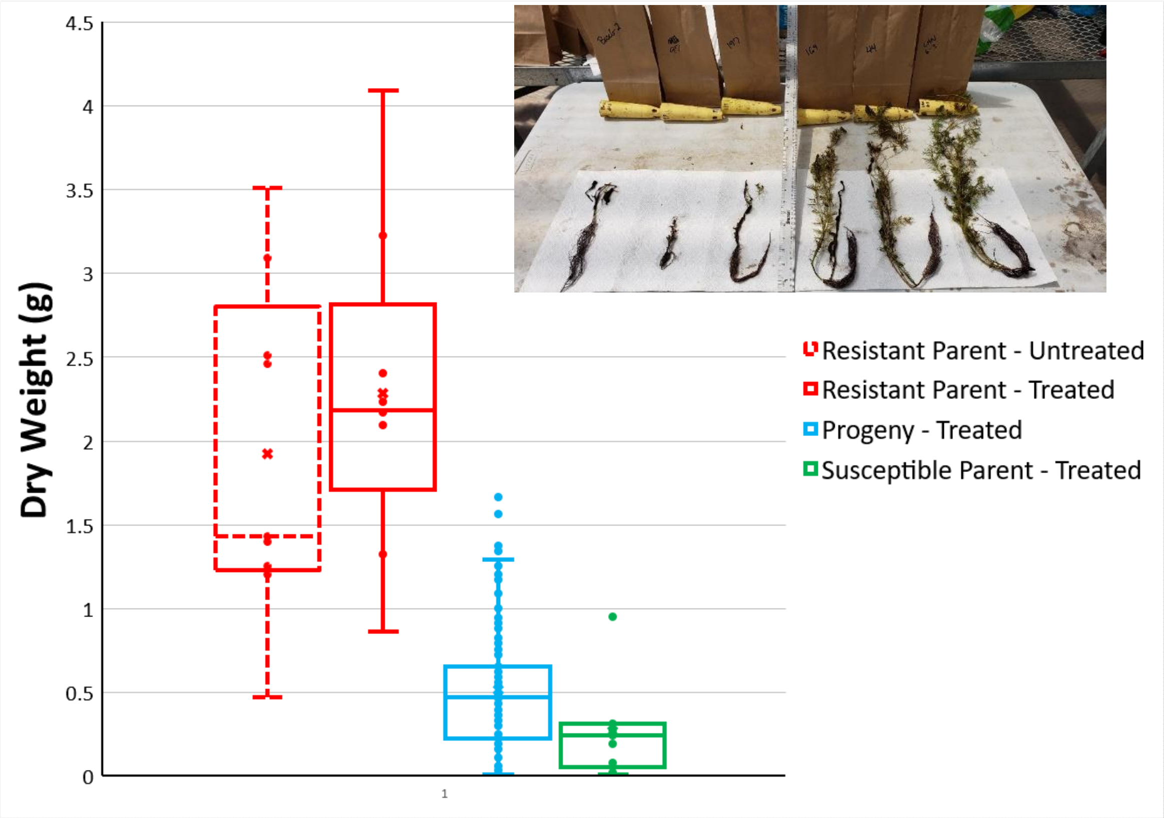
LONG-TERM: genetic crosses to produce herbicide resistance mapping populations



Chorak and Thum (2020)
Invasive Plant Science & Management

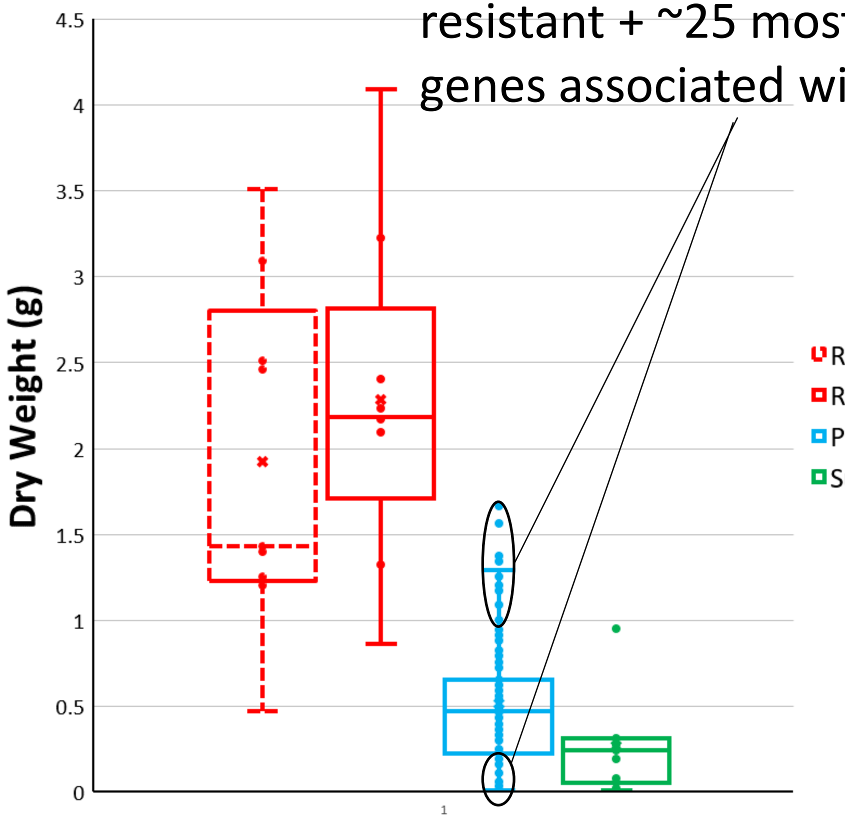


LONG-TERM: herbicide selection experiments with herbicide resistance mapping populations



LONG-TERM: next-generation sequencing of herbicide resistance mapping populations

Whole-genome resequencing of ~25 most resistant + ~25 most susceptible to look for genes associated with herbicide response



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Benefit/Relevance

- Short-term
  - Identifying specific lakes with characterized genotypes (e.g., fluridone resistant lakes in Michigan)
  - Facilitating the building of a catalog of strain distribution and response
- Long-term
  - Identifying the genetic basis of resistance
  - Having molecular assays that predict response (would be applicable for NEW strains that we have not seen, if they carry the same resistance allele(s) found in characterized strains (common for TSR in terrestrial weeds)