



# TRACKING COLD TOLERANCE IN PRAIRIE FORBS

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# What is Cold Tolerance?

- The ability to handle cold temperatures
- When the temperature drops below freezing, water in cells can freeze and form ice crystals
- Ability to combat this cell damage is cold tolerance
- Induced by changes in photoperiod
  - *Avoid the cold*
  - *Solute shuffling*
  - *Protein upregulation*

# Why Look at Cold Tolerance?

- Climate change is affecting winter in Wisconsin
  - *1950-2006 saw a 1.5 °C increase in the average Wisconsin winter temperature*
  - *Snow comes later and melts earlier*
- Only plants able to cope can survive
- Below ground tissue is a major storage organ, so highly tolerant tissue is more favorable for survival

# Biocore Prairie

- Biocore Prairie located in Lakeshore Nature Preserve; Madison, Wisconsin
- Restored in 1997, 11 acre plot, ~61 species

## Test Plant Identification:

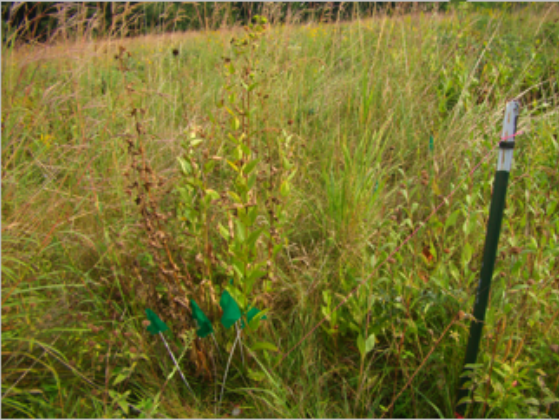
- *Solidago rigida* (Rigid Goldenrod) & *Silphium integrifolium* (Rosinweed)
- Common in the Midwest region
- Cold Hardiness Rating of 9
- Fibrous root systems





# Methods

## Field Preparation



August 2015  
5 healthy looking individuals per species flagged & tagged with numerical ID numbers  
Voucher roots collected

- Two soil cores taken from perimeter of each plant.
- Target roots identified, washed, cut to uniform pieces



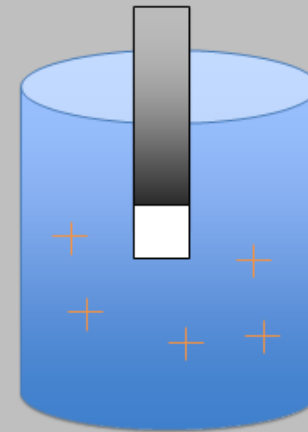
## Collection & Processing

## Freezing Tests

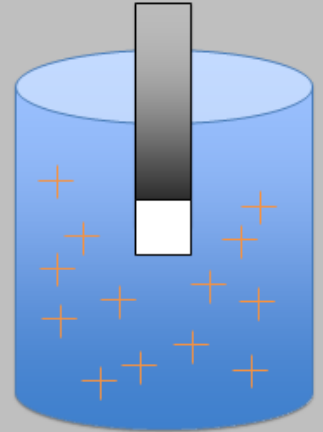
- Roots paired into microfuge tubes with water.
- One tube per plant placed at 5°C, -5°C, -10°C, -26°C or -40°C for two hours



## Data Measurement



Ambient Temperature, Low cell damage, Low Electrical Conductivity



Extreme Temperatures, High cell damage, High Electrical Conductivity

Solute loss in a ruptured cell is primarily electrolytes, allowing cell damage to be calculated through changes in electrical conductivity of the surrounding environment before and after a stress event.

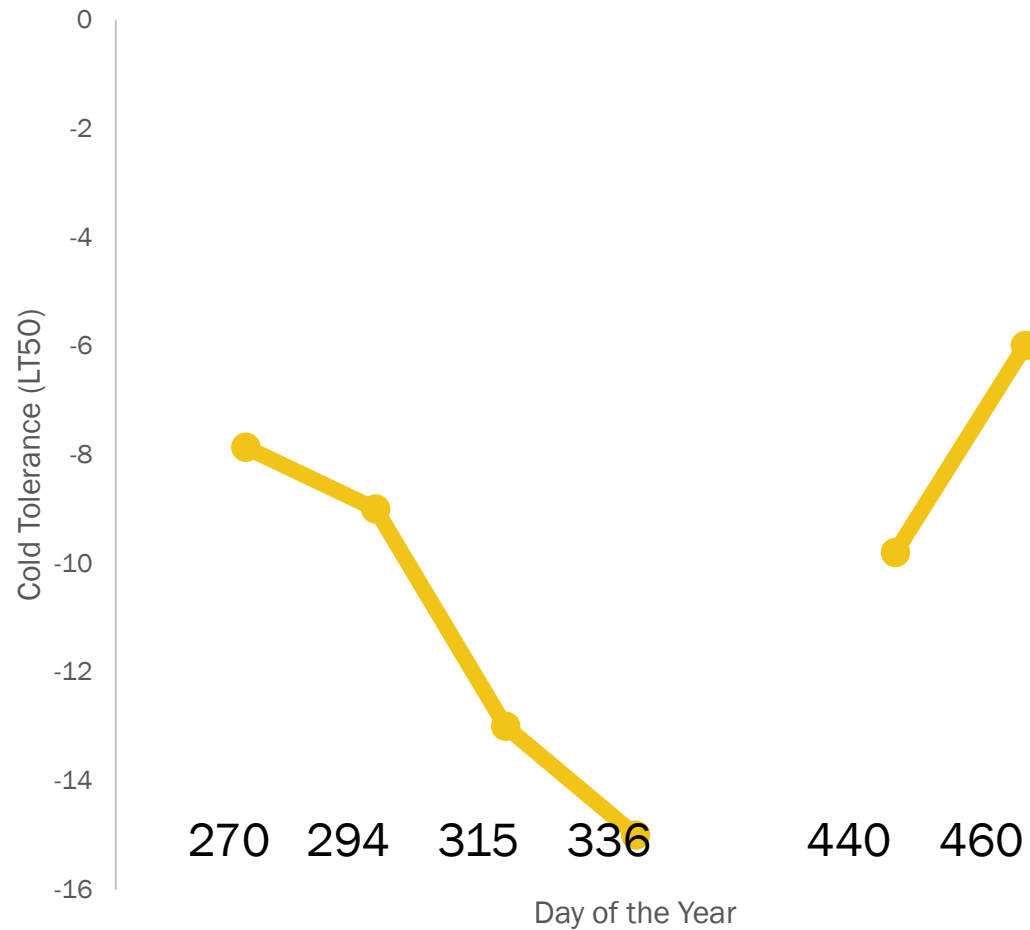
# Temperature Loggers

- Temperature collected every 4 hours
- Placed in PVC caps and sealed
- Placed at various depths
  - *Surface*
  - *Below litter*
  - *3cm below ground*
  - *10cm below ground*

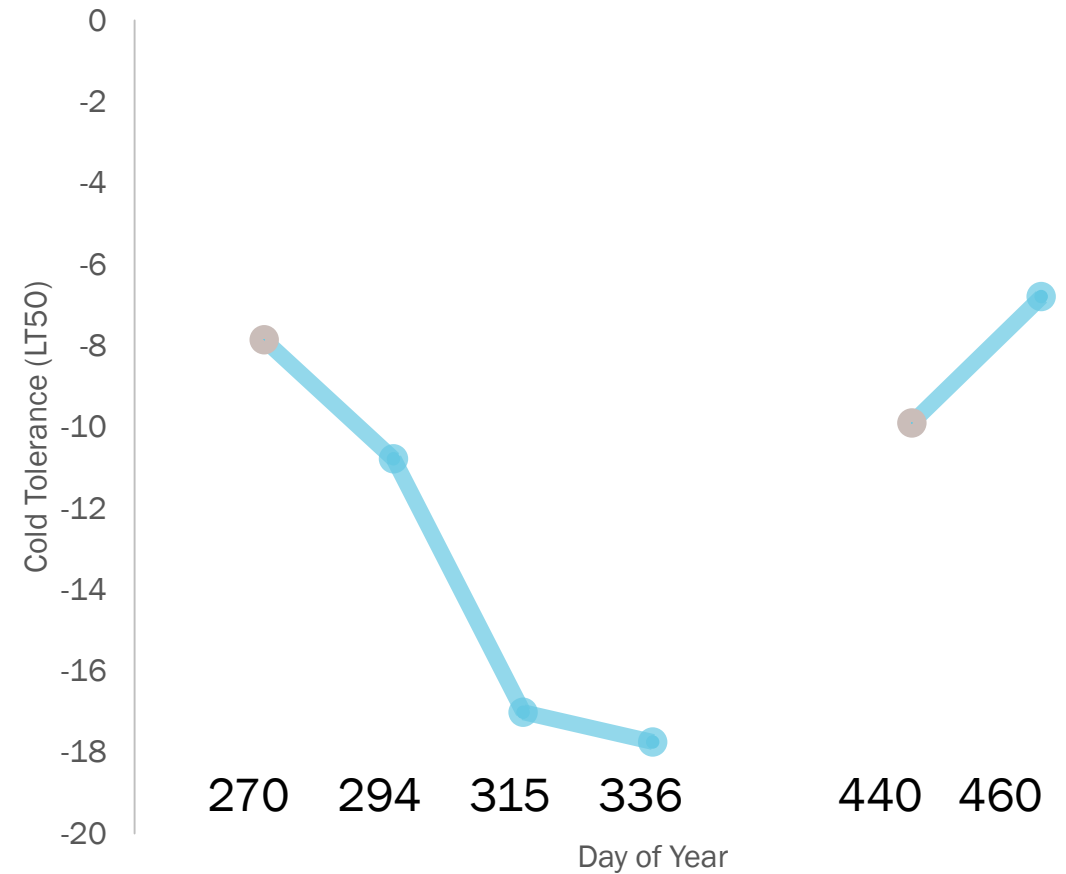


# Expected Results: Cold Tolerance

Rosinweed Expected Cold Tolerance Trends



Rigid Goldenrod Expected Cold Tolerance Trends



# Expected Results: Temperature



Air- the coldest temperatures

Snow pack- a bit less cold than air

Subnivium- a slightly warmer area

Ground- warmest temperatures



# Experimental Results: Cold Tolerance

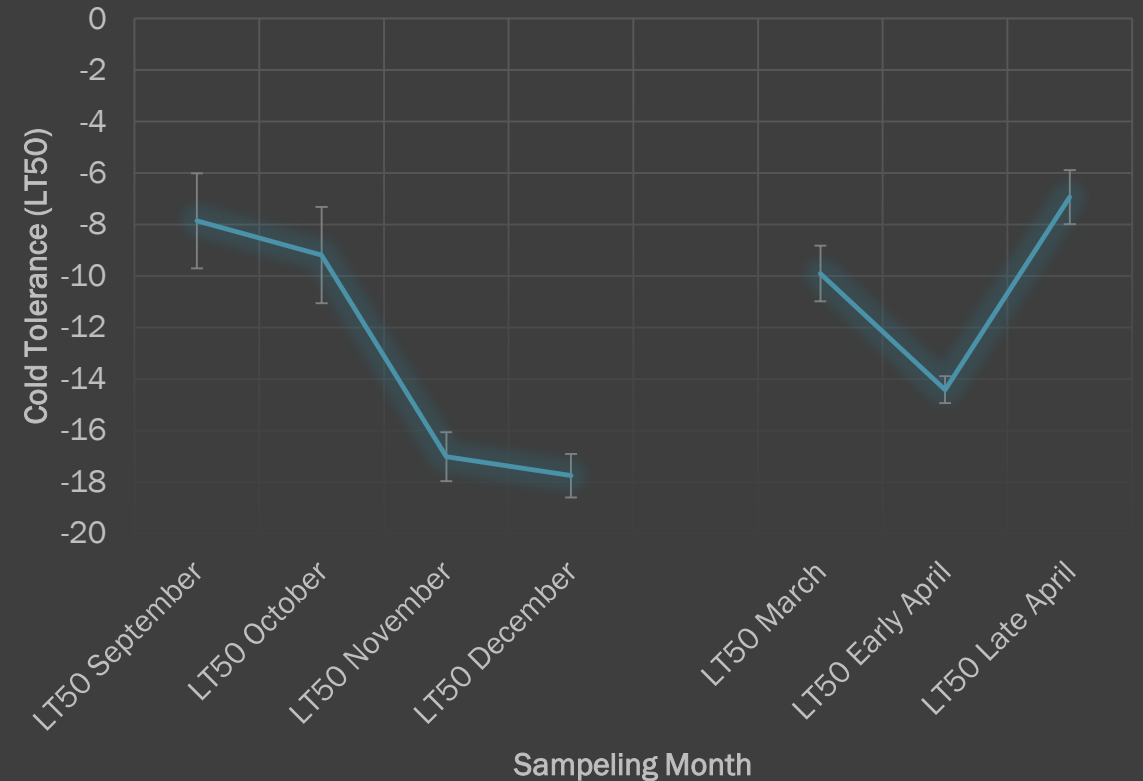
## Rosinweed Fall to Spring Cold Tolerance

— SILINT average



## Rigid Goldenrod Fall to Spring Cold Tolerance

— SOLRIG average



# Experimental Results: Temperature



Air- the coldest,  
most variable  
temperatures

Snow pack- a bit  
less cold than air,  
variable

Subnivium- a  
slightly warmer  
area

Ground-warmest,  
most stable  
temperatures

# Conclusions

- It appears that cold tolerance is more variable than originally anticipated
- Rosinweed seems to be more sensitive to shifts in temperature than Rigid Goldenrod
- Snow pack is an important temperature stabilizer

# Future Plans & Goals

- Potential spring protein assay
- Use of Student Engagement Grant Money
  - *Temperature Loggers*
  - *Electrical Conductivity Equipment*
- Publication