Continuing Project

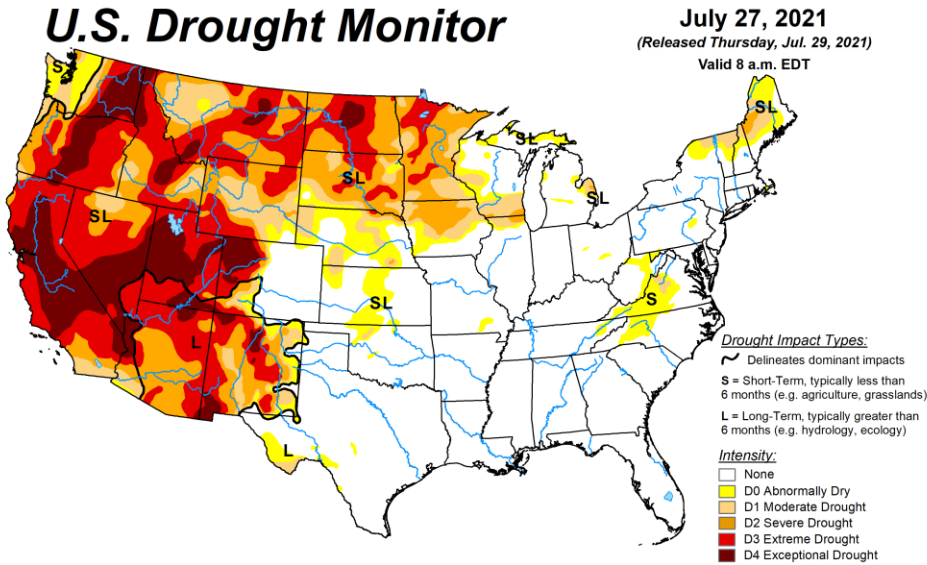
Intraspecific Hydraulic Responses of Commercial Tree Seedlings to Nursery Drought Conditioning

CAFS.20.78

Andrew Nelson, University of Idaho
Douglass Jacobs, Purdue University
Carlos Gonzalez-Benecke, Oregon State University

Presenter: Andrei Toca

Justification



Hypotheses or Objectives

Our general **objective** is to examine seedling physiology and root system architecture in response to nursery-induced drought conditioning of coastal Douglas-fir, western larch, and black walnut seed sources across a range of maternal tree environments.

- Specifically, this study assesses whether drought stress memory formed during the first year of growth affects seedling new growth biomass allocation and the cascading effects on gas exchange under a subsequent drought.

Nursery drought conditioning treatments

Douglas-fir

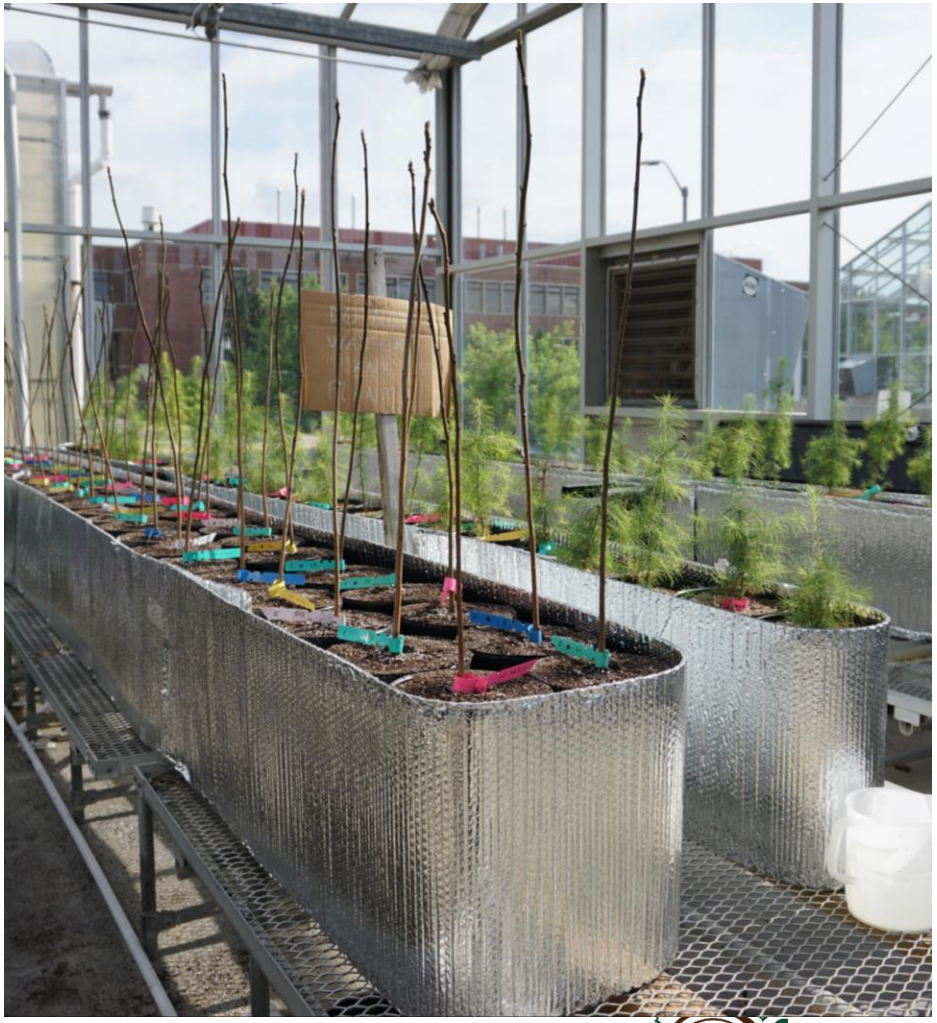
Black walnut

Western larch

Species	Provenance	Drought conditioning
Douglas-fir	Coast Range Inland Cascade Foothills	Control 75% Moderate 60% Extreme 50%
Western larch	8 seed sources (British Columbia- Inland North West)	Control 75% + Moderate 60%-75% Extreme 45-60%
Black walnut	Indiana Maryland	Control 85-95% Moderate 75-85% Extreme 55-65%

Simulated outplanting

- Controlled environment conditions
  - Moisture
  - Nutrient availability
  - Temperature
  - Light



Outplanting Experiment

Black walnut, Indiana

Western larch, Idaho

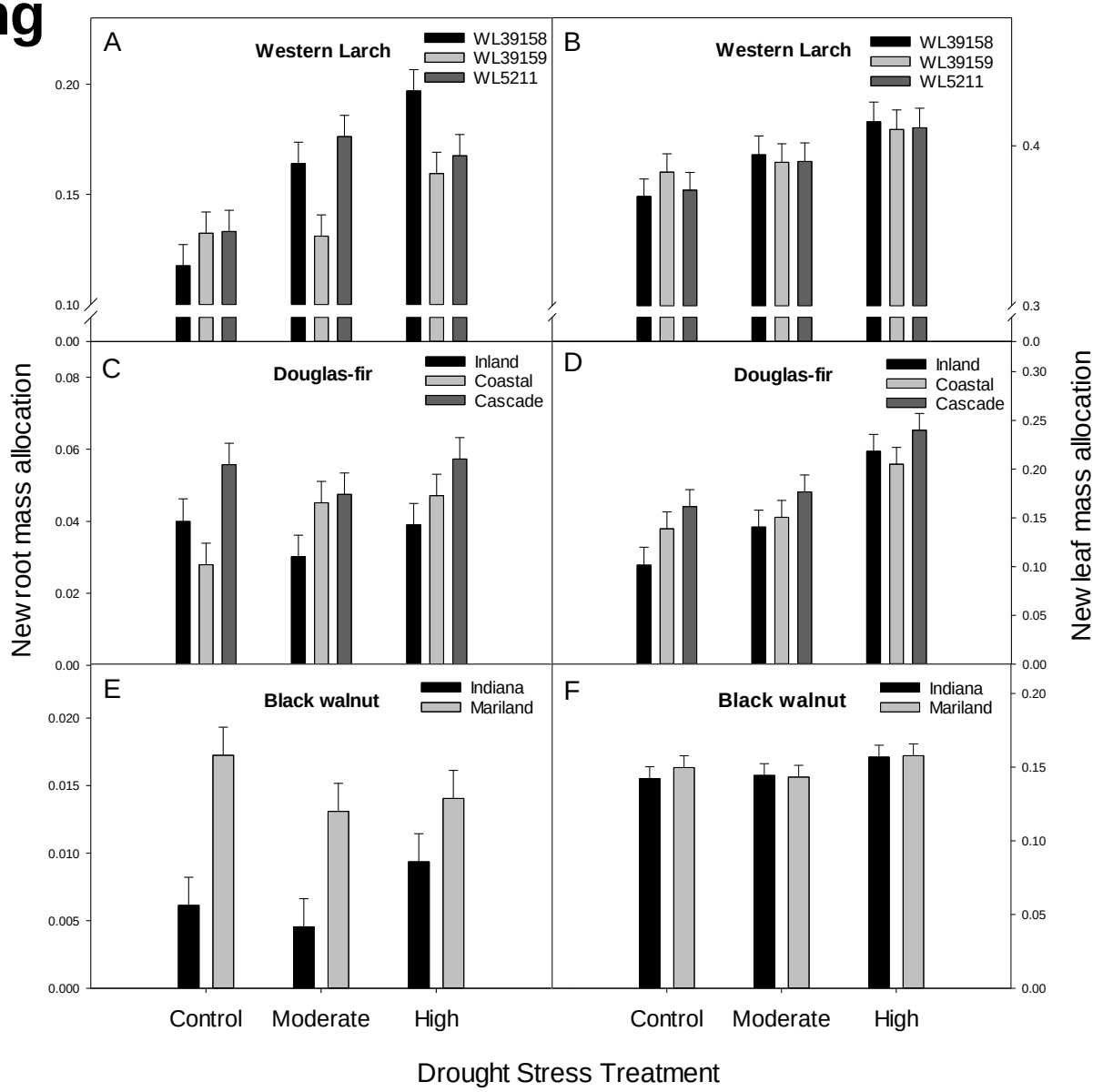
Douglas fir, Oregon

Major Findings

Simulated outplanting

Effects of drought preconditioning

- ❑ Western larch
  - ↑ Allocation new roots and foliage
  - ↑ E_{plant}
- ❑ Douglas-fir
  - ↑ Allocation to new foliage
  - ↑ Earlier bud break
  - ↑ A_{net}
  - ✘ No effects on root allocation
- ❑ Black walnut
  - ✘ Biomass allocation
  - ✘ E_{plant}
  - ✘ A_{net}



Outplanting Experiment

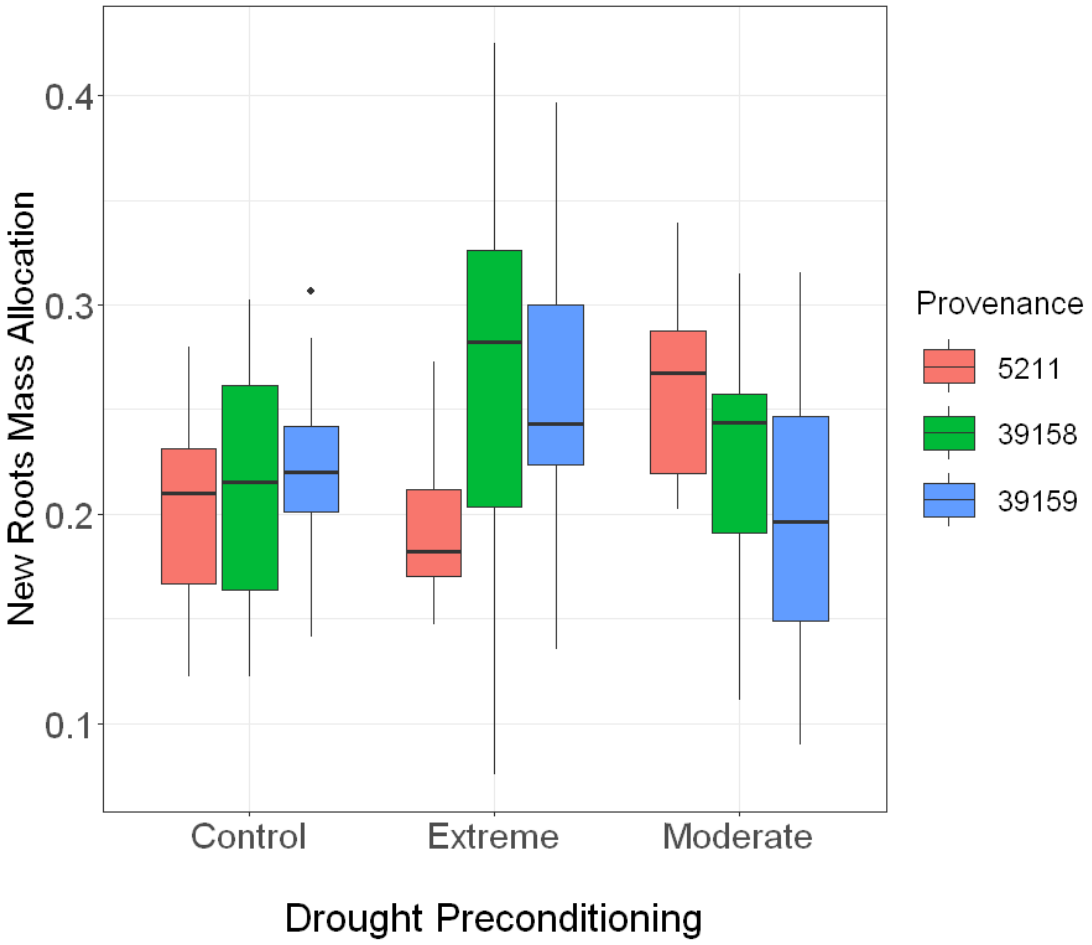
Major Findings

Effects of drought preconditioning

- Western larch

↑ Allocation new roots

Drought preconditioning: P=0.142
Provenance: P= 0.683
DP x Prov: **P= 0.007**

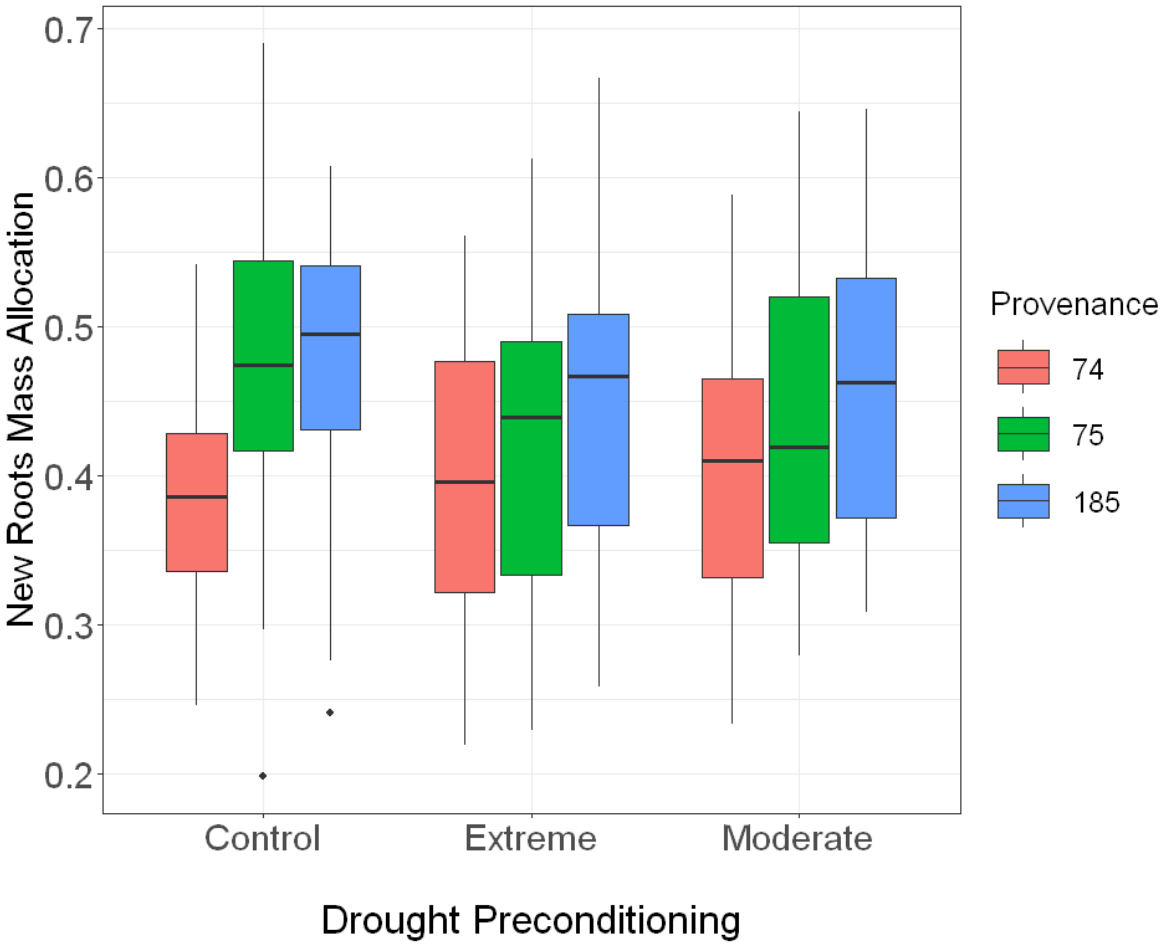


Outplanting Experiment

Major Findings

- Douglas-fir
  - ✘ No effects on root allocation

Drought preconditioning: P=0.167
Provenance: **P<0.001**
DP x Prov: P= 0.329



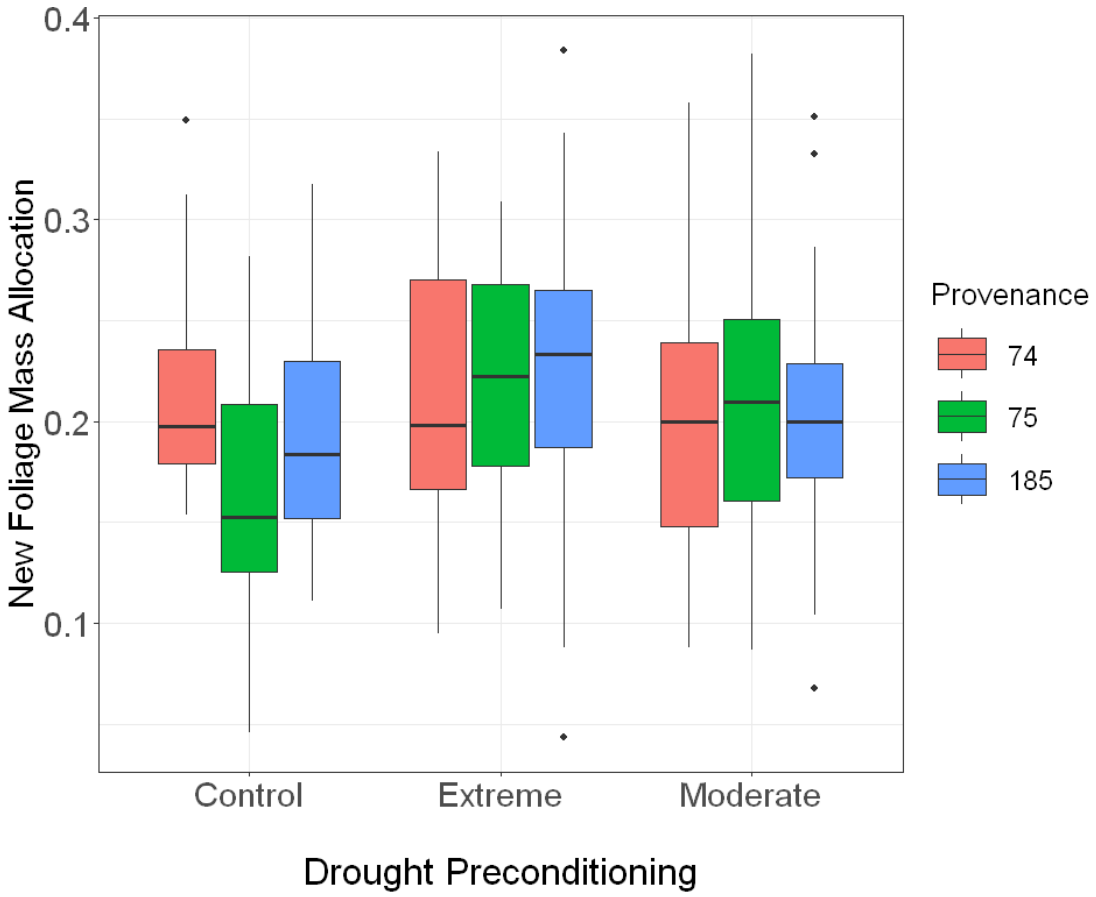
Outplanting Experiment

Major Findings

- Douglas-fir

↑ Allocation to new foliage

Drought preconditioning: **P=0.019**
Provenance: P=0.399
DP x Prov: P= 0.078



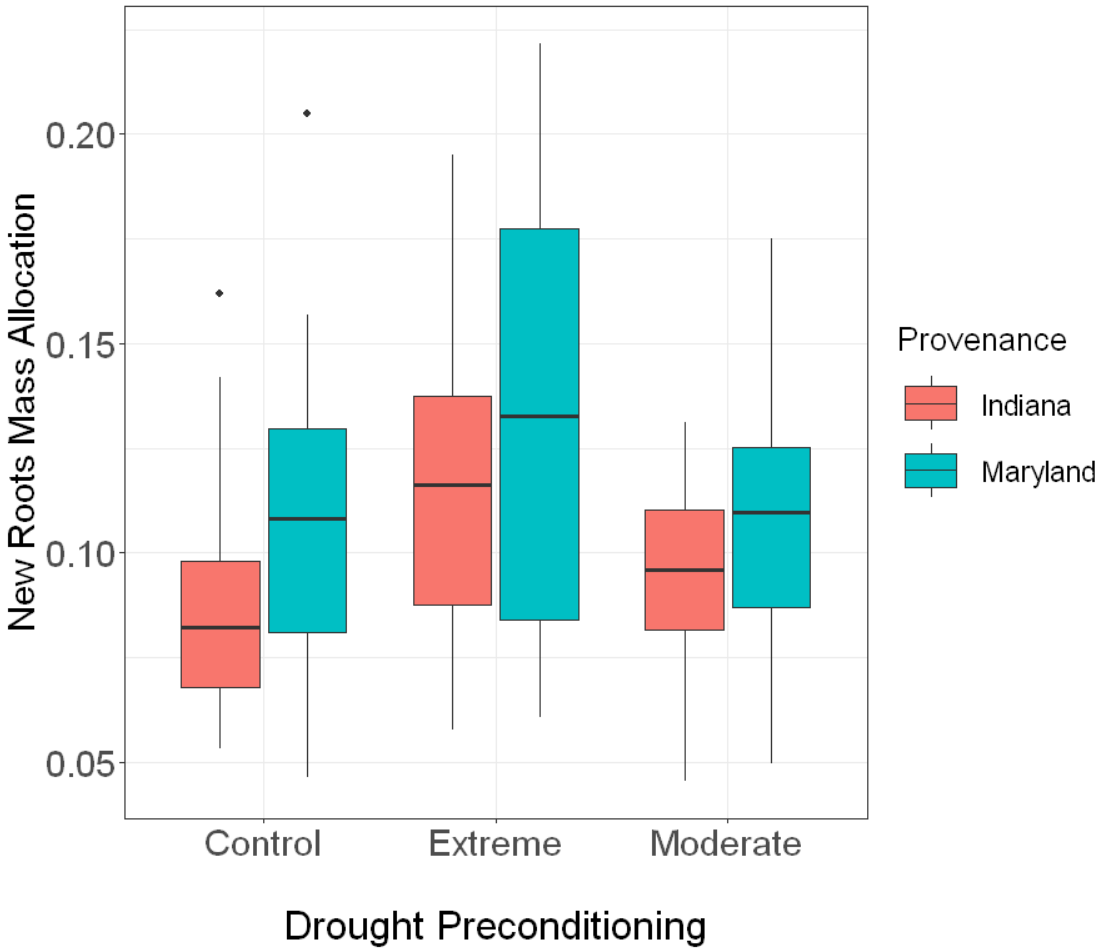
Outplanting Experiment

Major Findings

- Black walnut

Allocation to new roots

Drought preconditioning: **P=0.007**
Provenance: **P=0.021**
DP x Prov: P= 0.944



Company Benefits and Deliverables

- Species-specific **drought conditioning protocols** may help reduce reforestation costs associated with replanting failed plantations by tailoring phenotypes to match a broad range of site conditions across three major forestry regions of the US.

Summary

- Our controlled environment and outplanting experiments suggest the presence of a drought memory
- These findings underscore the importance of drought memory for stress resistance in trees, influencing the capacity of forests to regenerate and respond to recurrent droughts and climate change.
- The formation and expression of drought memory, however, varied across species, highlighting the complexity of adaptive responses across different forest ecosystems