Continuing Project

Intraspecific Hydraulic Responses of Commercial Tree Seedlings to Nursery Drought Conditioning

CAFS.20.78

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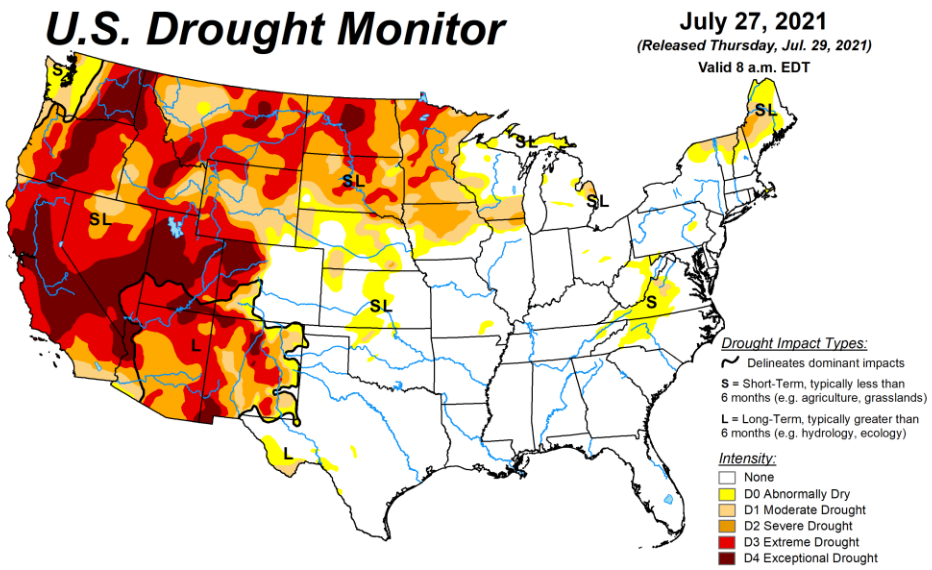
Justification



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

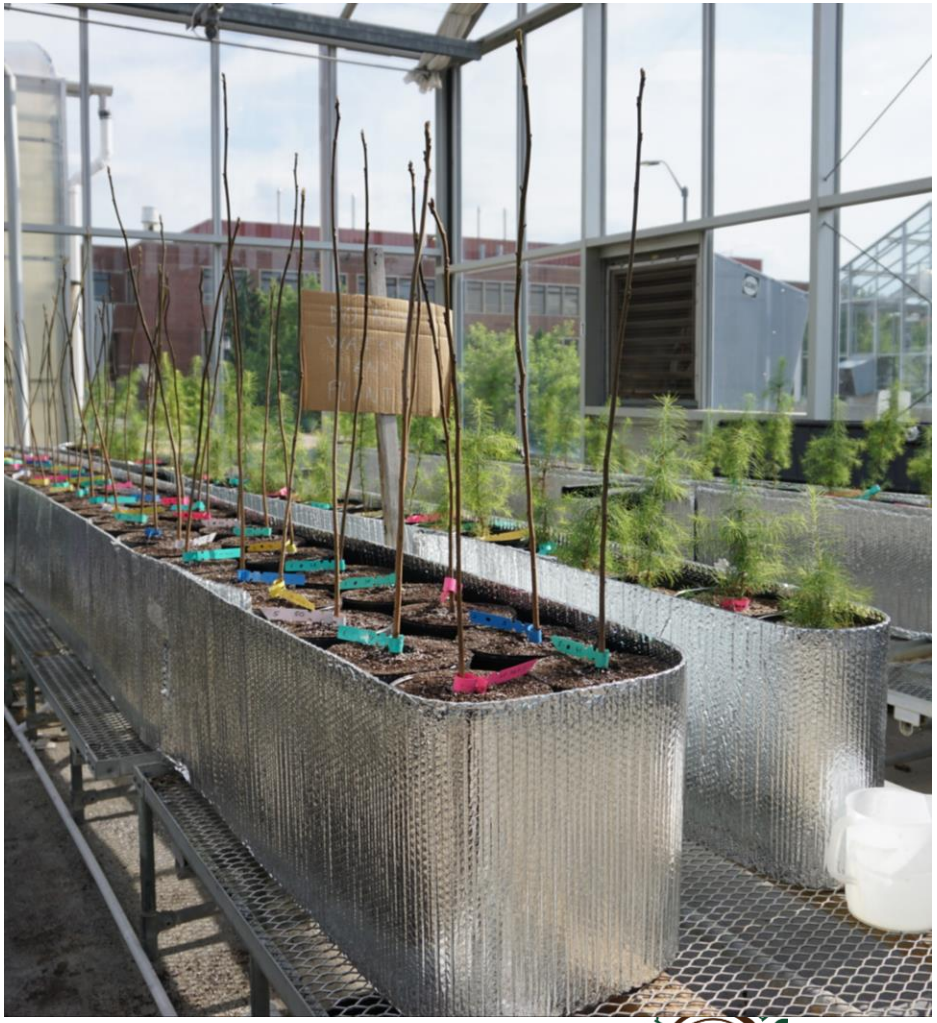
Black walnut

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



Simulated outplanting

- Physiological measurements under drought and optimal watering
  - Whole seedling transpiration rate (E_{plant})

$$E_{plant} = \frac{Weight\ loss}{\Delta time \cdot Leaf\ area}$$

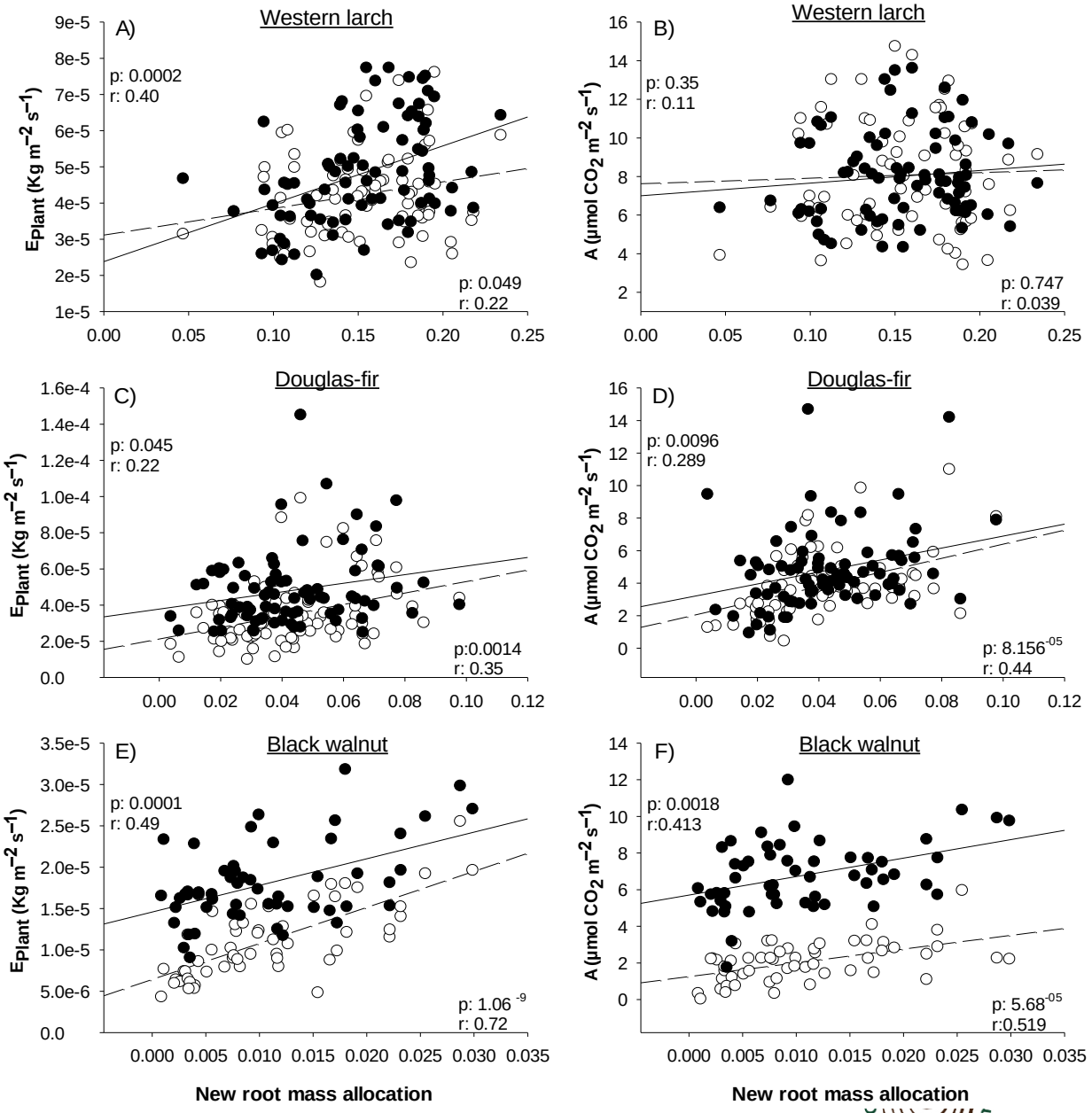
  - Net photosynthesis (A_{net})
  - Water potential

Simulated outplanting

- Morphological measurements
  - Egressing root length and dry weight
  - Foliage area and dry weight
  - Root plug dry weight
  - Stem dry weight

Major Findings

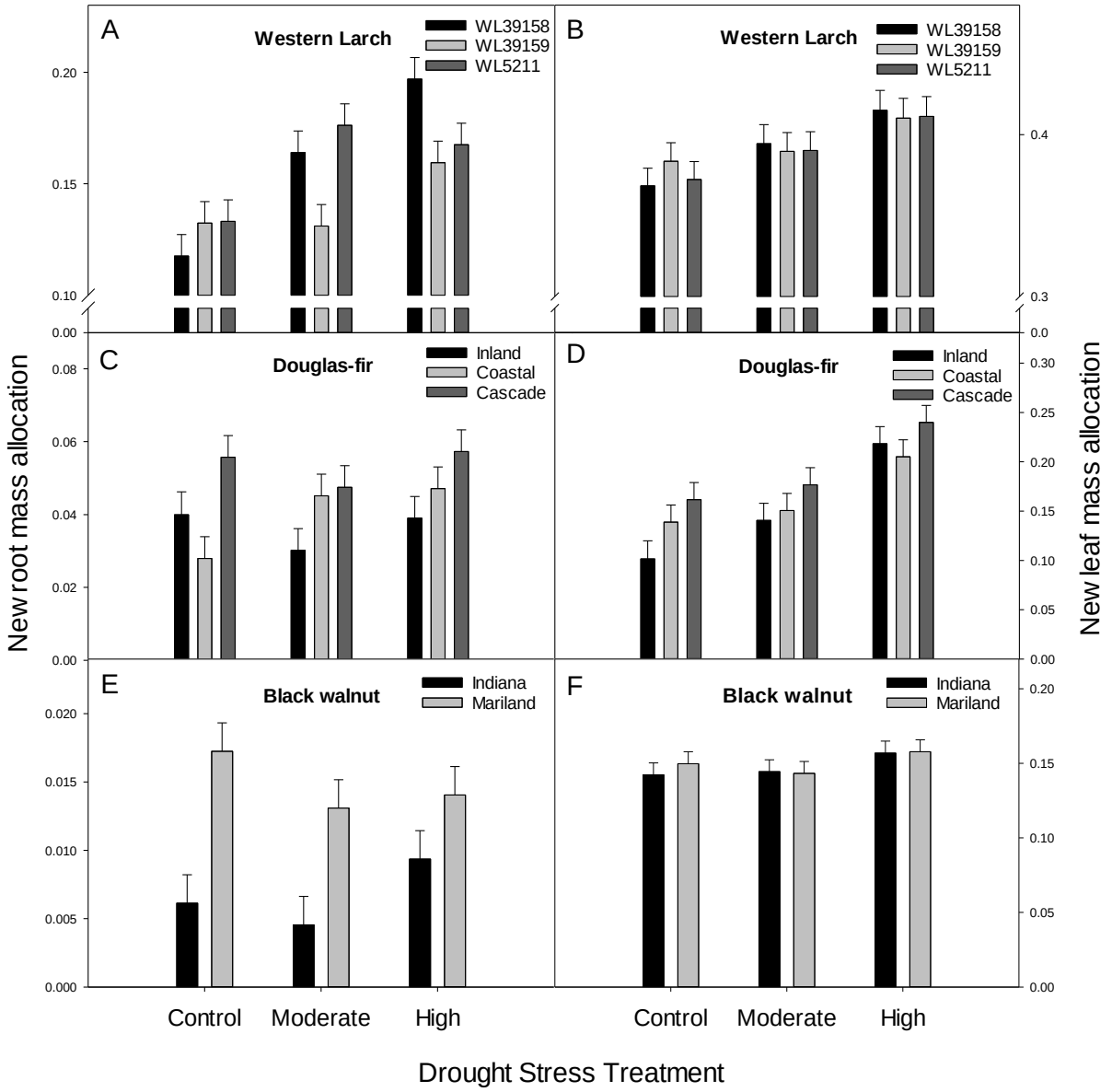
- Biomass allocation to new roots was positively correlated to E_{plant} and A_{net} under drought and after watering



Major Findings

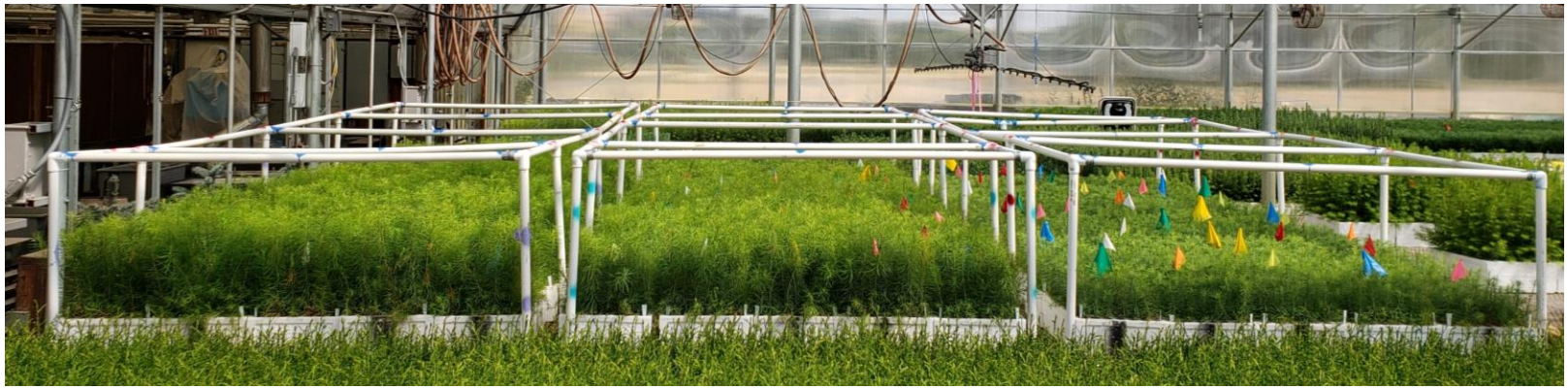
Effects of drought preconditioning

- ❑ 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}



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 results suggest the presence of a drought memory, in that early drought stress modified seedling responses to subsequent drought events.

- These results also highlight the importance of species ecology and provenance of the seed in the formation of drought memory, and its impact on the morpho-physiological acclimation responses to subsequent drought stress.