Interior Douglas Fir: investigating latitudinal differences in seedling drought tolerance

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Background

Target Plant Concept: the right plant for a specific site for the highest probability of establishment success

- **Plant characteristics**
- **Genetics**
- **Nursery practices**

(Davis & Pinto, 2021)

Restoration and reforestation becomes more difficult in the face of climate change:

- **Difficult site conditions → drought**
- **Range shifts**

(Clark et al., 2016)

Contract tree planters with some of the 530,500 seedlings that would be planted across 2,536 acres in the Lolo National Forest in Montana. Courtesy photo by Dave Gardner, Creative/National Forest Foundation.

Background

Douglas fir is considered an “adaptive specialist”

- **Wide geographic distribution**
- **Wide genetic variation**

Increasing drought hardiness from north to south
(Howe et al., 2006)

Drought-resistance traits of Douglas fir were influenced by:

- **Short-term environmental conditions**
- **Long-term genetic differences among populations**
- **The interaction of environmental conditions and genotypes**

(Bansal et al, 2014)

The Natural Range of Douglas Fir

Figure 2.2 Natural range of Douglas-fir (from Little 1971).

Research Questions

My two seed populations come from Northern and Southern climates:

- **Northern Interior Douglas Fir, from north of Potlatch, ID, 3100’ elevation**
- **Seed B: Southern Interior Douglas Fir, Lincoln National Forest in New Mexico, ~9,000’ elevation**

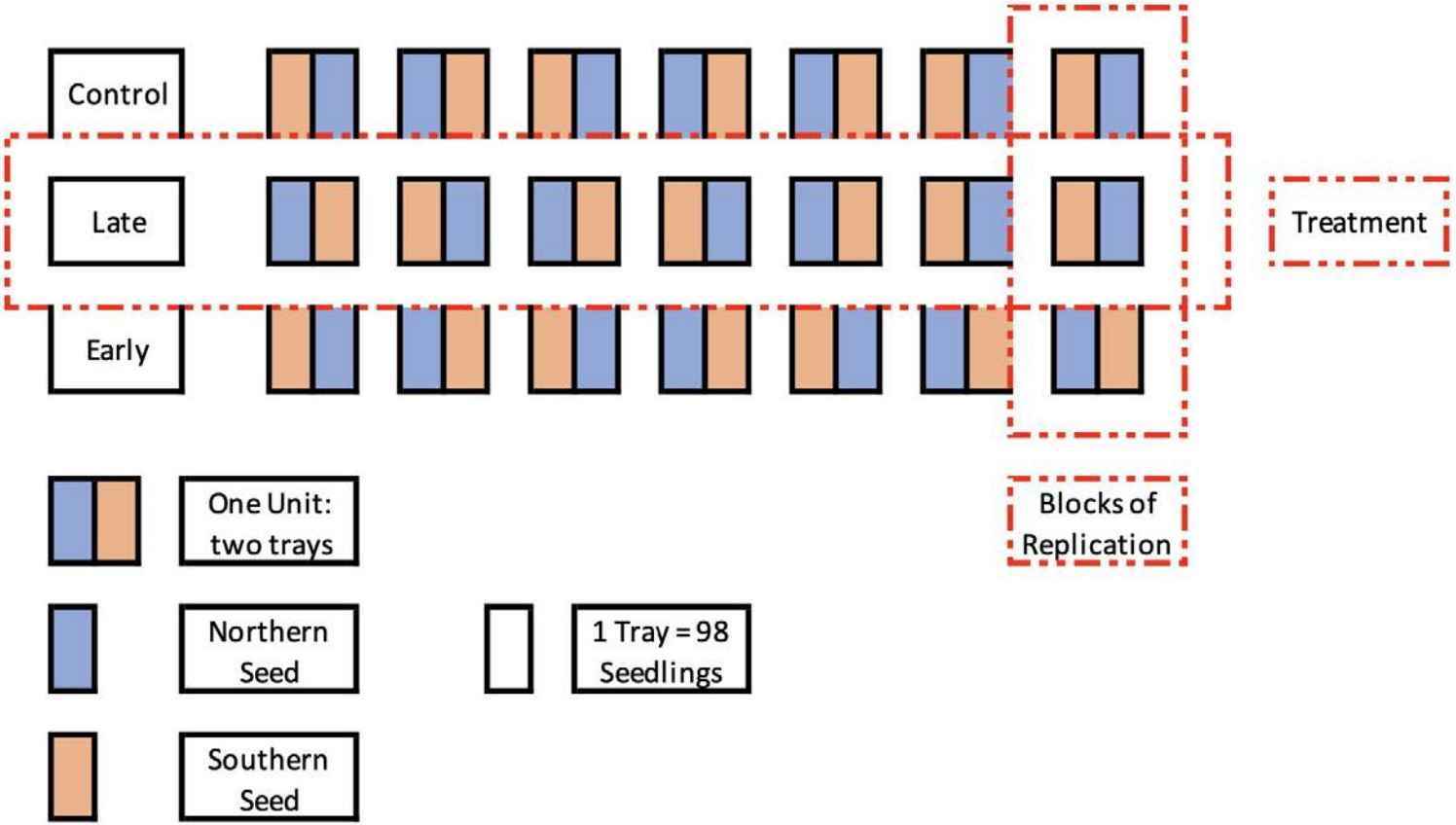
Two drought treatments:

- **Early: drought conditioned before budset, July-August**
- **Late: drought conditioned after budset, August-September**

Measuring various aspects of drought tolerance:

- **Morphology → height, diameter, specific leaf area, root-to-shoot ratio**
- **Physiology → transpiration, photosynthesis, water stress**
- **Anatomy → xylem structure**

Experimental Design



Data Collection Plan & Analysis

Regular Measurements:

- Licor: photosynthesis, stomatal conductance
- Pressure Bomb: xylem water potential
- Biomass: root-to-shoot ratio, height, diameter

End of Experiment Measurements:

- Xylem anatomy
- Sugar analysis
- Root water potential
- Vulnerability curves

Images

Control Treatment (August)

Northern seed:
- Taller
- Lighter color

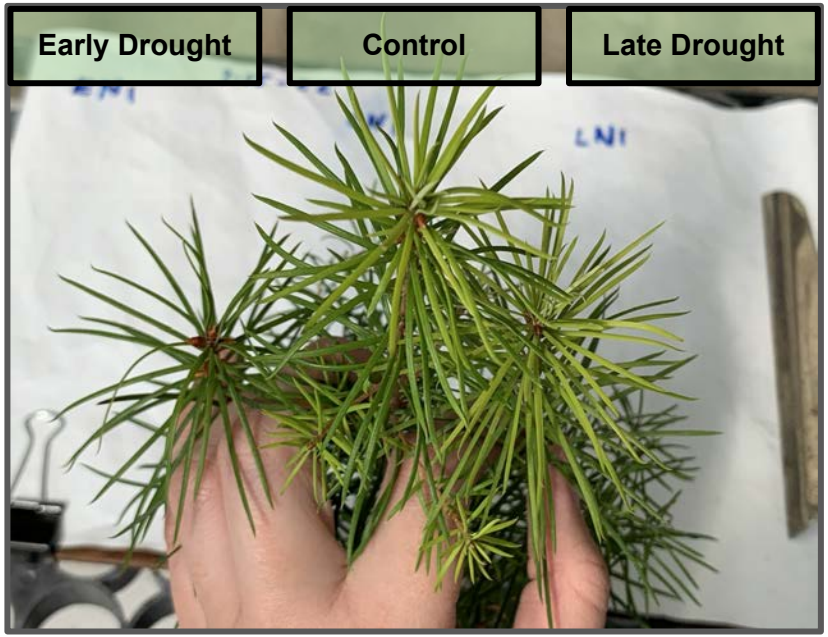
Southern seed:
- Shorter
- Blue / dark color
- Floppy tops (see below)

South

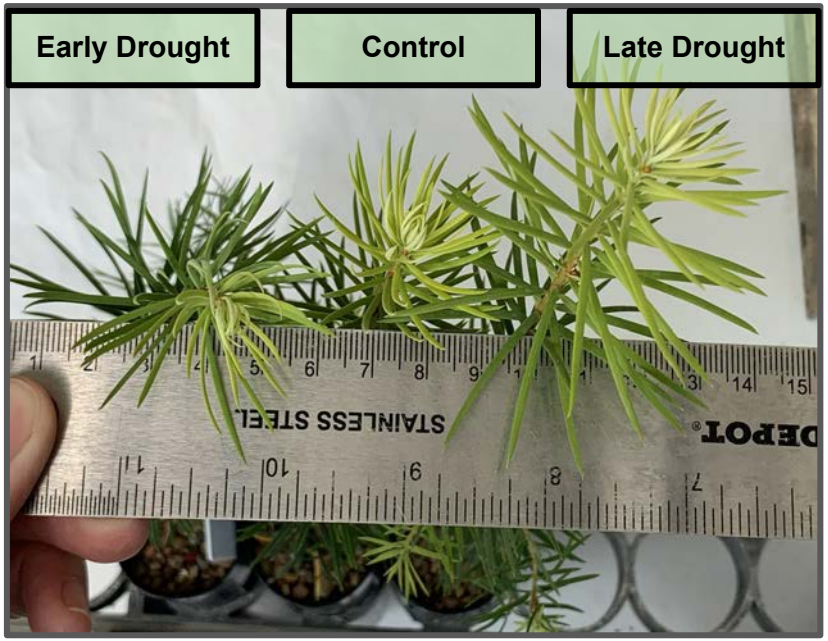
North

Images

Northern Seed

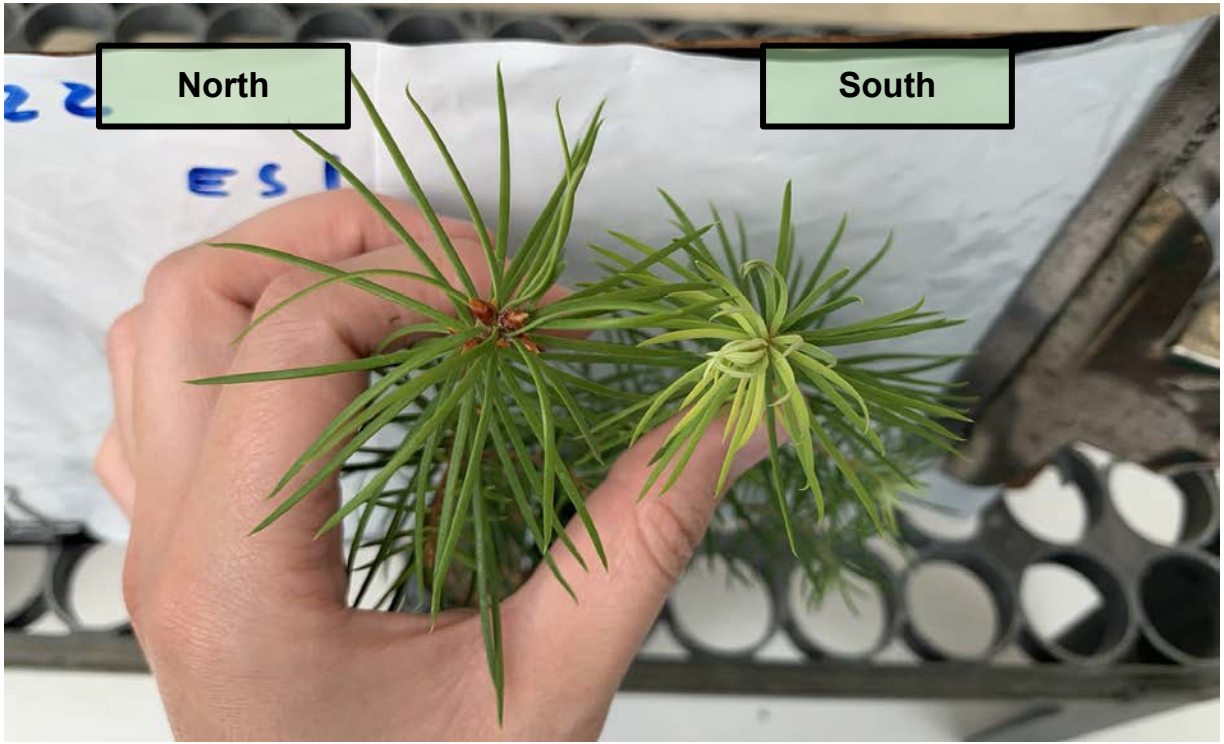


Southern Seed



Images

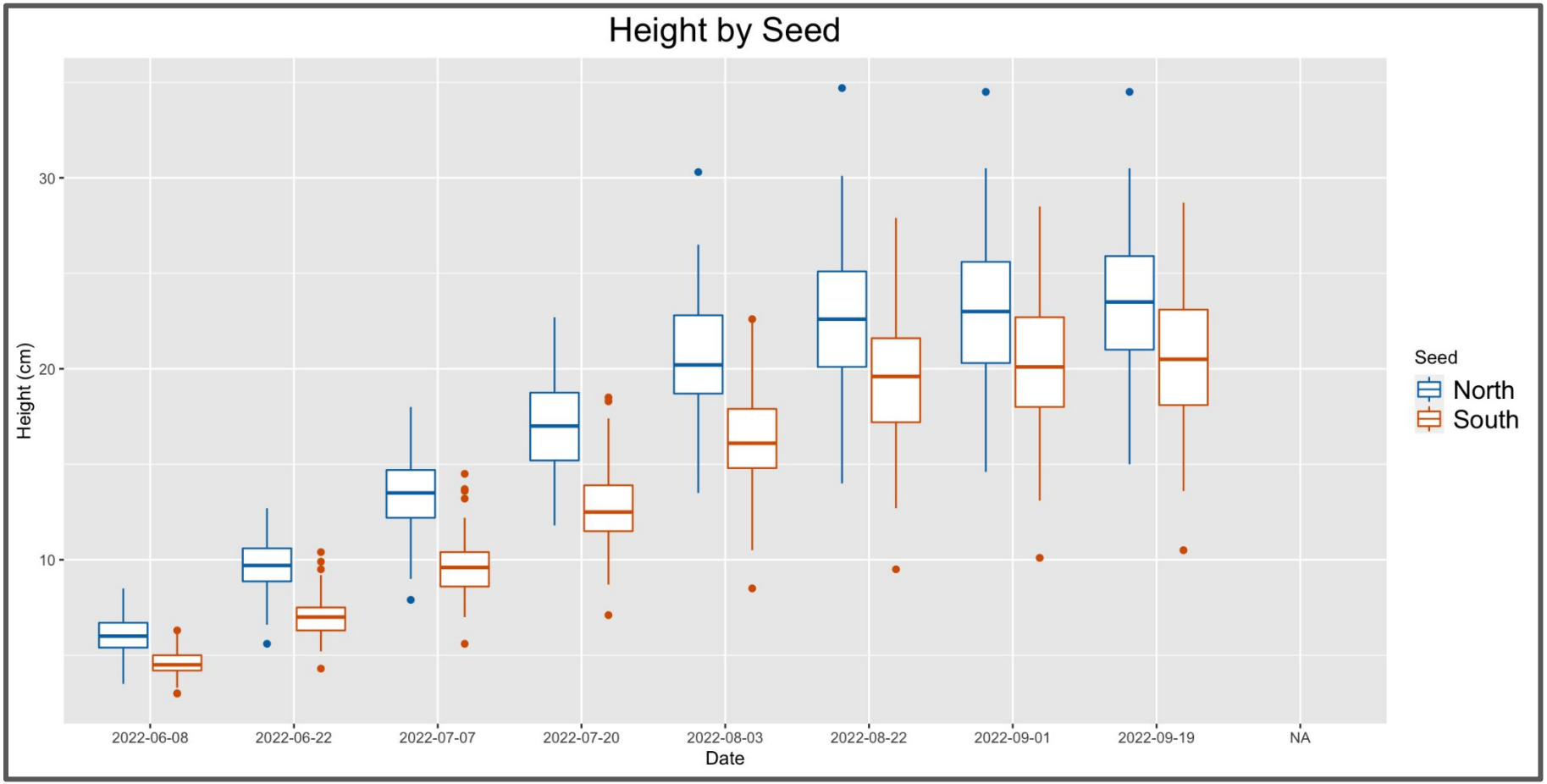
Early - Droughted Seedlings



Generalized Observations:

- Southern seed was shorter
- Southern seed was difficult to set bud
- Southern seed had darker, shorter and wider leaves
- Southern seeds were larger (22k per lbs) compared to Northern (36k per lbs)

Preliminary Results



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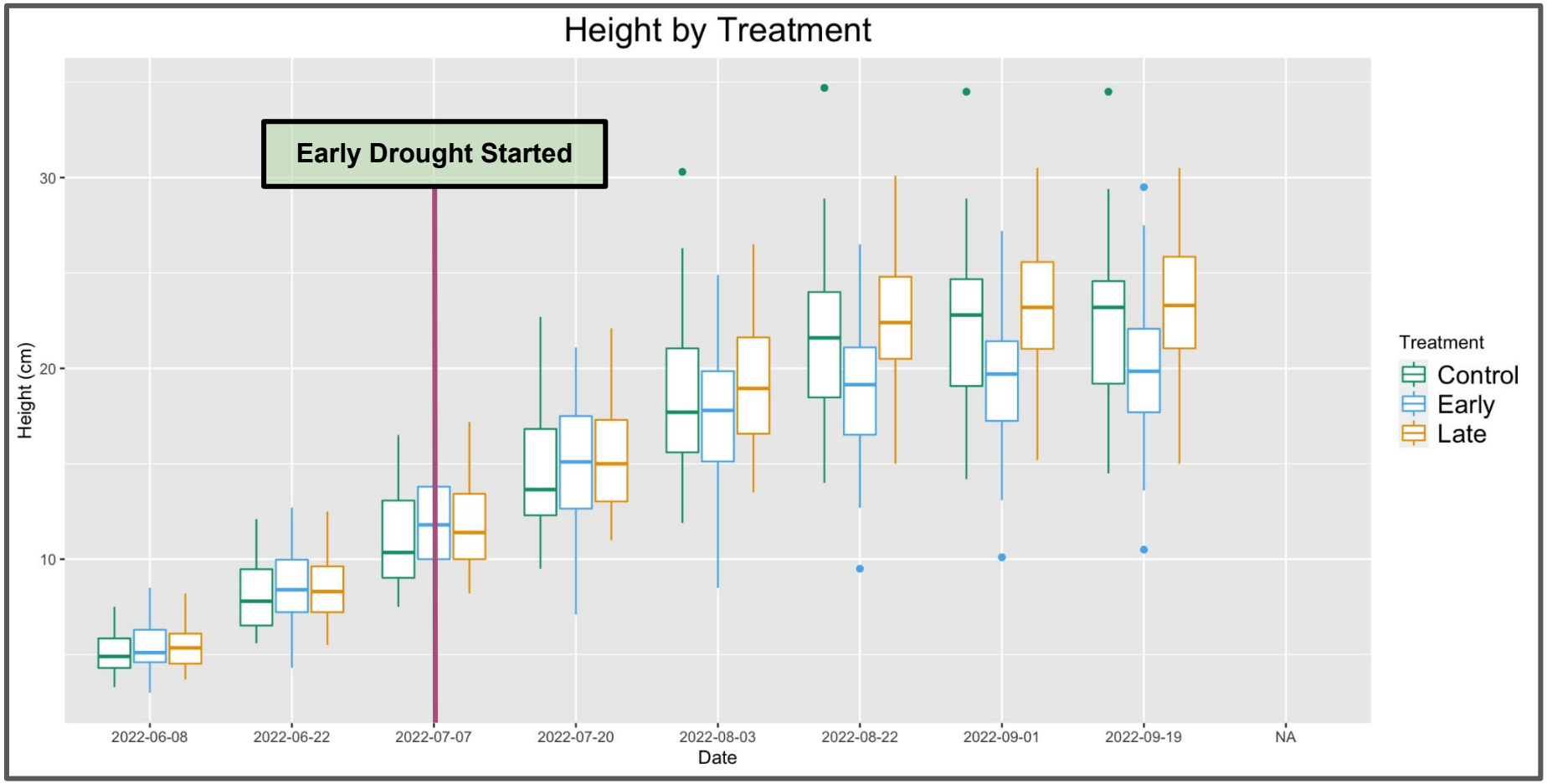

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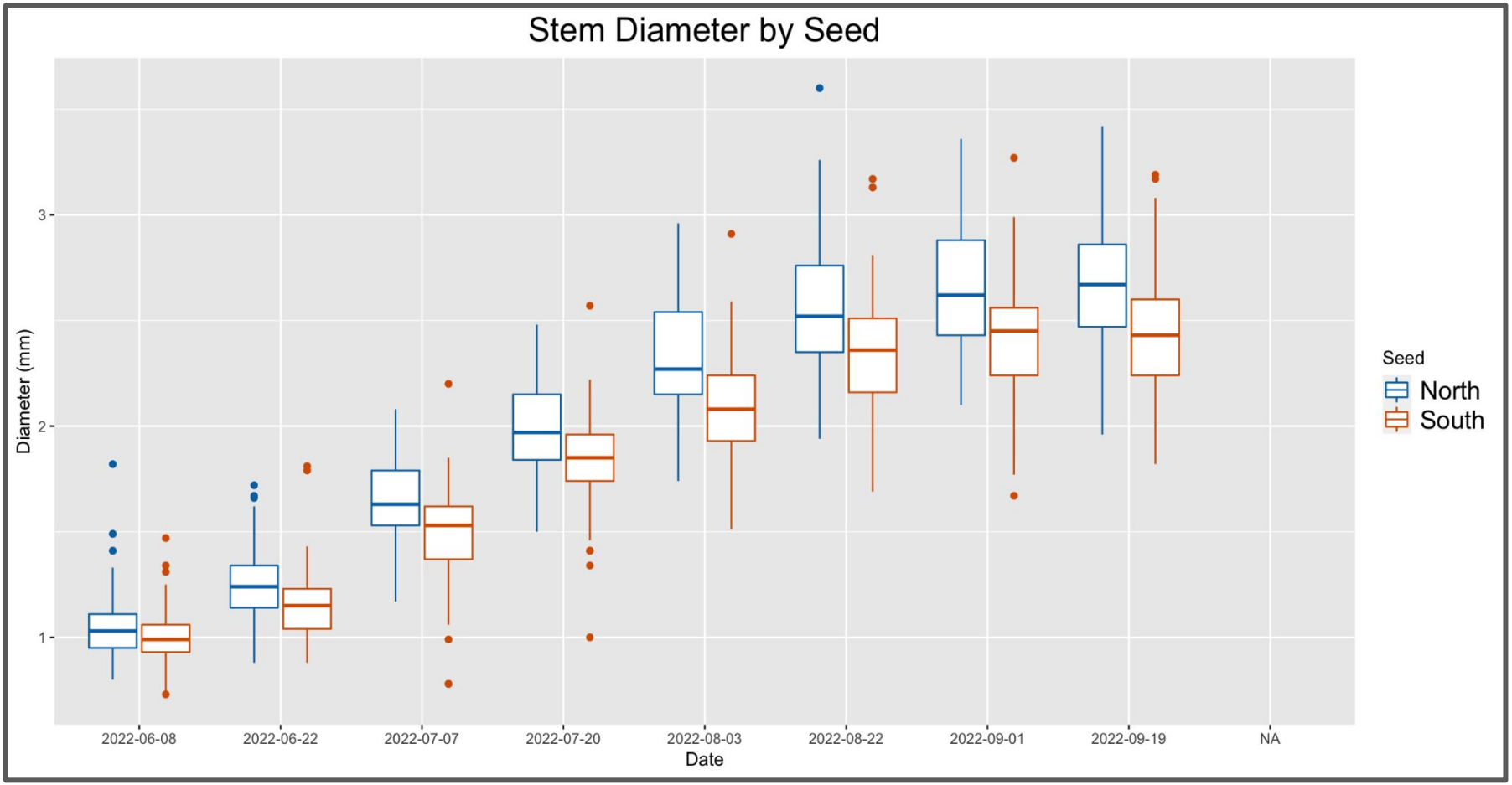

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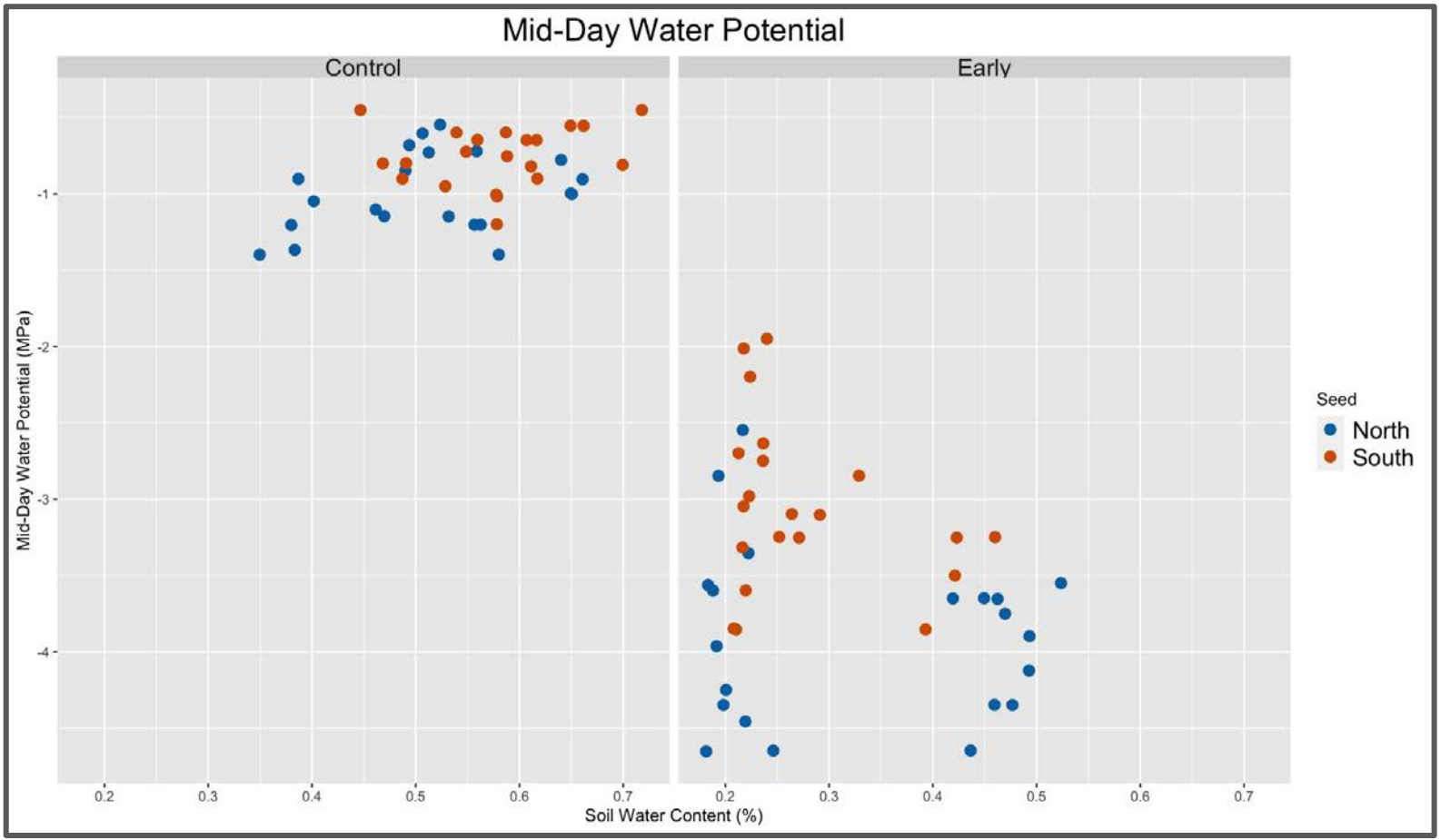

Thank you!

Sources:

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