Intraspecific Roots Trait Variability of Western Larch (*Larix occidentalis*) Seedlings in Response to Drought

Western Forestry and Conservation Association

The Reforestation Pipeline In The Western United States
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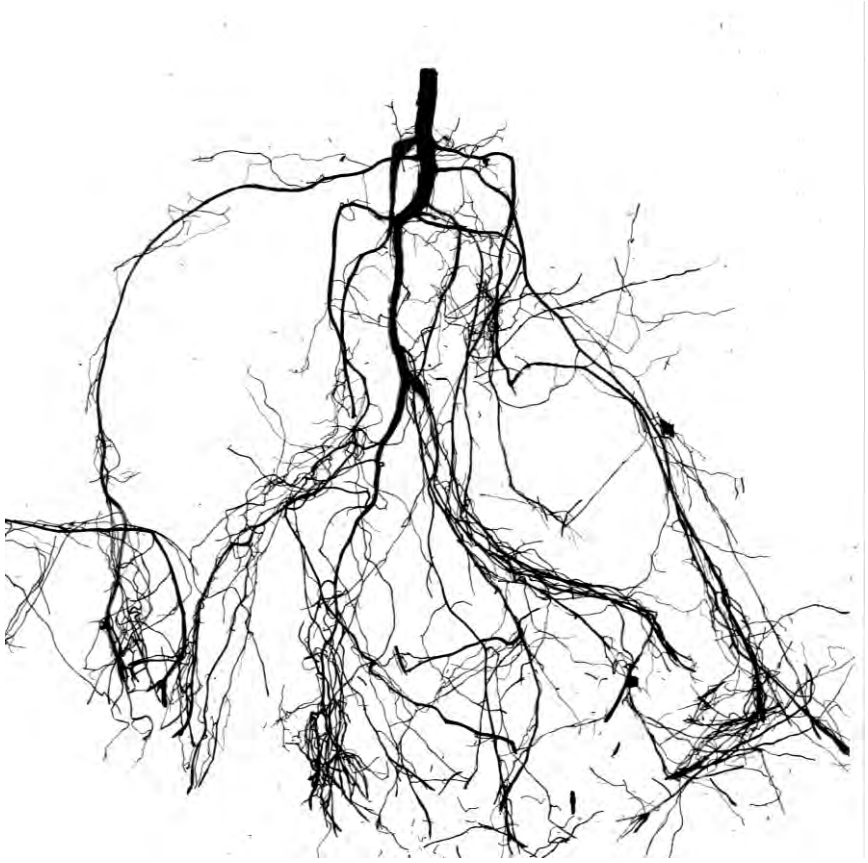
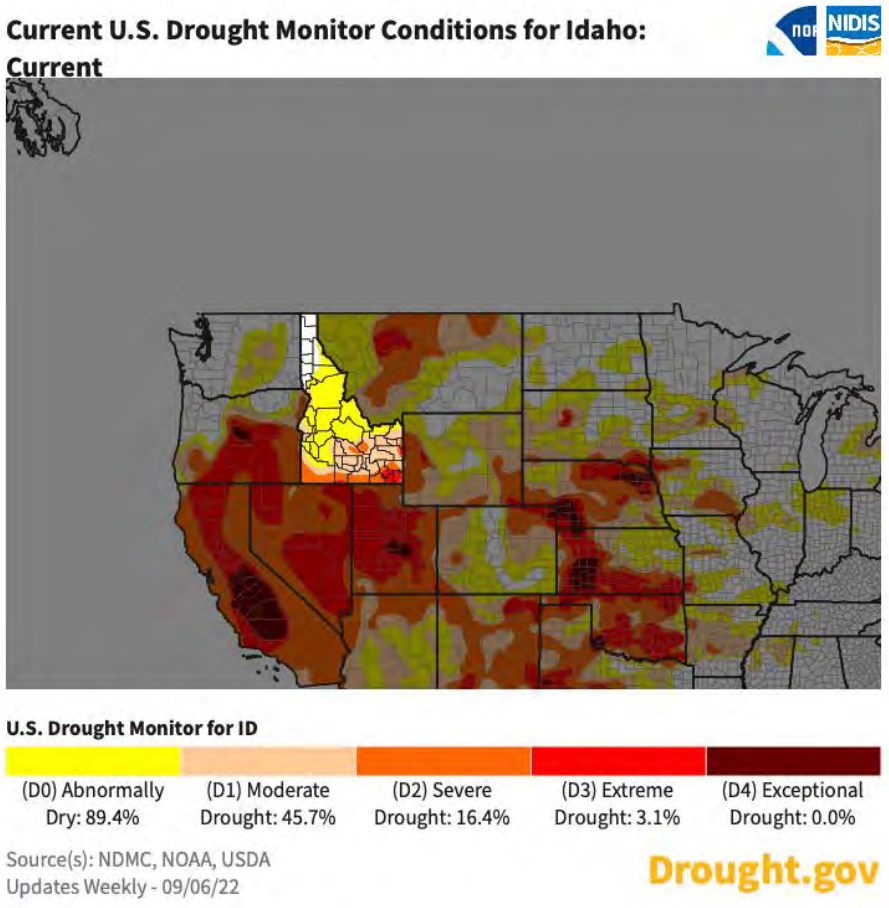


Background

Drought is a major concern for the forestry in northern Idaho since it can result in seedling mortality costing millions of dollars if reforestation fails.

Little knowledge of cultivation conditions and techniques to grow tree seedlings with desirable drought-hardiness on site (Moler & Nelson, 2021)

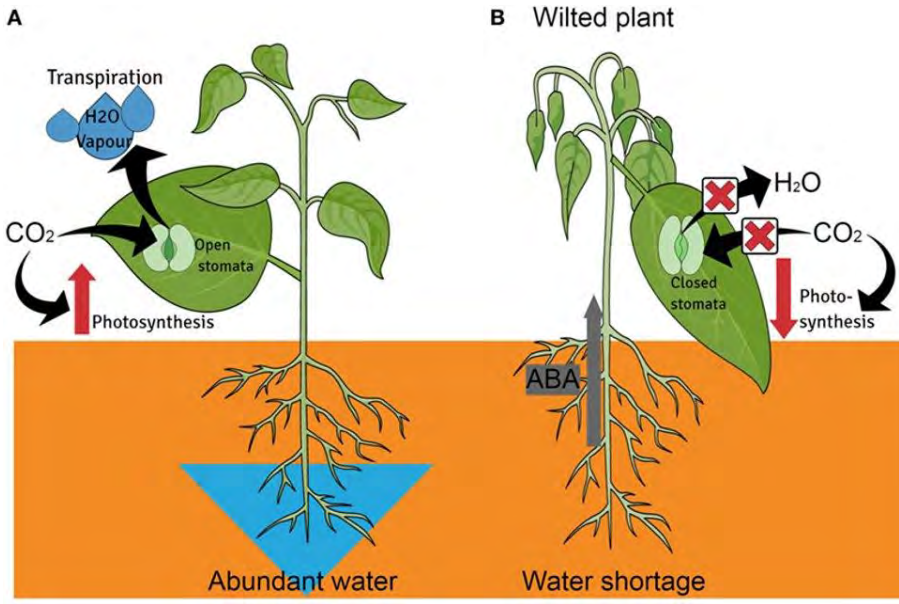


Background

- Need to optimize forest nursery methods to produce drought hardy seedlings to match reforestation site (Moler & Nelson, 2021).

- Western Larch is considered valuable for commercial lumber but is threatened with range constriction under climate change scenarios(Rehfeldt and Jaquish, 2010).

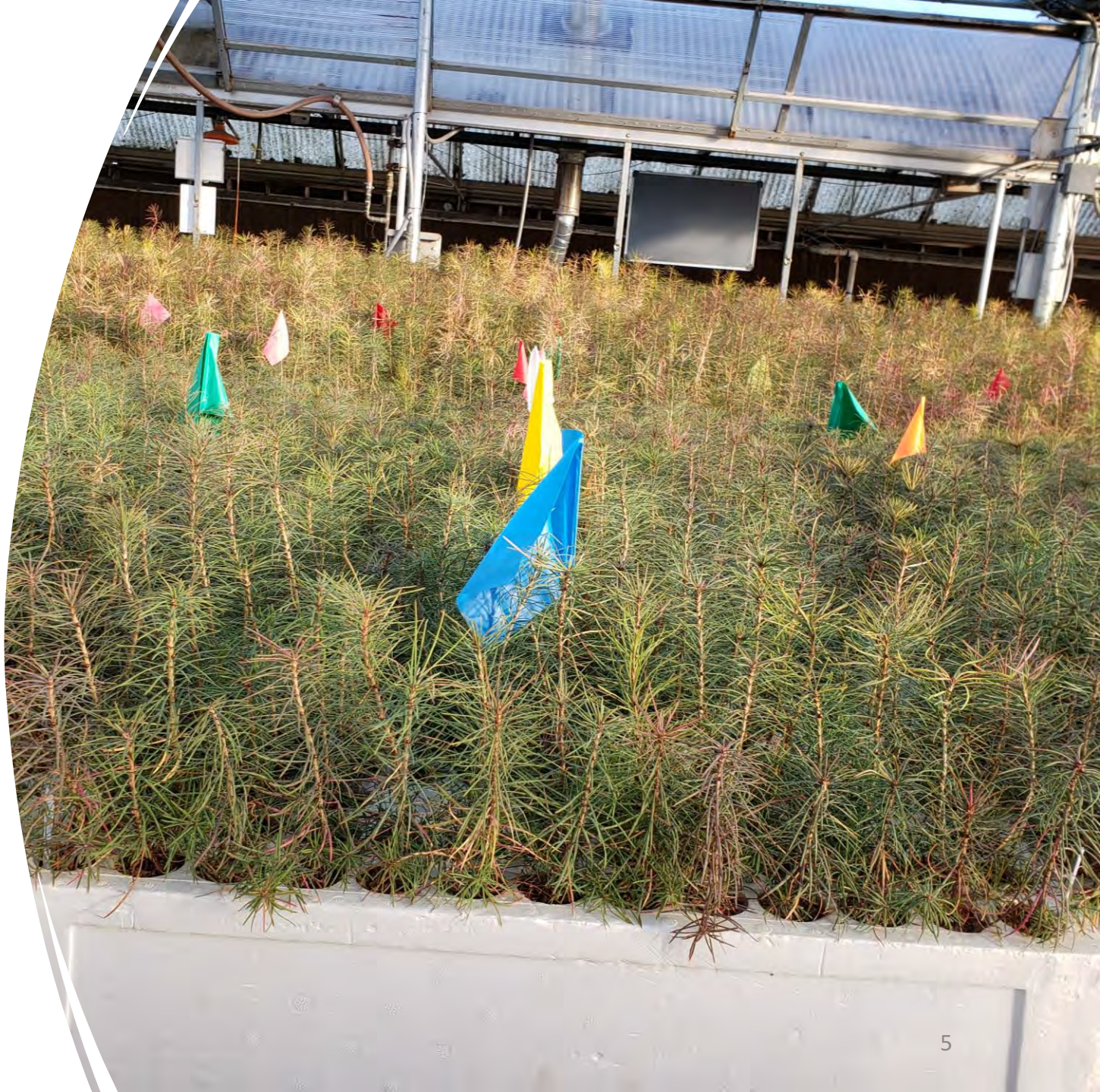
Source: https://www.oregon.gov/ODF/Documents/ForestBenefits/Drought.pdf



Source: Frontiers for Young Minds

Objective

Understand the influence of drought on western larch seedlings.



Specifics Objectives

- Examine the influence of drought on the physiology of Western larch seedlings across a range of seed provenances representing unique climates in the Inland Northwest.

- Assess nursery-grown western larch genotypes' ability to produce desirable roots traits under drought conditions.

Western Larch genotypes and their habitat-types

Family	Biogeoclimatic Ecosystem Classification_Subzone	Biogeoclimatic Ecosystem Classification_ZoneName
5211	Dry Cool	spruce-fir
27269	Dry Warm	interior DF (IDF
39158	Moist Cool	Cedar-Hemlock (ICH)
39159	Very Hot Dry	Interior DF (IDF)
39160	Dry Mild	Montane spruce (MS)
39264	Moist Warm	Cedar-Hemlock
50106	NA/Orchard	NA/Orchard
50117	NA/Orchard	NA/Orchard

6 woods-run collections were from southeastern British Columbia, while the origin of the two seed orchard sources is western Montana

Location of the study

- Greenhouse at the University of Idaho Center for Forest Nursery and Seedling Research.
- Seeds were sown by hand in 415C Styroblock® containers filled with growing media
- Media were amended with 7.9 g slow-release Osmocote® fertilizer and peat-perlite percentages: (*N* = 15%, *P*= 9%, *K* = 12%) per liter soil media.

Drought treatments

- Seedlings were exposed to 26 weeks of drought preconditioning treatments (from June 1st to December 30, 2020) 6-7 weeks after sowing.
- 8 seed sources randomly exposed to three gravimetric soil moisture contents:
  - Extreme: 50–65% container weight at field capacity corresponding to 32-42% GWC
  - Moderate: 60–75% container weight at field capacity corresponding to 39-48% of GWC)
  - Control(High): 75–100% container weight at field capacity corresponding to 48–65% GWC). (Dumroese et al., 2015).
- Containers were weighed daily and irrigated when tray weights reached the lowest weight permitted for a given soil moisture content treatment.

Western larch genotypes under drought treatments (Pitkin Nursery)

Results

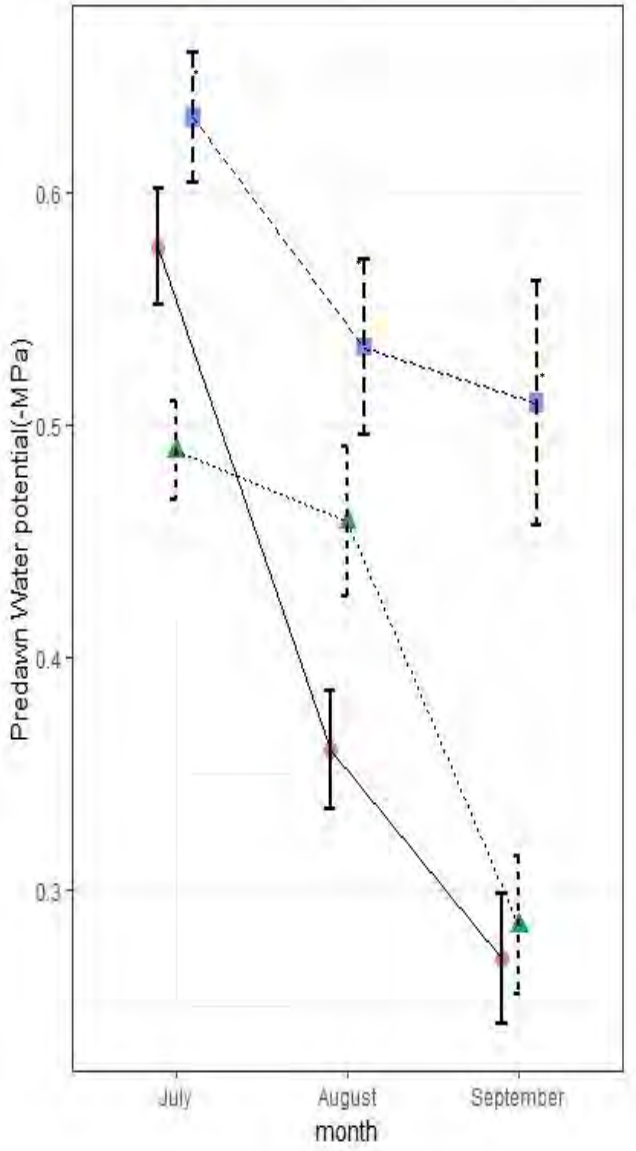
- No significant differences of western larch seed sources and treatment x seed sources on root length, root average diameter and root volume.

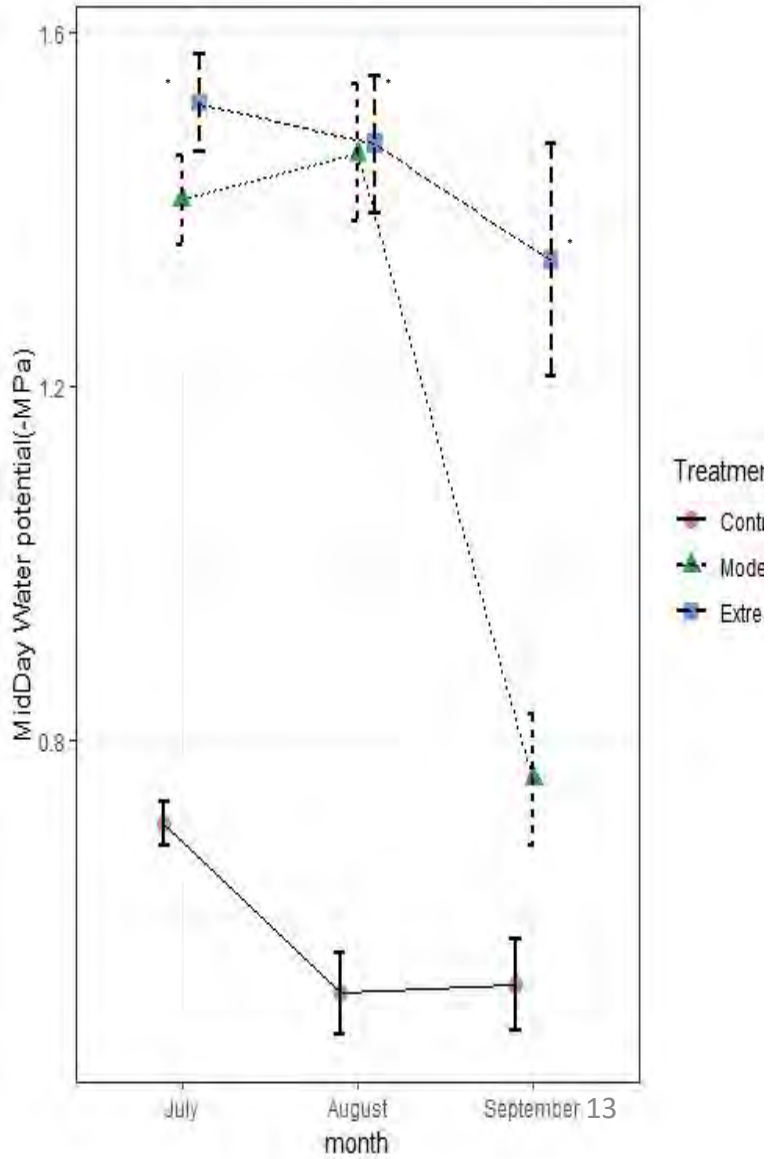
Table 2.-Anova root volume

NUM	DF	DENDF	F-VALUE	P-VALUE
(Intercept)	1	92	122.38248	<.0001
Treatment	2	92	5.23447	0.007
Seed sources	7	92	0.43168	0.880
Treatment:seed source	14	92	1.38988	0.174

Treatments effect on predawn and mid-day water potential

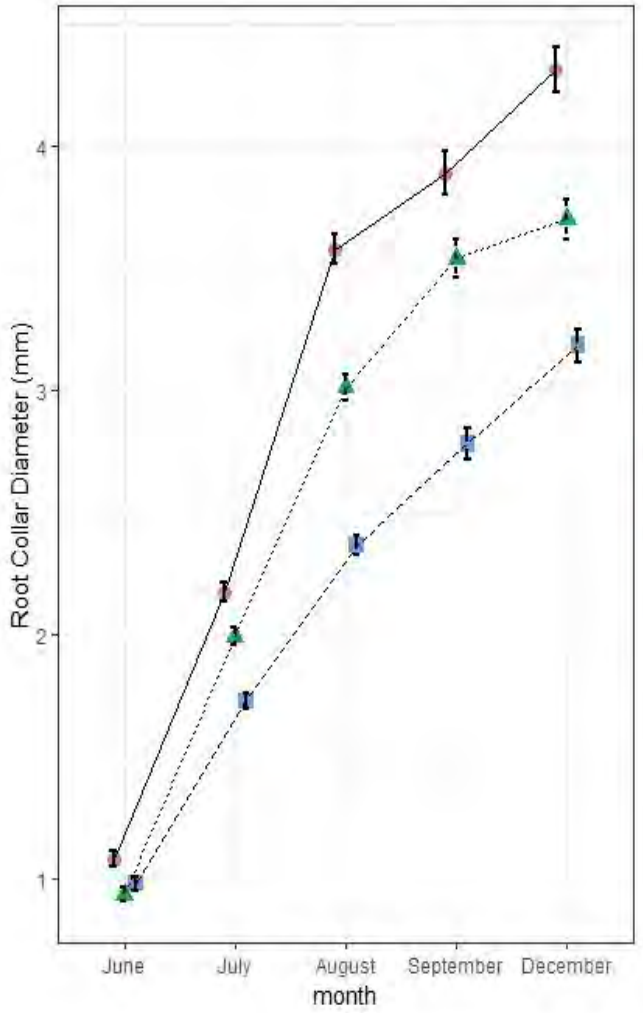
- At the end of the growing season, predawn water potential was significantly lower for seedling under extreme drought (no Significant differences between control and moderate)
- Mid-Day water potential, measured between 11:30 am and 1:00pm was significantly more negative.

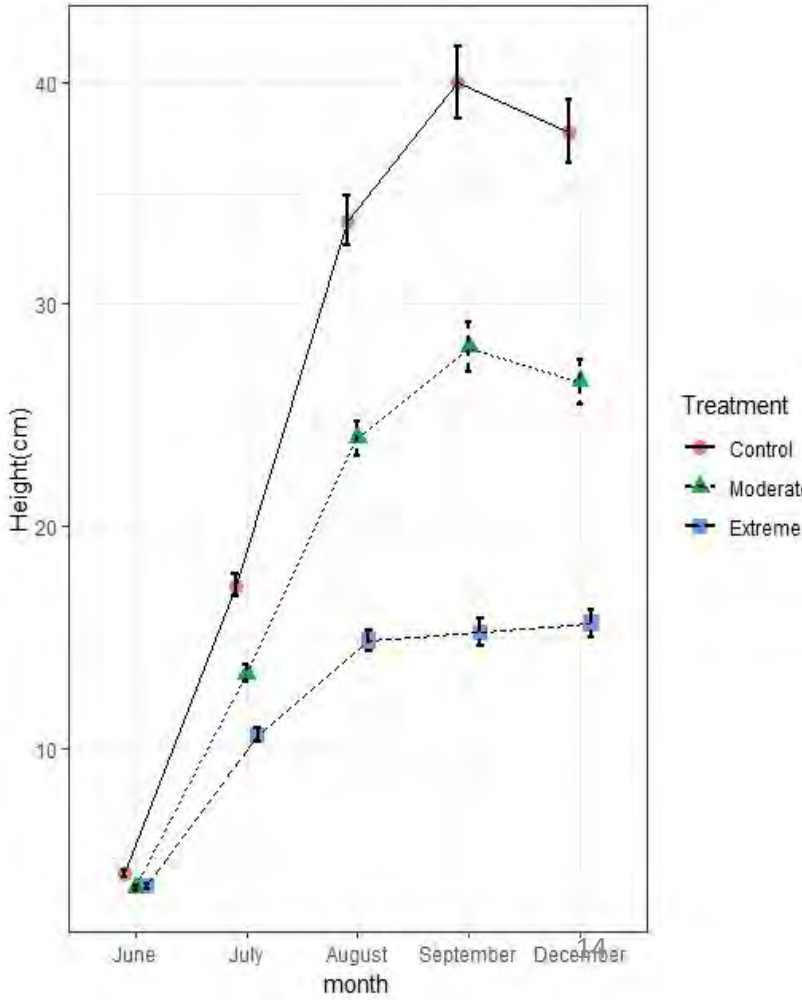




Treatments effect on height and root collar diameter.

- Higher root collar diameter(RCD) under control treatment ($p < 0.05$) than the other treatment. Smaller RCD for seedlings under extreme drought.
- Seedlings height was significantly higher under control but was reduced from September to December. Under extreme treatment seedlings were smaller ($p<0.001$).

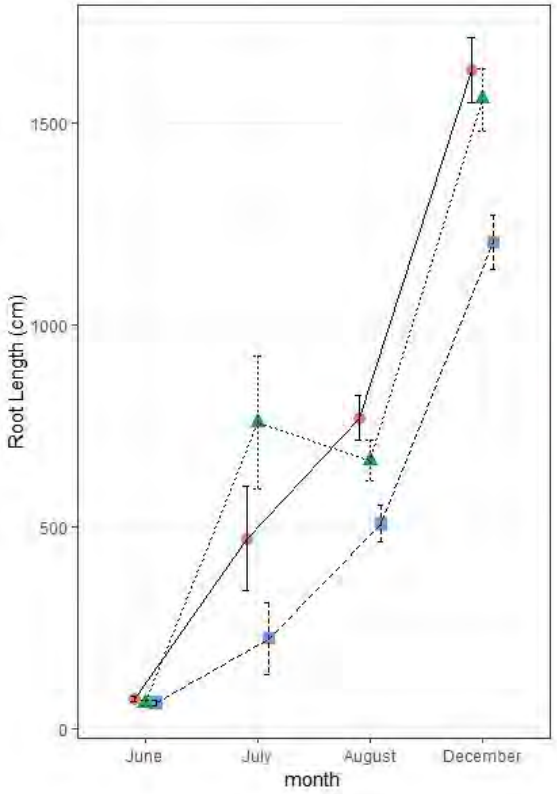


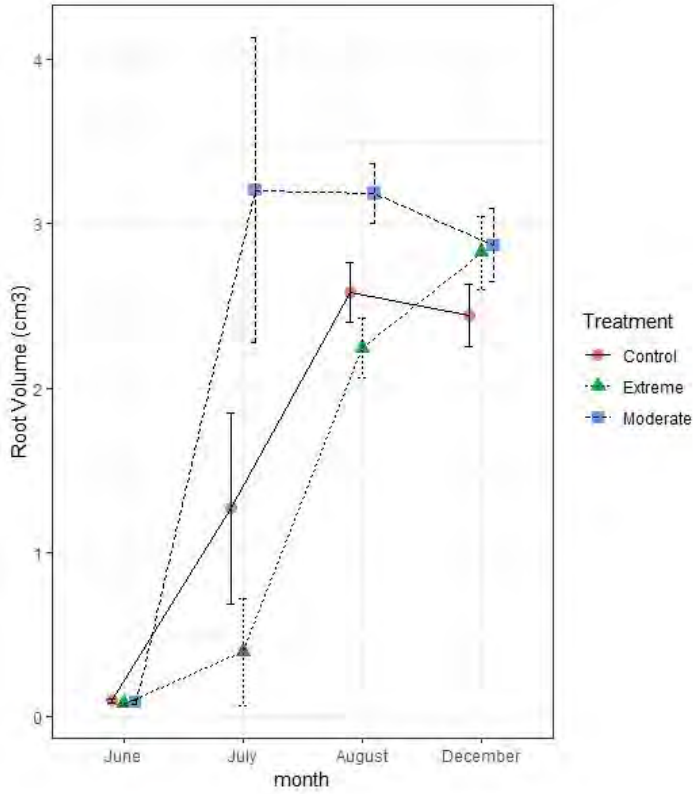


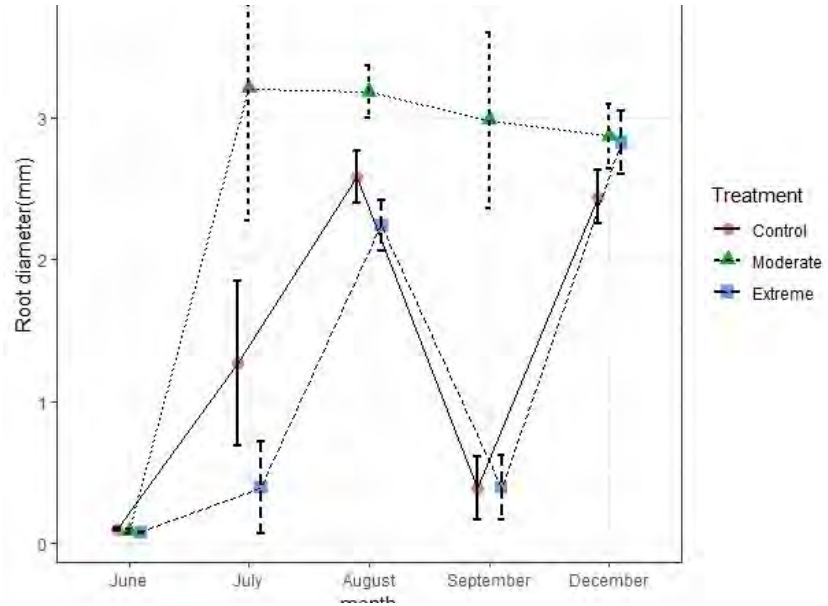
WL Root System Architecture under Drought

- Root Volume (*p=0.3913*) and Root diameter (*p=0.001*) were greater in Extreme and Moderate stress, lower in Control at the end of growing stage.

- Root length is greater in control and moderate, lower in extreme







Conclusion

- Although there are no differences among western larch family, drought stress has an important effect on western larch physiology, morphology, and root architecture.

- A moderate stress (water regime of 60–75% saturated container weight) produces drought-hardy seedlings with desirable traits (longer root, smaller root diameter, greater root collar diameter, taller seedlings) that can match reforestation site.

Future Work

- Outplanting experiment to evaluate seedlings' performance on reforestation sites.

- Further research to understand how exposure to drought intensity and timing in the nursery affects different root traits.

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Thank you