Nursery practices to mitigate drought

Intertribal Nursery Council

Boise, Idaho • 26 July 2018

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Outline

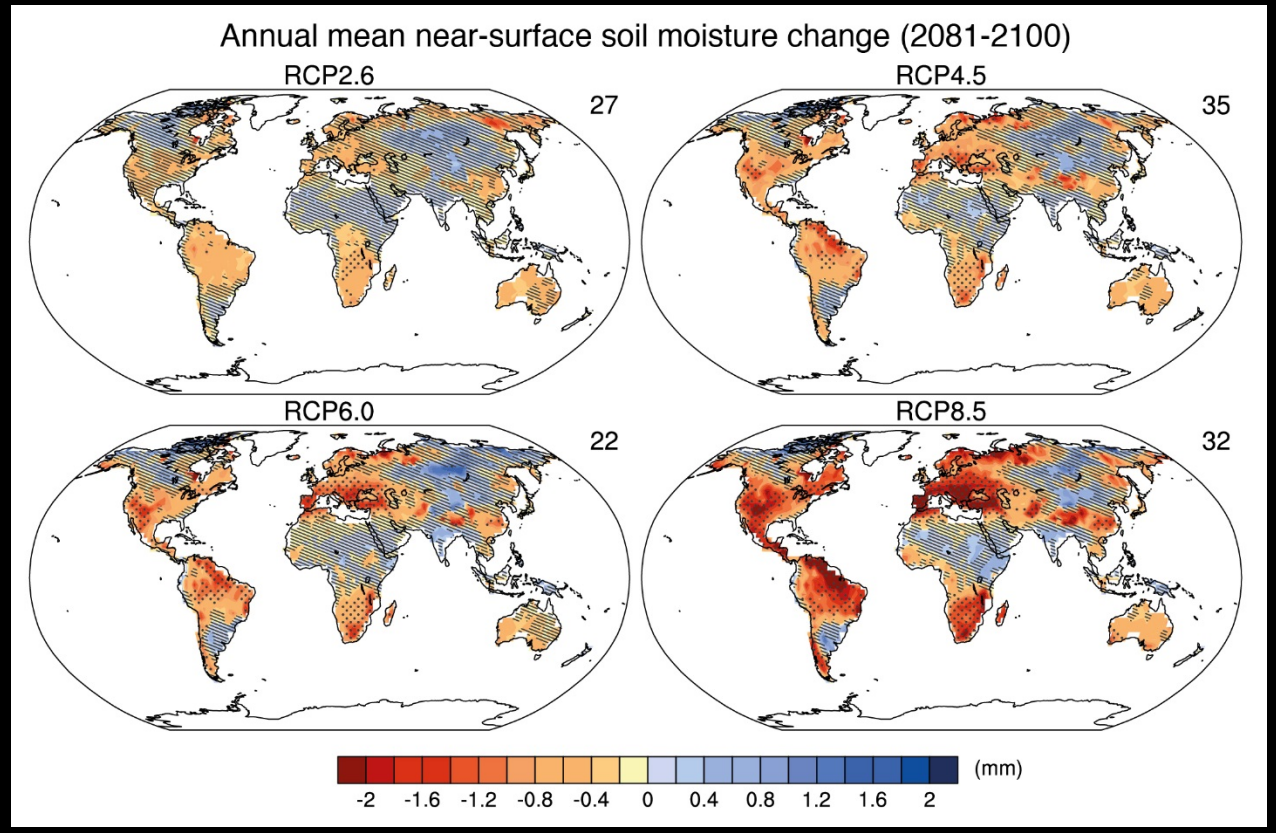
Climate change and its implications

- Target Plant Concept – framework for everything
- Drought Strategies
- Quiz

Climate change and its implications

Changes in the US:

- Changes in temperature and precipitation
- Increases in weather variability
  - Droughts
  - Storms
  - Heat waves
- Interaction with other global forces
  - Air pollution
  - Invasive species
  - Disturbance patterns and intensities
- What does RCP stand for?
- What are the major concerns locally?



IPCC 2013

Climate change and its implications

Other implications for nurseries and seedling survival

- Resources
  - Water, energy
- Materials
  - Media, plastics, fertilizers, structures
- Nursery stock
- Outplanting conditions
- Outplanting timing
- Genetics

Where do you start?

Target Plant Concept

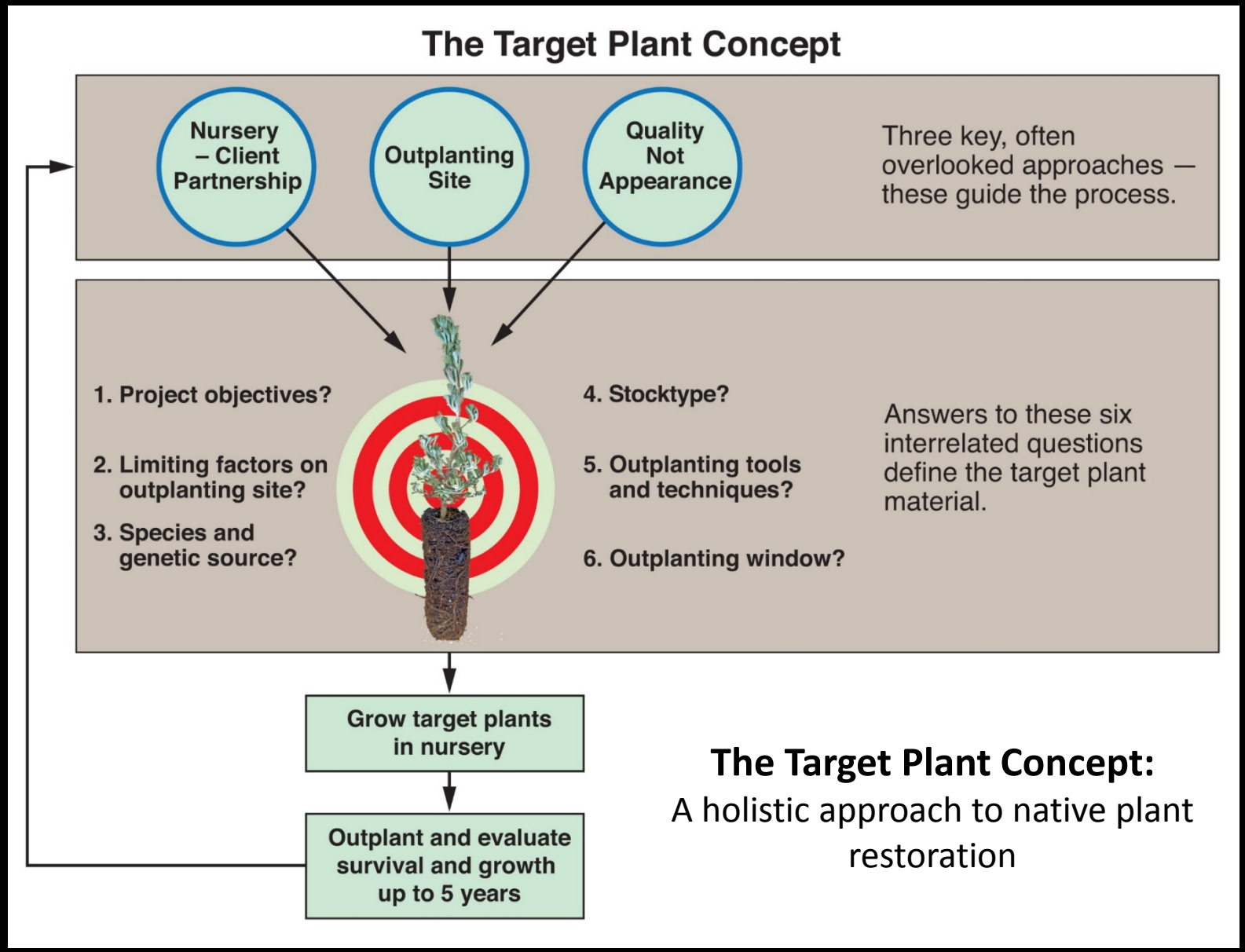
- What is it?
- A *holistic* approach to native plant restoration and reforestation
- Based on three ideas:
    1. Start at the outplanting site
    2. Nursery and client are partners
    3. Emphasis is on plant quality
- Targets specific physiological and morphological characteristics that can be quantitatively linked with outplanting success
- One change may impact the whole process

Target Plant Concept

Six Interrelated Components:

1. Objectives of outplanting project
2. Limiting factors on the outplanting site
3. Genetic considerations
4. Type of plant material
5. Timing of outplanting
6. Tools and techniques

Target Plant Concept



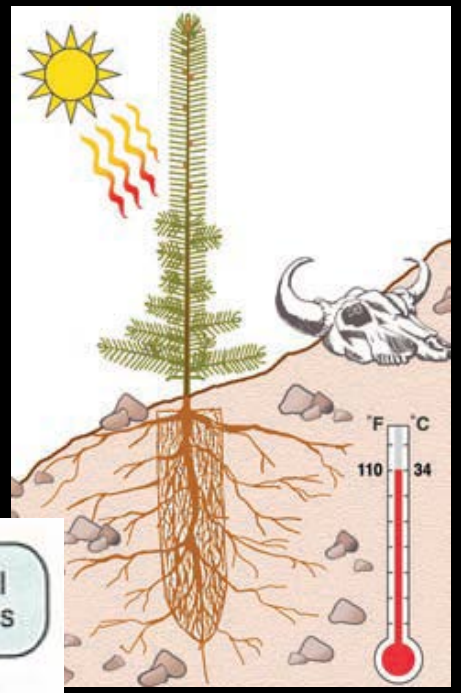
The Target Plant Concept:
A holistic approach to native plant restoration

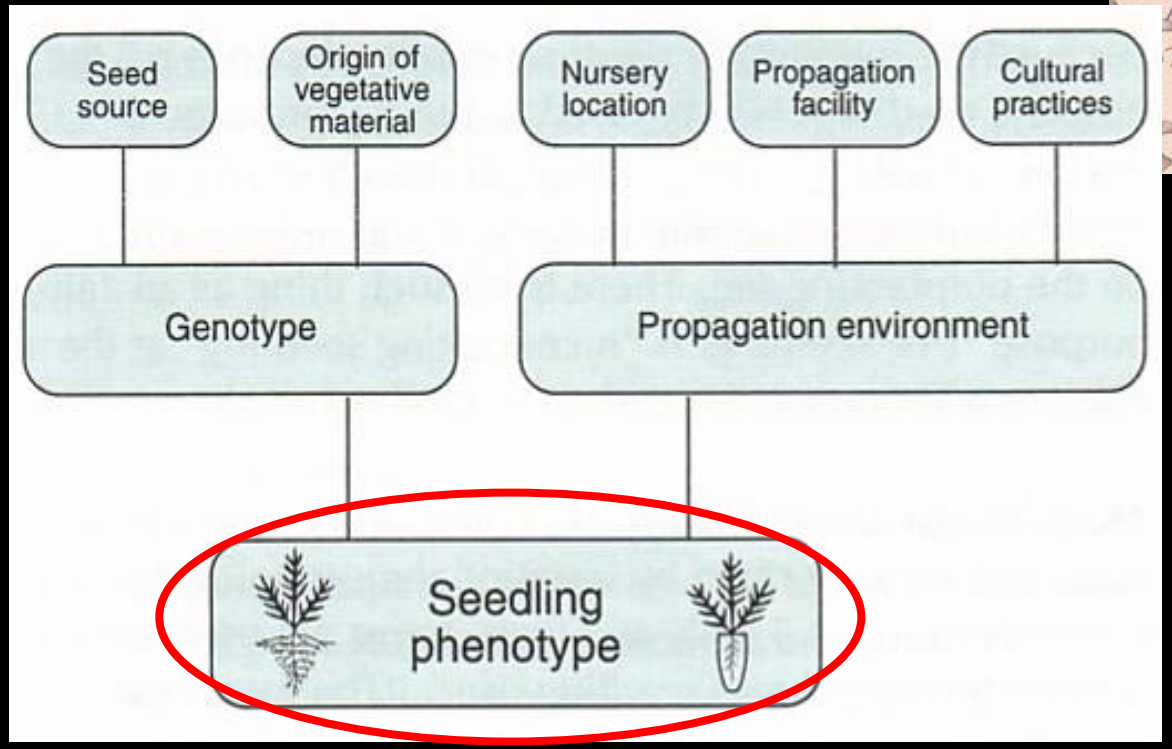
Objectives

- What is the project goal?
- Reforestation
- Restoration
- Ecosystem services
- Biological diversity
- Cultural
- Disturbance
- Invasive species

Target plant and nursery practices

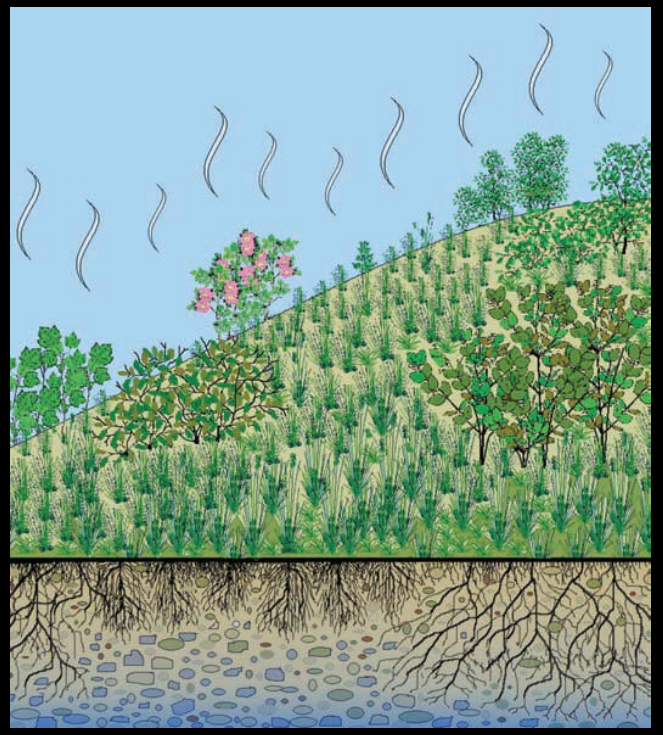
- Limiting factors on the outplanting site
- Genetic considerations
- Type of plant material

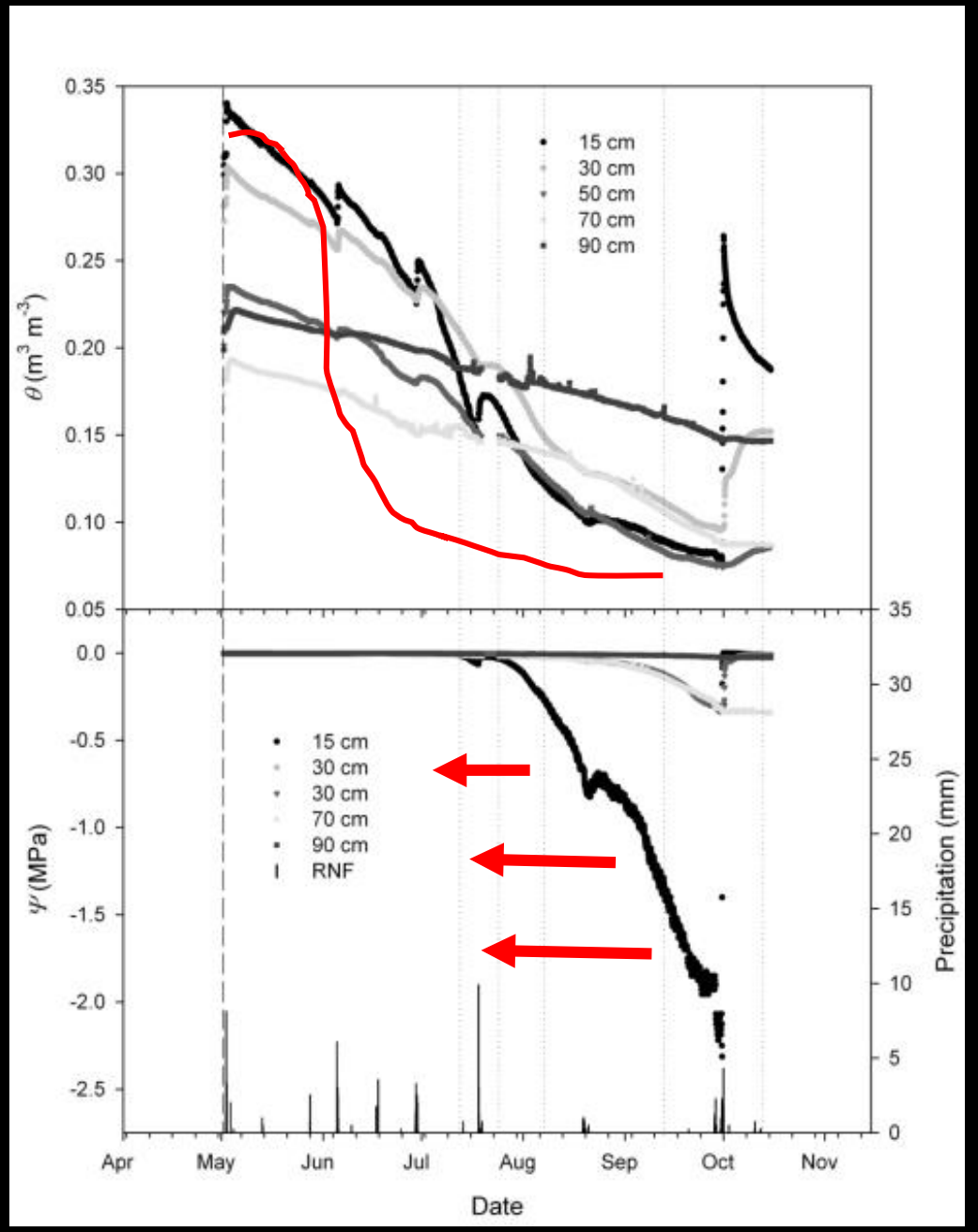




Limiting factors

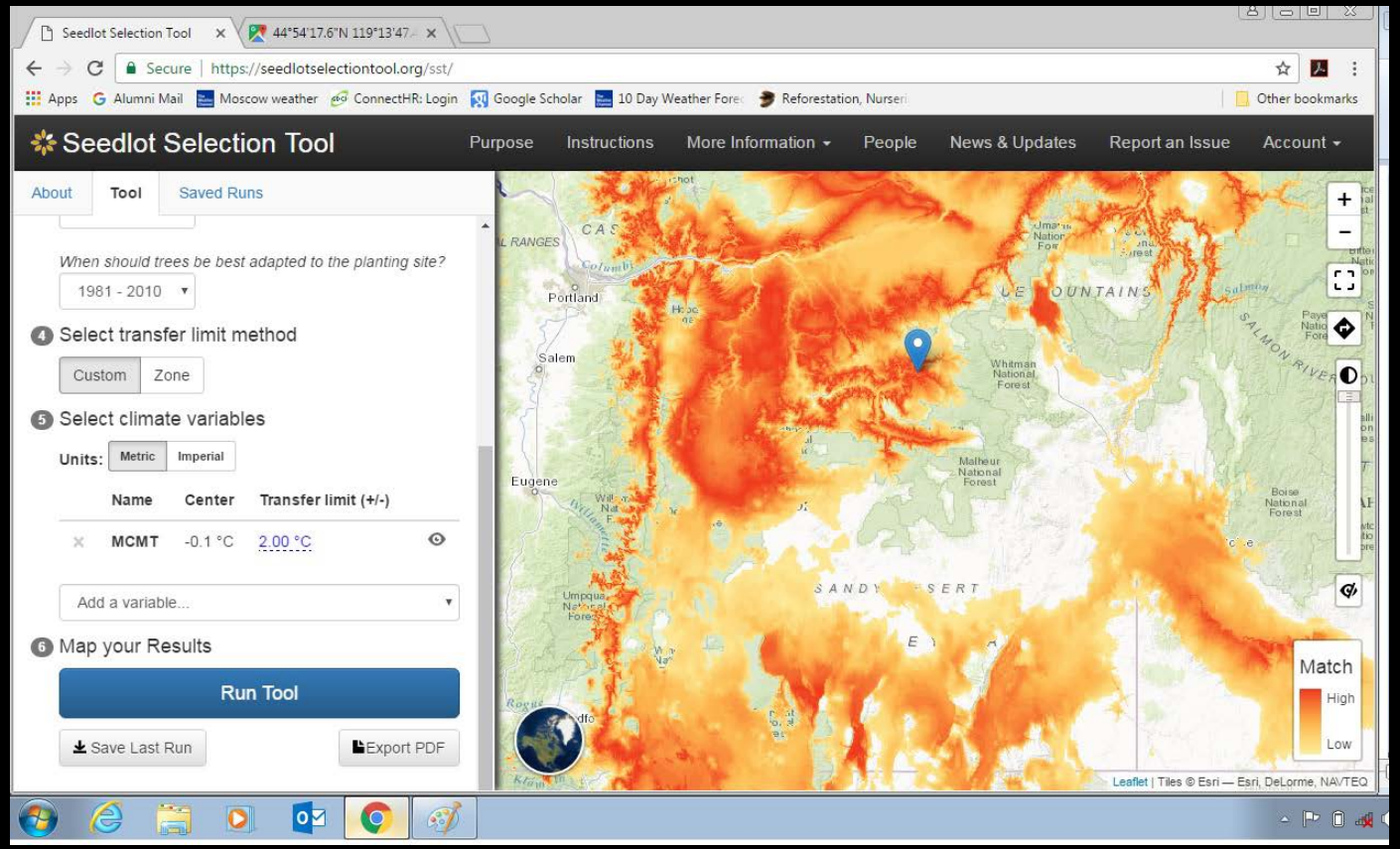
- What are the anticipated drought impacts?
  - Seasonal
  - Disturbance
- Soil moisture
  - Temporal
  - Spatial
  - Competition



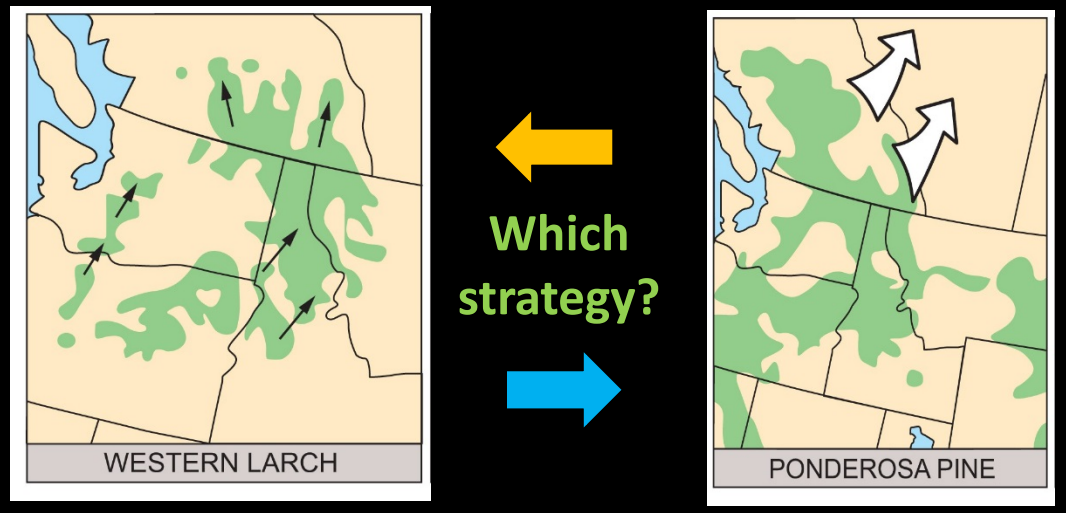


Genetic considerations

- Seed zones and transfer
  - Local adaptation
  - Anticipated conditions
  - Assisted migration



Assisted population migration

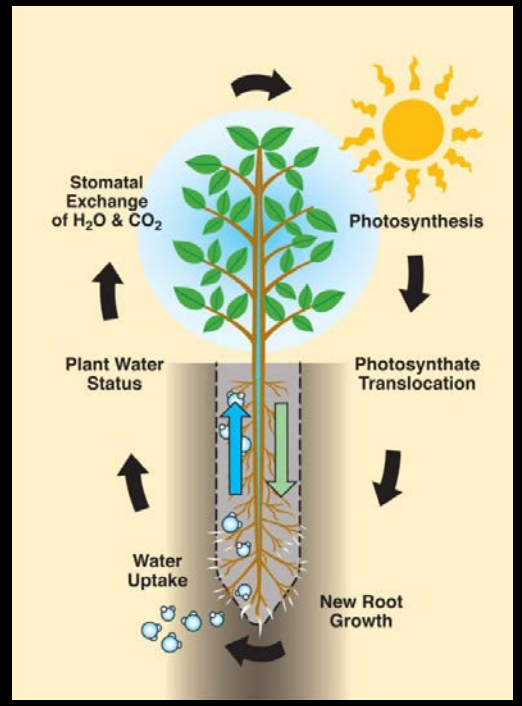


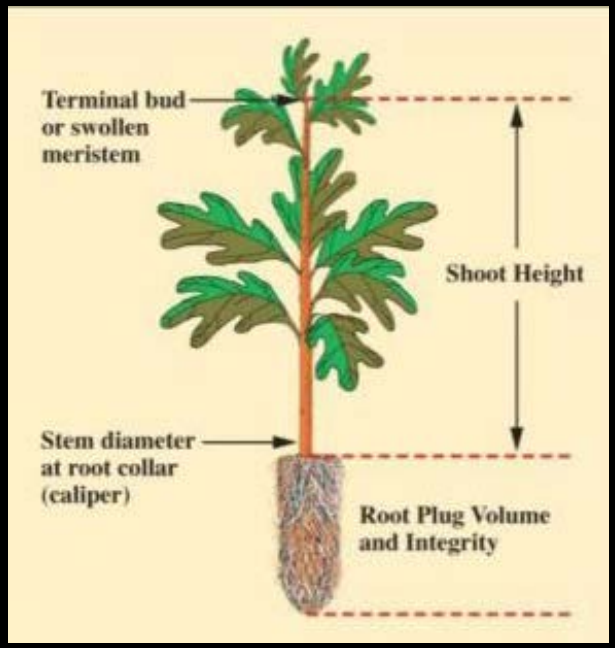
Which strategy?

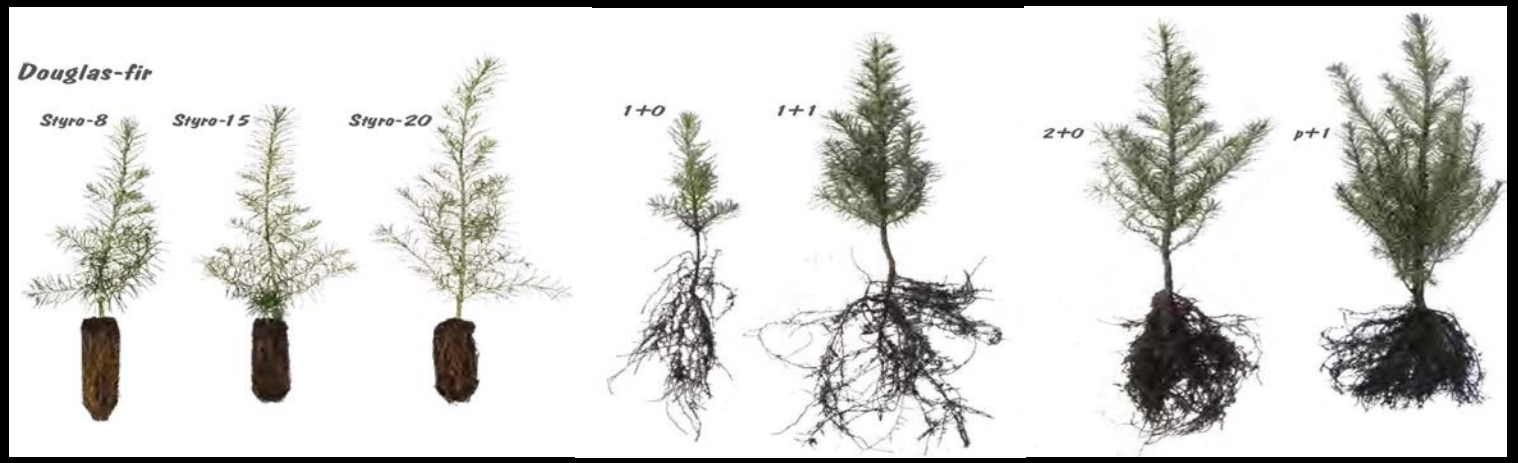
Assisted range expansion

Type of plant material

- Stocktype selection
  - Age
  - Size
  - Shape
  - Container
- Morphological characteristics
- Physiological characteristics



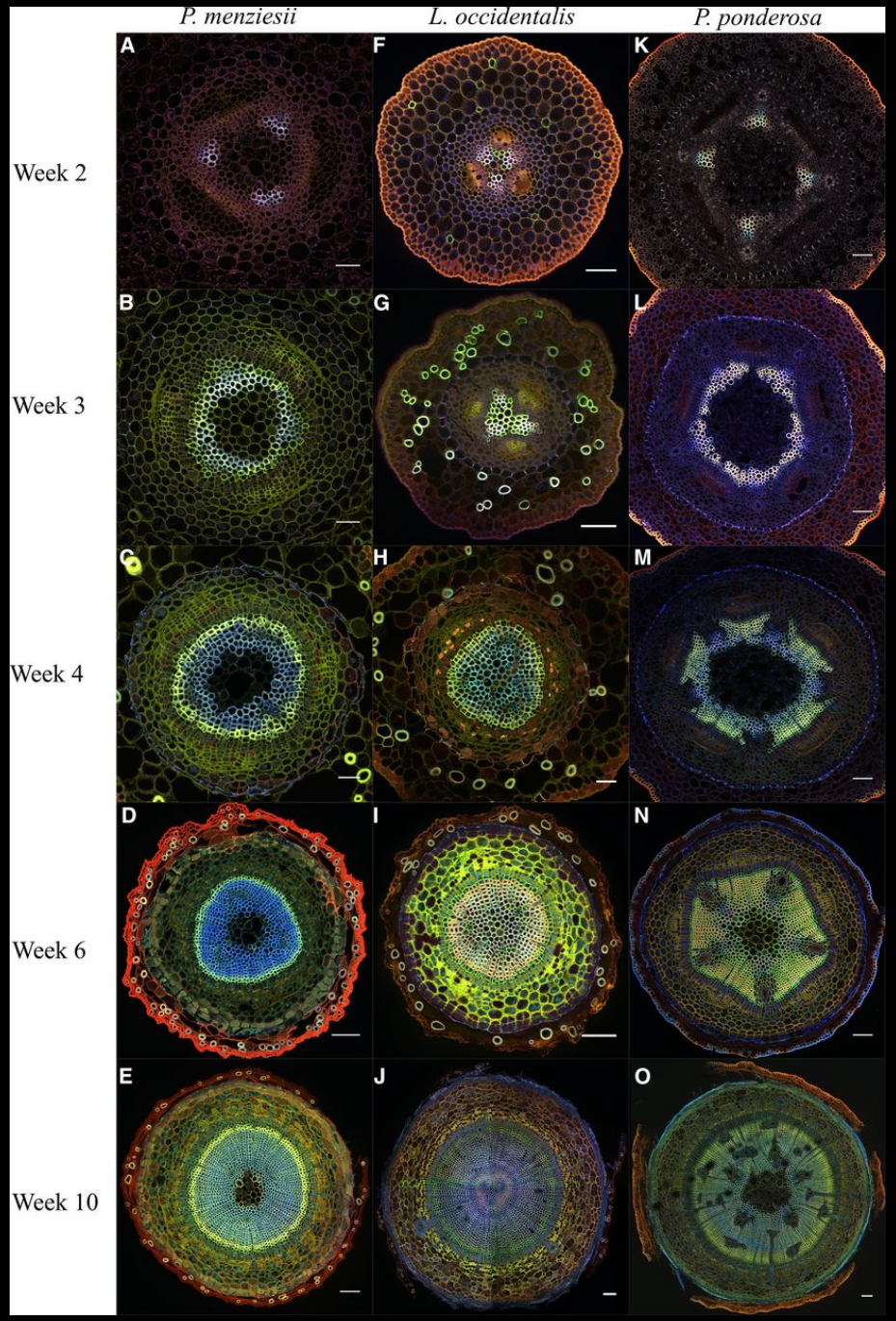




(Rose and Haase 2006)

Physiological Functioning

- Nursery cultural practices => Seedling quality => Performance
- Foundational building blocks of establishment

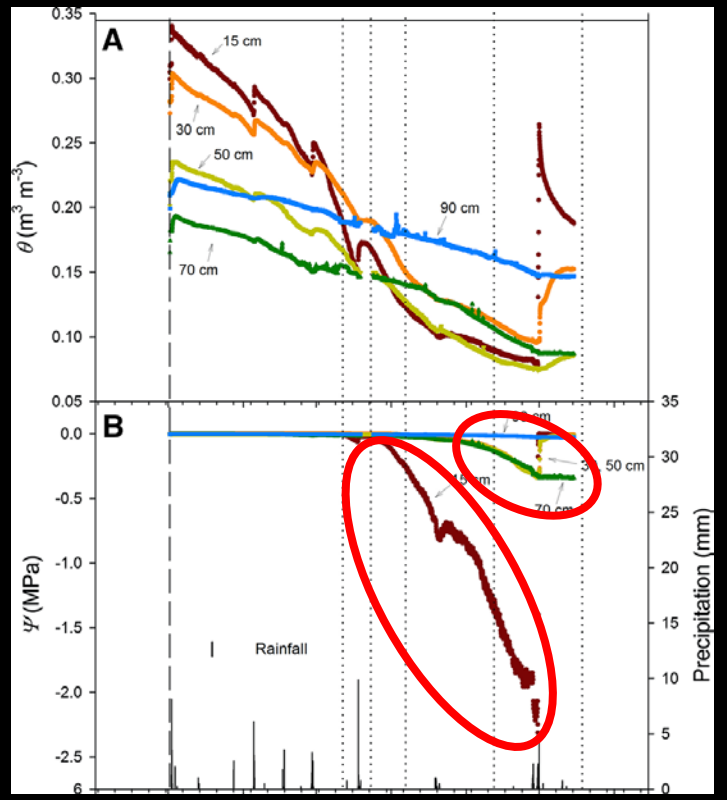


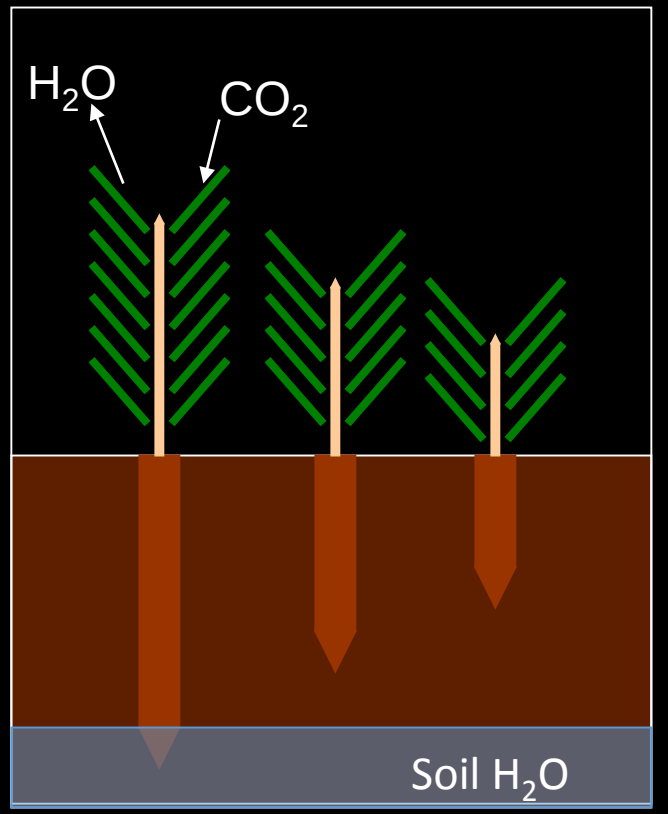
Vascular development over 10 wk.

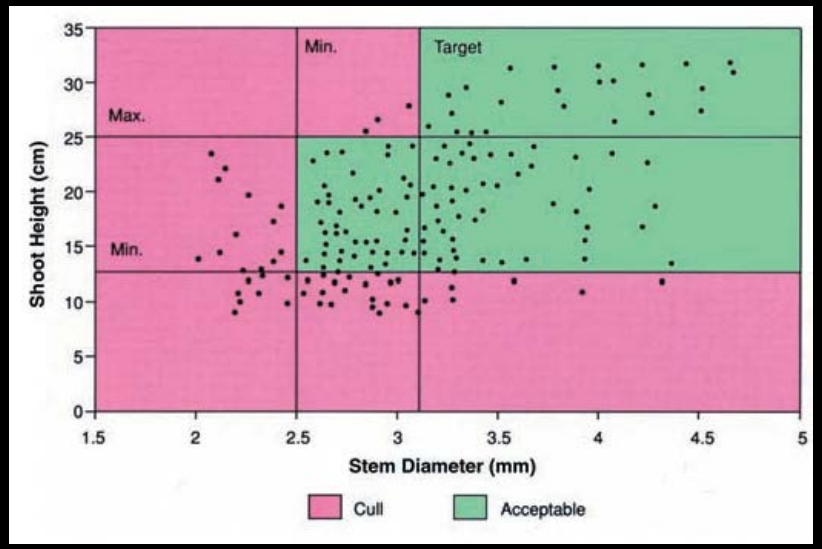
Megan L. Miller, and Daniel M. Johnson Am. J. Bot. 2017;104:979-992

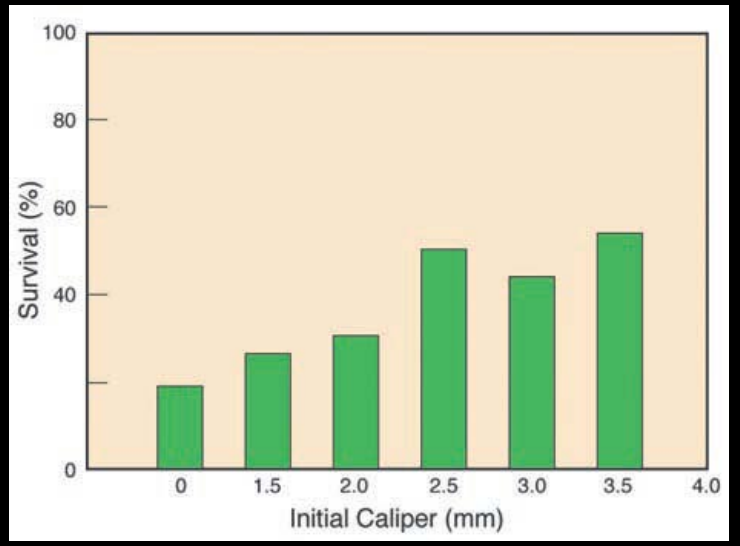
Nursery practices

- Outplanting site conditions
- Container selection
  - Volume (large vs. small)
  - Depth (long vs. short)
  - Density (high vs. low)
- Root and shoot morphology





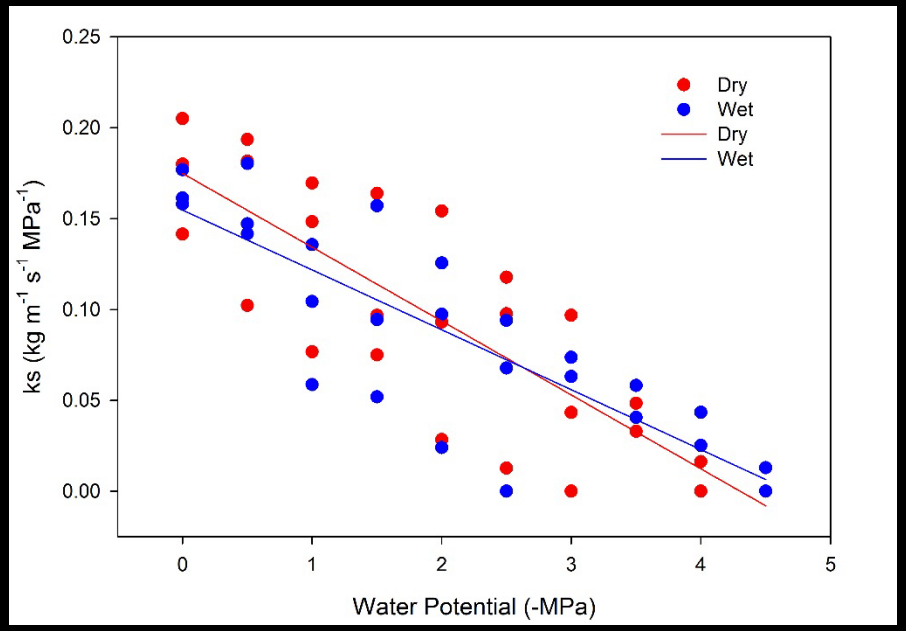




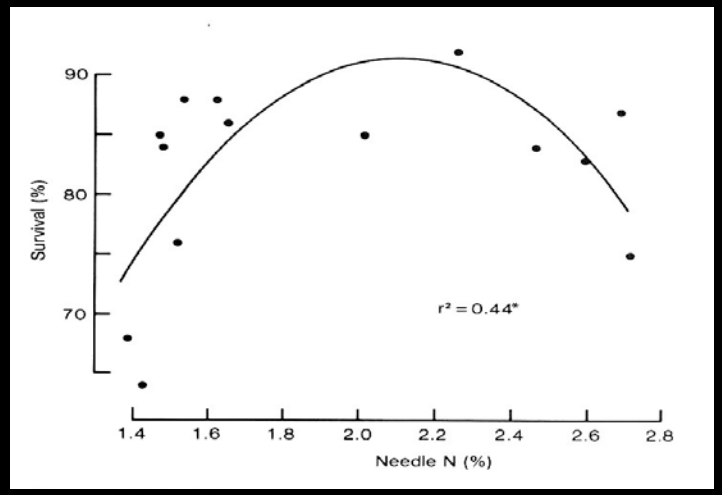
(modified from Hines and Long 1986)

Fertilizer and irrigation

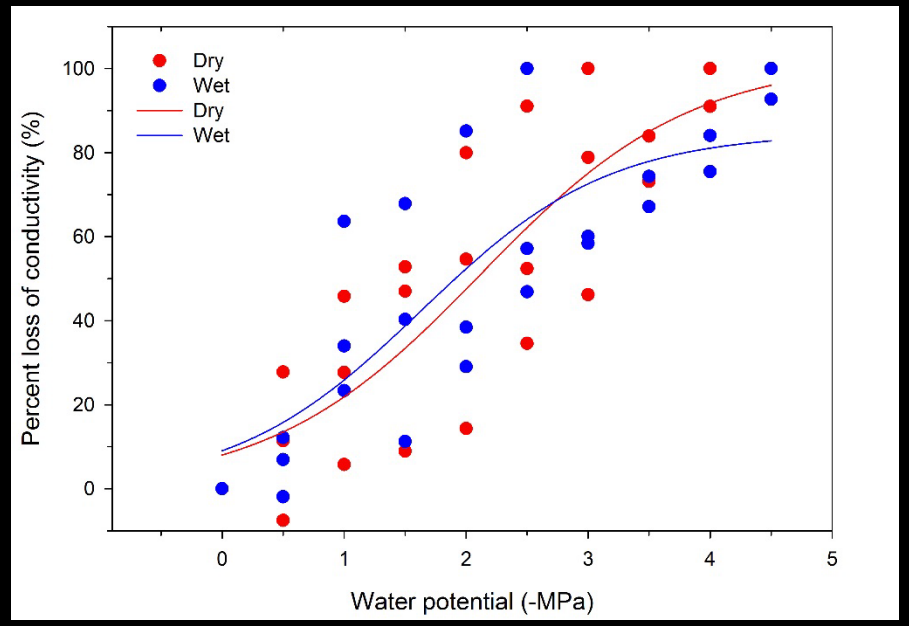
- Nursery provides the foundational building blocks
  - Nurture? Tough love?
  - Race through the Sahara desert
  - Starvation or hydraulic failure
- More research!



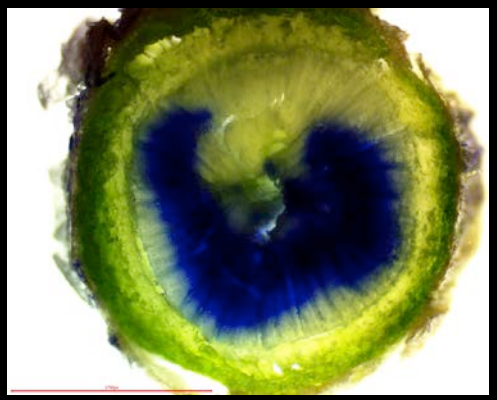
Xylem vulnerability curves



(Van den Driessche 1988)



Percent loss of hydraulic conductivity



Fertilizer and Irrigation

Resource perspective

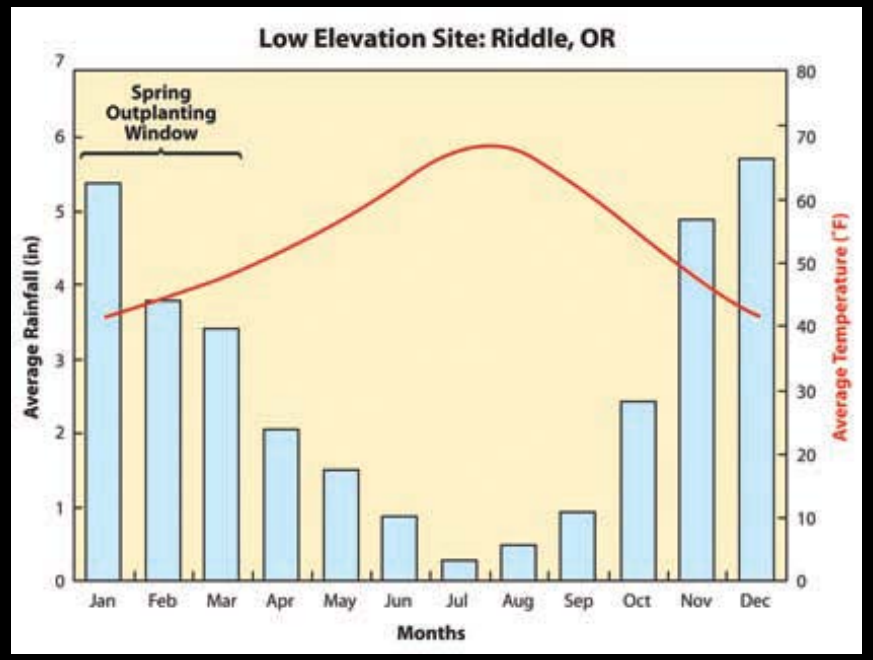
- Efficiency
  - Irrigation based on plant needs
    - Using container weights to determine irrigation needs: a simple method – Native Plants Journal (2015)
  - Timing – diurnal
  - System type
    - Automated systems are most efficient
    - Minimize waste
    - Reduce runoff
    - Maximize fertilizer use efficiency
  - Minimize pests (Tree Planters' Notes 2018)
  - Preserve resources

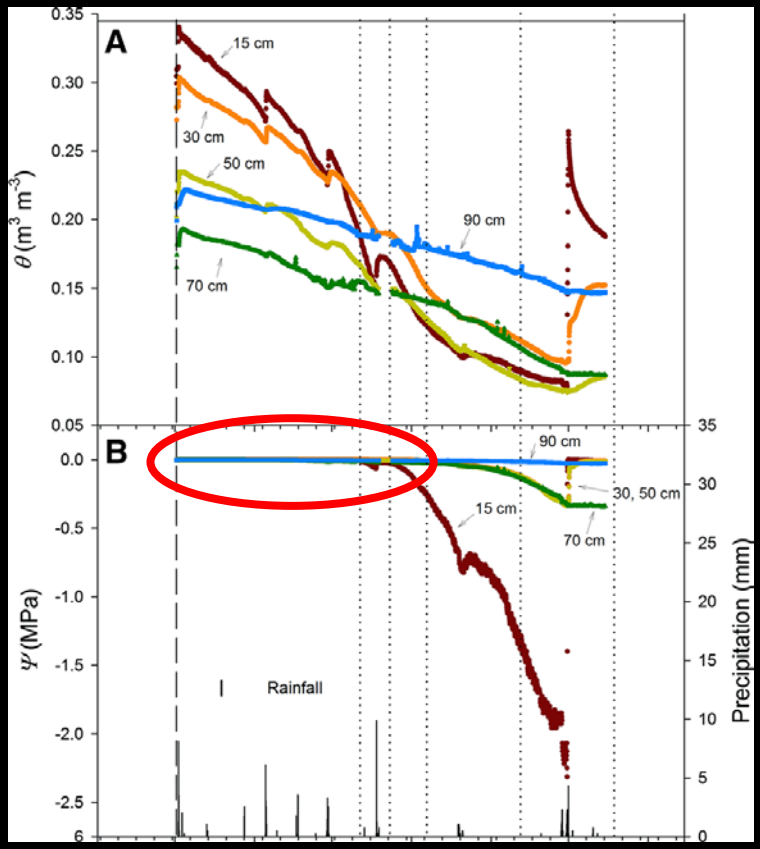
Misting treatment	Amount of water per application	Number of applications every 4 days	Total water applied every 4 days	Germination after 21 days (%)	Germination rate (days to 50% germination)
Low	6.7	1	6.7	82.0 (1.0)	9.6 (0.2)
Medium	4.2	2	8.4	84.0 (1.4)	9.4 (0.2)
High	2.1	12	25.4	84.0 (1.4)	9.7 0.2)

Pinto et al 2009

Outplanting

- Timing
  - Seasonal drought
  - Anticipated drought
  - Shifts
  - Duration

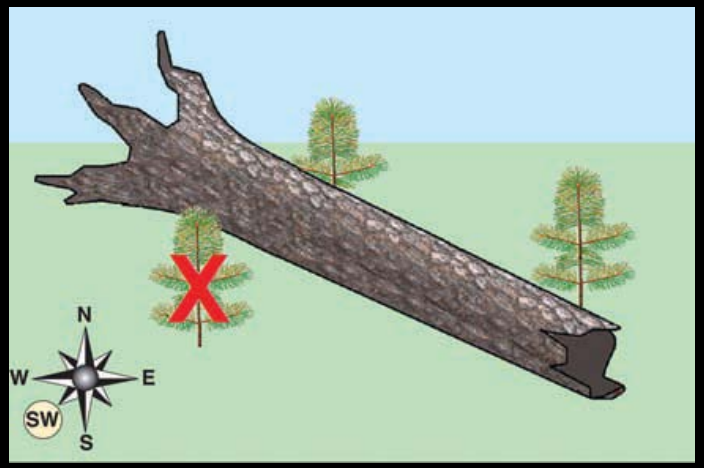


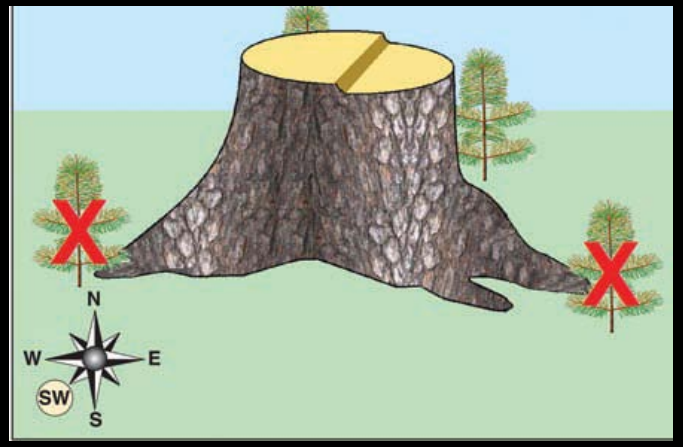


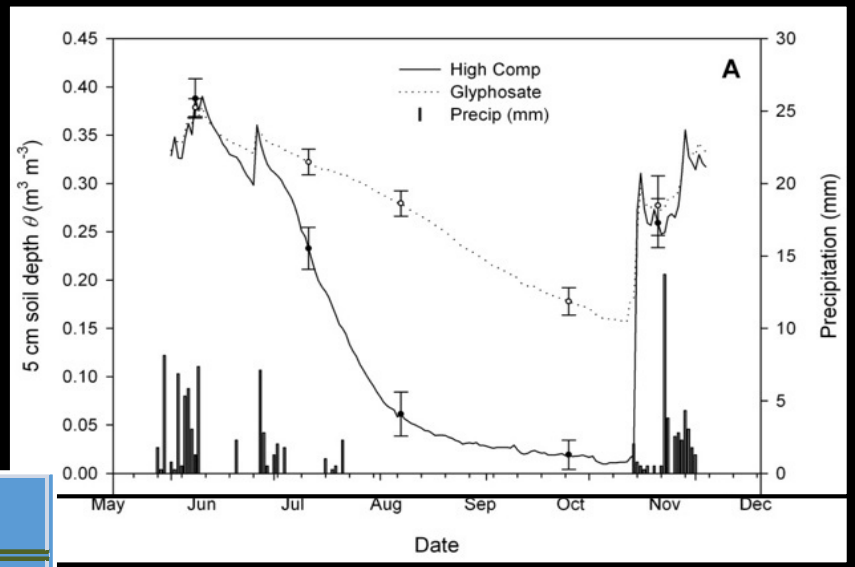
Outplanting

- Site conditions
  - Vegetation can compete for water
  - Exacerbated by drought
- Site preparation
  - Herbicide
  - Microsites

Pinto et al 2016



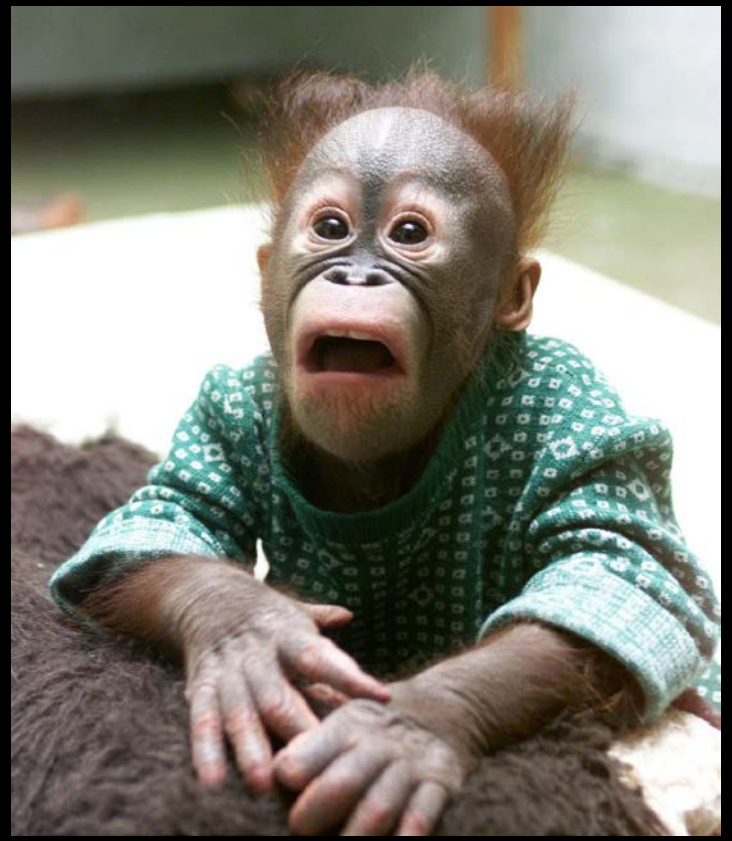




Pinto et al. 2018

Western Larch Mortality		
Glyphosate	2%	a
High Comp	98%	b

Quiz time!!!



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Acknowledgements:
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Container Tree Nursery Manual
Nursery Manual for Native Plants: A Guide for Tribal Nurseries
YOU!!