Nursery practices to mitigate drought

Intertribal Nursery Council
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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
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!

(Van den Driessche 1988)

Xylem vulnerability curves

Percent loss of hydraulic conductivity

Plot of percent loss of hydraulic conductivity against water potential: Dry vs. Wet conditions.
Fertilizer and Irrigation

Resource perspective

• Efficiency
  • Irrigation based on plant needs
  • 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

<table>
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<tr>
<th>Misting treatment</th>
<th>Amount of water per application</th>
<th>Number of applications every 4 days</th>
<th>Total water applied every 4 days</th>
<th>Germination after 21 days (%)</th>
<th>Germination rate (days to 50% germination)</th>
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<tbody>
<tr>
<td>Low</td>
<td>6.7</td>
<td>1</td>
<td>6.7</td>
<td>82.0 (1.0)</td>
<td>9.6 (0.2)</td>
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<tr>
<td>Medium</td>
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<td>2</td>
<td>8.4</td>
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<tr>
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<td>12</td>
<td>25.4</td>
<td>84.0 (1.4)</td>
<td>9.7 (0.2)</td>
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</tbody>
</table>

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

Western Larch Mortality

<table>
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<tr>
<th>Glyphosate</th>
<th>High Comp</th>
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<tbody>
<tr>
<td>2%</td>
<td>98%</td>
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\[a\] Pinto et al. 2016

\[b\] Pinto et al. 2018
Quiz time!!!
Thank You!

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