PAIRED PLOT DENSITY TRIALS: WESTERN LARCH– 4YR RESULTS

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PRESENTATION OVERVIEW

- For PPDM overview, revisit prior PP presentation
- Distribution of WL installations
- 4-Yr Results
- Outcomes and Products
IFC WL PPDM NETWORK

WL INSTALLATIONS ACROSS THE INLAND NORTHWEST

- 23 installations
  - 6Yr measurements (n=0)
  - 4Yr measurements (n=11)
  - 2Yr measurements (n=23)
WL SITE DISTRIBUTION: SDI x SI

Distribution of Installations
SDI x 10YRSI
WESTERN LARCH THINNING RESPONSE BY:
INDIVIDUAL/CROP TREE – DBH/HT
CROP TREE/STAND – VOLUME
FULL WL REGRESSION MODELS*

TREE & STAND LEVEL

Individual/Crop Tree Growth – DIA and Height

\[ \text{DIA/HT}_{\text{annual}} = \beta_0 + (\beta_1 \times \text{SI10YR}) + (\beta_2 \times \text{SDI}_{\text{Pre-Trt}}) + (\beta_3 \times \text{SI10YR} \times \text{SDI}_{\text{Pre-Trt}}) \]
\[ + (\beta_4 \times \text{DIA}_{\text{Post-Trt}}^{**}) + (\beta_5 \times \text{SDI}_{\text{Post-Trt}}) + (\beta_6 \times \text{SDI}_{\text{Post-Trt}} \times \text{SDI}_{\text{Post-Trt}}) \]

Whole Stand/Crop Tree Stand Growth – Volume (cu ft)

\[ \text{NetVOL}_{\text{annual}} = \exp(\beta_0 + (\beta_1 \times \text{SI10YR}) + (\beta_2 \times \text{SDI}_{\text{Pre-Trt}}) + (\beta_3 \times \text{SI10YR} \times \text{SDI}_{\text{Pre-Trt}}) \]
\[ + (\beta_4 \times \text{QMD}_{\text{Post-Trt}}) + (\beta_5 \times \text{SDI}_{\text{Post-Trt}}) + (\beta_6 \times \text{SDI}_{\text{Post-Trt}} \times \text{SDI}_{\text{Post-Trt}}) ) \]

* All models fit using SAS 9.4 PROC GLM

** Post-treatment implies Yr0 baseline measurements
### WL RESPONSE MODEL STATISTICS

<table>
<thead>
<tr>
<th>Model</th>
<th>R²</th>
<th>RMSE</th>
<th>F-Value</th>
<th>Pr&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ind Tree – DIA (in)</td>
<td>0.81</td>
<td>0.05</td>
<td>23.8</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Ind Tree – HT (ft)</td>
<td>0.61</td>
<td>0.29</td>
<td>7.0</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Crop Tree – DIA</td>
<td>0.63</td>
<td>0.06</td>
<td>9.65</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Crop Tree – HT</td>
<td>0.41</td>
<td>0.33</td>
<td>3.2</td>
<td>0.0169</td>
</tr>
<tr>
<td>Crop Tree Stand – NetVol (cu ft)</td>
<td>0.75</td>
<td>0.28*</td>
<td>13.3</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Whole Stand – NetVol</td>
<td>0.80</td>
<td>0.35*</td>
<td>18.1</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

*Not back transformed, values roughly equivalent to 25 cu ft/ac/yr*
DBH RESPONSE SURFACE

INDIVIDUAL VS CROP TREE – INITIAL LOW-DENSITY STAND

NOTE: To convert SDI to BA, multiply by 0.5454
DBH RESPONSE SURFACE

INDIVIDUAL VS CROP TREE – INITIAL HIGH-DENSITY STAND
HEIGHT RESPONSE SURFACE

INDIVIDUAL VS CROP TREE – INITIAL LOW-DENSITY STAND
HEIGHT RESPONSE SURFACE

INDIVIDUAL VS CROP TREE – INITIAL HIGH-DENSITY STAND
STAND VOLUME RESPONSE SURFACE

CROP TREE VS WHOLE STAND – INITIAL LOW-DENSITY STAND
STAND VOLUME RESPONSE SURFACE
CROP TREE VS WHOLE STAND – INITIAL HIGH-DENSITY STAND
VALIDATING SDI_{\text{MAX}} MODELS

“DENSITY MANAGEMENT DIAGRAM”

HR9SM, near Samuels, ID

Corp Line, near Dworshak Reservoir, ID
BROAD OUTCOMES TO DATE

- Similar DIA results as seen with PP:
  - WL DIA growth increment response in initial low-density stands (<150 SDI) was driven primarily by thinning intensity, not by site type
  - DIA growth increment in initial high-density stands (>150 SDI) was affected both by thinning intensity and by site type – average tree and crop tree response patterns were similar at higher thinning intensities; however, crop trees outperformed the average tree at higher post-treatment densities

- Height growth increment was not greatly affected by thinning across site types; however, there was a strong interaction between initial stand density and site type

- Unlike PP, WL did not see height suppression on “lower” productive sites at “higher” stand densities (>150 SDI)
SUMMARY

BROAD OUTCOMES TO DATE

- Site type did not express itself in volume response across low density stands (<150 SDI)
- As pre-treatment SDI exceeded 150 SDI, there was a very significant interaction with site type on volume response
- Crop tree volume response in initial high-density stands dominated stand response across low productivity site types and/or in aggressive thinning regimes
- Highly productive site types showed a greater capacity to carry more crop and non-crop tree volume than low-productivity sites
- IFC SDImax WL model is overall predicting relevant maximums, and tracking mortality in unthinned stands
- Tracking to assess future over/under predictions
CONCLUDING STATEMENTS

THE FUTURE OF PPDM

- Validate SDImax models
- Validate G&Y models
- Develop growth and mortality multipliers by site quality, stand density, and species composition
- Calibrate G&Y software packages for thinning response by site/species
- Develop silvicultural guidelines for targeting optimal timing window and thinning to maximize growth response on crop trees while minimizing mortality