Fertilizer and Commercial Thin (FERT-THIN) Responses of Three Douglas-fir Stands on Three Soil Strata Types in Northern Idaho

PotlatchDeltic Corporation
Abbie A. Acuff
&
Intermountain Forestry Cooperative
Terry M. Shaw
FERT-THIN Objectives and Concepts

Fertilization
- Improves stand health and vigor
- Increases tree size
- Accelerates stand development
- Shortens rotation

Thinning
- Reduces competition for site resources
- Reduces competition induced mortality
- Redistributes growth to individual “Crop Trees”
- Increases individual tree size
- Accelerates stand development
- Shortens rotation
Objectives
- Timber Supply Strategy – Improve Size and Timing
  - Addresses age-class imbalances
  - Increases long-term harvest levels
- Optimize combination of fert and thin regimes by site types

Concepts
- Stand & tree growth cannot be simultaneously maximized
- Compromise b/t max production per acre and individual tree size
- Fertilization can partially compensate volume loss due to thinning
FERT-THIN SITE LOCATIONS

Moe’s Ranch
FERT-THIN SITE LOCATIONS

Tired Wolf
FERT-THIN SITE LOCATIONS

Elk Creek
FERT-THIN - Site Characteristics

- All Sites:
  - ~25 YO @ study est.
  - Cedar vegetation series; temp_moist (warm_wet)
  - 90%+ DF (%BA species comp)
  - Commercial Thin

- Each Site:
  - Soil Strata
    - Moe – Ash/Tertiary Sediment/Basalt (variable)
    - Tired Wolf – Ash/Basalt (good)
    - Elk Creek – Ash/Granitic (moderate)
  - Elevation:
    - Moe – 3,018’
    - Tired Wolf – 3,000’
    - Elk Creek – 4,220’
# FERT-THIN

Stand Metric Characteristics No-Thin at Est.

<table>
<thead>
<tr>
<th>METRIC</th>
<th>MOE</th>
<th>TIRED WOLF</th>
<th>ELK CREEK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quadratic Mean Diameter (QMD)</td>
<td>6.3”</td>
<td>6.4”</td>
<td>8.5”</td>
</tr>
<tr>
<td>Site Height</td>
<td>48’</td>
<td>47’</td>
<td>50’</td>
</tr>
<tr>
<td>Trees Per Acre (TPA)</td>
<td>767</td>
<td>663</td>
<td>500</td>
</tr>
<tr>
<td>Basal Area (BA - ft² ac⁻¹)</td>
<td>163</td>
<td>148</td>
<td>197</td>
</tr>
<tr>
<td>Volume (ft³ ac⁻¹)</td>
<td>2,926</td>
<td>2,594</td>
<td>3,626</td>
</tr>
<tr>
<td>Relative Density (RD - Curtis DF⁰.⁵)</td>
<td>65</td>
<td>58</td>
<td>68</td>
</tr>
<tr>
<td>Stand Density Index (SDI-IFC DF¹.⁴⁴⁹)</td>
<td>366</td>
<td>324</td>
<td>385</td>
</tr>
<tr>
<td>Max Stand Density Index (maxSDI-IFC)</td>
<td>352</td>
<td>357</td>
<td>377</td>
</tr>
</tbody>
</table>
### FERT-THIN Treatments

<table>
<thead>
<tr>
<th>Site</th>
<th>Fert Mix*</th>
<th>FERTILIZER*</th>
<th>THINNING</th>
<th>TRT CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moe</td>
<td>N+K+S+B</td>
<td>No-Fert</td>
<td>MOE</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fert</td>
<td>No-Thin</td>
<td>NFT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No-Fert</td>
<td>Thin 17</td>
<td>NFT17</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fert</td>
<td>Thin 17</td>
<td>FT17</td>
</tr>
<tr>
<td>Tired Wolf</td>
<td>N+P+K+S+B</td>
<td>No-Fert</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fert</td>
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<td></td>
<td>No-Fert</td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Fert</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LBS. ACRE*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>200 Nitrogen (N)</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>100 Phosphorus (P)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>170 Potassium (K)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>90 Sulfur (S)</td>
<td></td>
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</tr>
<tr>
<td>3 Boron (B)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Copper (Cu)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 Magnesium (Mg)</td>
<td></td>
<td></td>
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<td></td>
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</tbody>
</table>

### TIRED WOLF

- No-Fert, No-Thin: NFNT
- Fert, No-Thin: FNT
- No-Fert, Thin 16’ and 20’: NFT16 and 20
- Fert, Thin 16’ and 20’: FT16 and 20

### ELK CREEK

- No-Fert, No-Thin: NFNT
- Fert, No-Thin: FNT
- No-Fert, Thin 14’: NFT14
- Fert, Thin 14’: FT14
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<td>NFNT</td>
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<tr>
<td>Tired Wolf</td>
<td>N+P+K+S+B+Cu+Mg</td>
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**LBS. ACRE***
- 200 Nitrogen (N)
- 100 Phosphorus (P)
- 170 Potassium (K)
- 90 Sulfur (S)
- 3 Boron (B)
- 10 Copper (Cu)
- 10 Magnesium (Mg)

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**TIRED WOLF**
- No-Fert
- Fert
- No-Fert
- Fert

**ELK CREEK**
- No-Fert
- Fert
- No-Fert
- Fert
Individual Tree:
8YR Diameter Combined Diameter Response

- **FERT-THIN**
  - Additive effect @ Tired Wolf FT16 and Elk Creek FT14; Moe combined effect FT17 declined relative to thin alone
  - Accelerate Stand Development??
Whole-Stand: 8YR Volume Trends at Moe

- **Stand Trends**
  - High density treatments have steeper growth trend lines
  - High density treatments carry more per acre volume over time than low density (cost of thinning)
  - No “positive” fertilizer effect (high or low density)
Whole-Stand:
8YR Volume Trends at Tired Wolf

- **Stand Trends**
  - High density treatments have steeper growth trend lines
  - High density treatments carrying more volume over time
  - Fertilizer effect on all densities; Strong effect on FT16
  - Ash/Basalt soil strata at Tired Wolf a “good” fert responder
Whole-Stand: 8YR Volume Trends at Tired Wolf

- **Stand Trends**
  - High density treatments have steeper growth trend lines
  - High density treatments carrying more volume over time
  - Fertilizer effect on all densities; Strong effect on FT16
  - Ash/Basalt soil strata at Tired Wolf a “good” fert responder
Stand Trends
- Again, high density treatments have steeper growth trend lines
- Again, high density treatments carrying more volume over time
- Small fertilizer effect for the FT14

Whole-Stand: 8YR Volume Trends at Elk Creek
Crop-Tree Trends

- Crop-Tree high density & low density treatments have similar growth trend lines, 8YR volumes and 8YR QMDs
- Similar crop tree trend line relationships were shown for Moe
- These results beg the question: Should stands similar in stand development, as Moe and Elk Creek when treated, be commercially thinned or don’t treat and remove all at harvest.
Commercial Thin at Elk Creek and Moe cont.

- Key Management Talking Points
  - Probably missed the PCT window
  - Commercial thin must be financially viable
  - Managing for Crop Trees at end of rotation?
  - However, short time period until final harvest if CT
  - If not CT, additional stand volume in non-crop trees at harvest
Crop Tree Trends

- Crop-Tree FT16 has highest 8YR volume and largest 8YR QMD
- Crop-Tree FT16 “crossed over” NFNT and FNT
- Crop-Tree FT16 steeper trend line than all treatments
- Crop-Tree NFT16 steeper trend line than NFNT
- Is fertilization partially compensating volume loss due to thinning? Absolutely!
• **Stand Development:**
  – NFNT in “Stagnation/Mortality” RD phase, 8YR 152% maxSDI
  – NFT17 always in “Open Grown” all eight years after treatment, 50% maxSDI, not fully utilizing site growth potential
  – The commercial thin leave stand at Moe did not capture the full growth potential of the site
Whole-Stand: Relative Density Growth Phase at Moe

- **Stand Development:**
  - NFNT in “Stagnation/Mortality” RD phase, 8YR 152% maxSDI
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  - The commercial thin leave stand at Moe did not capture the full growth potential of the site
Whole-Stand:
Relative Density Growth Phase at Tired Wolf

- Stand Development:
  - NFNT in “Stagnation/Mortality” RD phase, 8YR 130% maxSDI
  - NFT16 always in “Open Grown” phase all eight years after treatment, 49% maxSDI, not fully utilizing site growth potential
  - NFT20 always in “Open Grown” phase, 17% maxSDI, way underperforming
  - The thin-leave stands at Tired Wolf do not utilize the full site growth potential
Whole-Stand:

Relative Density Growth Phase at Tired Wolf

- **Stand Development:**
  - NFNT in “Stagnation/Mortality” RD phase, 8YR 130% maxSDI
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  - The thin-leave stands at Tired Wolf do not utilize the full site growth potential
Whole-Stand:
Relative Density Growth Phase at Elk Creek

- **Stand Development:**
  - NFNT in “Stagnation/Mortality” RD phase, 8YR 139% maxSDI
  - NFT14 always in “Peak Productivity” phase, fully utilizing site potential
  - 78% maxSDI agrees with RD “Peak Productivity” phase
  - Poster Child!!!! The commercial thin leave stand at Elk Creek did capture the full growth potential of the site
Whole-Stand: Relative Density Growth Phase at Elk Creek

- **Stand Development:**
  - NFNT in “Stagnation/Mortality” RD phase, 8YR 139% maxSDI
  - NFT14 always in “Peak Productivity” phase, fully utilizing site potential
  - 78% maxSDI agrees with RD “Peak Productivity” phase
  - Poster Child!!!! The commercial thin leave stand at Elk Creek did capture the full growth potential of the site
FERT-THIN Gross and Net Stand BA Growth

- **Stand Mortality:**
  - Overall BA mortality low
  - Not surprisingly, mortality higher for the high density treatments
  - Highest BA Annual: Moe ~ 1.4%, Tired Wolf ~ 2.0% and Elk Creek ~ 1.0%
  - No strong relationship b/t fertilization and mortality
**FERT-THIN Summary**

- **Stand Growth Trends:**
  - FERT-THIN Highly Dependent on site and density
    - Stand fert response – Tired Wolf > Elk Creek > Moe
    - Stand no-thin always higher yields
  - Crop Tree 8YR trend lines, volumes and QMDs were similar b/t density treatments
  - Fertilization response for the FT16 treatment at Tired Wolf compensated for stand volume losses due to thinning

- **Stand Growth Phases:**
  - Timing of stand entry, as it relates to stand development, is crucial in capturing full site growth potential after treatment

- **Stand Mortality:**
  - Low annual mortality
  - Higher on high density plots
FERT-THIN Summary

– WHAT IF: site types similar to Tired Wolf were fertilized and thinned to similar stand metrics and timing as Elk Creek

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<td>Basal Area (ft² ac⁻¹)</td>
<td>11.4</td>
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MAXIMUM PRODUCTIVITY!!!!