Rapid Assessment of New Zealand Coast Heartwood Durability using NIR Spectroscopy

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Overview

• Review of resurgence of NZ interest in coast redwood as a commercial species
• The problem & previous research
• Study overview
• Preliminary results
• Summary
Coast redwood resurgence – early 2000’s

- Lobbying by Dr Bill Libby and others lead to renewed interest in NZ
- Found that coast redwood can be readily established with right practices
- Better selection of sites
- Good genetics, and good nursery & establishment practices greatly increased seedling survivability
- Active collaboration with:
  - NZ Farm Forestry Association Sequoia Action Group
  - NZ Forestry Limited
  - NZ Redwood Company
Coast redwood resurgence – early 2000’s

• However, many questions remain about NZ grown redwood:
  – Where to grow it?
  – What provenances & genotypes would do the best in NZ?
  – Can NZ produce high value timber grades?
  – How best to manage it?
  – Is the wood naturally durable?
Coast redwood resurgence – early 2000’s

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  – Where to grow it?
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  – Is the wood naturally durable?
The problem

• Natural durability of NZ grown coast redwood poorly understood
• Seen as a “minor” forestry species with little durability research done
• Genetic origins unknown for stands > 20 yrs old
• NZ Standards durability rating based on 13 ground contact “graveyard test” samples
• Are some provenances more durable than others?
• How does genetics, site, and age influence durability & is there any interactions?
• Can we readily identify “durable”, “non-durable” wood?
Promising results from previous research

- Good correlation between near-infra red (NIR) spectra and wood mass loss with fungal incubation
  - Methodology promising – $R^2 = 0.62$

- Only 3 sites were sampled – all at different ages (22, 38, & 71 yrs)
  - Unknown genetics at 2 sites

- Indication that durability could be highly variable within the tree

### Study sites

<table>
<thead>
<tr>
<th>Site</th>
<th>Region</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tairua</td>
<td>Bay of Plenty</td>
<td>80</td>
</tr>
<tr>
<td>Waipuna</td>
<td>Waikato</td>
<td>13</td>
</tr>
<tr>
<td>Ohakuri</td>
<td>Bay of Plenty</td>
<td>15</td>
</tr>
<tr>
<td>Kinleith</td>
<td>Waikato</td>
<td>72</td>
</tr>
<tr>
<td>Rotoehu</td>
<td>Waikato</td>
<td>34</td>
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<tr>
<td>Waiotapu</td>
<td>Waikato</td>
<td>32</td>
</tr>
<tr>
<td>Mangatu</td>
<td>Gisborne</td>
<td>45</td>
</tr>
<tr>
<td>Awaho</td>
<td>Hawke’s Bay</td>
<td>13</td>
</tr>
<tr>
<td>Hunterville</td>
<td>Manawatu</td>
<td>12</td>
</tr>
<tr>
<td>Midhirst</td>
<td>Taranaki</td>
<td>13</td>
</tr>
<tr>
<td>Hundalee</td>
<td>Canterbury</td>
<td>13</td>
</tr>
</tbody>
</table>
Analysis process

Disk
- Disks at 0.2m, 1.4 m, 4m, 6m, 10m
- Up to 20 trees per site
- Disk measurement & photos

Prep
- Cut into Sutter blocks (50 x 25 x 15 mm) up to 30 blocks per disk
- Dried to 12% MC
- NIR spectra capture

Decay
- Fungal decay resistance European Standards EN 113 & 350-1
- Inoculated with 2 white & 1 brown rot fungi
- Incubated 4 months, weighed, & classified by resistance class

NIR
- Statistic analysis of spectra & Sutter blocks
- Analysis for genetics x site x age effects & within-tree variability
- Develop NIR durability algorithm
Preliminary results: 13 yr-old site

- Moderate to high productivity
- Genetic origin known
  - Selected for good growth & form traits
- 20 trees sampled
Preliminary results: 13 yr-old site

• More resistance than expected
• Little decay with *Coniophora puteana* & *Gloeophyllum trabeum*
• More susceptible to *Trametes versicolor*
• Decay from *T. versicolor* increased with tree height
Preliminary results: 13 –yr-old site

Partial least squares regression minimum root mean press = 0.7911
Preliminary results: 13 yr-old site

- Good relationship between NIR and mass loss
- Opportunity to identify heartwood with poor fungal resistance
- Could be a unique spectral pattern for more durable heartwood
Summary

• Uncertainty of natural durability barrier for use & expansion of coast redwood as a commercial species
• Study to comprehensively investigate genetic, site, & age effects and their interactions
• Preliminary results promising
  – Strong correlation between *T. versicolor* decay & NIR spectra
  – Decay increased with tree height
  – Decay similar between inner & outer disk heartwood
• Final results in 2017
Questions?