Improving hardwood of durable eucalypts

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High quality products

- Posts (agricultural industries)
- Poles / cross-arms (power companies)
- Wharf timbers
- Decking / outdoor furniture
- Flooring ...

Only heartwood is durable and has colour
Heartwood

Bark

Sapwood

Heartwood

8-year old *E. bosistoana*
Variability

Large trees are not necessarily the most valuable

- Screen for heartwood quantity
Heartwood quality

Quality

- Durability
- Colour

Highly variable

Table 2. Performance of stakes cut from 5 trees, after 14 years in the ground.

<table>
<thead>
<tr>
<th>Species</th>
<th>Tree 1</th>
<th>Tree 2</th>
<th>Tree 3</th>
<th>Tree 4</th>
<th>Tree 5</th>
<th>Total stakes remaining per species</th>
</tr>
</thead>
<tbody>
<tr>
<td>E. pilularis</td>
<td>5</td>
<td>0 (av. life 7 yr)</td>
<td>3</td>
<td>0 (av. life 5.7 yr)</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>E. muelleriana</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>0 (av. life 8 yr)</td>
<td>6</td>
</tr>
<tr>
<td>E. globoides</td>
<td>4</td>
<td>6</td>
<td>2</td>
<td>0 (av. life 4 yr)</td>
<td>1</td>
<td>13</td>
</tr>
</tbody>
</table>

Ensure quality

Reduce variability in a breeding programme

- Large sample numbers

Extractives

- Key factor for durability and colour
  → Proxy measurement of heartwood quality
- Variable
  → 4-yr *E. bosistoana*: 1.4 - 15.0 (wt%)
Sampling – Tree corer

Battery powered
• Fire safety

Light-weight
• Less fatigue

Quick
• <60s per tree

14 mm core with ‘small’ wound
Heartwood

Bark

Sapwood

Heartwood

Transition zone
Cell nuclei – bark to bark

6-year old *E. bosistoana*

True heartwood 4 - 6 cm: parenchyma cells dead (no nuclei)
True heartwood

- ~1 cm transition zone
- True heartwood in 6-year old *E. bosistoana*
- Allows to assess heartwood at this age

<table>
<thead>
<tr>
<th>Position</th>
<th>1 cm</th>
<th>2 cm</th>
<th>3 cm</th>
<th>4 cm</th>
<th>5 cm</th>
<th>6 cm</th>
<th>7 cm</th>
<th>8 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starch (KI stain)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes (some)</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes (some)</td>
<td>Yes</td>
</tr>
<tr>
<td>Nuclei (histone labelling)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Tyloses</td>
<td>No</td>
<td>No</td>
<td>Yes (forming)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes (forming)</td>
<td>No</td>
</tr>
<tr>
<td>Tissue type</td>
<td>Sap wood</td>
<td>Sap wood</td>
<td>Transition zone</td>
<td>Heart wood</td>
<td>Heart wood</td>
<td>Heart wood</td>
<td>Transition zone</td>
<td>Sap Wood</td>
</tr>
</tbody>
</table>
Heartwood quantity
7-year old *E. bosistoana*
3 sites, >1000 trees
Measuring extractive content (EC)

Extraction
• Slow
• Labour intensive

NIR
• Measures sample chemistry
• Used in agriculture (e.g. protein content of grains)
• Quick (seconds)
• No sample preparation (solid wood – cores)
• Needs calibration
Calibration of NIR for extractive content (EC)

*E. bosistoana*

*E. argophloia*

working on *E. globoidea*

RMSE ~1%

independent of

- grain
- particle size
- (air dry) MC
Extractive content in heartwood

7-year old *E. bosistoana*

3 sites, >1000 trees
Typical heartwood gradient

- Radial extractive content gradient
- Reinforcing possibility to improve wood quality early
Environment and heartwood formation

<table>
<thead>
<tr>
<th></th>
<th>Lawson's East</th>
<th>Lawson's North</th>
<th>Craven's Road</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heartwood diameter (mm)</td>
<td>5</td>
<td><strong>32</strong></td>
<td>16</td>
</tr>
<tr>
<td>Sapwood diameter (mm)</td>
<td>64</td>
<td>60</td>
<td>81</td>
</tr>
<tr>
<td>Core diameter (mm)</td>
<td>76</td>
<td>91</td>
<td><strong>104</strong></td>
</tr>
</tbody>
</table>

Most heartwood

Biggest trees

Need to include heartwood into site-species and growth & yield models
Durability

Selections for high extractive content

- Allows incorporation of heartwood quality into breeding programme (assess large number of samples)
- Early assessment (smaller samples)
- Increases probability of quality (durable) heartwood in selected trees

Need to certify durability of selection

- Manageable number of samples
- Better outcome
- Independent laboratory
- According to (export market) standards
- Larger samples needed (older trees)