Impact of number of stems retained per stool on harvester productivity and fuel consumption in *Eucalyptus globulus* second rotation coppiced plantations in south-west Western Australia

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Overview

• Background – eucalypt plantations in Australia
• Description of site and study
• Results
• Conclusions
• Further research
Background

• Australia has over 900,000ha of eucalypt plantations
• Most are grown on a 10 year rotation for export wood chips
• Major species is *Eucalyptus globulus*
Background

• *E. globulus* coppices readily after felling
• Coppice re-estabishment is cheaper than re-planting
• Coppice can be thinned at age two or left unthinned. Thinning is mostly done manually by chainsaw
Background

• In Australia, *E. globulus* plantations are being re-established by planting, or coppice thinned to a single stem, 2 - 3 dominant stems or unthinned

• *However, little is known of the impacts of coppice on mechanical harvesting*
Study coppice treatments

Unthinned

Two stems

Single stem
## Study site description

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Single stem</th>
<th>Two stems</th>
<th>Unthinned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean stem number per stool</td>
<td>1</td>
<td>1.5</td>
<td>3.1</td>
</tr>
<tr>
<td>Stems per hectare</td>
<td>848</td>
<td>1200</td>
<td>2745</td>
</tr>
<tr>
<td>Stools per hectare</td>
<td>848</td>
<td>800</td>
<td>864</td>
</tr>
<tr>
<td>Mean stem DBHOB (mm)</td>
<td>167</td>
<td>127</td>
<td>105</td>
</tr>
<tr>
<td>Mean stem height (m)</td>
<td>20.4</td>
<td>15.7</td>
<td>15.0</td>
</tr>
<tr>
<td>Mean stem volume (m³)</td>
<td>0.21</td>
<td>0.09</td>
<td>0.06</td>
</tr>
<tr>
<td>Volume per hectare (m³/ha)</td>
<td>175</td>
<td>107</td>
<td>174</td>
</tr>
</tbody>
</table>
Study description

- Harvester: Hyundai 210LC-9 excavator base with an SP 591LX harvesting head
- Experienced operator
- Felling, debarking and processing each stem to ~4.6m logs at the stump
- Felling across a 3 row face
- Forwarder (JD1410D) was not studied
# Study description

<table>
<thead>
<tr>
<th>Studied</th>
<th>Methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Productivity</td>
<td>Time and piece counts</td>
</tr>
<tr>
<td>Cycle and elemental times</td>
<td>Digital video recordings</td>
</tr>
<tr>
<td>Fuel consumption</td>
<td>Top up fuel tank to same level on shift completion</td>
</tr>
</tbody>
</table>
• Suggests the major harvester productivity driver was stem volume
Results - cycle/elemental times

- Time (seconds)
  - One stem
  - Two stems
  - Unthinned

- Process
- Fell
- Move/posn
# Fuel consumption

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Harvester fuel consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>l/PMH₀</td>
</tr>
<tr>
<td>Single stem</td>
<td>32.4</td>
</tr>
<tr>
<td>Two stems</td>
<td>27.1</td>
</tr>
<tr>
<td>Unthinned</td>
<td>28.0</td>
</tr>
</tbody>
</table>
Conclusions

• Cycle time & productivity differences mostly reflected stem size differences

• Significant differences between moving/positioning & felling times were too small to impact cycle times

• Fuel consumption was higher than expected. The highest fuel consumption was in the single stem treatment & may have reflected the lower sph and larger stems
Further research

- Conduct harvesting trials on further coppice sites
- Study the impact of coppice on a forwarder
- Compare harvester / forwarder system with feller-buncher / skidder / infield chipper system
- Compare full rotation costs between coppice treatments
- Compare wood and chip properties and wood yield/ha between coppice treatments and planted stands
Acknowledgements

• We would like to thank the plantation owners, Australian Bluegum Plantations, WAPRES and the harvesting contractor Wilsons Logging for their assistance in this trial.
Thank-you