Growing *Acacia melanoxylon* using *Eucalyptus nitens* and *Pinus radiata* nurse crops on farmland in northern Tasmania

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Australia Forest Growers
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The site

- 20 km south of Devonport
- West exposed lower gully slope
- Moderate to poor loamy gravelly soils
- 1200 mm average annual rainfall - 1997 to 2007 was significantly less than average and 2006 which was the driest year on record.
- Moderate to heavy frosts - severe in 1998/2000
- Strong westerly winds - up to 100km/hour in winter and early spring
- Mount Roland is snow covered in late winter.

The site is considered of low to moderate quality for growing *A. melanoxylon*. 
One of six sites established by Private Forests Tasmania and landholders under the Australian Government’s Wood and Paper Industry Strategy program (1996 – 2000) to evaluate species selection and site establishment for commercial tree species on marginal sites on cleared farmland.

History: 1996 - 2000

Images 1997 - 2006
History: 2001 - 2014

The trial was managed by Private Forests Tasmania to evaluate:

- *Acacia melanoxylon* clearwood production with selected nurse crops and
- Clearwood production of *E. nitens* and *P. radiata* in pure stands.
**Layout of plots, treatments and species treatments**

<table>
<thead>
<tr>
<th></th>
<th>6</th>
<th>5</th>
<th>4</th>
<th>3</th>
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<tbody>
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</tr>
</tbody>
</table>

**Legend**

- **A. melanoxylon & E. nitens**
  - 6, 7, 10, 12, 18, 19, 27, 30, 31, 41, 42

- **A. melanoxylon & P. radiata**
  - 1, 2, 3, 4, 16, 21, 23, 24, 32, 35, 36, 37

- **Other species/treatments**

**Pure stands:**
- *E. nitens* - plots; 13, 14, 22, 26, 34, and 40 were first thinned at age 6 years.
- *P. radiata* plots; 11, 15, 28 and 38 and were first thinned at age 7 years.
Trial Design
### Establishment and early silvicultural operations (1997 – 2000)

<table>
<thead>
<tr>
<th>Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weed control</td>
<td>Sprayed out in Autumn 1997. Residual herbicides applied after cultivation and 4 weeks before planting. All rows were sprayed with a knockdown in late Spring 1997. From about 3 years the site was grazed with sheep, then cattle and later horses.</td>
</tr>
<tr>
<td>Cultivation</td>
<td>In late Autumn 1997 the western half of the site was spot rotary cultivated and the eastern half ripped and mounded with a Savannah mound plough.</td>
</tr>
<tr>
<td>Planting</td>
<td>Over 3 consecutive days in mid-winter 1997.</td>
</tr>
<tr>
<td>Fertilising</td>
<td>Spot application of 100 gram DAP 6 weeks post planting.</td>
</tr>
<tr>
<td>Browsing Animals</td>
<td>1.2m Tubex re-usable tree guards installed at planting.</td>
</tr>
<tr>
<td>Toppling</td>
<td>In the second and third year about 15% of trees, predominately <em>P. radiata</em> across the site were staked upright after toppling events.</td>
</tr>
<tr>
<td>From Pruning</td>
<td>Commenced in April 2000.</td>
</tr>
<tr>
<td>Clearwood Pruning</td>
<td>None done in the first 3 years as the Tubex guards overcame the need to prune below 1m.</td>
</tr>
</tbody>
</table>
### E. nitens and P. radiata nurse treatments for final stands of A. melanoxyylon

<table>
<thead>
<tr>
<th>Nurse Species</th>
<th>Treatment</th>
<th>Age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>5 years</td>
</tr>
<tr>
<td>P. radiata</td>
<td>A</td>
<td>No thinning</td>
</tr>
<tr>
<td>E. nitens</td>
<td>B1</td>
<td>Stem Inject 50% of nurse trees (full dose*)</td>
</tr>
<tr>
<td>E. nitens</td>
<td>B2</td>
<td>Stem Inject 50% of nurse trees (half dose**)</td>
</tr>
<tr>
<td>E. nitens</td>
<td>B3</td>
<td>Fell 50% of nurse trees</td>
</tr>
</tbody>
</table>

- **Full dose** - 50% of nurse trees (every second tree) was injected with 100% Glyphosate (~2ml injected every 15 cm of stem circumference) to kill the tree.

- **Half dose** - Remaining live nurse trees were injected with 50% Glyphosate (50/50 mix of water and Roundup, ~2ml injected every 15cm of circumference) to retard growth.
Sacrificial thinning of *E. nitens* nurse species

2005

2012
A ‘well’....
• A shaft
• An open space extending vertically
• An enclosed space ..... to allow for light

It’s all about control of side light ..... light ‘wells’ if you like

Light for the taking...

The ‘well’

Butt logs in the ‘well’
**A. melanoxylon height, diameter and form at 9 years**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Eucalyptus nitens</th>
<th>Pinus radiata</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blackwood Form Class</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Mean Height, Blackwood (m)</td>
<td>10.3</td>
<td>10.0</td>
</tr>
<tr>
<td>Mean Diameter, Blackwood (cm)</td>
<td>11.0</td>
<td>11.0</td>
</tr>
<tr>
<td>Trees in each form class (%)</td>
<td>34</td>
<td>32</td>
</tr>
</tbody>
</table>
Mean growth of *A. melanoxylon* at age 15 years, with *E. nitens* nurse species

Basal area increment (CAI and MAI) for *A. melanoxylon*.

Note: Growth was not retarded by nurse species.
Growth of *A. melanoxylon* at age 15 years and culling treatment of the *E. nitens*

<table>
<thead>
<tr>
<th>Method of nurse species removal</th>
<th>Treatment B1 (First injection 50% of trees, full dose)</th>
<th>Treatment B2 (First injection 50% of trees, half dose)</th>
<th>Treatment B3 (First felling 50% of trees at age 5 years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Diameter (cm)</td>
<td>18.0</td>
<td>20.2</td>
<td>19.1</td>
</tr>
<tr>
<td>Mean Height (m)</td>
<td>14.6</td>
<td>15.2</td>
<td>15.4</td>
</tr>
<tr>
<td>Stand basal area (m²ha⁻¹)</td>
<td>13.0</td>
<td>16.7</td>
<td>15.1</td>
</tr>
<tr>
<td>Mean abundance of form 1 &amp; 2 trees (%)</td>
<td>13</td>
<td>14</td>
<td>15</td>
</tr>
</tbody>
</table>

- Treatment B1 is inferior.
- Treatments B2 and B3 are not significantly different in growth response but substantially different in time and effort to apply.
Some of the 20 findings:

- **Nurse species provided shelter and control of side light** - within 3 years, health, height and form of *A. melanoxylon* was improved.

- *A. melanoxylon* trees under an unmanaged *P. radiata* nurse crop had significantly lower growth rates and poorer form than under *E. nitens* because the *P. radiata* suppressed *A. melanoxylon* from an early age.

- Removal of the *E. nitens* nurse trees at 5 to 7 years where *A. melanoxylon* was exposed to prevailing winds years resulted in significantly poorer form.

- *A. melanoxylon* form changed over time and early selection of final crop trees could not be guaranteed.

- Gradual removal of the *E. nitens* nurse by phased stem injection served to slowly acclimate the *A. melanoxylon* to withstand added exposure, reduced the potential risk of wind damage.

- The highest diameter increment and maximum proportions of form 1 and form 2 trees occurred in *A. melanoxylon* planted with *E. nitens* nurse trees, which were culled (stem injected) during ages 5 to 7 years.

- Over 15 years the average annual diameter increment of *A. melanoxylon*, under an *E. nitens* nurse crop was 1.3cm/yr which compares favourably to 0.55 to 0.75cm/yr in Tasmanian swampland, 1.00cm/yr in sheltered forests and in plantations up to a maximum of 2.5cm/yr in the most ideal conditions.
Financial Assessment

Modelling (Farm Forestry Toolbox V 5.3.3)

*A. melanoxylon* grown with an *E. nitens* nurse crop (Treatment B2) on a marginal site, has at age 40 years potential to yield 220 m$^3$ha$^{-1}$ of clearwood and other sawlogs*.

- At current blackwood stumpages of $110 /m^3$ for clearwood and $50 /m^3$ for non-clearwood sawlogs, the venture is unprofitable. ($13,480/ha revenue)
- To breakeven, stumpages must increase by 300%. ($40,450/ha revenue). IRR = 5.18%
- On-site sawmilling, either ‘green’ ($67,000/ha revenue) or ‘dry’ ($137,000/ha revenue) is more profitable (Swanson).

*E. saligna* was used as a verified growth analogue and stocking and competition parameters defined by Reid (2006) were applied.
Five Silvicultural Conclusions

This trial investigated one non-industrial scale option for growing *A. melanoxylon* on farms.

Silviculturally, the study reinforces the need to:

1. Focus on the objective –
   the production of a final crop of high quality *A. melanoxylon* clearwood timber.

2. Pay close attention to the **silvicultural requirements** of *A. melanoxylon* and
   ‘**match’ the nurse crop** to essential growth and form requirements of *A. melanoxylon*
   throughout stand development.

   (The essential objective of the nurse strategy:
   Nurse species must compete for early sidelight, especially for optimal form of
   *A. melanoxylon* which has minimal shoot apical dominance).
Five Silvicultural Conclusions (continued)

3. **Sacrifice the nurse crop** when it has done it’s job and before it competes excessively with *A. melanoxylon*.

   *(The nurse species is not commercial)*

4. Use an ongoing adaptive **research based management strategy** (and close observation/monitoring) to suit individual sites.

   *(Know what you are doing and be prepared to change).*

5. Commit to strict adoption of **timely and appropriate nurse treatments** (e.g. culling schedules), and pruning techniques.

   *(i.e. management, management, management ....)*
State of Play 2014

A. melanoxyylon

E. saligna (foreground)
A. melanoxyylon (mid ground)
E. nitens (background)

Plot 26
Dia 47.5cm
Ht 27.0m
Stocking 244 trees/ha

Plot 15
Dia 47.6cm
Ht 22.8m
Stocking 244 trees/ha

Plot 30
Dia 23.4cm
Ht 16.9m
Stocking 408 trees/ha
Conclusion

A. *A. melanoxylon* can be grown with *E. nitens* nurse species with:
   - Considerable initial success and
   - Potential for high value *A. melanoxylon* sawlog production in the long term.

B. There is potential to:
   - Evaluate alternative plantation designs (both with and without nurse crops) and
   - More timely pruning regimes
   to facilitate adoption by farmers in Tasmania and on suitable sites elsewhere in southeast Australia.

C. *A. melanoxylon*:
   - A small scale, long-term but potentially high value-adding timber species
   - Can be integrated into farms on selected sites
   - Significant stumpage increases are required before investment is profitable.
Acknowledgements

Brett Miller and Stuart Swanson for their valuable assistance in establishing, managing and monitoring the trial at various stages from 1997 to 2014.

Landholders Ray and Kerrie Cross for providing the land and assisting to plant, prune and maintain the trees to 2010, and from 2011, landowner Greg Turner.