Harvesting and extraction impacts on *Eucalyptus grandis* x *E. urophylla* coppicing potential and rotation-end volume in Zululand, South Africa

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Background

- Traditionally, manual methods were used to fell, de-bark, cross-cut and stack the timber.
- The only mechanical operation in these stands would be the extraction of the timber from the site where the access of these vehicles was limited to specific extraction routes.
- Damage to bark on stumps was generally limited to extraction routes.
Shift towards mechanization

• From early 1990’s there was a shift towards the mechanization of the various harvesting operations (felling, debarking, cross-cutting and stacking)

• Concern was expressed as to the impact of these mechanical methods of harvesting on the damage/removal of bark from the stumps during these operations, and how this damage would influence the ability of that stump to produce adequate coppice shoots
Requested to:

Quantify the impact of mechanization at felling, such that management decisions could be made regarding the potential to re-establish through coppice regeneration, or whether one should consider re-planting.
Trial design

• Area of trial = 6 ha

• 4 treatments replicated 4 times and arranged in a RCBD
  – treatments reflected the then current practices
  – ranged from manual → semi-mechanised → mechanised
  – felling swathes from road to road to approximated commercial operations
  – there were three sub-plots of 60 trees per whole plot

• 2 880 stumps measured, with 27 assessments made per stump
Manual felling  Bell 3W  Manual cross-cutting

Manual stacking  Flexiloader + Bell tractor & trailer

Man_Mech_Flexi
Mech

Felled, debarked cross-cut and “stacked” with Waratah head on Hitachi excavator

Extracted with flexiloader + Bell forwarder (T17)
Measurement plot: Location of stumps relative to extraction route

- Stumps on extraction route
- Stumps adjacent to extraction route
- Two stumps lines away from extraction route

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Description of trial site

• **Site:**
  – Trust Plantation, Sappi Central area

• **Soils:**
  – deep yellow Fernwood
  – low clay and OC contents

• **Mat and Map**
  – 21.8 °C
  – 1033 mm

• **Previous site history**
  – indigenous grassland (palmveld)
  – many rotation of *E. grandis*
  – planted in 1992 with GU A380
    • one of the first commercial plantings with this clone
• Standing crop felled between the 13\textsuperscript{th} September – 18\textsuperscript{th} October 2002

• Slash removed from stumps

• Reduction operations
  – 1\textsuperscript{st} reduction to 2 stems stump\textsuperscript{-1} at 5 months
  – 2\textsuperscript{nd} reduction to final stocking at 15.5 months

• Coppice stand felled 10\textsuperscript{th} October 2010
  – 8 yrs
Coppice reduced in a stepwise process

i) 1st reduction to 2 stems per stump at 3-4 m in height

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ii) 2nd reduction to original stocking at 7-8 m in height
Measurements

• Stump measurements
  – Diameter, height and volume
  – Presence or absence of stumps for determination of stocking

• Damage to bark on stumps
  – graded from 0-2 (0 = no damage; 2 = severe)

• Type of visible damage to stumps
  – Tyres; Tear out; Stumps ground; Damage during felling; Damage during debarking etc…

• Presence or absence of coppice

• Dbh, Ht, BA, Vol and number of stems before and after reduction operations
Partitioning of stump into 4 quarters at 2 levels, each of which was assessed for damage to bark and presence of coppice.
Influence of distance from extraction route on stump height
Stump and stem survival for different harvesting treatments

- Original stocking of planted trees (1R) = 1 333 stems ha\(^{-1}\)
- Stumps ha\(^{-1}\) when felled (1R) = 1 223 or 9.1 % mortality
- Stumps ha\(^{-1}\) after felling (2R) = 1 197 or 2.1 % mortality
- Stems ha\(^{-1}\) after final reduction (2R) = 1 308 or 98 % of original stocking
Stump quarters with evidence of bark damage relative to position on stump
Total number of stump quarters with evidence of bark damage (maximum score of 8)
Stump quarters with presence of coppice relative to position on stump
Total number of stump quarters with presence of coppice (maximum score of 8)

- **Extraction**
- **1st Row**
- **2nd Row**

**Presence of coppice (n = 8)**

- Man
- Man_Mech_3W
- Man_Mech_Flexi
- Mech
Evidence of vehicle damage to bark on stumps

- **Extraction**
- **1st Row**
- **2nd Row**

**Vehicle damage (n = 8)**

- **Man**
- **Man_Mech_3W**
- **Man_Mech_Flexi**
- **Mech_Mech**
Evidence of damage to bark on stumps during the felling of trees and by log stripping

![Graph showing log stripping damage for different methods]

- **Extraction**
- **1st Row**
- **2nd Row**

Log stripping damage (n = 8)
Coppice performance as affected by different felling operations

- Volume (m³ ha⁻¹)

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Conclusions

• Stump height is influenced by distance from extraction route
  – higher stumps further away

• Methods of harvesting and extraction had no impact on stump survival, or the number of stems after the final reduction operation

• Irrespective of the method of harvesting or extraction, there was more damage and less coppice on:
  – the upper half of the stump than the lower half
  – the stumps in the extraction route or immediately adjacent
• Severity of damage
  – Least in Man and highest in Man_Mech_3W

• Presence of coppice
  – Highest in Man and lowest in Man_Mech_3W

• Damage to stumps caused by:
  – Tyres in Man_Mech_3W and Man_Mech_Flexi treatments
  – Mechanical de-barking of logs in all treatments except in the manual de-barking treatment

• No significant difference on Vol/BA/Dbh etc.
So what?

- GU A380 coppice’s exceptionally well

- What about other species?
  - May be a problem where stocking of stand to be coppiced is low, or in weakly coppicing species

- After felling, 20 species in two site-species were assessed for their ability to coppice. *E. benthamii*, *E. smithii*, *E. macarthurii* and *E. quadrangulata* = +90 % stumps coppiced.

- Species such as *E. dunni*, *E. saligna*, *E. elata*, *E. badjensis*, *E deanei* and *E. andrewsii* = 80 % stumps coppiced, or only coppiced well on one site, may be affected by damage to stumps
Thanks !!!!

Team effort between Industry, Contractors and ICFR

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– Denis Oscroft, Gert van den Berg, Paul Viero, Greg Fuller, Carol Rolando, Musa Mkwanazi + Victor from the ICFR