

# Peeling coconut



The challenge of peeling coconut stems for high-quality veneer.



*Thanks to Rob McGavin and the QDAF team for the base presentation content.*

# Content



- The challenge of peeling coconuts
- ENSAM trial results.
- Implementing results in commercial and research trials.
- Take home messages for successful coconut processing.

# Variation in coconut wood character

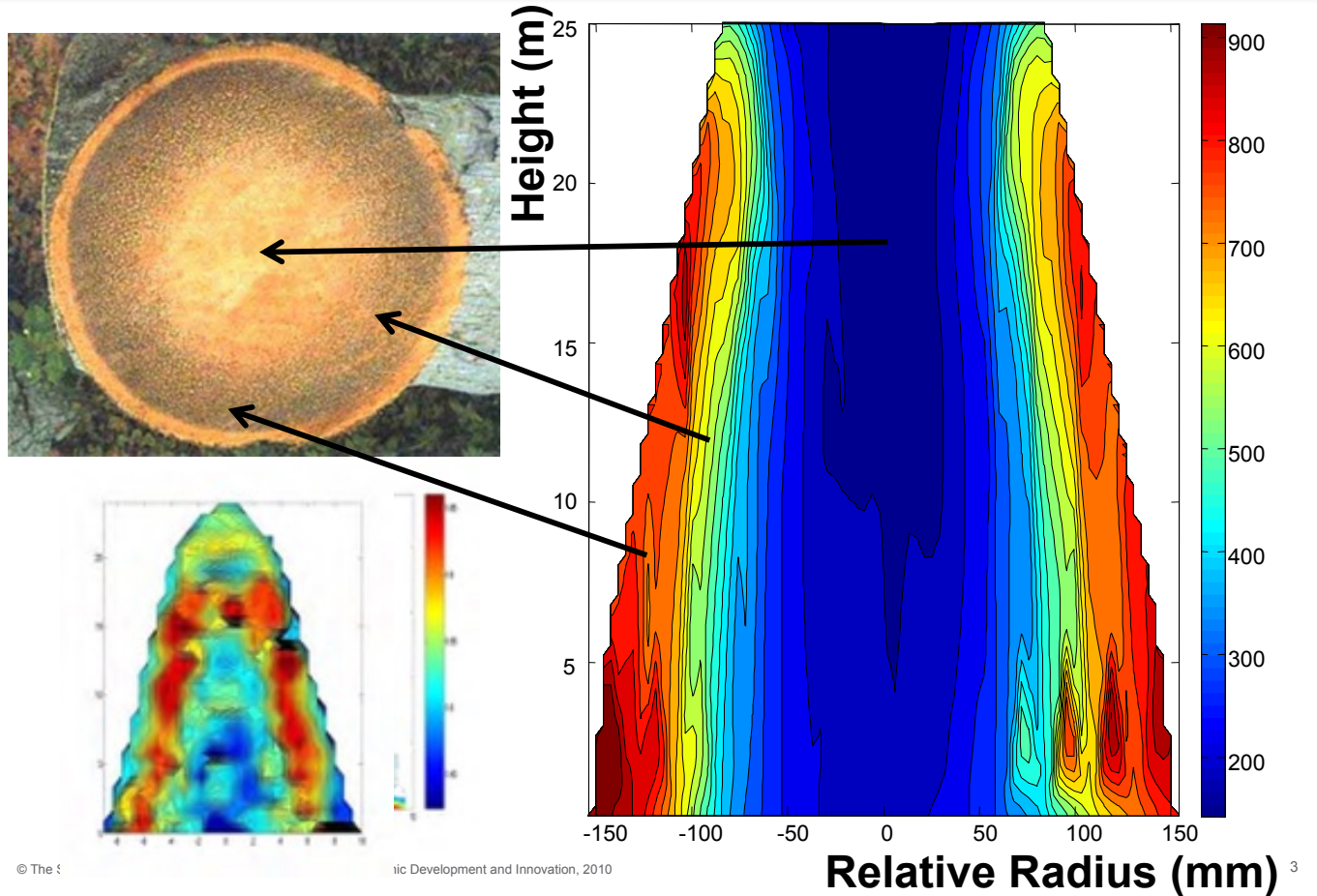
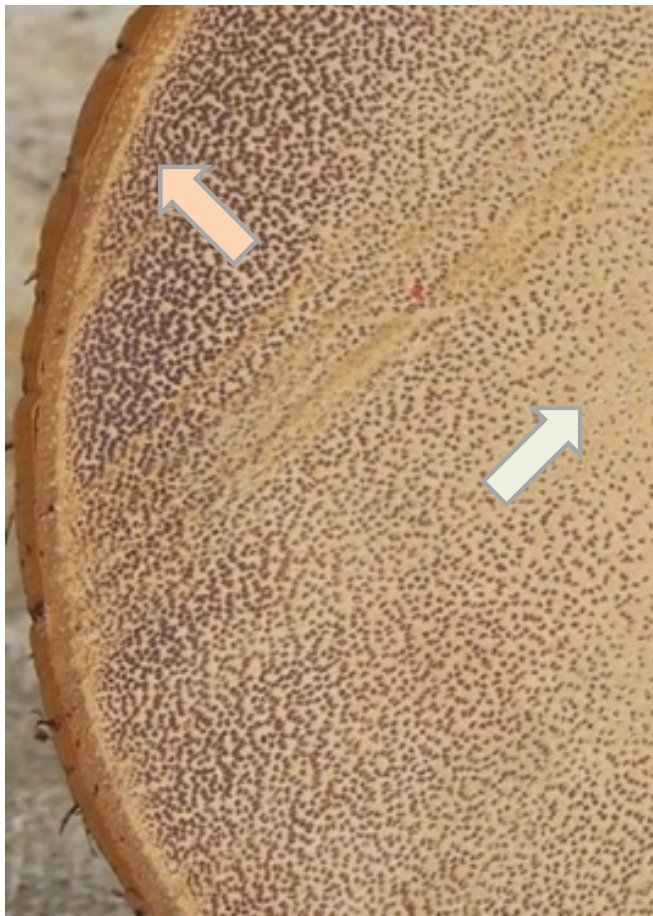


Image from QDAF CocoWood project

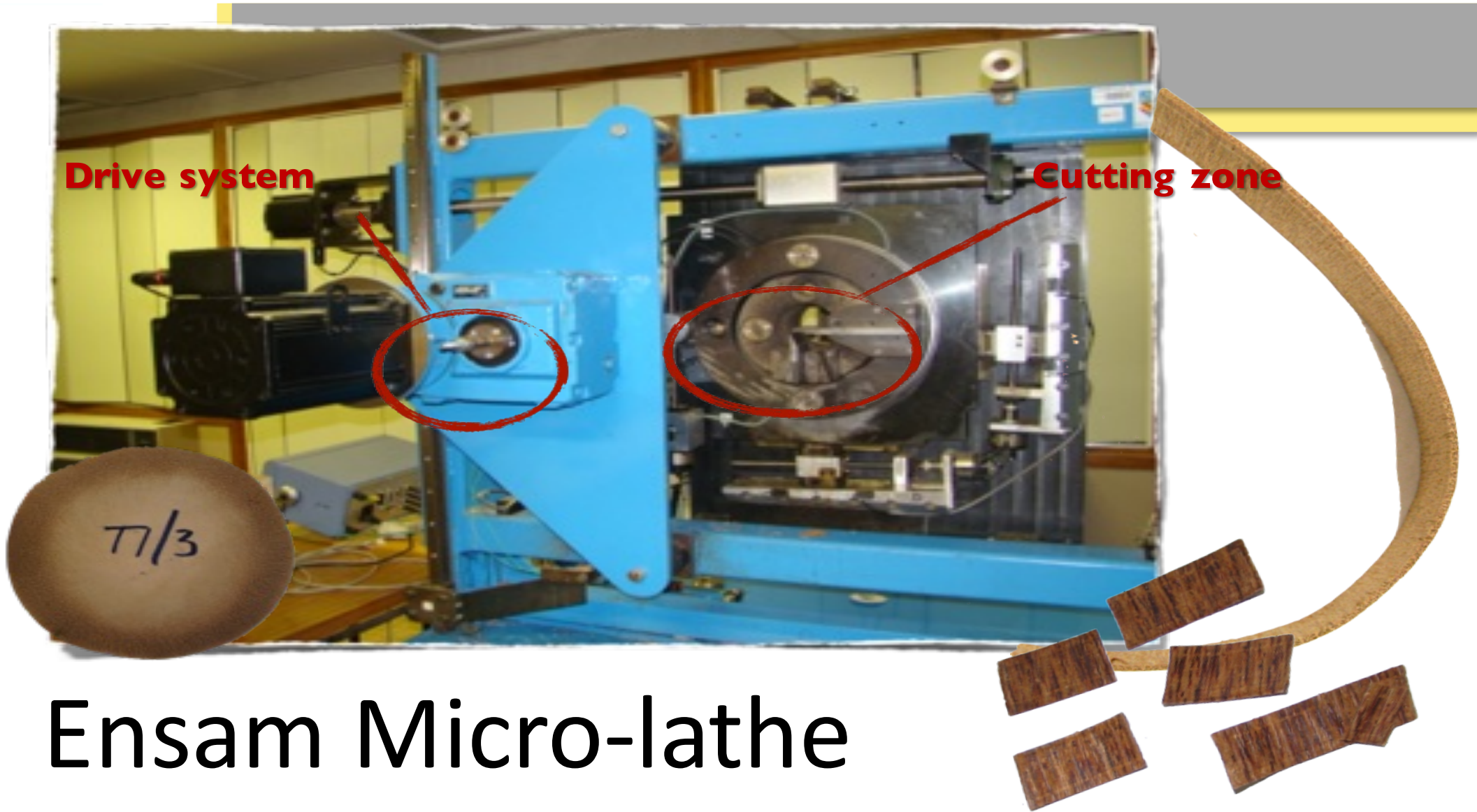
# Complexity in veneering



The key challenges include:

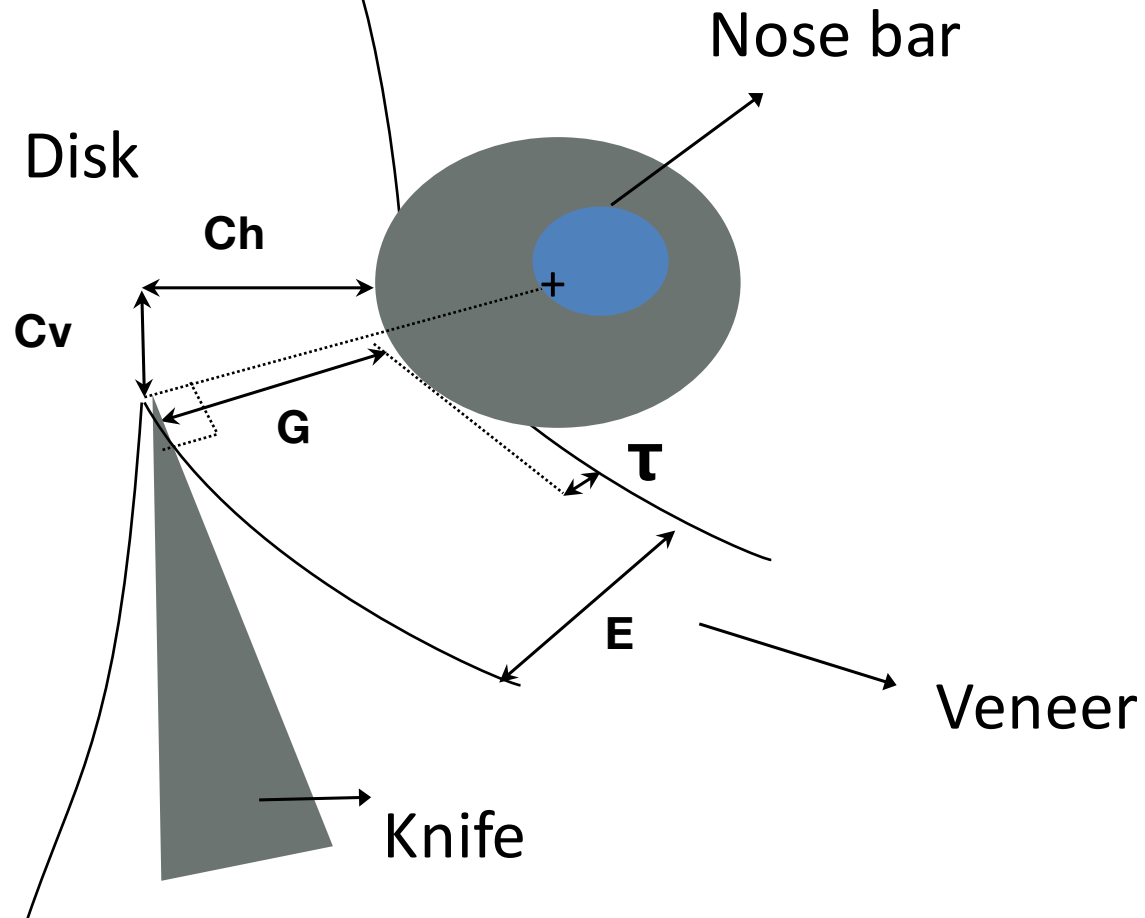
- Slicing the hard vascular bundles without undue damage to the surrounding soft matrix.
  - To manage surface coarseness & reduce sheet damage.
- Recovering useful material from small diameter logs.
- Accommodating varying density across the log.

Controlled spindleless lathe approaches offered a possible solution.



Ensam Micro-lathe

# Ensam trial- Range of parameters



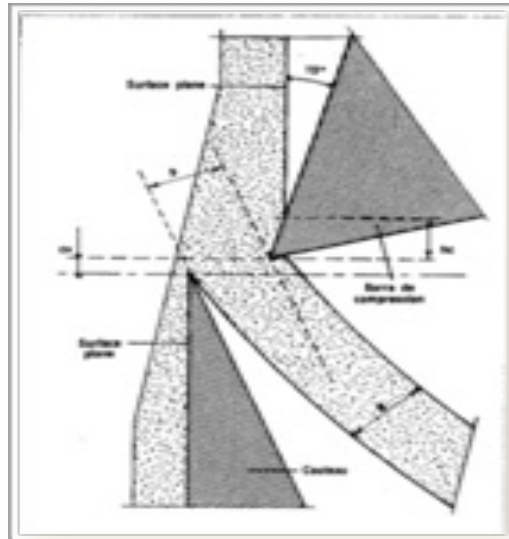
G : Gap between knife and nose bar

E : Veneer Thickness

Ch : Horizontal Gap

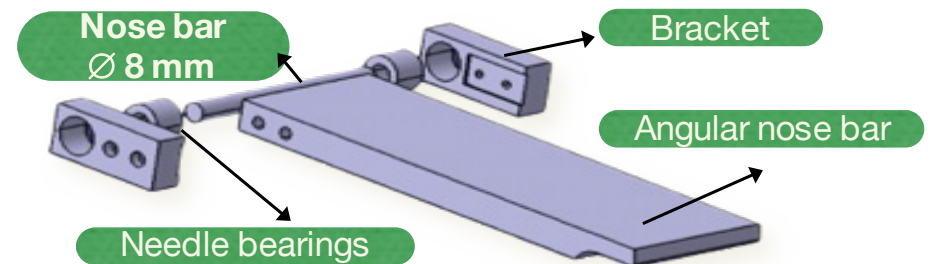
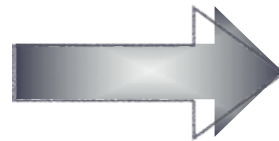
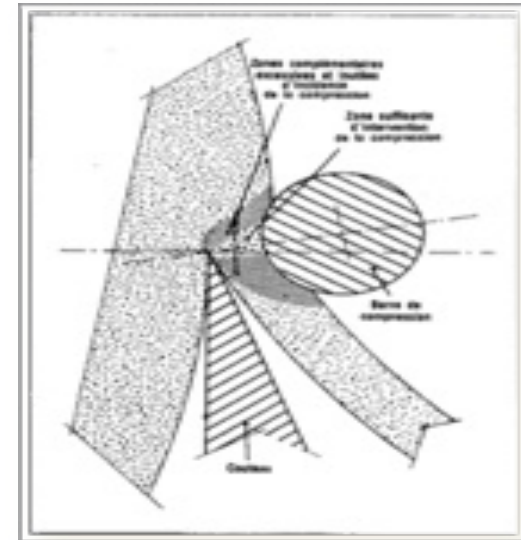
Cv : Vertical Gap

# Ensam Trial - Range of parameters



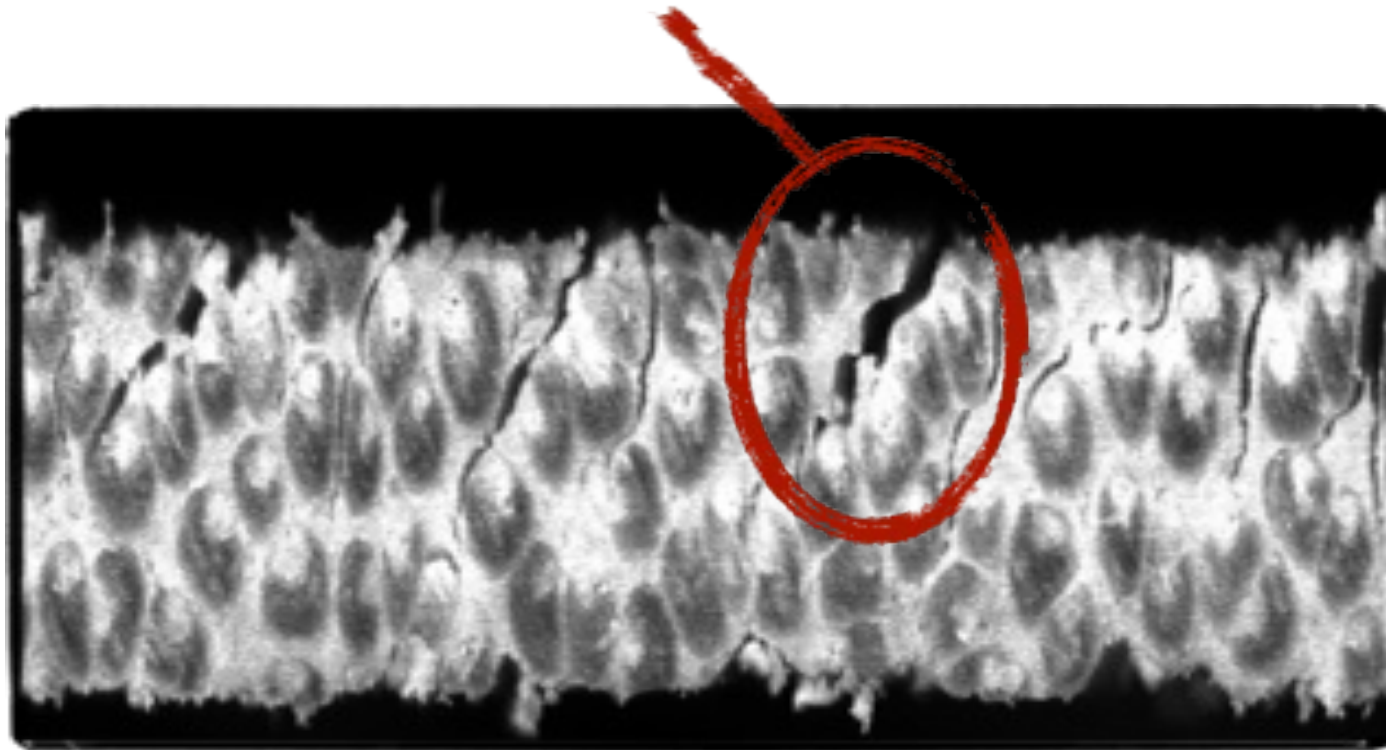
Angular

Cylindrical



# Trial 1 - Range of parameters trialed

Lathe checks

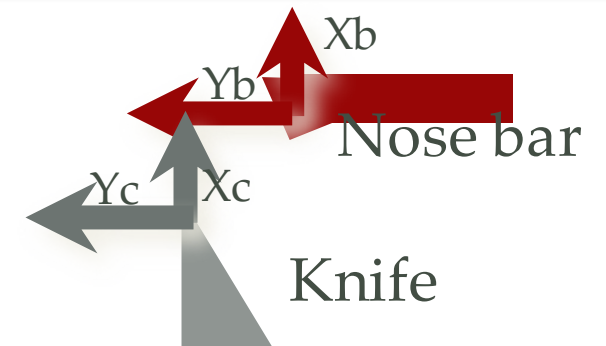




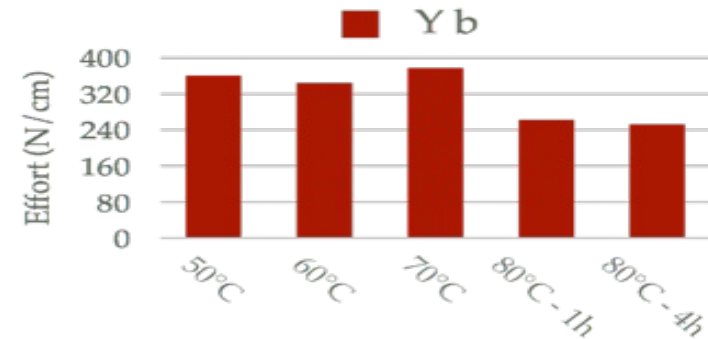
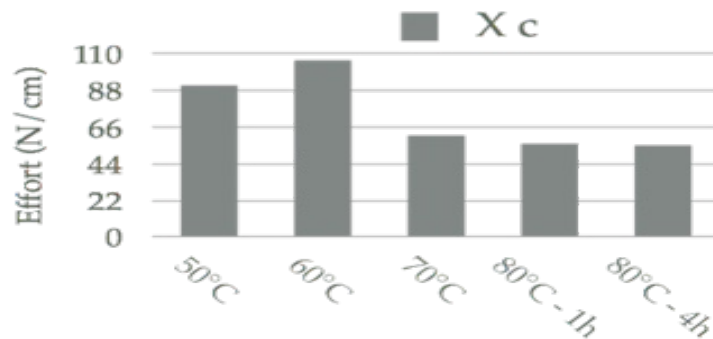
# Temperature effect

## Experiment plan

	50 °C	60 °C	70 °C	80 °C
1h	x	x	x	x
4h	x	-	-	x



## Results



## Conclusion

- Temperature
- Time



- 80° C
- 1 hour (disc)

# Pressure

## Experiment plan

Nose bar	5 %	7 %	10 %	12 %	15 %	20 %
Angular	x	-	x	-	x	x
Cylindrical	x	x	x	x	x	x

## Observations

- Angular:
- Chipping
  - Image analysis (SMOF) **impossible**

- Cylindrical:
- Continuous ribbon  
(low and medium density)
  - Image analysis (SMOF) **possible**  
(low and medium density)

# Trial 1 – Completed

PEER-REVIEWED ARTICLE


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## Experimental Investigation on Rotary Peeling Parameters of High Density Coconut Wood

Henri Bailleres,<sup>a,\*</sup> Louis Denaud,<sup>b</sup> Jean-Claude Butaud,<sup>b</sup> and Robert L. McGavin<sup>a</sup>

Substantial quantities of senile coconut palms are present in plantations within the Asia-Pacific region. Once coconut palms become over-mature, their production of traditional products, such as coconuts, significantly decreases, resulting in profitability challenges for farmers. Presently, few profitable markets exist for over-mature, senile coconut palms. Using the coconut palm stem in composite or engineered wood products could, however, provide an attractive alternative. Due to some of its unique characteristics, a processing system able to recover wood from the high-density zone near the stem periphery is desirable. A series of rotary veneer laboratory trials were undertaken to establish fundamental benchmark lathe settings and veneering characteristics for coconut palm stems. Different pressure bar configurations, billet pre-treatment temperatures, and veneer thicknesses were tested, and the resulting cutting forces and veneer quality were assessed. Optimal setting recommendations for peeling coconut wood are provided.

**ARTS ET MÉTIERS ParisTech**  
**LaBoMaP**  
LABORATOIRE BOURGUIGNON DES MATÉRIAUX ET PROCÉDÉS

**EXPERIMENTAL APPROACH OF COCONUT PEELING PROCESS** 


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### Introduction

A substantial area of senile coconut palms exists within the Asia-Pacific region. Once coconut palms become over-mature and senile, their production of traditional products, such as coconuts, significantly decreases, resulting in profitability challenges for farmers. Due to some of its unique characteristics, a processing system able to recover wood from the high-density zone near the stem periphery is desirable. A series of rotary veneer laboratory trials were undertaken to establish fundamental benchmark lathe settings and veneering characteristics for coconut palm stems.


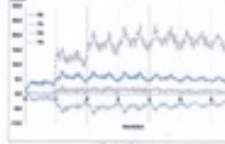
### Material and Methods

- Cocowood Sampling**  
A total of 43 senile coconut palms (70 or more years old) were sampled from several Fg plantations. Four discs, 25 mm thick, were taken from each palm trunk. These were cut from the trees at breast height (approximately 1.3 m from the ground) and then 25, 50, and 75% of the stem height and were labeled D1, D2, D3, and D4, respectively.
- Veneer processing**  
Veneer processing was done using an instrumented micro-lathe system developed by the LaBoMaP (Arts et Métiers ParisTech AMPT) in Cluny, France (3). The micro-lathe system peels discs equipped with force sensors.
- Trials:**
  - Pressure bar/type (Pressure)
  - Heating temperature
  - Veneer thickness
  - Clearance angle




### Quality indicators

- Cutting Forces**  
The forces exerted in the cutting plane, both on the pressure bar and the knife, were measured using piezoelectric load cells.
- Veneer Quality**  
A specifically designed apparatus (SMOP (2), with checks recorded by the SMOP) optical system) was used to characterize veneer lathe checks. Veneer checks produced during peeling are opened by bending the veneer on a diameter roller. The software algorithm identifies each check, calculates its depth, and determines the distance between consecutive checks. Only veneers with a visual score of 2 or above were assessed with the SMOP.



### Results and conclusions (3)

Parameter	Value 1	Value 2	Value 3	Value 4	Value 5
1	0.20	0.20	0.20	0.20	0.20
2	0.40	0.40	0.40	0.40	0.40
3	0.70	0.70	0.70	0.70	0.70
4	0.70	0.70	0.70	0.70	0.70
5	0.70	0.70	0.70	0.70	0.70



Advanced veneer and other product from coconut wood

## Conclusion on the best settings



- Heating of discs to a temperature 80 °C for 1hour.
- Cylindrical bar pressure
- Pressure sufficient for 10% veneer compression.

The implementation on a production lathe requires a relatively large diameter, cylindrical nose bar in order to make the pressure more uniform.

# Peeling trials - initial



Advanced veneer and other product from coconut wood

# Peeling trials - initial

## Initial experimental peeling trial in Fiji

- Lathe performed well
- 23 logs (1.5 m<sup>3</sup>) processed, 249 veneer sheets produced.
- Around 60% recovery
- Supporting equipment problems: pretreatment chamber couldn't heat logs sufficiently!
- Veneer quality negatively impacted by:
  - Lack of log heating capacity.
  - Lack of opportunity to optimise lathe settings.



# VTB commercial peeling trial



Advanced veneer and other product from coconut wood

# VTB commercial peeling trial



Advanced veneer and other product from coconut wood



# VTB commercial peeling trial



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Advanced veneer and other product from coconut wood

# VTB commercial peeling trial

## Compact commercial peeling trial in Fiji

- 171 of 2500mm billets processed.
- About 15 m<sup>3</sup> of veneer produced.
- No drying challenges.
- Good quantity of suitable quality veneer for product development activities.
- Equipment issues demonstrated the challenges of peeling coconut.
- Equipment performance and surface quality issues reinforced the necessity of billet pre-conditioning.

## Further peeling trials at TUD, Suva

Additional log heating capacity was installed.



# Heating assessment



# Peeling heated logs with improved settings



## Improved peeling quality observed

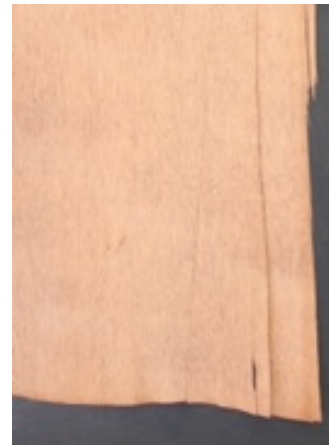


Veneer grade recovery and quality through the log currently being assessed.

# Veneer grading

Recovered coconut veneer was graded but this presented challenges.

- The major grading criteria for wood species don't relate well to coconut.
- Grade-reducing characteristic common for wood species in the standards don't apply to coconut.
  - The basic characteristics of the coconut veneer vary considerably and need be included in
- Some desirable features of coconut, such as density, are not prominent or included.
- Production-induced characteristics can dominate grading if not controlled during production.





# Peeling summary

Rotary veneer processing presents several advantages over conventional sawing. These include:

- Recovering around double the usable product from logs.
- Much higher recovery from the periphery of logs.
  - In coconuts, this can have the most attractive characteristics and properties.
- Easier management of the log's variable properties.
- Faster veneer drying than sawn timber with less degrade.
- The use of logs unsuitable for sawmilling.
  - Generally shorter, smaller diameters logs.

# Peeling summary

The project has demonstrated that coconut palms can be rotary peeled using currently available spindle-less lathe technologies.

- These approaches overcome the barriers to peeling coconut using traditional methods.



# Peeling summary

The project has identified:

- The need for specific lathe setups and processing protocols to produce quality coconut veneer.
- The recovered veneer has a wide range of qualities (mechanical, physical and appearance).
- To gain the most value from the veneer, careful grading and segregation is needed to manage this range of qualities.
- Effective veneer grading systems need to be developed along the supply chain: between the processor, product manufacturer and the customer to allow efficient trade of the material.



# Questions

