EXPERIMENTAL APPROACH OF COCONUT PEELING PROCESS

ARTS ET MÉTIERS ParisTech Cluny

Queensland Government

LaBoMaP
LABORATOIRE BOURGUIGNON DES MATÉRIAUX ET PROCÉDÉS

Henri Bailleres[1], Louis Denaud[2], Jean Claude Butaud[2], Robert L. McGavin[1]

[1] Queensland Department of Agriculture, Fisheries and Forestry, Horticulture and Forestry Science, Salisbury Research Facility, 50 Evans Road Salisbury, Queensland 4107 Australia

[2] Arts et Metiers ParisTech, LaBoMaP, 71250 Cluny

Contact : henri.bailleres@daff.qld.gov.au; louis.denaud@ensam.eu

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

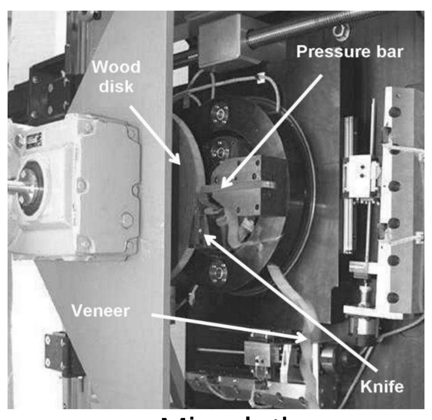
- Cocowood Sampling

A total of 43 senile coconut palms (70 or more years old) were sampled from several Fiji 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.

Cocowood disc

- Veneer processing

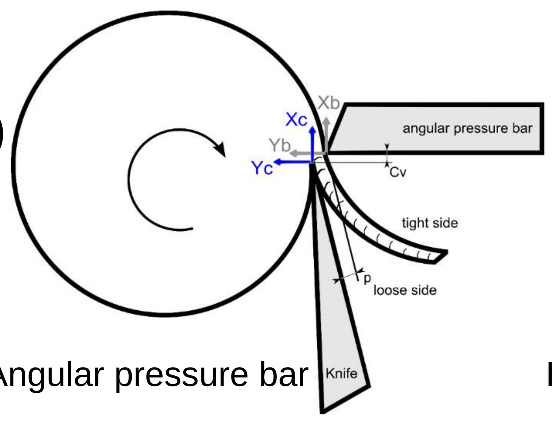
Veneer processing was done using an instrumented micro-lathe system developed by the LaBoMaP (Arts et Métiers ParisTech AMPT) in Cluny, France (1). The micro-lathe system peels discs equipped with force sensors.



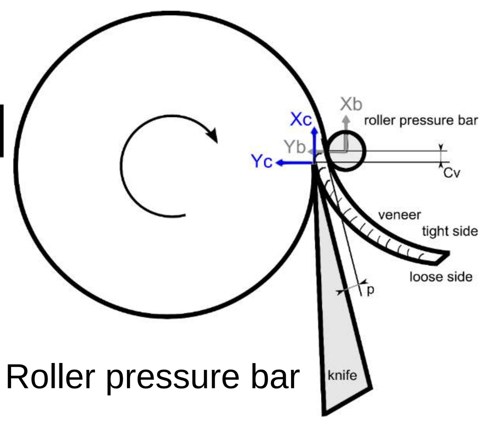
Microlathe

- Trials:

-Pressure bar(type &pressure)
-Heating temperature
-Veneer thickness
-Clearance angle



Angular pressure bar

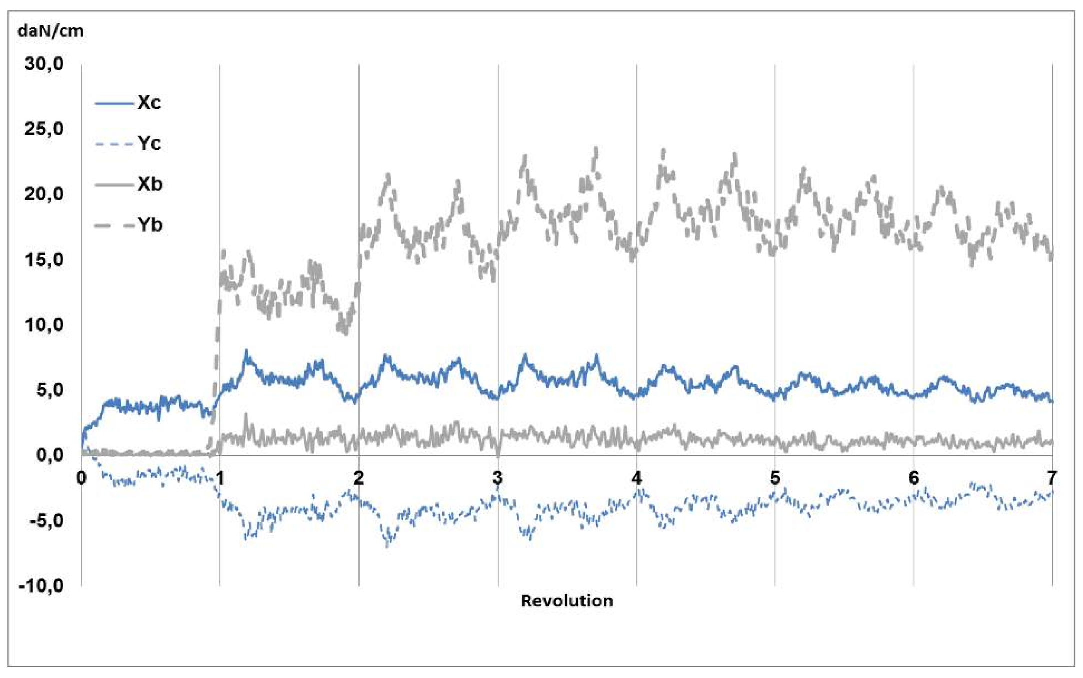


Roller pressure bar

Quality indicators

- Cutting Forces

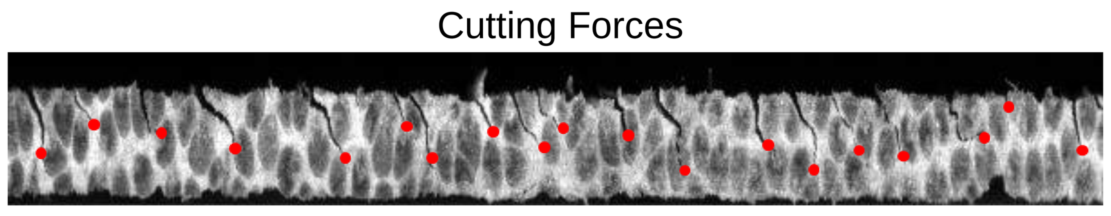
The forces exerted in the cutting plane, both on the pressure bar and the knife, were measured using piezoelectric load cells.



Cutting Forces

- Veneer Quality

A specifically designed apparatus (SMOF (2), optical system) was used to characterize veneer lathe checks.



Coconut wood veneer (2.5-mm-thick) lathe checks recorded by the SMOF

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 SMOF.

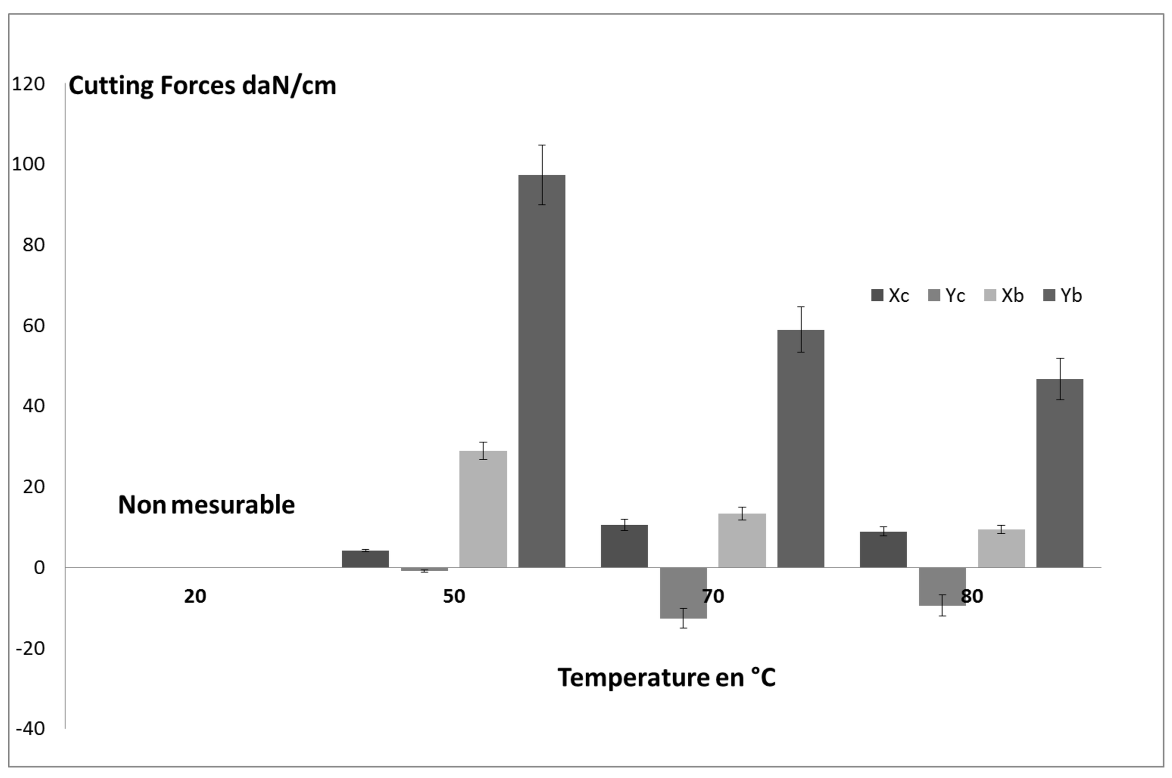
Results and conclusions (3)

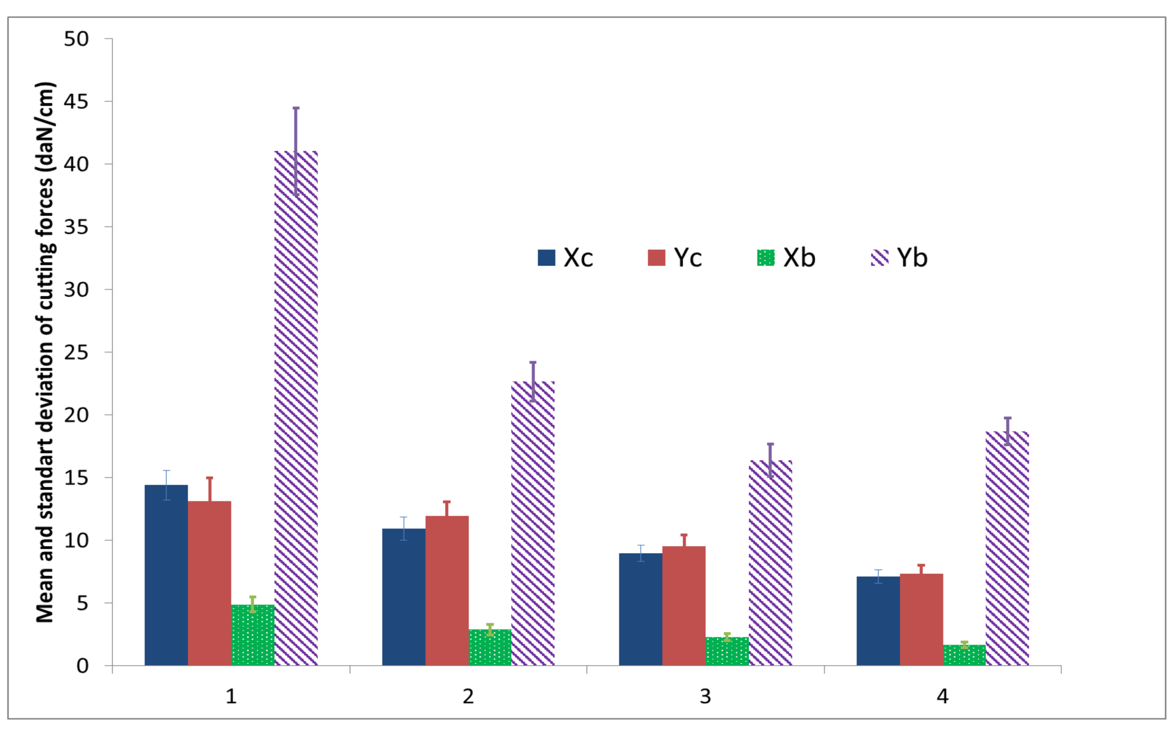
Compression rate (%)	Mean Xc (daN/m)	Mean Yc (daN/m)	Mean Xb (daN/m)	Mean Yb (daN/m)	Mean veneer quality score
5 N=14	9.05 (1.48)	8.60 (2.66)	2.26 (0.61)	-16.65 (3.93)	2.64 (1.39)
10 N=12	10.17 (1.71)	10.30 (2.00)	2.65 (0.70)	-23.68 (3.05)	2.42 (1.16)
20 N=9	15.10 (2.20)	14.61 (3.19)	5.77 (1.32)	-53.65 (6.90)	1.67 (1.32)

Mean Cutting Forces and Mean Veneer Quality Scores for Different Compression Rates

Compression rate (%)	Mean Check Depth (mm)	Median Distance Between Checks (mm)
5 (N=8)	1.30 (0.26)	2.94 (1.27)
10 (N=5)	1.21 (0.19)	4.08 (3.31)
20 (N=2)	1.21 (0.22)	2.03 (0.29)

Veneer Quality Assessments Using the SMOF System for Different Compression Rates





1. **Steaming logs above 70 °C is recommended** to limit cutting forces required, improve surface quality, and limit premature knife damage. Anyway, the cutting forces involved still are considerable as regard to wood cutting forces.
2. **The use of a roller nose bar and a relatively low compression rate (around 10%) provided a favourable effect** on most of the critical processing parameter (cutting forces, checks, and surface quality).
3. **The minimum peelable veneer thickness** (around 2 mm) is limited by the size of the fibrovascular bundles.
4. The high density of cocowood requires a **positive clearance angle** to limit the forces on the clearance face of the blade.
5. These observations should be confirmed using an industrial spindleless lathe with a large-diameter roller pressure bar to enhance the positive effect of the bar on the checking mechanism.
6. The **friction phenomenon** observed when using an angular nose bar highlights the unusual cutting characteristics of coconut wood. In future studies, it would be relevant to analyse the choice of knife alloys to optimize the cutting properties.

Références

(1) Butaud, J. C., Deces-Petit, C., and Marchal, R. (1995). "An experimental device for the study of wood cutting mechanisms: the microlathe," In: Poster Session Proceedings of the 12th International Wood Machining Seminar, Kyoto, Japan, pp 479-485.

(2) Palubicki, B., Marchal, R., Butaud, J. C., Denaud, L., Bleron, L., Collet, R., and Kowaluk, G. (2010). "A method of lathe checks measurement; SMOF device and its software," *European Journal of Wood and Wood Products* 68(2), 151-159, DOI: 10.1007/s00107-009-0360-y

(3) Bailleres H, Denaud L, Butaud J.C., McGavin R (2015), "Experimental investigation on rotary peeling parameters of high density coconut wood", *Bioresources,* in final reviewing process