A FEW CLARIFICATIONS ARE IN ORDER!

QUALITY OF PLANTATION VARIETIES FOR USE AS LUMBER

Excerpt from: *Mémento du Forestier Tropical* (Memento of the Tropical Forester) - Editions Quae
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PREAMBLE

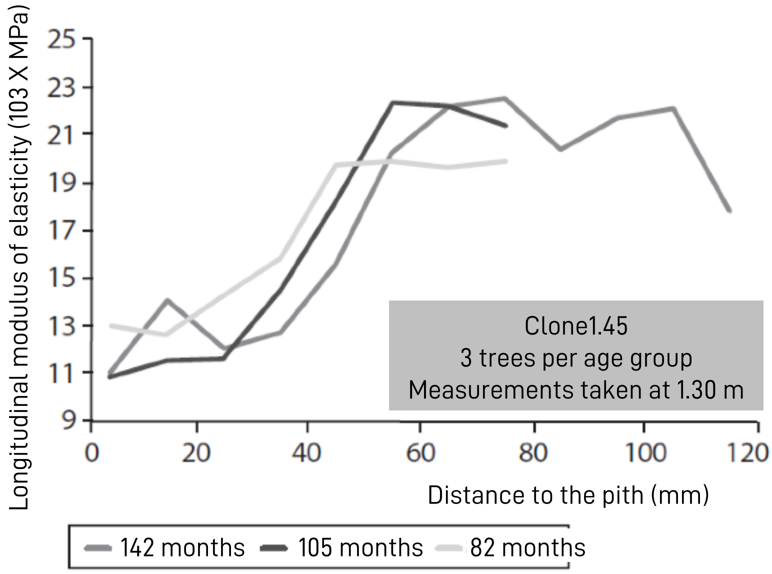
Timber production in natural tropical forests is steadily declining and this trend is likely to continue in the years to come. The tropical forestry industry is therefore naturally turning to plantation timber.

Plantation forestry requires a high level of investment that must be compensated for by the harvested forest products, for which quality is now as important as quantity. The technological properties of timber from plantation trees are different from those of the same varieties grown in a natural forest, which poses both technological and commercial problems.

In particular, the properties of plantation timber are very heterogeneous within a same tree, as trees are very often harvested before they have reached maturity. The observed differences vary according to the timber varieties: the effect of tension timber or juvenile timber on a timber's properties, the consequences of the release of growth constraints on the quality of sawn timber, the impact of branching on the visual grading of softwoods, the relationship between the immaturity of timber and its low natural durability, etc.

JUVENILE TIMBER AND ADULT TIMBER

Young trees (under 30 years old) have a greater or lesser proportion of so-called juvenile timber whose properties are inferior to those of mature timber. Thus, the properties of timber can vary greatly from the heartwood to the bark. The greatest variations are observed during the first years of growth (figure 1). The transition from juvenile timber to mature timber is never abrupt, but rather a "decrease in the timber's juvenility", from the heartwood to the periphery. The age ceiling for the formation of juvenile timber has been estimated at 20 years for *Eucalyptus regnans* and 10 years for *E. saligna*. However, these limits remain highly empirical.



Juvenile timber is concentrated in a core of approximately 8 cm in diameter

Figure 1: example of radial property variations (longitudinal modulus of elasticity) in a eucalyptus PF1. (Gérard et al., 1995)

TENSION TIMBER AND GROWTH CONSTRAINTS

The use of certain varieties of plantation timber, typically eucalyptus, but also fraké, framiré and other hardwoods, is limited by the timber's lack of stability during primary processing.

This type of defect is mainly due to the presence of tension timber coupled with high growth stress.

Tension timber is formed by the tree in response to external events. It induces radial and circumferential heterogeneities. Growth stresses allow the stem to withstand reorientations induced by changes in environmental conditions (sunny spells). Peripheral tension forces help to brace the stems so that they can resist the action of external forces.

The release of these growth constraints coupled with the heterogeneity of properties due to tension timber is the cause of defects that occur during occur during felling and primary processing (sawing):

- in hardwoods, heart splits appear after felling or chainsaw cutting, sometimes even splitting the logs; the sawn timber deforms due to the high longitudinal stresses on the periphery of the log;

- the sawn timber and veneers of hardwoods or softwoods deform (warping, buckling, etc.) and cracks appear during drying due to the accentuated heterogeneity of drying shrinkage. This is what we refer to as the "nervousness" of timber.

Reaction timber can also lead to other defects: the poor surface condition of timber after planing or sanding (in some timber varieties, tension timber is "fluffy"), abnormal discolorations ("green veins" or "fatty grain" due to the presence of tension timber, red compression timber in softwoods).

PRUNING AND NODOSITY

In plantation softwoods, the presence of knots is one of the main factors in the depreciation of timber quality. These knots are more or less abundant, more or less large, healthy, black, rotten, etc. Although knotty timber is considered more decorative for certain uses, knotty timber can cause difficulties in sawing and machining, in particular during planing, mortising, or shaping.

In addition, as the timber's grain is deflected in the vicinity of the knots, it can lead to localised deformations of sawn timber. In some tropical pine species such as Pinus caribaea or Pinus elliottii, the presence of penetrating knots from young branches next to the pith is associated with resin-infiltrated heartwood zones that have a traumatic origin due to winds, cyclones, or repeated fires.

Knots reduce the mechanical strength of timber, especially if they are numerous and have a large diameter. Natural or artificial pruning is a determining factor in the future quality of processed timber.

IMPACT OF PLANTATION TIMBER'S IMMATURITY ON ITS COLOUR AND NATURAL DURABILITY

In some tropical forest species, young plantation timber is lighter in colour than older timber or natural forest timber. Their natural durability is often lower, as their hardening is incomplete.

These differences can be seen in teak. The appearance of natural forest teak is characteristic and highly valued; the colour of its timber varies from beige-brown to golden brown with some olive tones; it darkens slightly in the light to take on a deeper colour with coppery highlights.

This colour can be uniform or streaked with a brown-black grain. In plantation teak, the colour and appearance of the timber can vary depending on its origin and its age. Improper silviculture can lead to very uneven colour, grain defects and even discolouration. Plantation teak timber under 10 years of age can be very pale - from yellowish white to pale beige - in colour due to the absence of mature timber, when the stems are almost entirely made up of sapwood.

Thus, the European NF EN 350-2 standard (2016) on the natural durability of timber makes a distinction between Asian teak (said to originate from natural forests) and cultivated teak:

- the former falls under class 1 of natural durability against fungi (the highest class) and under class M (medium durability) in terms of natural durability against termites;
- the latter falls under classes 1 to 3 of natural durability against fungi and under class M-S (medium to sensitive) natural durability against termites.

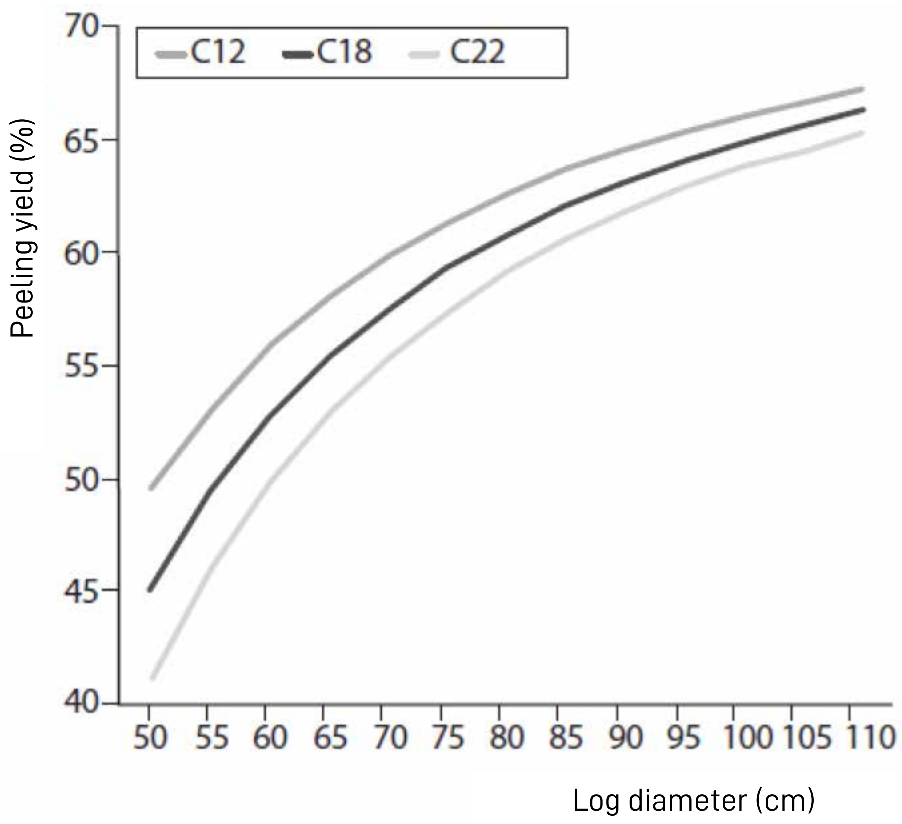
This distinction reflects the difference in quality, especially in natural durability, observed between the various teaks that are currently marketed. Some plantation teaks used for mid to low range garden furniture may have a natural durability lower than class 3. Others, on the other hand, are quite comparable in quality to natural forest teaks.

IMPORTANCE OF LOG SHAPES AND DIAMETERS ON PROCESSING YIELDS

The age of a harvested tree has an impact on the quality of the timber (the larger the diameter of the tree, the lower the rate of juvenile timber and the greater the hardening of perfect timber) and also on the overall yield of the raw material. The processing yield of peeling depends on three factors: the cylindricity of the log, its diameter and the tooling used to peel it to a core of varying diameter.

The specific conformation of the logs also plays a role in the quality and appearance of the obtained product (figure 2). It has an influence on the material yield. Defects in straightness and cylindricity generate more waste (e.g. rounding in peeling). Other defects in the log (e.g. off-centre cores, too steep a thread, etc.) lead to the elimination of the parts of the finished product that include these defects or considerably reduce its value because of the included defects (knots, splits, other defects).

Lumber silviculture should therefore be adapted as much as possible in order to obtain logs that are as straight as possible, with little splitting, no knots, no internal tensions and sufficiently hardened. This therefore involves medium to long-term silviculture which can only be profitable through the obtaining of a very high quality raw material.



The yield quickly decreases for log diameters below 60 cm: e.g. with an 18 cm core (C18, old-style peeler), the yield is 45% for a 50 cm diameter log under bark and 65% for a 100 cm diameter log.

Figure 2: Peeling yield as a function of log diameter and core diameter

CONCLUSIONS

Improving the quality of plantation timber in the tropics must be considered and conducted in conjunction with the development of processing industries.

Indeed, the time constraints inherent in production (except perhaps for very fast-growing plantations) mean that local and international timber markets must constantly use new raw materials, without any certainty that these can be adapted to an already defined production tool.

A basic, quick diagnosis of the properties of an exploitable resource should make it possible to improve its usability: for example sinewy timber should be cut up quickly and dried in the form of small pieces, using appropriate tools and with suitable cutting and drying methods.

Peeling can be an advantageous process for timbers with a strong contrast between juvenile and mature timber, since batches of homogeneous veneers can be reconstituted and matched when making plywood, and there are tools suitable for peeling small-diameter timber pieces.

Tropical timber plantations - Côte d'Ivoire