Quality of plantation species for timber use

This is a translation of « Qualité des essences de plantation pour une utilisation en bois d'œuvre » from the « Mémento du Forestier tropical »

Wood production in natural tropical forests is steadily declining and this trend is likely to continue in the coming years. The tropical forestry industry is therefore naturally turning to plantation timber.
Forest plantations require a high investment that must be paid by the harvested forest products, for which quality now counts as much as quantity. The technological properties of wood from plantation trees are different from those of the same species grown in natural forests, which leads to technological and commercial issues. In particular, the properties of plantation wood are very heterogeneous within the same tree, because trees are very often harvested when they have not yet reached maturity. The differences observed differs according to the species: effect of tension wood or juvenile wood on wood properties, consequences of the release of growth constraints on the quality of sawing, impact of branching on the softwood appearance grading, relationship between the lack of maturity of wood and its low natural durability, etc.

Juvenile and adult wood

Young trees (less than 30 years old) have a greater or lesser proportion of juvenile wood whose properties are inferior to those of mature wood. Thus, the properties of wood can vary greatly from the heartwood to the bark. The greatest variations are observed during the first years of growth (Figure 8.1.8). The transition from juvenile to mature wood is never abrupt, but it is more a "decrease in juvenility" of the wood from the heartwood to the periphery. The age limit for the formation of juvenile wood is estimated at 20 years for Eucalyptus regnans and 10 years for *E. saligna*. However, this limit remains very empirical.

Tension wood and growth constraints

The timber value of some plantation species, typically eucalyptus, but also fraké, framiré and other hardwoods, is limited by the lack of stability of the wood during primary processing. This type of defect is mainly due to the presence of tension wood associated with high growth constraints.
Tension wood is formed by the tree in reaction to external events. It induces radial and circumferential heterogeneities. Growth constraints allow the stem to withstand reorientations induced by changes in environmental conditions (thinning). Peripheral tensile forces contribute to bracing 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 wood is the cause of defects that occur during felling and primary processing (sawing):

- In hardwoods, heart splits appear during felling and bucking, sometimes leading to the splitting of the logs; the sawn timber is deformed because of the strong longitudinal tensions at the periphery of the log;

- in sawn timber and veneers of hardwoods or softwoods, sawn timber deforms (warping, buckling...) and splits appear during drying because of the strong heterogeneity of the drying shrinkage. This is called the "nervousness" of wood.

Reaction wood is sometimes the cause of other defects : poor surface condition of wood cut after planing or sanding (in some species, tension wood is "fluffy"), abnormal colorations ("green vein" or "fat vein" due to the presence of tension wood, red compression wood in softwood).

Pruning and nodosity

In plantation softwoods, the presence of knots is one of the main factors in the depreciation of wood quality. These knots can be more or less abundant, larger or smaller, sound, black, rotten, etc. Although knotty wood is considered more decorative for some, knotty wood causes difficulties in sawing and machining (planing, mortising, shaping).

Moreover, as the wood grain is deviated in the vicinity of the knots, it can lead to localized deformations of the cut wood. In some tropical pine species such as *Pinus caribaea* or *Pinus elliottii*, the presence of penetrating knots from young branches near the pith is associated with areas of heartwood infiltrated with resin from traumatic events such as winds, cyclones and repeated fires. Knots reduce the mechanical strength of wood, especially if the knots are numerous and large in diameter. Natural or artificial pruning is a determining factor in the future quality of processed wood.

Impact of the immaturity of plantation wood on its color and natural durability

In some tropical forest species, young plantation wood is lighter in color than older wood or natural forest wood. Their natural durability is often lower because their hardening is incomplete.
These differences can be observed in teak in particular. The appearance of natural forest teak is characteristic and very popular; the color of its wood varies from beige-brown to golden brown with some olive tones; it darkens slightly in the light to a deeper color with copper highlights. This color can be uniform or streaked with a brown-black veining. In plantation teak, the color and appearance of the wood may vary depending on its origin and age.
Inappropriate silviculture can lead to very heterogeneous color, grain defects and even discoloration. Plantation teak less than 10 years old can have a very pale color, yellowish-white to pale beige, due to the absence of mature wood, when the stems are almost entirely made of sapwood.

Thus, the European standard NF EN 350-2 on the natural durability of wood distinguishes between Asian teak (implied natural forest) and cultivated teak :

- the first one is in class 1 of natural durability to fungi (highest class) and in class M (medium durability) of natural durability to termites;
- the second is in classes 1 to 3 of natural durability to fungi and in class M-S (medium to sensitive) of natural durability to termites.

This distinction reflects the difference in quality, especially in natural durability, between the different teaks currently marketed. Some plantation teaks used for mid to low-range garden furniture probably have natural durability lower than class 3.

Importance of log shape and diameter on processing yield

The age of the harvested tree has an importance on the quality of the wood (the larger the diameter of the tree, the lower the rate of juvenile wood and the higher the hardening of the perfect wood), but also on the rate of valorization of the raw material. The yield of the peeling process depends on three factors : the cylindricity of the log, its diameter and the tooling used to peel it to a core of more or less small diameter.

The shape of the logs also affects the quality and appearance of the products obtained. It influences the material yield. Defects in straightness and cylindricity generate greater waste (e.g., rounding of the peeler). Other defects in the log (off-center hearts, threads of too great a slope.) lead to the elimination of the parts of the finished product that include these defects, or considerably reduce its value when defects are included (knots, splits, other defects).

Lumber silviculture must therefore be adapted to obtain logs that are as cylindrical as possible, with little scrolling, no knots, no internal tensions and as hardened as possible. It is therefore a medium to long-term silviculture which can only be profitable by obtaining a very high-quality raw material.

Conclusions

The improvement of the quality of plantation wood in tropical regions must be thought out and conducted jointly with the development of processing industries. Indeed, the time constraints inherent in forest production (except perhaps for very fast-growing plantations) mean that local and international timber markets must constantly use new raw materials, without these being able to be adapted with certainty to a production tool defined.

A simple quick diagnosis of the properties of an exploitable resource must be used to improve its valorization : thus, for example, nervous wood must be cut quickly and dried in the form of small pieces, with the help of appropriate tools and according to adapted cutting and drying methods.

Peeling can be an interesting way to valorize wood with a strong contrast between juvenile and adult wood, since it is possible to reconstitute batches of homogeneous veneers and to match them when composing plywood (there are also tools adapted to peel small diameter wood).