Development of a method to predict natural durability of teak wood by Fourier transform near-infrared spectroscopy

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Teak wood *(Tectona grandis)*, the world's most cultivated high grade tropical hardwood is a high priced timber because of its golden brown color, its high dimensional stability and the high natural durability due to extractives. Teak wood is known to be highly durable to moderately durable. Short rotation affects the decay resistance of teak wood with consequences on its end-uses. Near infrared spectroscopy (NIRS) is useful to estimate parameters preliminary related to *wood chemistry*. ***The objective of this study is therefore to develop a method to determine and correlate the decay resistance with NIRS data in order to propose NIRS like prediction tool of natural durability of teak.***

Material and method

- Wood samples were prepared from the outer, intermediary and internal heartwood from 41 trees (30 years) from Ivory Coast (Seguié plantation). Natural durability tests were performed according to European standard EN 350-1 with *Antrodia* sp with exposure duration of 16 weeks. A second test was carried out on twin samples with a duration exposure of 32 weeks in order to increase the variability of the results.
- FT-NIR spectra were recorded on wood blocks before fungal exposure with Bruker FT-IR spectrometer to measure diffuse reflected light from a 10 nm spot.

Results

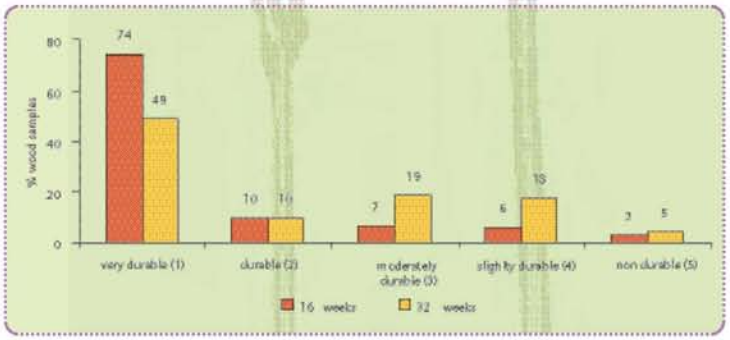

Figure 1. *Natural durability distribution of teak wood according to exposure duration (n= 164 and 154).*

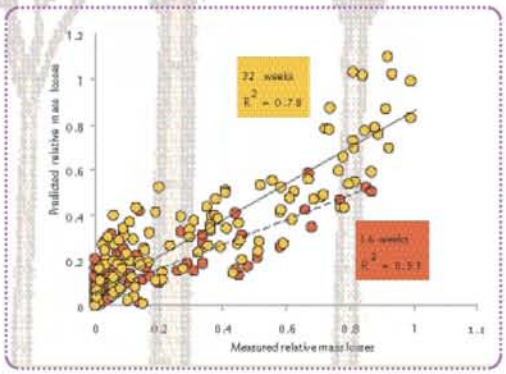

Figure 2. *Comparison of reference values with predicted values for relative mass losses.*

Table 1. *NIRS PLS calibration values (SD standard deviation; SECV standard error of cross Validation; R² determination correlation; RPD ratio of performance to deviation).*

Exposure	Treatment	N	N	Mean	SD	Min.	Max.	SECV	R²	RPD
16 Weeks	snv+detrend+D2	140	190	0.1	0.19	0	0.7	0.13	0.53	1.5
32 Weeks	snv+detrend+D3	157	151	0.29	0.31	0	1.2	0.15	0.78	2.1

Table 2. *Contingency table for durability classes (number of wood samples with green box good prediction; yellow box bad prediction; white box very bad prediction).*

Predicted durability classes		1	2	3	4	5	Good prediction
Measured durability classes	1	49	21	7	0	0	64%
	2	4	5	6	0	0	33%
	3	1	9	19	0	0	66%
	4	0	0	13	9	2	38%
	5	0	0	0	3	5	63%

Conclusion

- High natural durability of teak wood ▸▸ strong tree control.
- Wood samples from Ivory Coast belong to five classes of natural durability, but 74 % of the wood samples are very durable according to EN 350-1.
- Increasing the exposure time against *Antrodia* sp. increases the distribution of wood in all the classes.
- Increasing the exposure time of teak wood against *Antrodia* sp. increases the modelisation of the relative mass losses with NIRS.

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