analysis of the macroscopic characteristics of wood, observation in pocket magnifier (10x) and observation of the histological sections in microtome. Were fabricated and tested 120 samples, according to COPANT standards. Before the destructive bending test, the samples were evaluated non - destructively through the technique of stress waves for determining the dynamic modulus of elasticity and propagation of waves speed.

The Tukey test showed significant differences between the species for physical and mechanical properties. There was no relationship between the propagation waves speed and wood density, however, the Pearson's correlation between the propagation waves speed and static and dynamic MOE, showed values up to 0.90 with α = 0.01. Linear models were adjusted to relationships between the propagation waves speed, dynamic and static MOE for each species and for all data, in both cases the models showed high R2, but superior results were found to analysis of all data. In estimating the static modulus of elasticity, the dynamic modulus of elasticity explained 95.0% of the variation of the observed data. The relation between wave speed and MOE are high, to estimate MOE, the wave propagation speed explained 85.0% of the variation of the data. It is concluded that the method is suitable for predicting the bending properties, capting also the intra-specific variations, allowing the development of models with good predictability.

Keywords: Tropical forest; material selection; wood; stress waves.

Global Nirs Models to Predict Main Chemical Compounds of Eucalyptus Woods

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The Nirs technology is particularly well-suited to tree improvement programmes where huge numbers of samples must be analysed, but it can be used in any forestry application where the rapid measurement of wood property data is required or to screen unknown samples. Forest breeders include chemicals wood properties as selection criteria for new varieties, especially lignin, cellulose, hemicellulose. Efforts to develop multi-site, multiple-species, multiple age calibrations are rare. Because of the genotype x environment/age interactions, we try to develop a very useful multispecies Nirs calibrations to predict chemical properties for varied eucalyptus in term of species, age, and site plantation.

Global near infrared models to predict wood properties of Eucalyptus were developed using more than one hundred samples well representatives from 3,000 wood samples. These calibration set was selected on spectral data based on Mahalanobis distance. Samples were provided from different country and location (Congo, Senegal, Brazil), including different species and hybrids of Eucalyptus (E. urophylla, E. grandis, E. camaldulensis, E. urophylla x E. grandis, E. urophylla x E. pellita) from different age (from 5 to 30 years old). The global models tested by cross-validation, based on our own reference data, shown encouraged fits for extractives, lignin, cellulose, hemicelluloses. The models for lignin and extractives showed higher fits than cellulose and hemicellulose even if for these late, the model remained sufficient for prediction. The high variability of chemical properties due to the sampling, associated to the good repeatability of reference measurements, provided high values of model parameters. These results suggest that global calibration could be useful in tree breeding program and for different experiment trials from the fields, to rank genotypes for extractives, lignin, cellose, and hemicelluloses. Local models are more accurate usually and in order to get local models, we are improving our sampling in term of number and origin of wood. The main interest of this type of calibration is the possibility to screen samples for different species, different origins and the other interest is to select new samples to be included in calibration and validation sets.

Keywords: Nirs; Eucalypt; wet-chemistry; multi-site calibration

Sustainable Mycology Alternatives In Natural Forests And Conifer Plantations In México

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Concepts of mycoforests, mycosylviculture and mycoparks and their relationship to education, production and sustainable management of fungi in forests in México are analyzed. These concepts applied in Mexican protected areas, parks and forestry rural communities and improve socio-economic conditions. Two decades ago commerce of wild edible mushroom in the world was relatively small; mushroom industries were selling their products in a rather informal way. At the end of the 80´s important changes in mushroom commerce occurred; and it became organized in activities such as mushroom picking, cleaning, processing and packing and selling to retailers. Mushrooms prices may depend on factors such as: size, freshness, color, abundance, appearance, flavour, texture and familiarity of sellers and buyers with the species. Currently natural forests and forest plantations where mushrooms grow produce an important income in some European countries. Those countries have multifunctional forest practices integrating mushrooms into sustainable forest management. Mexicans living in most rural forestry conditions are used to picking and eating wild edible mushrooms every year. Natural forests in protected areas and national parks are ideal places for implementation of mycosilviculture and mycopark projects, mushroom courses may be offered to park officers and people living in rural communities inside parks and protected areas. These activities will serve to educate people and generate yearly income for them and these activities should be conducted in keeping with current laws to achieve sustainable management and conservation. Forest management programs and mushroom harvesting practices for commercial and home purposes use should be regulated to ensure sustainability. Thus, mushrooms pickers should buy mushroom picking permits, price to accord to their activities. Money obtained from these permits can be reinvested in forest and edible mushroom management that focuses on multifunctional conservation practices. Countries already applying some degree of mycosilviculture practices to mycoparks or truffleculture include France, Italy, Spain, Potugal, United States of America, New Zeland, Australia, Argentina, Chile, Israel and Morocco. Every year these countries produce significant income from wild edible mushrooms.

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Preliminary first global NIRS models to predict chemical properties of Eucalyptus woods

ForEST industries objectives require adapted material according to end-uses. Forest breeders include chemicals wood properties as selection criteria for new varieties, especially lignins, celluloses, hemicelluloses.
Near infrared spectroscopy is more and more applied and this tool allows breeders to phenotype a huge number of wood samples for selection. Because of the genotype x environment/age interactions, we try to develop a very useful multispecies Nirs calibrations for main properties to predict chemical properties for varied eucalyptus in term of species, age, and site plantation.

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## Materials and methods

- We collected more than 3,000 wood samples of different species and hybrids (*E. urophylla, E. grandis, E. camaldulensis, E. urophylla x E. grandis, E. grandis x E. urophylla, E. urophylla x E. pellita*) from different age of plantation (from 5 to 30 years old), and location (Congo, Senegal, Brazil - **Table I**). The grounded samples were measured by Nirs. Less than 100 samples were selected on the Mahalanobis distance calculated on spectral information (**Figure 1**).

Table I. Site origin and age of wood sampling in month (in bracklet number of sample)

	Congo		Brazil	Senegal
	Loudima	Pointe Noire		
Eucalyptus urophylla	410 (25)	165 (6)	78 (12)	-
Eucalyptus grandis	-	-	78 (12)	-
E. urophylla x grandis	-	60, 141, 222 (27)	74 (8)	-
Eucalyptus camaldulensis	-	-	-	120 (12)
E. grandis x urophylla	-	-	74 (9)	-
E. urophylla x pellita	-	222 (10)	-	-

Figure 1. Selection of samples for reference measurements and Nirs calibrations.
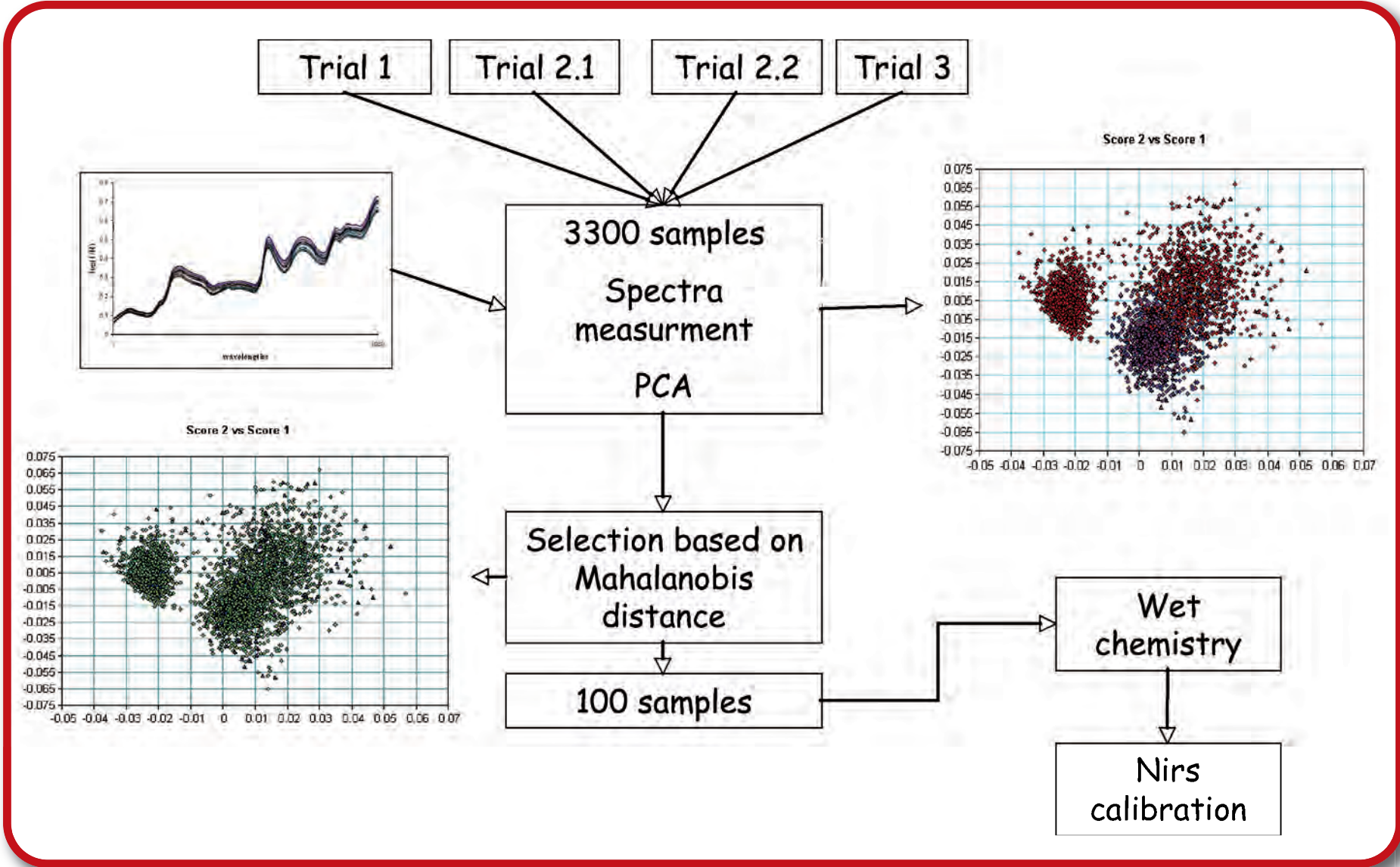
- Nirs spectral: Bruker Vector 22N-1 apparatus, 8 cm^{-1}, 32 sans
- Wet chemistry adapted to Tappy norms: water extractives (WE), ethanol extractives (EE), total extractives (TE=WE+EE), Klason lignin (KL), acid soluble lignin (ASL), holo-cellulose (HO=CE+HE), alpha-cellulose (CE), hemi-cellulose (HE)
- Calibration method: Partial Least Square Regression, cross-validation (5 random groups)

Results

- **Figure 2** and **Table II** show the results of wet chemistry laboratory obtained on selected samples.

Table II. Reference data for the sample set from wet chemistry laboratory (SD: Standard Error, CV: Coefficient of variation)

	Water extractives	Ethanol extractives	Total extractives	ASL	Klason Lignin	Total Lignin	Hemi-cellulose	Alpha cellulose	Holo-cellulose
Minimum	1.0	1.5	2.9	1.1	12.5	14.1	19.0	23.4	48.4
Maximum	6.4	15.9	21.5	5.1	39.4	43.5	34.7	46.7	76.2
Mean	3.1	6.5	9.6	3.7	29.3	33.0	26.1	34.1	60.3
SD	1.4	4.2	5.4	0.9	3.9	3.8	4.0	4.1	6.8
CV	46	65	57	23	13	11	15	12	11
Number	91	91	91	97	97	97	76	76	79

Figure 2. Reference data for the sample set from wet chemistry laboratory (water extractives (WE), ethanol extractives (EE), total extractives (TE), Klason lignin (KL), acid soluble lignin (ASL), holo-cellulose (HO), alpha-cellulose (CE), hemi-cellulose (HE)).
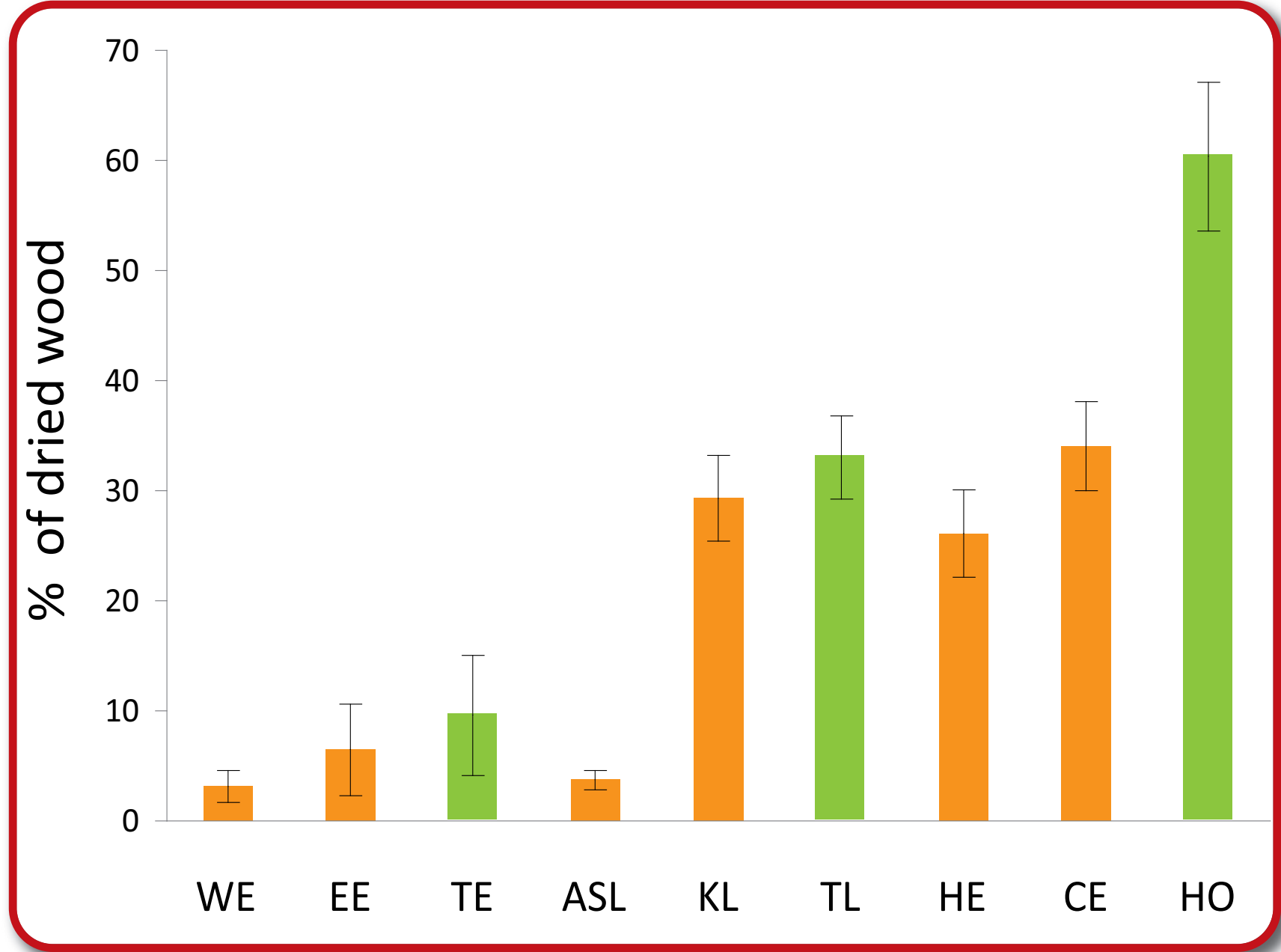
- The global models tested by cross-validation (**Table III** and **figure 3**), based on our own reference data, shown encouraged fits for extractives (correlation coefficient R^{2}cv = 0.98 and error of cross-validation SECV = 0.76 and ratio of performance deviation RPD = 7.2), lignin (R$^2_{CV}$ = 0.91, SECV = 1.1, RPD = 3.3), alpha-cellulose (R$^2_{CV}$ = 0.89, SECV = 1.2, RPD = 3.0), hemi-celluloses (R$^2_{CV}$ = 0.82, SECV = 1.6, RPD = 2.4).

- The high variability of chemical properties due to the sampling (example extractive contents varied from 3 to 21%), associated to the good repeatability of reference measurements, provided high values of model parameters.

Figure 3. PLS-R cross-validation results for Klason lignin and Alpha-cellulose.

Table III. PLS-R model results for whole properties (SECV: standard error of cross-validation, RPD: ratio performance to deviation, LV: latent value)

Wood properties	N	SECV	R²	Spectral Treatment	RPD	LV
Water extractives	89	0.47	0.89	snvdd1	3.0	6
Ethanol extractives	86	0.87	0.96	snvdd2	4.8	2
Total extractives	85	0.76	0.98	snvdd1	7.2	6
ASL	91	0.42	0.74	snvdd2	2.0	4
Klason Lignin	92	1.07	0.91	d2	3.3	3
Total lignin	93	1.18	0.87	d2	2.7	3
Hemi-cellulose	73	1.61	0.82	snvd2	2.4	2
Cellulose	74	1.43	0.84	snvdd2	2.5	5
Holo-cellulose	76	2.07	0.90	snvdd1	3.2	2

Conclusion

These results suggest that global calibration could be useful in tree breeding processes and for different experiment trials from the fields, to rank genotypes for extractives, lignins, celluloses, and hemicelluloses. In order to get near infrared local models, we are improving our sampling in term of number and origin of wood.

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