Les 20èmes Rencontres HélioSPIR, 14 et 15 octobre 2019,
Agropolis Montpellier

La spectroscopie proche infrarouge appliquée au bois à travers les âges

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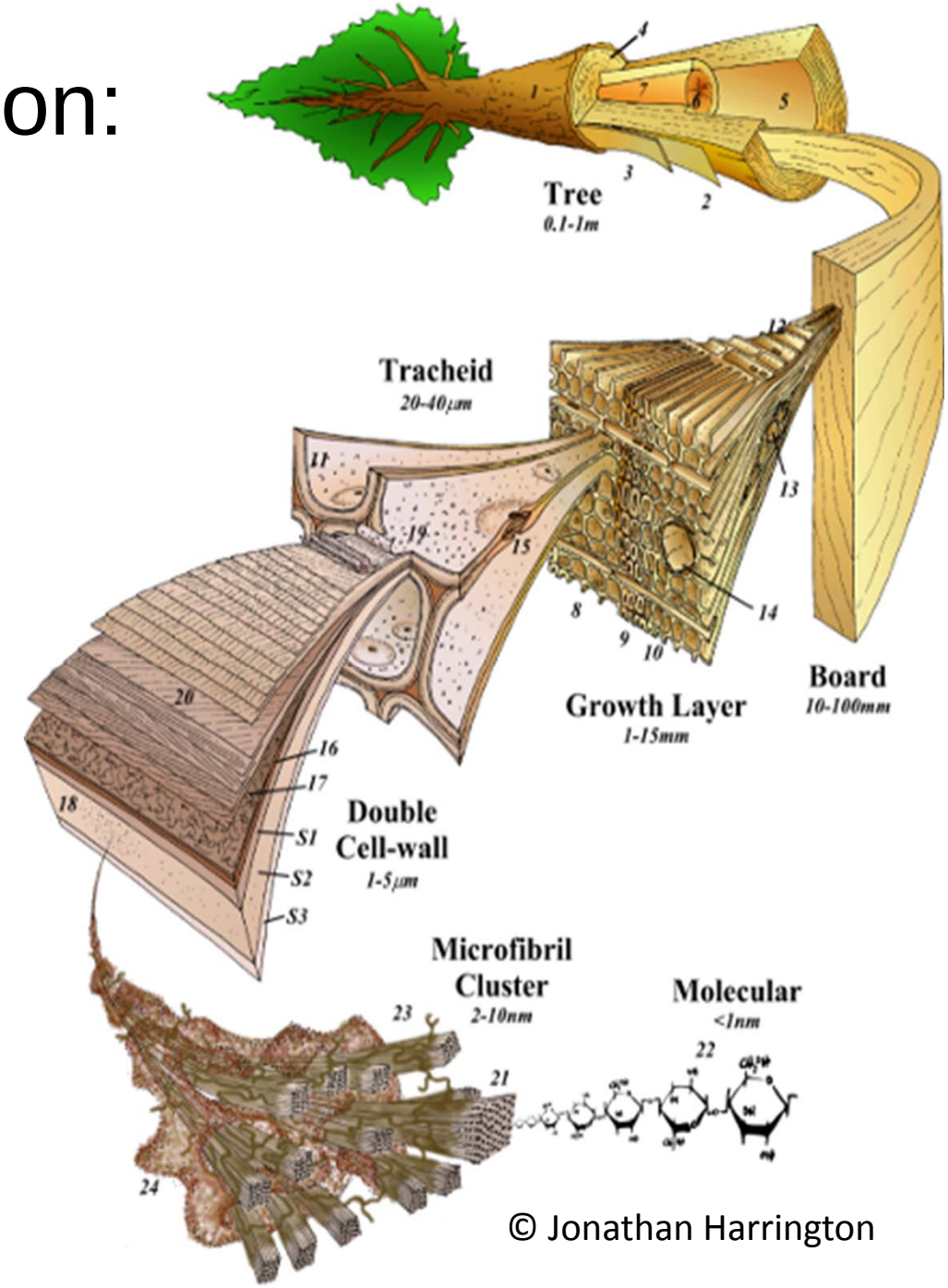
Interventions "bois" aux Rencontres HélioSPIR

Rencontres	Titre	Auteur	
1	Utilisation de la SPIR pour la prédiction des caractéristiques chimiques, physiques, mécaniques et biologiques du bois.	H. Baillères	
8	Apport de la SPIR pour les études génétiques de l'eucalyptus	G. Chaix	
18	Transfert de calibration - HSI et chimie du bois	M. Pires-Franco et al.	
18	Discrimination pour l'aide à l'identification des bois malgaches.	M. Andrianindrina et al.	
18	Utilisation de la spectroscopie proche infrarouge pour la prédiction des propriétés physiques et mécaniques et la discrimination de 5 essences autochtones de la station forestière de Mandraka (Madagascar)	M. Andrianindrina et al.	poster
18	Détermination des taxons de mélèze par spectroscopie proche infrarouge	Vincent Segura et al.	poster
19	Utilisation de spectromètres Proche Infra Rouge portables pour l'évaluation de propriétés du bois sur arbres sur pieds : approche méthodologique et premiers résultats	J.P. Charpentier et al.	
19	Assessment of wood chemical composition in Eucalyptus grandis by hyperspectral imaging and calibration transfer	M. Pires Franco et al.	
19	Microspectromètre SPIR : modèles de prédiction multispécifiques des propriétés de bois de plusieurs espèces forestières de Madagascar	A.R. Razafimahatratra et al	

Wood characterization:

– it’s complicated !

- Highly heterogeneous
  - Radial, longitudinal, circumferential
- Trees 30 m or more
- Where to sample?
- How to sample?
- When to sample?
- Volumetric sampling / weighting?



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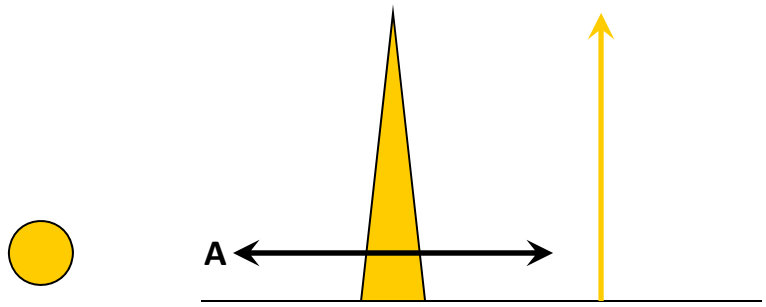
Year 1



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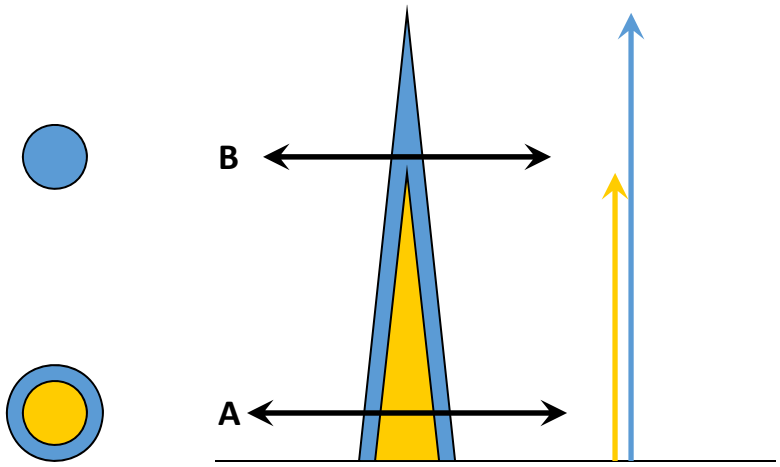

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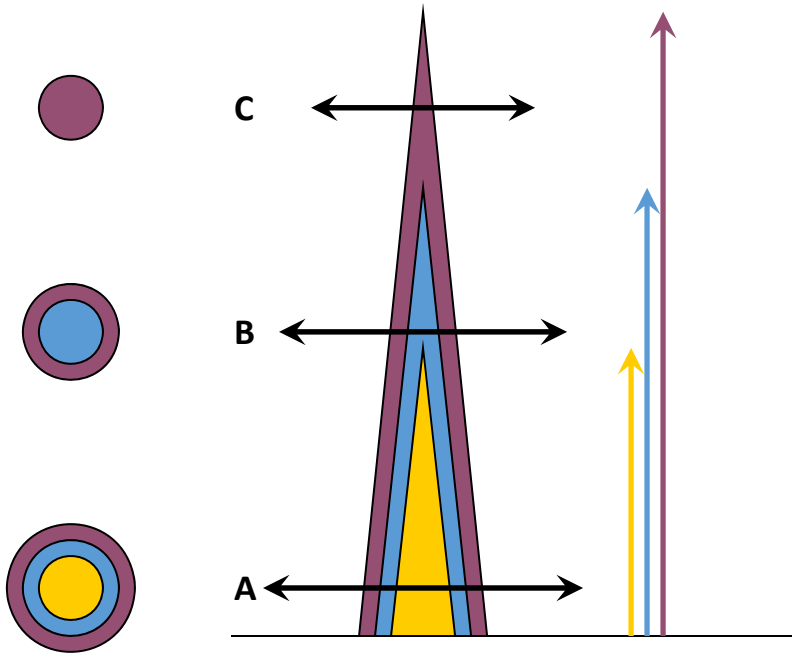
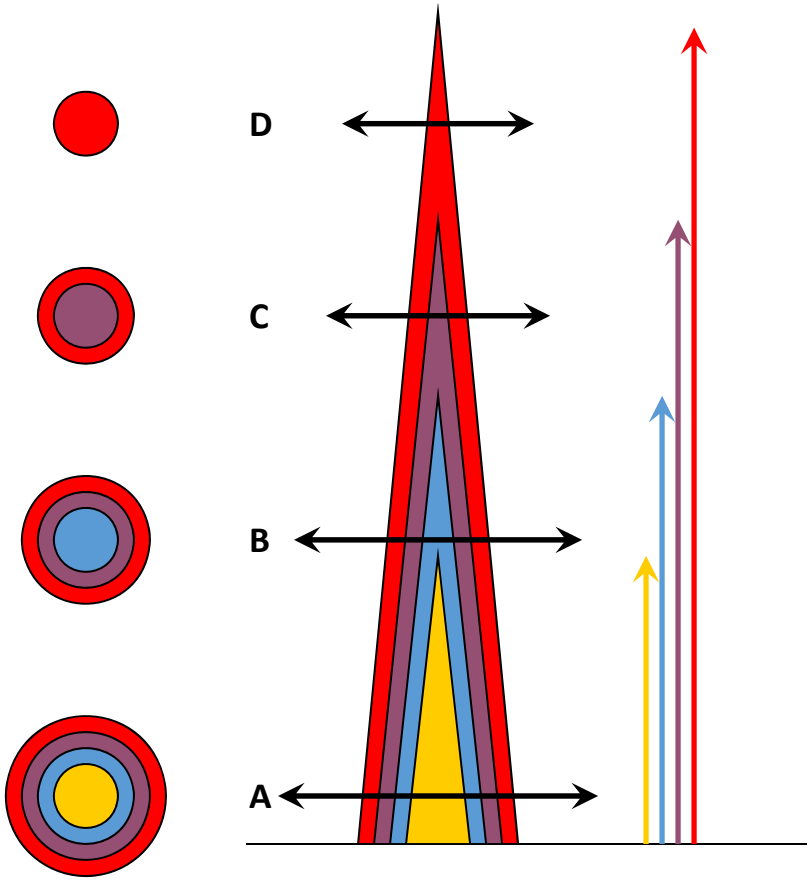
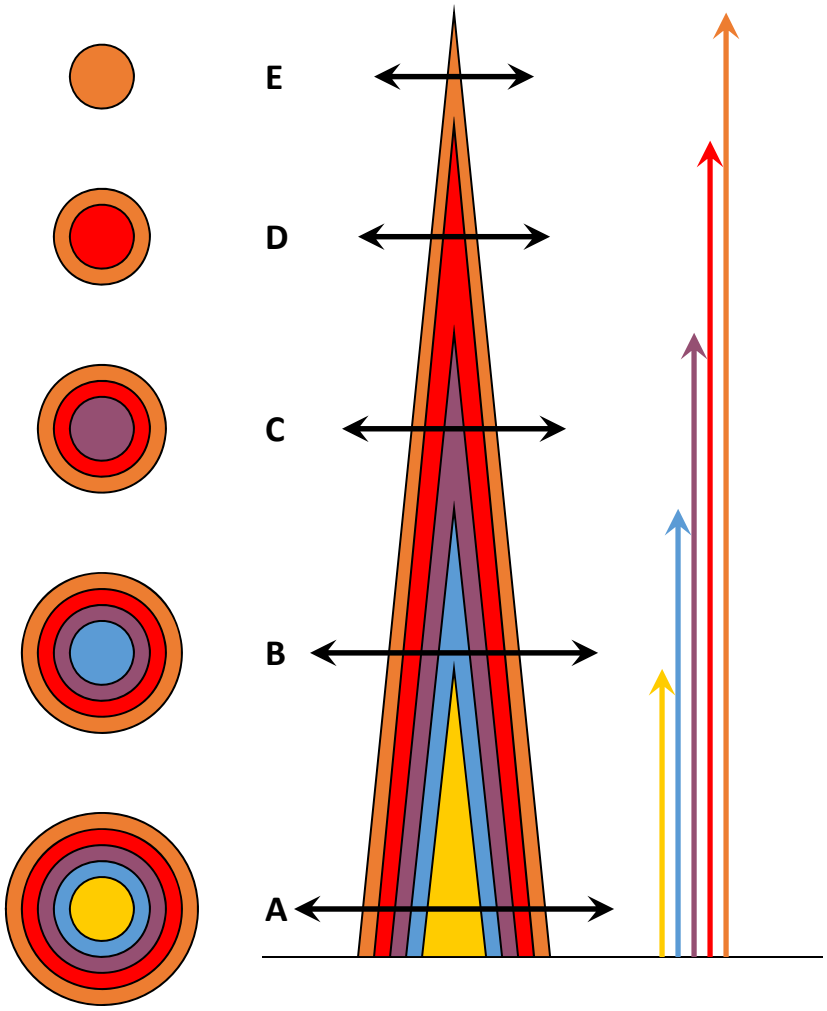


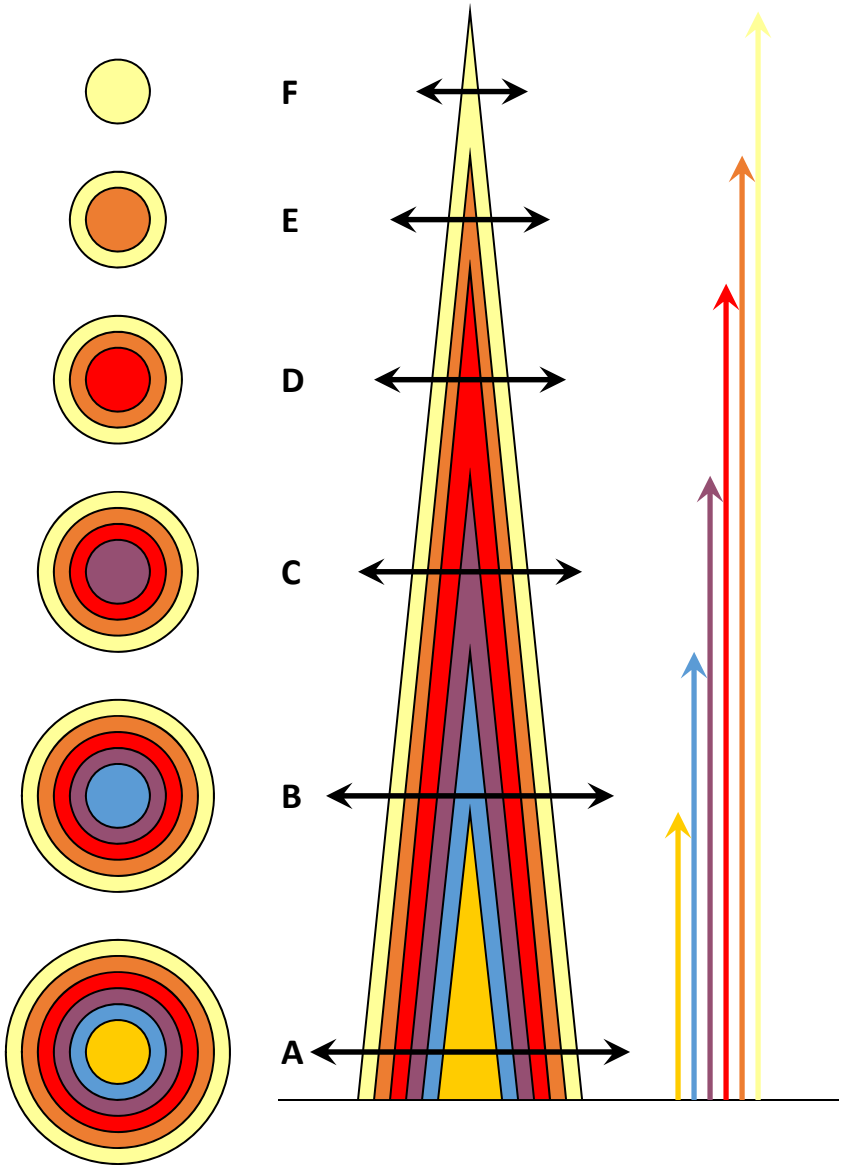
Year 4



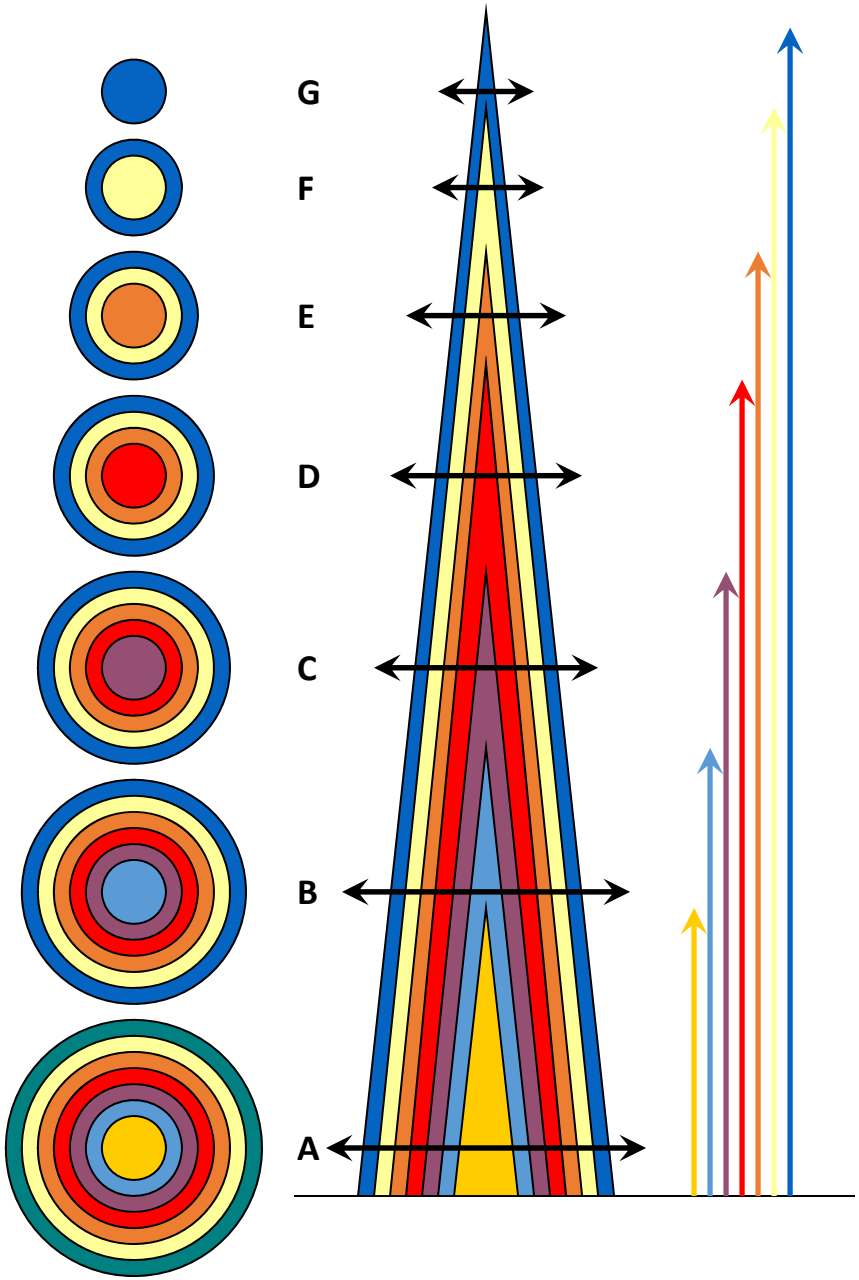
Year 5



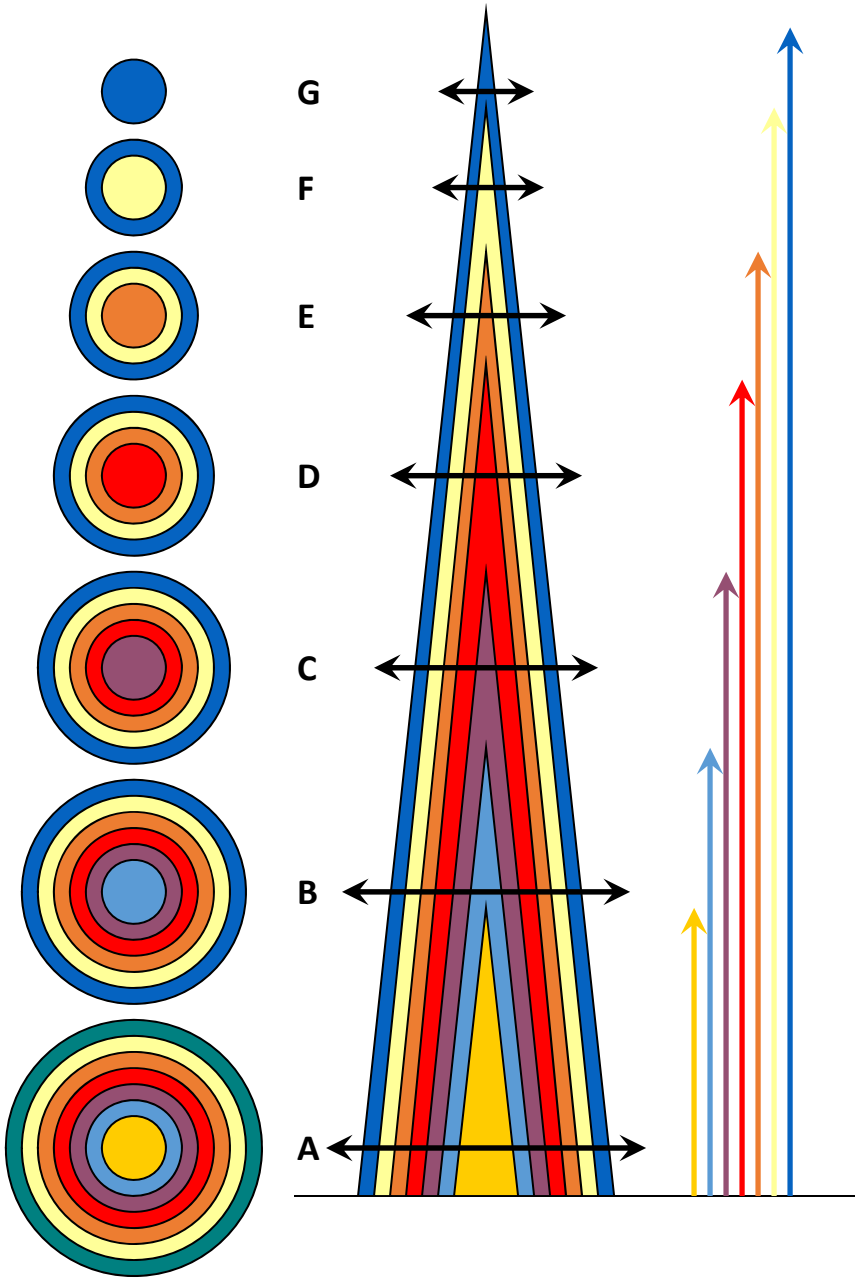
Year 6

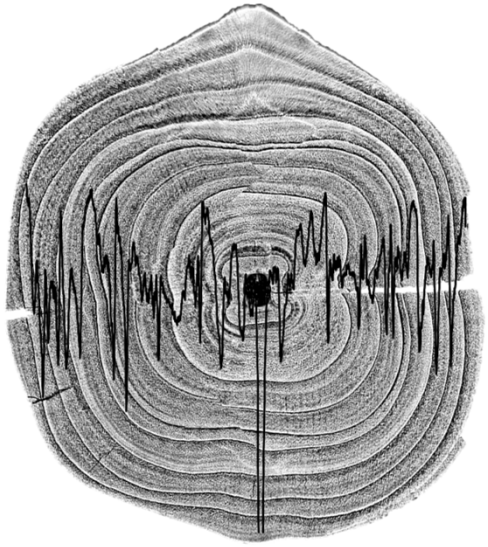


Year 7

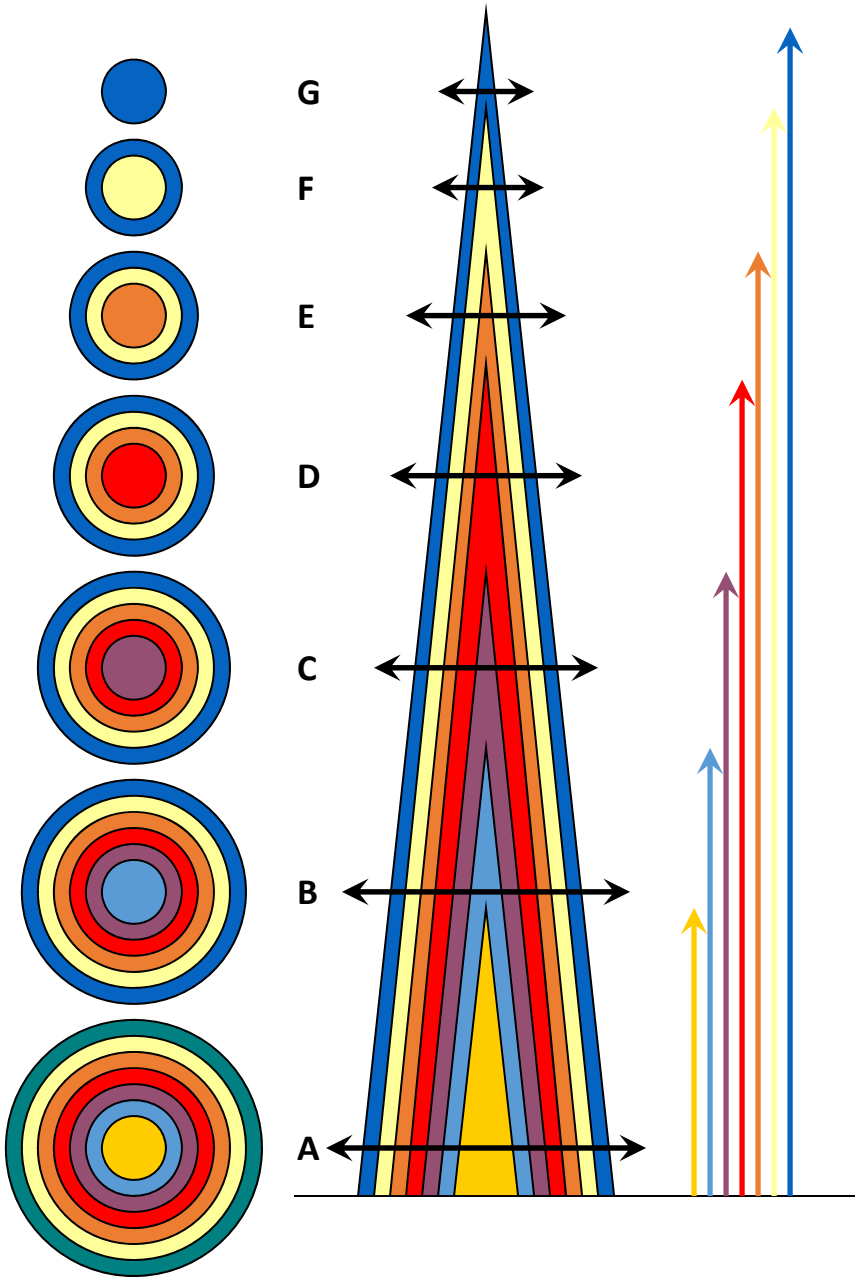


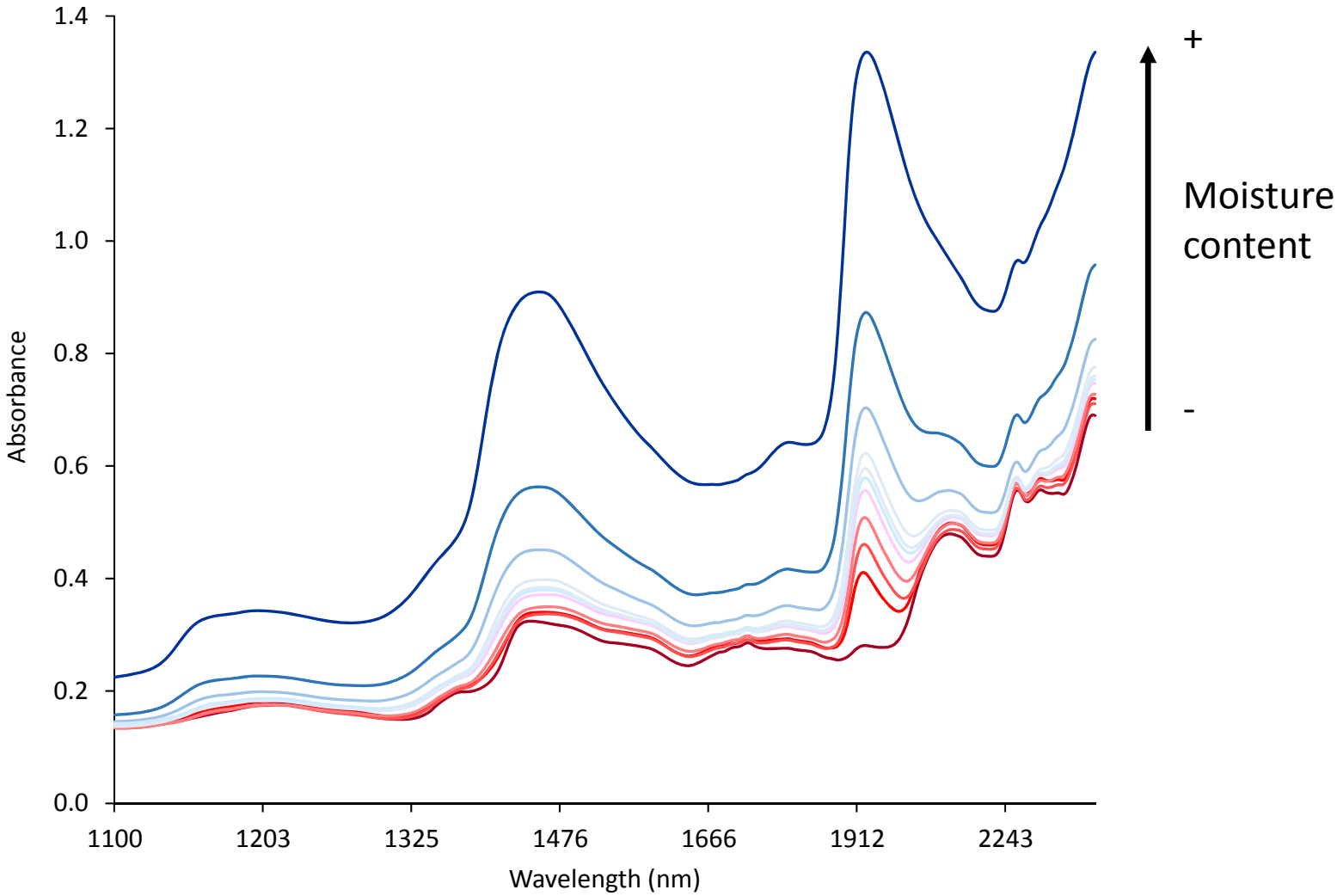
Year 7





Year 7




1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Absorbance
1100
1203
1325
1476
1666
1912
2243
Wavelength (nm)
+
Moisture content
-

Applied Spectroscopy Reviews, 42: 43–71, 2007
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DOI: 10.1080/05704920601036707

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A Review of Recent Near Infrared Research for Wood and Paper

Satoru Tsuchikawa

146 ref.

Applied Spectroscopy Reviews, 48:560–587, 2013
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ISSN: 0570-4928 print / 1520-569X online
DOI: 10.1080/05704928.2011.621079

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A Review of Recent Near-Infrared Research for Wood and Paper (Part 2)

SATORU TSUCHIKAWA[1] AND MANFRED SCHWANNINGER[2]

194 ref.

J Wood Sci (2015) 61:213–220
DOI 10.1007/s10086-015-1467-x

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REVIEW ARTICLE

61 ref.

A review of recent application of near infrared spectroscopy to wood science and technology

Satoru Tsuchikawa · Hikaru Kobori

BIRKETT, M. D.; GAMBINO, M. J. T. Potential applications for Near Infrared Spectroscopy in the pulping industry. Paper Southern Africa, v.11, n.12, p.34-38, 1988.

M. Schwanninger, J.C. Rodrigues and K. Fackler, *J. Near Infrared Spectrosc.* **19**, 287–308 (2011)
Received: 22 August 2011 ■ Revised: 1 November 2011 ■ Accepted: 5 November 2011 ■ Publication: 15 November 2011

JNIRS JOURNAL OF NEAR INFRARED SPECTROSCOPY
Special Issue on Wood and Wood Products

A review of band assignments in near infrared spectra of wood and wood components

Forest Systems
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https://doi.org/10.5424/fs/2017263-11892
Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria O. A., M. P. (INIA)

REVIEW ARTICLE

OPEN ACCESS

Challenges in the use of Near Infrared Spectroscopy for improving wood quality: A review

Paulo R. G. Hein[1], Hannu K. Pakkanen[2], and António A. Dos Santos[3]

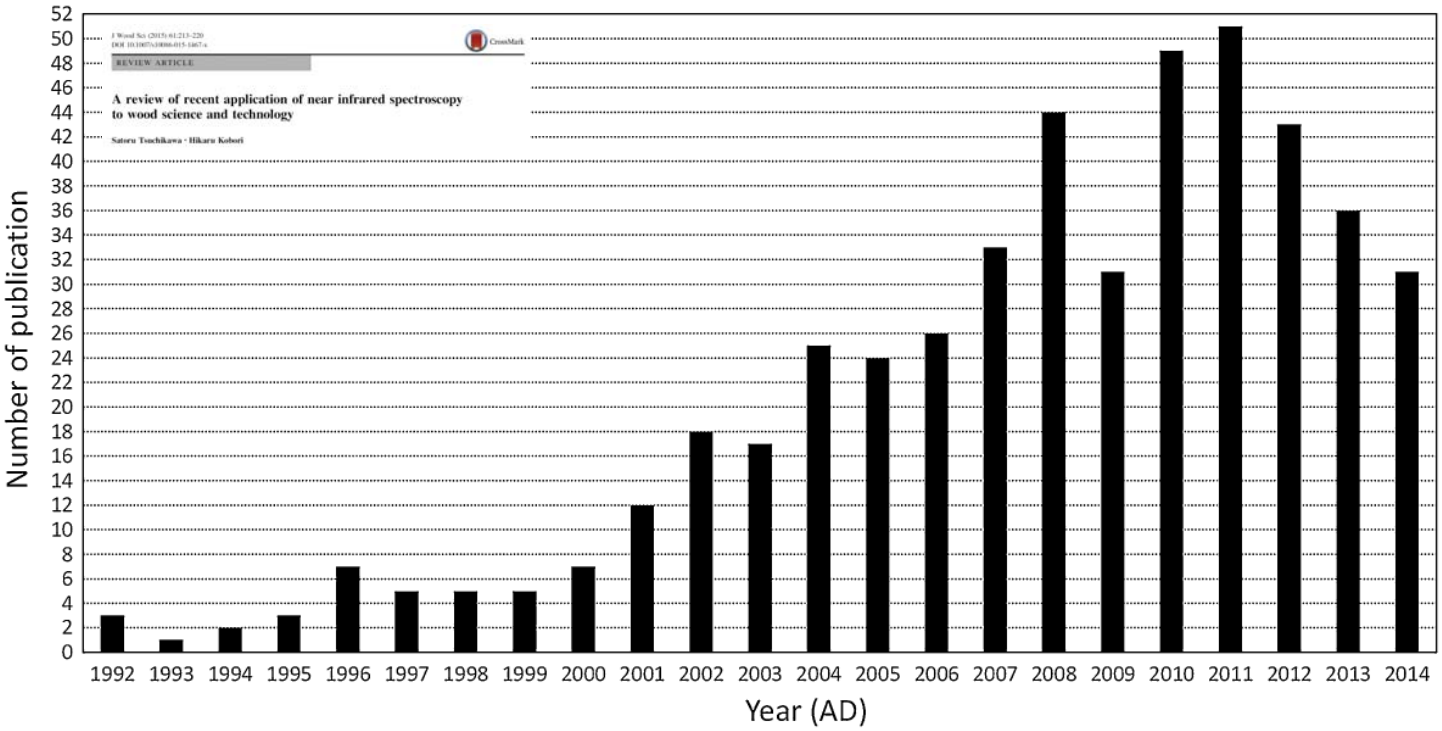
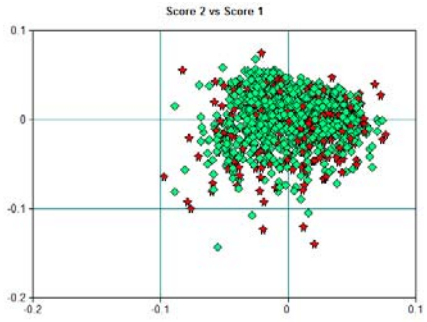


Table 1 Major country of publication due to "NIR" and "Wood" [3]

Country	Number of publications
USA	139
Japan	65
Australia	59
Peoples Republic of China	51
Austria	46
Brazil	42
Sweden	32
France	27
Germany	25
Portugal	18
Canada	18

Bases de la motivation

Sampling and NIR strategy – Example for genetic studies



Selection based on PCA results or relative ranking with previous calibrations

Breeding population

ex: more than 2000 trees

Set of 200 trees

150 trees for calibrations

50 trees for validation

Reference values from laboratories

Hein PRG

Prediction

Outliers

Breeding population

Estimation of individual values for genetic parameters

Hein PRG

Thanks to NIRS:

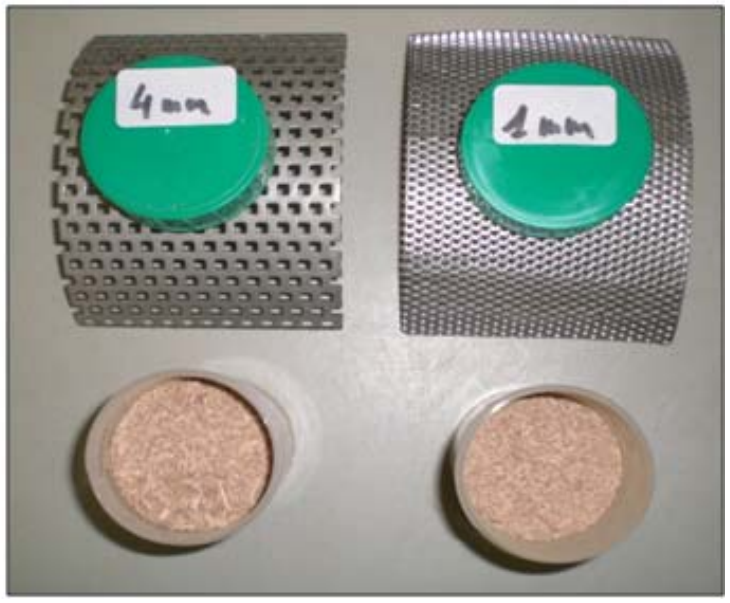
Breeders are including wood properties as selection criteria

Genetic studies on wood properties are possible as association genetic approaches

Non destructive wood sampling for reference analysis and NIR spectroscopy prediction

Bailleres H.

Type of wood samples – NIR spectroscopy

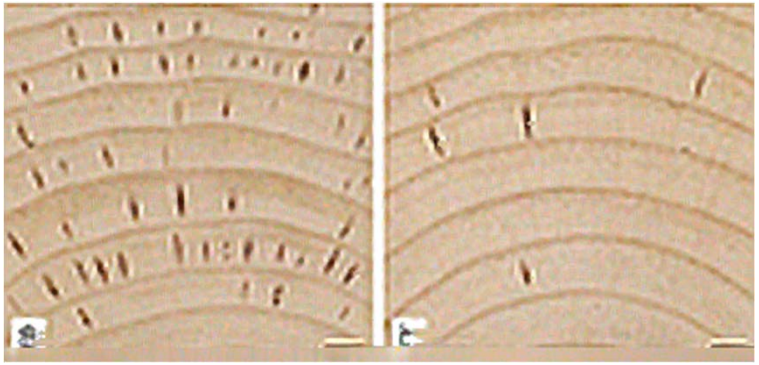


PLS	Wood chemical	Extrait/totaux/individual
		Lignine, S/G
		Cellulose, hemi
		Moisture content
		Natural durability
	Wood physical	Wood density
		Grain Angle and surface Roughness
		Anatomical parameters, fiber length, MFA
		PSF, shrinkage
	Wood mechanical	MOE, MOR
	Wood product	Charcoal CF
		Panels, particule board, physical, mechanical, mixture
		Essential oil Yield
		Pulp Yield, pulp kappa number
DA	Wood product	Mixture composition of panels, particule board
		Qualité et niveau de traitement du bois
	Wood	Species, région identification
		Natural durability classes, preservatives detection
		Wood modification (weathering, temperature)

NIR does it always work?

<u>Intra-ring checking in *P. radiata*</u>

- 3 separate attempts to calibrate NIR with susceptibility to checking.
- No success. R^2 <0.4

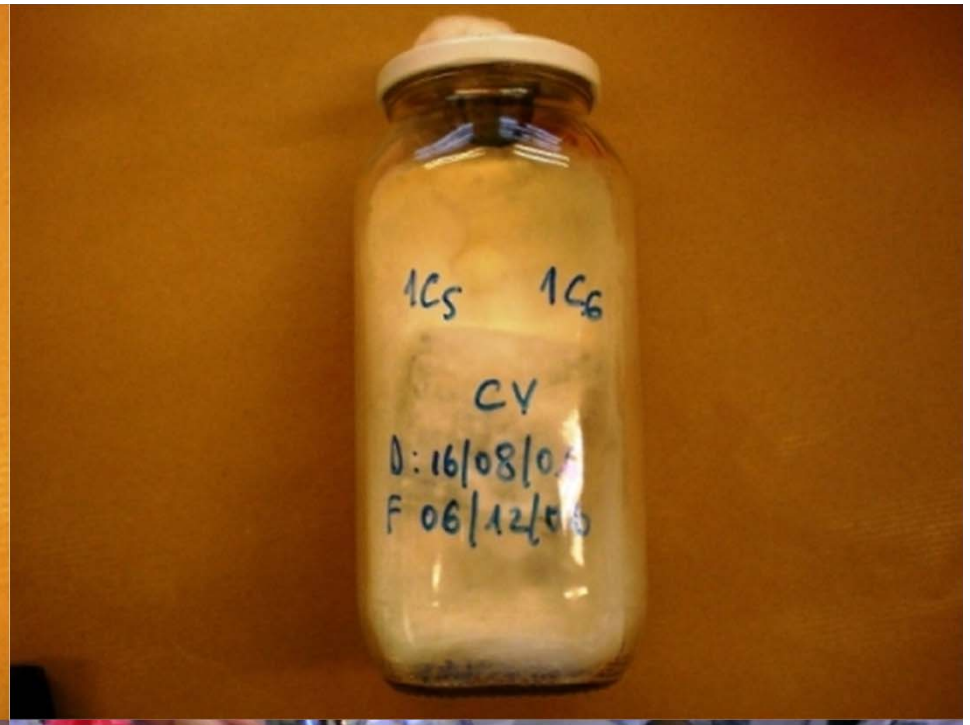


<u>End splitting in Eucalypt and Acacia</u>

- separate attempts to calibrate NIR with susceptibility in *A. mangium* and *E. grandis*
- No success. R^2 = 0

Slide from R. Meder

5 months !!!!



BRILL

IAWA Journal 37 (3), 2016: 420–430

iawa

NIRS IDENTIFICATION OF *SWIETENIA MACROPHYLLA* IS ROBUST ACROSS SPECIMENS FROM 27 COUNTRIES

Maria C. J. Bergo[1,2], **Tereza C.M. Pastore**[2,*], **Vera T.R. Coradin**[2], **Alex C. Wiedenhoeft**[3], and **Jez W.B. Braga**[1]

[1]Chemistry Institute, University of Brasília, 70910-000 Brasília, DF, Brazil
[2]Forest Products Laboratory, Brazilian Forest Service, 70818-970 Brasília, DF, Brazil
[3]Forest Products Laboratory, Madison, WI 53726, U.S.A.
*Corresponding author; e-mail: tereza.pastore@florestal.gov.br

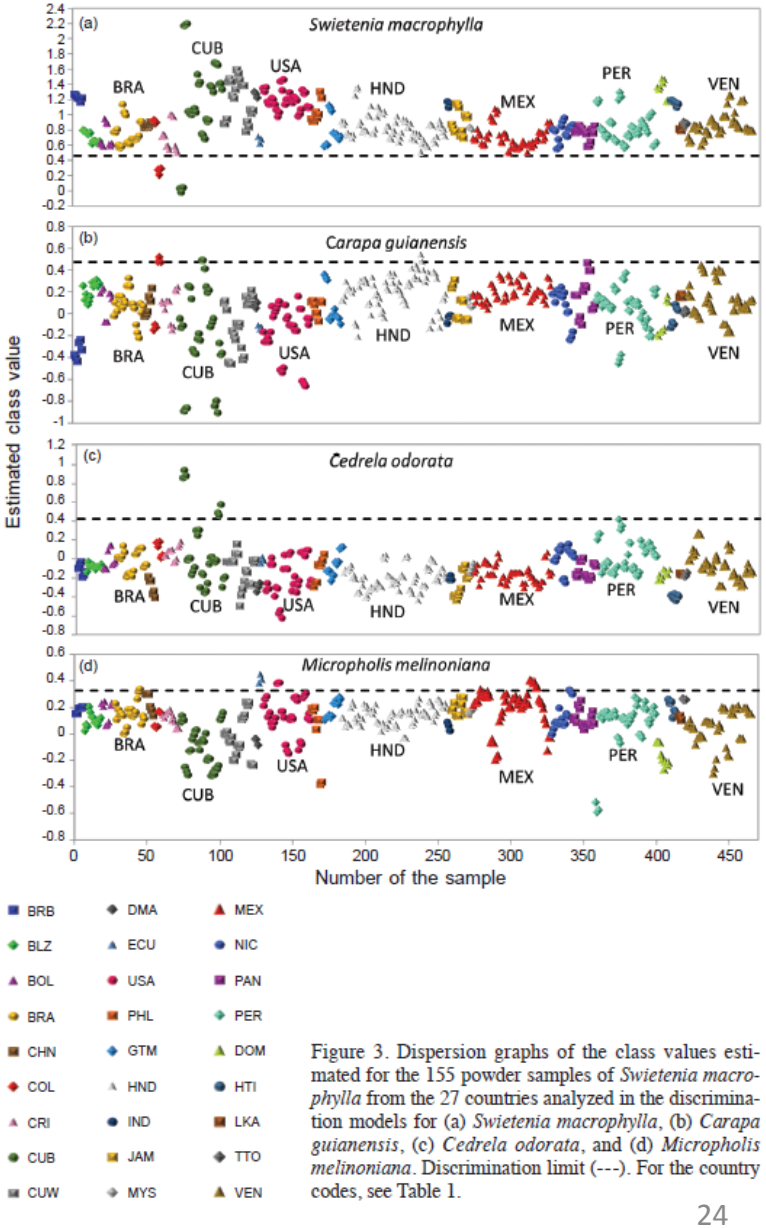
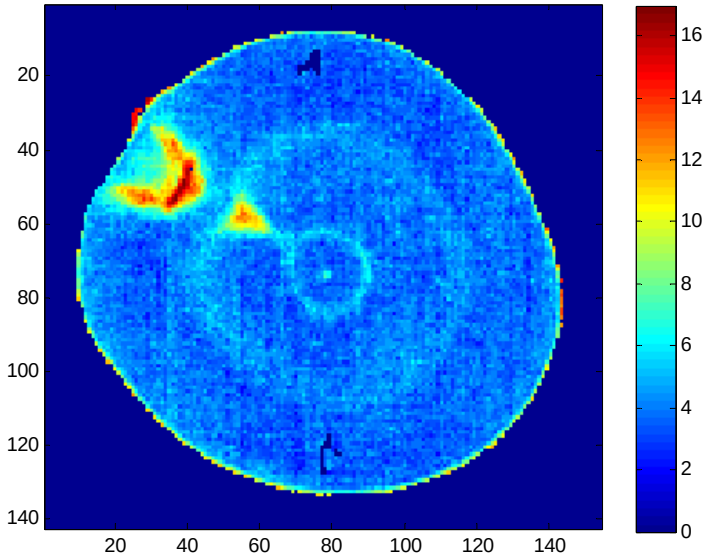


Figure 3. Dispersion graphs of the class values estimated for the 155 powder samples of *Swietenia macrophylla* from the 27 countries analyzed in the discrimination models for (a) *Swietenia macrophylla*, (b) *Carapa guianensis*, (c) *Cedrela odorata*, and (d) *Micropholis melinoniana*. Discrimination limit (---). For the country codes, see Table 1.

Hyperspectral imaging for wood

Image aquisition on wood disk

Extractives predicted map



Wood density predicted map