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Abstract (limited to 500 words)

Tension wood (TW) is a reaction wood produced by woody angiosperms in response to mechanical constraints. A high amount of TW in logs is traditionally considered as undesirable because it can twist, cup or warp dramatically during machining. However, TW is characterized by a low amount of lignins and a large amount of cellulose in comparison with normal or opposite wood (OW), which are desirable characteristics for bioethanol production. Whatever the final use of biomass, it is crucial to detect and quantify the occurrence of TW. However, current techniques are based on staining, microscopic sections or visual inspections (Jourez, 1997[a], Badia *et al.*, 2005[b]) and thus are costly and tedious, which do not allow their use in routine for screening a large number of samples.

Near infrared spectroscopy (NIRS) is a promising high throughput technique for evaluating the physical and chemical properties of wood. As TW is characterized by specific physical and chemical properties, its detection and quantification by NIRS should be possible. The present study aimed at testing this hypothesis on a set of poplar samples.

A synthetic calibration curve was built by mixing TW and OW powders that were sampled on a tilted tree (*Populus tremula x Populus alba*, clone 717-1B4), resulting in 11 samples that ranged between 0 and 100% of TW. NIR spectra have been collected on these samples using 3 different spectrometers: (1) a Perkin Elmer Spectrum 400 FTIR with the NIRA module ; (2) an ASD LabSpec 4 with a bifurcated probe or a muglight ; (3) a JDSU microNIR (JDSU). We first developed NIRS calibration using the entire spectral range for each equipment. Secondly, we focused on the common region, ranging between 1,000 and 1,676 nm. In both cases, calibration models were built using partial least square regression whose number of latent variables was optimized by cross-validation.

Using the entire spectral range the calibration models were quite accurate: they were characterized by R^2_{cv} ranging between 0.97 and 0.99 and $RMSE_{cv}$ ranging between 3.16 and 5.7%. Restricting the spectra to the common region (1,000-1,676 nm) the calibration models remain accurate with R^2_{cv} ranging between 0.98 and 1.00 and $RMSE_{cv}$ ranging between 1.74 and 4.94%. Within this common spectral region, we identified 4 bands highly correlated with TW amount (R^2 = 0.72 – 1.00) and located at 1,160, 1,432, 1,585 and 1,676 nm.

Our results demonstrate the potential of NIRS to detect and quantify TW in poplar wood. The robustness of present calibration models is currently being assessed in other poplar species. Also, since TW amount is typically quite low in natural conditions (between 0 and 15%), a validation of the present calibration will be required within these conditions before its use in routine for screening poplar wood samples.

Acknowledgements (limited to 30 words)

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Novelty (limited to 100 words)

This study is the first to our knowledge to propose a NIRS calibration for quantifying tension wood. Mc Lean *et al.*[c] have recently proposed to use NIR and ATR-FTIR for detecting compression wood

[a] MA Badia *et al.* (2006) Ann. For. Sci. 62: 43-49.

[b] B Jourez (1997) Biotechnol. Agron. Soc. Environ 1: 167-177.

[c] McLean *et al.* (2014) Can. J. For. Res. 44: 820-830.

in conifer but they haven't developed a calibration curve for its quantification.

[a] MA Badia *et al.* (2006) Ann. For. Sci. 62: 43-49.
[b] B Jourez (1997) Biotechnol. Agron. Soc. Environ 1: 167-177.
[c] McLean *et al.* (2014) Can. J. For. Res. 44: 820-830.