Comparison of NIR and FT-IR Spectral models in the Prediction of Cotton Fiber Strength

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Abstract **In routine programs, cotton strength has been mostly assessed by automation-oriented high volume instrument (HVI) system. An alternative method for cotton strength is near infrared (NIR) spectroscopy. Although previous NIR models have suggested the challenge in accurate and reliable prediction of HVI strength, in this research we have observed a much improved NIR model for HVI strength after applying the pre-screening procedure to determine appropriate calibration samples. As a validation and complementary approach, FT-IR spectra were correlated with cotton Stelometer strength. The capability of FT-IR model for Stelometer strength is in good agreement with that of NIR model for HVI strength, verifying the potential of NIR technique in robust, reliable and quantitative determination of cotton strength property.**

1. Introduction

- **We have demonstrated the consistency of strength readings between HVI and Stelometer tests if both values were divided by HVI micronaire, and also observed an improved NIR model with modified HVI strength as a reference.**
- **Until now, NIR models on HVI strength were poor.**
- **FT-IR technique is sensitive to changes in cottons.**

2. Objective

(1) to correlate the HVI with Stelometer strength.
(2) to propose a pre-screening procedure in determining appropriate calibrations for NIR model.
(3) to develop NIR model on HVI strength.
(4) to establish FT-IR model on Stelometer strength.
(5) to compare the modeling (NIR vs. FT-IR).

3. Experimental

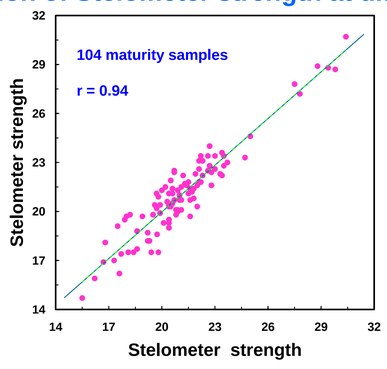
- **Cottons.** **They were collected to represent diverse varieties, locations and crop years, and also conditioned at relative humidity of 65% and temperature of 72 ± 2 ºF.**
- **Visible/NIR reflectance and HVI strength.** **Foss XDS spectrometer (400-2500 nm) was used. Ca 10 g of HVI samples were loaded into a Foss coarse cell.**
- **FT-IR ATR and Stelometer strength.** **Varian FTS 3000MX FT-IR spectrometer with an ATR accessory were used. ~ 0.5 mg of broken Stelometer fibers were loaded.**
- **Prediction models.** **PLSplus/IQ package in Grams/AI (V 7.01, Thermo Fisher Scientific, MA) was utilized to develop models. One third samples were assigned as validations, and 90% confidential was applied to exclude the outliers.**

Visible/NIR and HVI strength

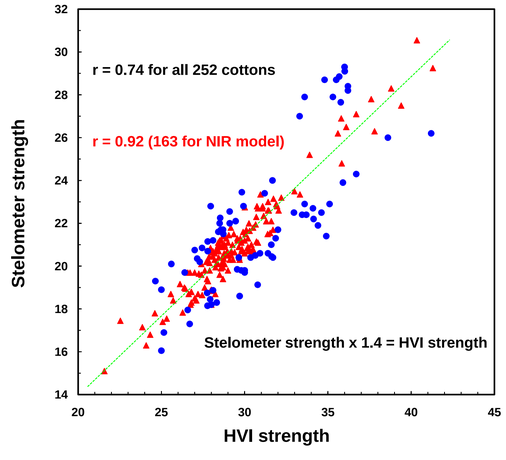
FT-IR and Stelometer strength

4. Results and Discussion

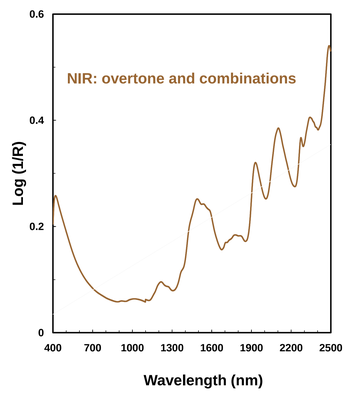
4.1 Correlation of Stelometer strength at different runs

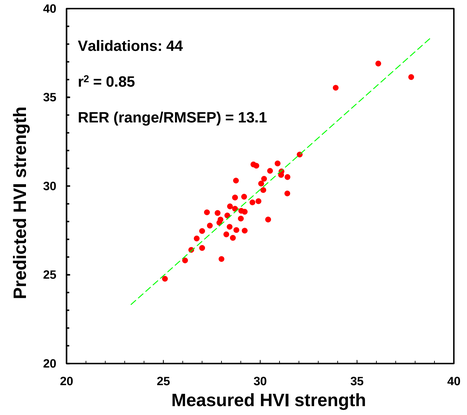


4.2 Correlation of HVI vs. Stelometer strength



4.3 NIR model for HVI strength





4.4 FT-IR model for Stelometer strength

5. Conclusions

- **The study demonstrates the consistency of cotton fiber strength between two measurements.**
- **We have proposed a pre-screening procedure to determine appropriate calibration samples (or to remove the outliers) before NIR model development.**
- **NIR model for HVI strength is in good agreement with FT-IR model for Stelometer strength. Both suggest the feasibility for quantitative prediction of cotton strength for the purpose of quality control (RER > 10).**

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