A NEW APPROACH TO COTTON TRASH MEASUREMENTS

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Abstract

A study has been carried out to determine the feasibility of measuring the mass of trash in a sample of cotton lint by means of a rapid/non-destructive spectroscopic method. Two different studies were conducted. The first (Study A) involved three cottons grown in three states in 2008. Cottons were subjected to two different harvesting treatments and were processed into yarn with waste samples collected at several points in the process line. A total of 165 samples were analyzed using a JASCO V-670 UV/visible/NIR spectrometer. Reflectance (R) readings were acquired over the 220 - 2500 nm wavelength range at 1-nm intervals and converted into log (1/R) values. The second (Study B) involved three cottons grown in Texas that were subjected to nine different ginning/cleaning treatments with a total of eight reps yielding 216 different samples. A total of 175 samples were analyzed using a FOSS XDS Rapid Content Analyzer. Reflectance (R) readings were acquired over the 400- 2500 nm wavelength range at 1-nm intervals and converted into log (1/R) values.

In Study A we used the Grams/AI package, with 67% (110/165) of the samples used for calibration and 33% (55/165) for validation. These were chosen by selecting every third sample. For Study B we used the FOSS Vision program, with 75% (131/175) of the samples used for calibration and 25% (44/175) for validation selected by the program. For each study, models were developed in 3 spectral regions with the following spectral pretreatments: the best prediction models were obtained from the combinations of such spectral pretreatments as mean centering (MC), standard normal variate (SNV), and the first derivative (1st deri.). A comparison of the validation models for the two studies is given in Tables I and II. In these tables we define RPD, the ratio of the standard deviation (SD) of reference value against root mean square error of validation (RMSEV). This is often used as a dimensionless gauge of the ability of a spectroscopic model to predict a property. An RPD value of greater than 2.5 indicates the suitability of the model for a screening program, and a value of 1.0 or less indicates the lack of modeling power.

Table I. Results from the validation model of Study A obtained with the JASCO spectrometer.

Region	Pretreatment	R^2	RMSEV	RPD
226-2469 nm	MC	0.90	6.42	3.0
226-1100 nm	MC + SNV	0.88	7.04	2.7
1100-2469 nm	MC + SNV	0.86	7.47	2.6

Reference range ± SD: Study A: 27.9 ± 19

Table II. Results from the validation model of Study B obtained with the FOSS spectrometer.

Region	Pretreatment	R^2	RMSEV	RPD
400-2469 nm	1st deri.	0.83	0.573	2.4
400-1100 nm	1st deri.	0.85	0.540	2.6
1100-2469 nm	1st deri.	0.85	0.567	2.4

Reference range ± SD: Study B: 2.82 ± 1.37

Preliminary results indicate it is feasible to obtain reasonable (R^2>0.8) models using UV/VIS/NIR instruments to predict the gravimetric trash content of cotton. Even with limited sample size using a relatively simple instrument it is possible to obtain very good results (R^2~0.9) with a set of samples containing a wide-ranging amounts of trash. Using a more sophisticated instrument with a larger sample holder, we can obtain good results (R^2~0.85) with a set of lint samples containing a relatively narrow range of non-lint content. We intend to continue this research using the FOSS to determine the impact of increased repetitions on enhancing accuracy