MODELING OF COTTON FIBER QUALITY FROM ENVIRONMENTAL PARAMETERS

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Abstract

The value of a cotton crop is determined by a combination of yield and quality parameters. Research to date has concentrated on the yield side of this relation. The objective here was to determine the relations between physiological and AFIS maturity/quality parameters and various environmental inputs. Two cotton varieties were grown in 1992 (PIMA S-6, DES 119) and two in 1993 (DPL 5415, PIMA S-6) in Starkville, MS. Cotton bolls were harvested at selected times throughout the growing season and analyzed by AFIS and Calcium-XRF techniques. Temperature data, at daily increments, was used to calculate heat accumulation (growing degree days) by several methods. Although several base and ceiling temperature combinations were investigated, the analyses indicated that a ceiling temperature of 32 ºC combined with a base temperature of 13.5 ºC consistently resulted in the highest correlations with fiber properties. For this reason, only data for these temperatures are presented.

The accumulated temperature results were then correlated to quality and maturity parameters. The highest correlations, for all heat accumulation models, were obtained for Theta, IFF, Micronafis, and Ca-XRF. These properties are associated with fiber maturity. Lower, but still significant, correlations were obtained for L(n), SFC(n), L(w) and SFC(w). These properties are associated with fiber elongation. Fiber diameter [D(n)] was not significantly correlated with any of the models investigated. When only the Pima S-6 variety was considered, higher correlations were obtained for almost all fiber properties. This was particularly evident for L and SFC. The correlation with Ca-XRF did, however, decrease significantly. When the DPL and DES varieties were considered alone, the correlations with the fiber maturity parameter Theta, IFF, FFF, Micronafis and Ca-XRF increased markedly. The L and SFC parameters did not change.

When all varieties were included, significant linear equations were obtained for all fiber properties, except diameter [D(n)]. The best relations were obtained with Theta, IFF and Micronafis, (r^2 = 0.73, 0.67 and 0.64), respectively. When only the Pima S-6 variety was considered, significant linear equations were obtained for all fiber properties. The highest correlation coefficients were obtained for Theta, IFF and Micronafis, (r^2 = 0.70, 0.68 and 0.68), respectively. Significant improvements were also observed in equations for L and SFC. Finally, a significant relation, albeit small was also observed for diameter [D(n)]. When the DPL and DES varieties were considered alone, significant linear equations were also obtained for all fiber properties. The results for L and SFC were similar to the complete data set, if slightly poorer. The coefficients of determination for Theta, IFF and Micronafis were the highest of the data sets analyzed, with r^2 = 0.78, 0.69 and 0.77, respectively. Highly significant equations were also obtained for fiber cross sectional area [A(n)] and Ca-XRF.

To investigate the influence of daylength and solar radiation (insolation), their values for a given day were multiplied by the total heat accumulated for that day. These values were then summed over the growing season and subjected to multiple linear regression techniques. The results were compared to linear combinations of the temperature model alone.

When all varieties were included in the analysis, significant equations were obtained for all fiber properties except diameter [D(n)]. Several interesting trends were also observed. When daylength was included in the model a significant improvement was observed in the coefficient of multiple determination for L and SFC. Insolation alone did not have this effect; although when combined with daylength in the three variable model, further increases were observed. Increases int he coefficient of multiple determination were only seen for the three-variable model for the remaining fiber properties. When only the Pima S-6 variety was considered, significant equations were obtained for all fiber properties. The trends observed were similar to the complete data set, although the coefficients of multiple determination were slightly higher. When only the DPL and DES varieties were considered, significant equations were also observed for all fiber properties. Improvements in the coefficient of multiple determination were seen for all fiber properties.

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