Understanding the Relationship between Cotton Fiber Properties and Non-Cellulosic Cell Wall Polysaccharides

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ABSTRACT

A detailed knowledge of cell wall heterogeneity and complexity is crucial for understanding plant growth and development. One key challenge is to establish links between polysaccharide-rich cell walls and their phenotypic characteristics. It is of particular interest for some plant material, like cotton fibers, which are of both biological and industrial importance. To this end, we attempted to study cotton fiber characteristics together with glycan arrays using regression based approaches. Taking advantage of the comprehensive microarray polymer profiling technique (CoMPP), 32 cotton lines from different cotton species were studied. The glycan array was generated by sequential extraction of cell wall polysaccharides from mature cotton fibers and screening samples against eleven extensively characterized cell wall probes. Also, phenotypic characteristics of cotton fibers such as length, strength, elongation and micronaire were measured. The relationship between the two datasets was established in an integrative manner using linear regression methods. In the conducted analysis, we demonstrated the usefulness of regression based approaches in establishing a relationship between glycan measurements and phenotypic traits. In addition, the analysis also identified specific polysaccharides which may play a major role during fiber development for the final fiber characteristics. Three different regression methods identified a negative correlation between micronaire and the xyloglucan and homogalacturonan probes. Moreover, homogalacturonan and callose were shown to be significant predictors for fiber length. The role of these polysaccharides was already pointed out in previous cell wall elongation studies. Additional relationships were predicted for fiber strength and elongation which will need further experimental validation.