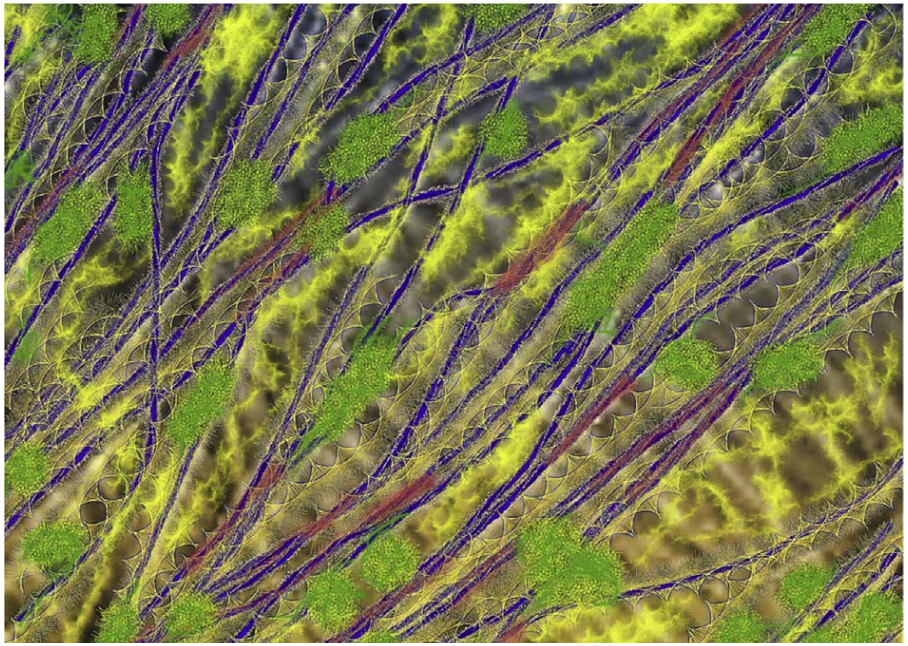
Re-constructing our models of cellulose and primary cell wall assembly

Scientific Achievement

An up-to-date synthesis of new developments in primary cell wall structure, especially physico-chemical interactions important for cell wall strength, selectivity of wall-modifying enzymes and the mechanism of plant cell growth.



Depiction of the arrangement of cellulose microfibrils (blue), xyloglucan (green) and pectins (yellow) in primary cell walls, based on advances in atomic force microscopy, NMR and enzymatic approaches.

Significance and Impact

Numerous aspects of the oft-cited 'tethered network' model of the plant primary cell wall are challenged by recent results. This review integrates recent discoveries into a coherent view of the primary cell wall to identify the next generation of questions:

- *Crystallographic structures of cellulose synthase enable a molecular foundation for understanding how cellulose microfibrils are made.*
- *The traditional 36-chain model of the cellulose microfibril is less likely than an 18-chain model which fits recent structural data and matches estimates of 18 catalytic units per cellulose synthesizing complex.*
- *Hydrophobic and hydrophilic surfaces of cellulose microfibrils bind differently to matrix polysaccharides.*
- *Direct contacts and bundling of microfibrils provide limited sites ('biomechanical hotspots') for wall loosening and control of cell growth.*
- *NMR indicates pectin-cellulose interactions are more prevalent than xyloglucan-cellulose interactions, but the basis of the interactions is not well understood.*

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