TRICHOME DEVELOPMENT

Constrained expansion

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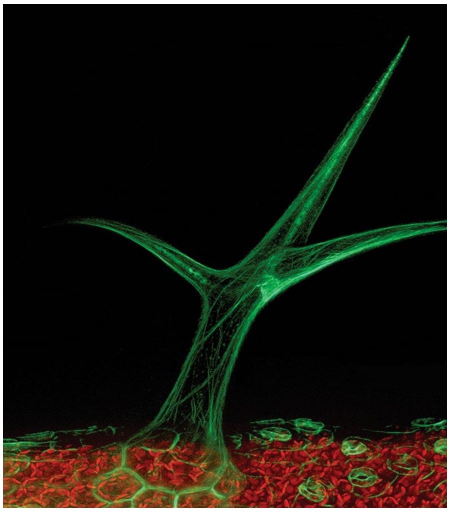

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The mechanical properties of the plant cell wall provide a relatively rigid casing to mature plant cells. However, during development it is the growth of the underlying cell that creates its final form. Using leaf trichomes as a model, Dan Szymanski of Purdue University, Indiana, and colleagues have shown that the polarised growth of these cells is achieved by the indirect interaction of both the microfilamental and microtubular cytoskeleton.

Trichomes are single cells that project from leaves and, sometimes, other organs. During development, they branch to produce a number of tapering spikes. These cellular extensions are formed by tip-growth, with new material added to the cell membrane at the growing edge. This is guided by a network of actin filaments organised by the actin polymerization promoting (ARP)2/3 complex, which itself is activated by the WAVE–SCAR regulatory complex. In trichomes the activity of these complexes is localised to the cell tip, but how this localization is achieved was unclear.

Szymanski and colleagues used live cell imaging in conjunction with specially designed biosensors to identify a guanine nucleotide exchange factor, SPK1, as key to the process. SPK1 exists in discrete structures associated with the cell's growing membrane and activates WAVE–SCAR, and thus ARP2/3, in this region. Microtubules, which lie just below the cell membrane, are essentially absent from the branch tip due to increased curvature of the cell membrane in that region. These microtubules then corral SPK1 to the apex of the growing cell.

This model — in which the cortical microtubule network decodes physical properties of cell membranes to affect the distribution of molecules that direct actin cytoskeleton assembly and thus cell growth morphology — may be recapitulated in other cell types. If so, it could provide routes to engineer economically significant traits such as the properties of cotton fibres.

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