Summary

In this study, trichome cells were chosen as a single cell model system for understanding cell shape formation. Trichome branching and branch elongation are distinctive phenotypes which are regulated by the cytoskeleton.

For studying how the spatial information determines cell development, I mainly focused on a trichome branching regulating gene *STICHEL* (*STI*). The trichome phenotype of the *sti* mutant is unbranched. The GFP-STI protein fusions indicate the localization of STI in the cortex at the tip of trichomes and at young epidermal pavement cells. Yeast two-hybrid and BiFC assays suggest that STI protein interacts with itself and a STI homologue (STI-hom). So, STI might act as an oligomer. Moreover, the function of the different domains of the STI protein was clarified. The N terminus of STI (S1) is an interaction domain containing two different binding domains, one for microtubule binding proteins and the other for actin related proteins. Mutation analyses of conserved residues within the ATPase domain in the middle part of STI indicate that this domain is essential for STI protein to regulate trichome branching. The C terminus of STI (S3) is necessary for the movement of STI to the plasma membrane.

By using S1, the middle part of STI (S2), and S3 as baits in yeast two-hybrid screens, several cytoskeleton related and membrane associated proteins were identified. The interacting factors PIPKs (Phosphatidylinositol phosphate kinases), ARPC4 (ACTIN-RELATED PROTEIN COMPLEX 4), and CLASP (CLIP ASSOCIATED PROTEIN) could be confirmed. In addition, STI also interacts with other Arp2/3 complex subunits. The interactions between STI, PIPK and Arp2/3 complex, one of the key regulators of actin cytoskeleton in plants, indicate that STI plays an important role for actin dynamics. Intriguingly, the interaction of STI and CLASP, a +TIPs protein which stabilizes microtubules, localizes at microtubule lattices in young trichomes. Furthermore, the microtubule disrupting drugs disturb the localization of STI. This reveals that the localization of STI may be dependent on microtubules. Therefore, I propose a new model to explain how STI regulates trichome branching. In summary, the results of this study highly indicate that STI has impact on the regulation of actin and microtubule dynamics during trichome branching and branch elongation.