Tight control of division plane orientation is necessary to optimize the growth capacity of tissues and organs in *Arabidopsis thaliana*

Magalie UYTTEWAAL

INRAE, Institut Jean-Pierre Bourgin, Versailles, France

Abstract

The position of cell division is robustly regulated in plants, but why and how? Plant cell division involves specific microtubule arrays (the Interphasic Cortical Microtubule array, the PPB that acts as a filter to suppress noise in the positioning of the division, and then the spindle and the phragmoplast) which accomplish the process of division but also integrate different signaling pathways including geometric and biomechanical status. Our group has identified a key regulatory complex of cortical microtubules: the TON1-TRM-PP2A protein complex which regulates the organization of cortical microtubules into arrays. More than 34 TRM proteins (for TON1-Recognition Motif) specify the activity of the TTP complex and thus participate in the control of anisotropic growth, cell differentiation and robustness of division.

To pinpoint more clearly the functional relevance of the PPB, we quantified key aspects of cell geometry and cell division in the shoot apical meristem of Arabidopsis in wild type plants and *trm678* mutant plants lacking functional PPB. The absence of the PPB causes an increase in the noise associated with the orientation of the division plane. Paradoxically, further quantification also revealed that the ability of a dividing mother cell to partition its surface area equally between its two daughter cells is not only preserved but in fact improved when the PPB is absent.

In another model, the gynoecium, by examining the function of the TRM sub-group 1 that has been shown in rice, maize, tomato, melon to determine fruit size and shape, we observed that the elongation defect of *trm1234* produces small deviations from transversality upon division, and that these small deviations are greatly amplified during the active phase of growth, with dramatic consequences on the growth capacity of cells and organs.

Regarding these results, we propose that the spatial control of division orientation has evolved to optimize the growth capacity of plants at various scales.