GDCB Promising Scientist Research Series

Dr. Pablo Martinez

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Mechanics of leaf growth and cell division patterns in plants

The construction of elaborate organs during the development of both plants and animals relies on the summative properties of individual cells across space and developmental time. In plants the cell walls also can impose physical constraints at both the cell and supracellular level as cells remain locked in place to their neighbors. In the maize leaf, the blade will anisotropically grow into an elongated simple leaf shape where the majority of epidermal cell types in the blade display an elongated shape which is oriented parallel to the main axis of organ growth. We are currently developing a live cell imaging approach where maize leaves are grown in-vitro and cell growth in the epidermis is tracked over the development of the leaf. Biochemical and immunological approaches are also employed to understand the composition of the cell wall which allows for the expansion of cells to occur. Biophysical measurements of cell wall stiffness will allow us to determine the mechanical outcomes of cell wall composition over time. In addition, the correct orientation of newly formed cell walls during cell division can also affect growth. The use of a maize mutant tangled1 (tan1) allows us to assess the implications of altered cell shapes in challenging a plant's ability to regulate organ level phenomena such as oriented tissue growth at the level of cell geometry. Ultimately, we aim to uncover the mechanical and biochemical properties of the cell wall which underpin the observed cell and tissue level growth patterns necessary for proper organ formation.

Recent publications:

TANGLED1 mediates microtubule interactions that may promote division plane positioning in Maize. **Martinez, P.**, R. Dixit, R.S. Balkunde, A. Zhang, S.E. O'Leary, K.A. Brakke, and C.G. Rasmussen. J. Cell Biol. November 2020. doi:10.1083/jcb.201907184

Predicting division planes of three-dimensional cells by soap-film minimization. **Pablo Martinez**, Lindy A Allsman, Kenneth A Brakke, Christopher Hoyt, Jordan Hayes, Hong Liang, Wesley Neher, Yue Rui, Allyson M Roberts, Amir Moradifam, Bob Goldstein, Charles T Anderson, Carolyn Rasmussen, The Plant Cell Oct 2018, tpc.00401.2018; DOI: 10.1105/tpc.18.00401

The Microtubule-Associated Protein IQ67 DOMAIN5 Modulates Microtubule Dynamics and Pavement Cell Shape. Hong Liang, Yi Zhang, **Pablo Martinez**, Carolyn G. Rasmussen, Tongda Xu, Zhenbiao Yang. Plant Physiology Aug 2018, 177 (4) 1555-1568; DOI: 10.1104/pp.18.00558

Proper division plane orientation and mitotic progression together allow normal growth of maize. **Pablo Martinez**, Anding Luo, Anne Sylvester, Carolyn G. Rasmussen. Proceedings of the National Academy of Sciences Mar 2017, 114 (10) 2759-2764; DOI: 10.1073/pnas.1619252114

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