We are offering Master theses in our lab

Join MAdLand

One of the most remarkable challenges mastered by plants was the water-to-land-transition (plant terrestrialization) that occurred some 500 million years ago. This change in habitat inevitably required molecular adaptations to cope with an array of new stresses. Plant terrestrialization also caused a dramatic change through the transformation of Earth's atmosphere and soil cover, priming Earth for life as we know it (https://madland.science/).

The dry terrestrial environment presented new challenges to plants, including abiotic stresses such as drought and heat. Plants – as we know them today – have evolved signaling pathways to facilitate the transmission of signals between cells in the plant body and to enable coordinated responses to environmental changes.

Our project

Electrical signals and the second messenger calcium are pivotal for cell-to-cell communication in multicellular plants, premised on the action of voltage-gated cation channels that modulate ion fluxes into and out of the cell. In our **MAdLand project** at the institute of **Plant Molecular Biology & Biophysics**, we aim to elucidate the evolutionary role of ion channels and membrane-delimited signalling networks in calcium and electrical signalling using the liverwort *Marchantia polymorpha* as our model system.

Topics

1. Evolution of green voltage-dependent K$^+$ channels

Voltage-dependent K$^+$ channels are found in the genomes of all organisms, including plants. Comparative genomics, however, suggest, that ancestors of seed plants, such as the liverwort *M. polymorpha*, possesses a different repertoire of **voltage-dependent K$^+$ channels** compared to the model plant *Arabidopsis thaliana*. In this part of the project, we offer the opportunity to compare the molecular and functional properties of voltage-dependent K$^+$ channels form Arabidopsis and Marchantia, to elucidate their evolutionary role in plant adaptation to terrestrial stress conditions.

2. Evolution of ionotropic Glutamate Receptors

Rapid signal transmission and the capacity to learn and form memories in the animal central nervous system (CNS) relies on **ionotropic glutamate receptors** (iGluRs) gated by the neurotransmitter glutamate. iGluRs are found in all three domains of life including photosynthetic bacteria, plants, and animals. Plant GLRs evolved plant-specific physiological functions, including sexual reproduction and long-distance electrical and Ca^{2+} signaling in response to wounding and herbivory. The *M. polymorpha* genome encodes a single GLR. In this part project we offer to analyze the expression and function of the MpGLR using heterologous and homologous expression systems.

During your Master thesis, you will learn and employ the following **techniques** among others: (i) **Molecular biology** including DNA and RNA preparation, PCR, cloning, mutagenesis; (ii) **Electrophysiology** including Two-Electrode-Voltage-Clamp, *in vitro* transcription, micro-electrode techniques; (iii) **Cell biology** including protein tagging, confocal laser-scanning microscopy, bimolecular fluorescence complementation.

If you are interested in any of the projects, please contact us by email or phone.

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