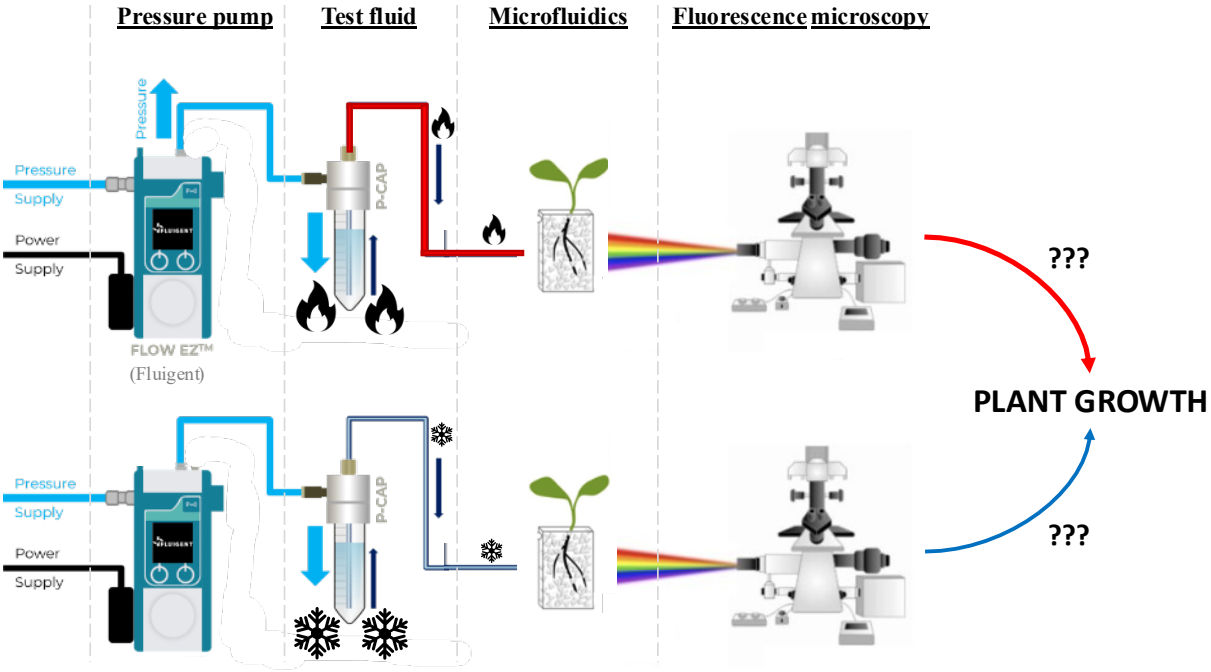
HOW DO TEMPERATURE CHANGES CAUSE RAPID CHANGES IN PLANT GROWTH?

We live in a plant-based economy which is being affected by a changing environment. In our lab we identify the molecular mechanisms that control plant cell growth, to provide the knowledge that is needed to sustain and improve crop yield and food security.
A change in temperature or temperature regime is one of the main drivers affecting plant growth. Roots rapidly (within seconds to minutes) respond to changes in their environment by attenuating or stimulating growth. This in turn affects their ability to collect nutrients and water, provide soil anchorage and interact with soil microbes. Perhaps surprisingly, little is known on how this mechanism of temperature-dependent growth works.

You will use state-of-the-art fluorescence microscopy coupled to microfluidics to study where, when and how a change in temperature affects root and root hair growth. Your thesis will rely on a variety of techniques and technologies (genetic modification, live cell imaging, in vitro cultures, microfluidics) which will benefit your CV. You will receive continuous mentoring in a friendly and stimulating environment. Data coming from your experiments will be combined to paint a mechanistic picture of the regulation of very fast temperature-dependent growth changes.



Methods:

- *In vitro* plant cultures
- Cloning to generate genetically modified plants/mutants
- *Live cell imaging* and advanced fluorescence microscopy
- Advanced image analysis
- microfluidics and a microfluidic pump system to rapidly alter the root's environmental temperature

References:

- Schoenaers et al. Nature Plants 2024 (https://doi.org/10.1038/s41477-024-01637-8)
- Zhou et al. Plant Physiology 2024 (https://doi.org/10.1093/plphys/kiae449)
- Pacheco et al. Curr. Opin. Plant Biol .2023 (https://doi.org/10.1016/j.pbi.2023.102386)

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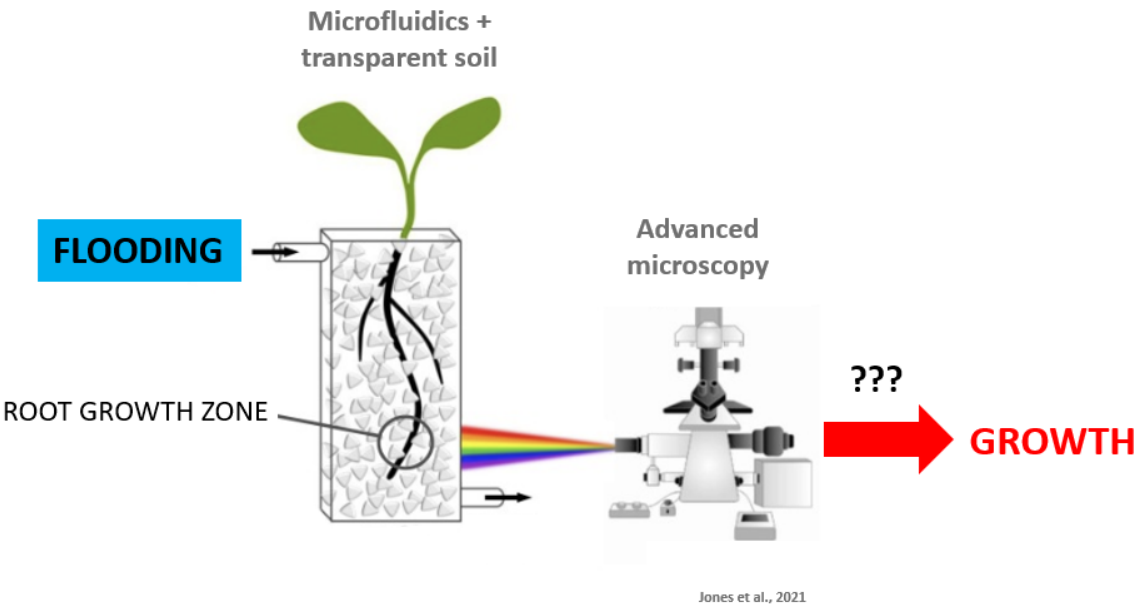
TRANSPARENT SOIL TO STUDY THE ROOT'S RAPID RESPONSE TO FLOODING

We live in a plant-based economy which is being affected by a changing environment. In our lab we identify the molecular mechanisms that control plant cell growth, to provide the knowledge that is needed to sustain and improve crop yield and food security. Farmers are increasingly being confronted with flooding of their agricultural lands. Flooding, if persistent, can induce severe stress and crop loss. Plant roots very rapidly (within seconds to minutes) sense and respond to flooding by altering their growth. Surprisingly, the mechanism that is controlling flooding-dependent growth responses is poorly understood. In our lab, we grow plants in microfluidic channels and subject them to stressors, while visualizing (using microscopy) the molecular mechanisms that control cell growth.

During your thesis, you will create transparent soil (based on transparent soil-like particles) and combine it with our state-of-the-art microfluidics and microscopy system to study where, when and how sudden flooding affects root and root hair growth. You will gain expertise in a broad set of modern techniques, which will benefit your future career. In addition, you will benefit from continuous mentoring and a friendly open-door policy. You will combine data from different types of experiments to construct a new molecular view on how plant roots sense flooding.



Methods:

- *In vitro* plant cultures
- *Live cell imaging* and advanced fluorescence microscopy
- Advanced image analysis
- microfluidics and a microfluidic pump system to rapidly alter the root's environment
- transparent soil optimization

References:

- Vissenberg et al. J Exp Bot 2020 (doi: 10.1093/jxb/eraa048)
- Jones et al. The Cell Surface 2021 (doi: j.tcsw.2021.100059)

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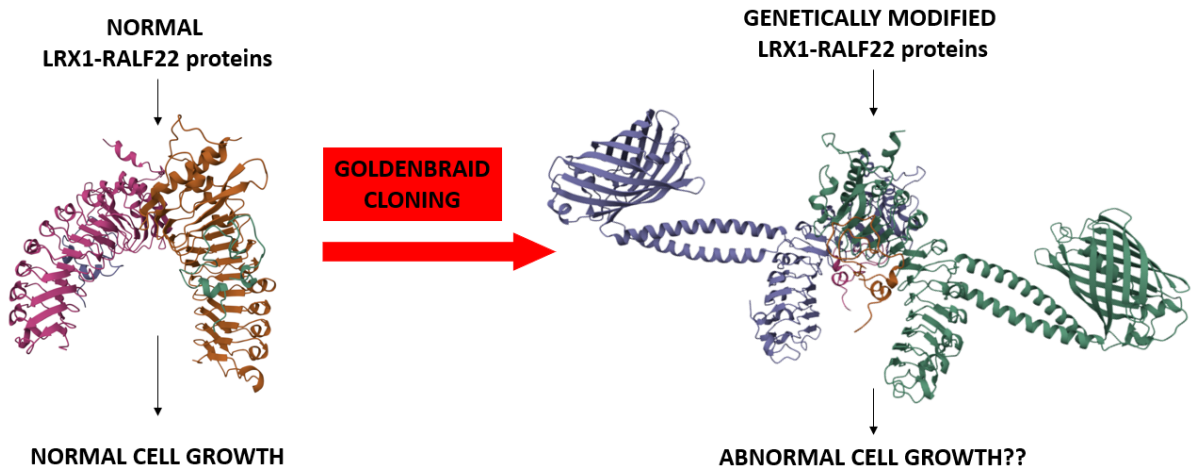
A NOVEL CLONING TECHNIQUE TO GENERATE GENETICALLY MODIFIED PLANTS

Crop yield and global food security depend on plant growth. Plant growth itself is the result of directional cell growth, a complex process which depends on a series of interconnected pathways. Understanding these pathways is absolutely crucial to create the next generation of climate-resilient crops.
In our lab, we discovered a pathway which is key to cell growth. At the core of this pathway lie 4 proteins (FERONIA, RALF22, LLG1 and LRX1), which together allow the cell to expand. We want to study and engineer these proteins in detail, so that we can unravel the mechanisms that control plant growth.

During your thesis, you will optimize a novel cloning technique (GoldenBraid), use this technique to mutate these proteins in specific localizations, and study the effect of these mutations on cell growth. You will benefit from a stimulating and friendly environment to learn a variety of techniques such as molecular modelling, modern DNA cloning, in vitro plant culturing and advanced live-cell fluorescence microscopy. You will receive continuous constructive mentoring and, like in all our projects, you will take active part in ongoing state-of-the-art research.
Combined, your results will lead to important new insights into how these core proteins regulate growth, at the molecular level.



Methods:
- Molecular modelling of protein-protein interactions and protein structures using Alphafold3
- Molecular biology/GoldenBraid cloning/transformation of bacteria and plants
- Identification and characterization of new genetically modified plants
- In vitro plant culture
- Advanced live-cell fluorescence microscopy.

References:

- Schoenaers et al. Nat Plants 2024 (doi: 10.1038/s41477-024-01637-8)
- Sarrion-Perdigones et al. PLoS One 2011 (doi : 10.1371/journal.pone.0021622)

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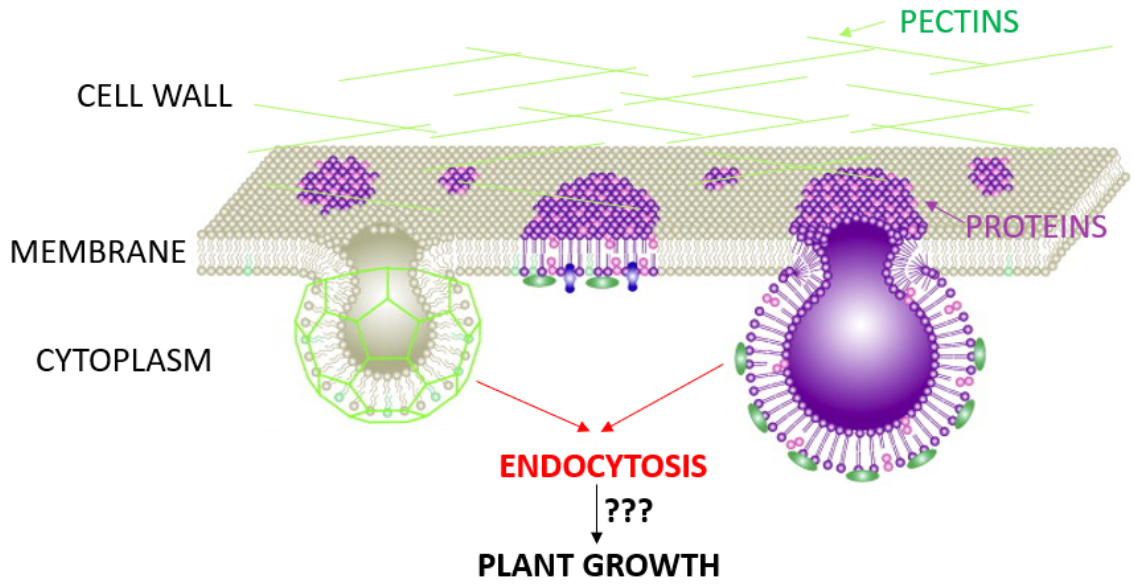
HOW DOES ENDOCYTOSIS CONTROL PLANT GROWTH?

Global food security largely depends on the successful growth of crops. A changing environment brings about a series of challenges that affect plant growth, and thus crop yield.
In our lab, we study the mechanisms that regulate plant growth, in order to provide the knowledge that is needed to create the next generation of resilient crops.

Endocytosis is the process by which cells selectively recycle molecules at the growing cell surface. It is proven to be crucial for successful plant growth. As such, understanding how endocytosis controls plant cell growth is very important if we want to be able to create better crops.

During your thesis, you will use state-of-the-art fluorescence microscopy and mutant screening techniques to study how endocytosis controls cell growth. More specifically, you will use growing root hair cells as a model to investigate how endocytosis controls the recycling of key proteins (FERONIA, RALF22, ERULUS and LRX1) and cell wall sugars (pectins) that lie at the basis of cell expansion.
You will be part of an open and constructive environment, and you will receive continuous mentoring. You will learn a diverse set of techniques such as advanced live cell imaging and image analysis, modern DNA cloning and in vitro plant culturing. Your results will be combined to advance our understanding of how, where and when endocytosis regulates plant cell growth.



Methods:
- Identification genetically modified plants, functional gene characterization
- Molecular biology/cloning/transformation of bacteria and plants
- Advanced fluorescence microscopy, live cell imaging, image analysis
- Advanced microfluidics to inhibit endocytosis in living plant cells

References:
Schoenaers et al. Nature Plants 2024 (doi: 10.1038/s41477-024-01637-8)
Schoenaers et al. Current Biology 2018 (doi: 10.1016/j.cub.2018.01.050)
Fan et al. Trend in plant science 2015 (doi: 10.1016/j.tplants.2015.03.014)

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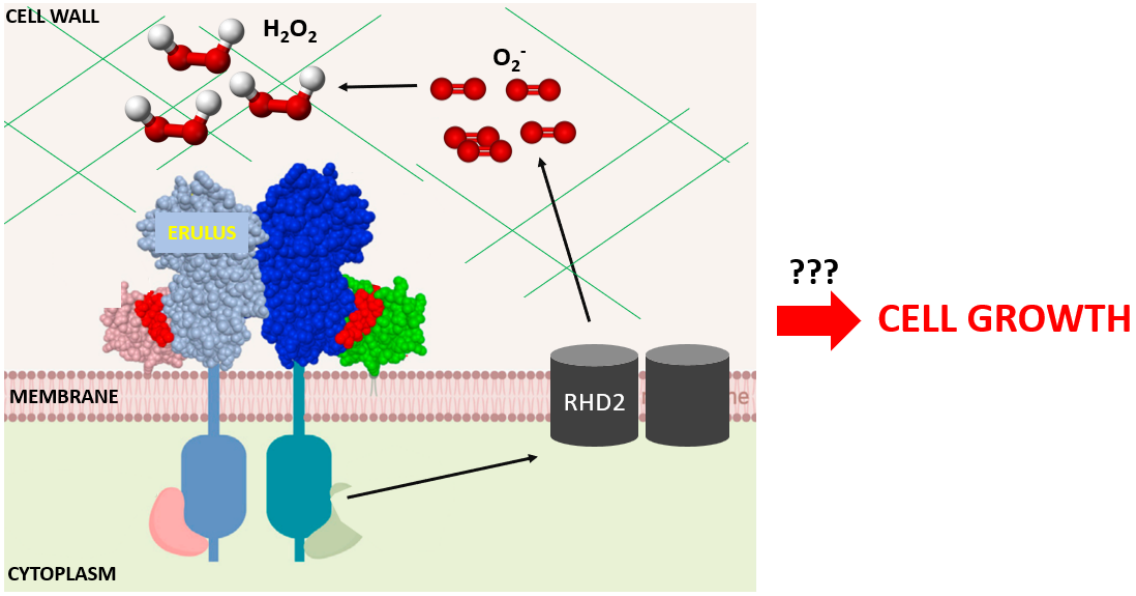
HOW DO REACTIVE OXYGEN SPECIES CONTROL CELL GROWTH?

We live in a plant-based economy which is being affected by a changing environment. In our lab we identify the molecular mechanisms that control plant cell growth, to provide the knowledge that is needed to sustain and improve crop yield and food security.
During growth, plant cells produce reactive oxygen species such as superoxide and hydrogen peroxide. These ROS are crucial for plant growth but, perhaps surprisingly, the underlying mechanism is poorly understood.
Our lab, together with the lab of Prof. Kudla (Univ. of Münster) discovered a molecular pathway that controls ROS-levels in the cell wall of growing cells. These ROS appear to modify the cell wall in such a way that cells can expand.

During your thesis, you will use molecular modelling and advanced live cell imaging to advance our understanding of how ROS interacts with the cell wall to control plant growth. More specifically, you will study how key proteins involved in ROS production (e.g. RHD2, ERULUS, MARIS, ATUNIS) sense and control cell expansion in root hair cells. Your research will be part of an ongoing state-of-the-art project. You will receive continuous constructive mentoring in a friendly open-door environment. You will combine a diverse set of techniques such as modern DNA cloning, microfluidics coupled to live cell fluorescence microscopy, molecular modelling and in vitro molecular biology. You will combine data from several experiments to expand our understanding of the role ROS has in controlling plant growth.



Methods:
- Molecular biology/cloning/transformation of bacteria and plants
- *Live cell imaging* using advanced fluorescence microscopy
- molecular modelling using Alphafold3
- Advanced microfluidics to perturb ROS signaling in living plant cells

References:

- Schoenaers et al. Current Biology 2018 (doi: 10.1016/j.cub.2018.01.050)
- Boisson-Dernier et al. PNAS 2015 (doi : 10.1073/pnas.1512375112)
- Franck et al. Plant Cell 2018 (doi : 10.1105/tpc.18.00284)

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