

Internship Proposal Master 2 – 2027

Expansion Microscopy for cell biology in phytopathology

Keywords : expansion microscopy, fungal phytopathogen, subcellular localization

Candidate profile : We seek a highly motivated candidate with interdisciplinary knowledge and skills in microbiology, imaging and chemistry. Candidates must be able to work as part of a team and have good communication and writing skills. The internship will ideally start in January 2027 and last 6 months.

Project description :

Expansion Microscopy (ExM) has revolutionized biological imaging by physically enlarging samples, enabling nanoscale visualization using standard microscope. ExM is a chemical approach for super-resolution imaging^{1,2}. While extensively employed across a wide range of biological samples, its application to plant tissues or fungi is sparse^{3,4}. To date, no application exists in phytopathology. The aim of the project is to set up this method for its application in phytopathology, on *in vitro* fungal culture first. For the set up, we will focus on *Botrytis cinerea*, a necrotrophic and polyphagous plant pathogen. This fungus produces a range of toxic specialized metabolites whose biosynthesis can be conducted in different subcellular compartments to avoid self-toxicity^{5,6}. During the internship, ExM will be used to investigate the **subcellular localization** of key enzymes involved in the biosynthesis of cyclic peptides. Localization will be assessed using fluorescent markers such as mCherry and StayGold to map their distribution within the expanded fungal cells.

Presentation of the Research Team :

BIOGER (BIOlogy of fungal plant pathogens: from GENomes to agRo-ecosystems) research unit studies pathogens responsible for fungal diseases of major economic importance. They comprise wheat rusts, *Zymoseptoria tritici* of wheat (Septoria Leaf Blotch-STB), *Leptosphaeria maculans* (stem canker of oilseed rape), generalist pathogens as *Botrytis cinerea* and *Colletotrichum higginsianum* species causing grey mould disease or anthracnose, respectively, on a series of hosts.

The BIOGER Cytology-Imaging platform, IMAFUN (IMAgIng plant-FUNgal and cytology platform) has the objective to support BIOGER research teams and other collaborator. IMAFUN is specialized in sample preparation, imaging and image analysis techniques on fungal diseases in plants.

Methods used during the internship :

- Microbiology: growth of transgenic strains from fungal phytopathogen
- Cytology, chemistry: Expansion microscopy
- Imaging: fluorescent microscopy, confocal microscopy, image analysis

References :

¹2026 - Bayer EM, Grison MS, **Curr Opin Plant Biol**, *Stretching the boundaries: Expansion microscopy a game changer in super-resolution imaging*, PMID: 41506152

²2023 - Truckenbrodt, **Analytical Chemistry**, *Expansion Microscopy: Super-Resolution Imaging with Hydrogels*, PMID: 36625105

³2023 - Czymmek et al, **Molecular Plant Microbe Interactions**, *Realizing the Full Potential of Advanced Microscopy Approaches for Interrogating Plant-Microbe Interactions*, PMID: 37083041

⁴2020 - Götz et al, **Frontiers in Microbiology**, *Expansion Microscopy for Cell Biology Analysis in Fungi*, PMID: 32318047

⁵2015 - Kistler & Broz, **Front Microbiol**, *Cellular compartmentalization of secondary metabolism*. PMID: 25709603

⁶2021 - Chen et al, **mBio**, *Compartmentalization of Melanin Biosynthetic Enzymes Contributes to Self-Defense against Intermediate Compound Scytalone in Botrytis cinerea*, PMID: 33758088

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