

# Master's Thesis Project Proposal

**Title:** The Rhizobial Hunger Games: Investigating the genetic determinants underlying bacteria high competitiveness in the soil

**Supervisors:** Dr. Paula Bellés-Sancho and Dr. Gabriella Pessi

**Location:** Irchel Campus

**Research group:** Lab of Dr. Gabriella Pessi, Dept. of Plant and Microbial Biology, UZH

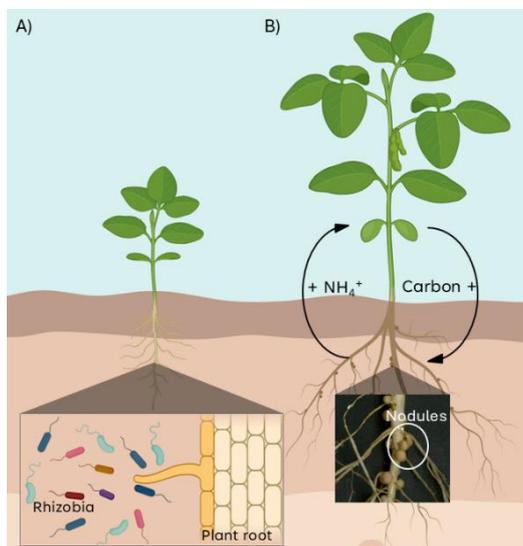
<https://www.botinst.uzh.ch/en/research/microbiology/pessi.html>

**Duration:** 1 year

**Start date:** Upon agreement, as soon as possible

## Project Description:

Rhizobia are soil bacteria forming symbiotic relationships with certain legumes. Rhizobia enter the plant root cells and induce the formation of a new plant organ known as a nodule (**Figure 1**). Inside the nodule, they differentiate into bacteroids that convert atmospheric nitrogen ( $N_2$ ) into ammonia ( $NH_3$ ), a nitrogen source that plants can metabolize. The use of rhizobia as bioinoculants is a sustainable alternative to chemical fertilizers that can help alleviate the climate change effects on legume



**Figure 1.** A) Interbacterial competition in the rhizosphere for root nodulation. B) Overview of the nitrogen-fixing symbiosis between the legumes and the rhizobia.

productivity. The establishment of this symbiosis requires sophisticated communication via signal molecules between rhizobia and host plant. However, what may appear to be a cooperative plant-rhizobia interaction can turn into a competitive struggle when multiple rhizobia strains are present in the soil and compete to infect and nodulate the same plant. The rhizobium *Paraburkholderia phymatum* STM815 is highly competitive against other rhizobia in root infection and can nodulate an extraordinary broad range of legumes, including the agriculturally relevant common bean. Rhizobial competitiveness in nodulation, together with effectiveness in  $N_2$  fixation, are key factors in the selection of inoculants aimed at increasing crop yield. Despite its importance, little is known about the molecular mechanisms contributing to the high competitiveness observed in *P. phymatum*. The aim of this project is to further investigate the molecular mechanisms underlying the high competitiveness of *P. phymatum* against other soil microorganisms for nodulation of legumes.

## What will you learn?

During this master's project, you will learn:

- Classical microbiological techniques
- Molecular biology techniques (DNA and RNA extraction from bacteria, PCR, cloning, transformation, conjugation, construction of bacterial mutant using double cross over and CRISPRi technologies, qPCR and RNA-seq analysis)
- Phenotypical characterization of bacterial strains (growth, competition assays, motility, exopolysaccharides production, production of secondary metabolites such as siderophores and antibiotics, stress resistance tests)
- Confocal microscopy with fluorescently tagged bacterial strains to visualize competition and plant infection
- Plant assays for assessing plant-growth promotion traits and protection to pathogens.

## How to apply?

Please contact us via email to [gabriella.pessi@botinst.uzh.ch](mailto:gabriella.pessi@botinst.uzh.ch) to know more about the project or to apply for the position.

We look forward to meeting you!