

Microbiology Unit - Laboratory of Microbial Genetics

Diversity and genetics of N₂-fixing symbioses between rhizobia and legumes

Background

In many soils, insufficient quantities of nitrogen that limit plant growth must be compensated by nitrogen fertilizers. However, most plants of the Fabaceae family, including important crops such as soybean, may form nitrogen-fixing symbioses with soil bacteria collectively known as rhizobia. This characteristic, which contributed to the global ecological success of legumes (>20,000 species), also provides the opportunity to use rhizobia as bioinoculants in soybean, bean, or chickpea fields to promote a more sustainable agriculture.

To fix atmospheric nitrogen (N₂) for the benefit of host plants, rhizobia must first colonize the intracellular space of specialized plant cells found inside root nodules. The process of infection that allows free-living rhizobia to enter roots and establish persistent colonies inside nodule cells is strictly controlled by plants. The exchange of many molecular signals between host plants and rhizobia helps discriminate symbiotic from pathogenic bacteria.

Research

Our laboratory explores two facets of these beneficial plant-microbe associations:

1. The natural diversity of rhizobia and their adaptation to specific plant cultivars, and
2. The genetic basis for the broad host-range of strain *Sinorhizobium fredii* NGR234.

Projects

As diversity of rhizobia in fields and natural ecosystems is still poorly explored, root nodules are collected in various ecosystems of Switzerland and foreign countries. Once isolated from nodules, strains of symbiotic rhizobia are identified using mass spectrometry and DNA sequencing.

For students who favour molecular genetics, genes of the selected rhizobia strains (e.g. NGR234) are targeted by site-directed mutagenesis. Symbiotic proficiency of mutants is then scored on various host plants, and documented by microscopy analyses.

Projects for Master thesis are defined together with the applicant, taking into account his/her primary interests as well as research currently underway in the laboratory.

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