RÉPUBLIQUE FRANÇAISE
Liberté Égalité Fraternité

INRAE

Exploratory project
2024–2025

PROCYABIOTE

Microbiota management and a strategy for biological denitrification inhibition (BDI): using procyanidins in plants of agronomic and/or horticultural interest

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Nitrogen cycle management, biological denitrification inhibition (BDI), procyanidins, rhizosphere microbiota, plant species of interest

Participating INRAE units
IRHS
LEHNA
LEM

Although agrifood systems are heavily reliant on nitrogen inputs, most crops (and especially cereals) have low nitrogen utilization efficiency (30–50%). This means that much of the nitrogen applied in agroecosystems ends up in the atmosphere or terrestrial and aquatic ecosystems, which then causes the nitrogen cycle to spiral out of control, in turn leading to various problems such as eutrophication and higher nitrous oxide emissions. This nitrogen cycle is largely governed by soil microorganisms.

Recent research, supported by the European Commission, has explored new strategies for more sustainable soil nitrogen management (e.g. improving nitrogen retention in agricultural systems), with the development of solutions and levers for action based on microbiota management (Theme 3 of the HOLOFLUX metaprogramme).

The current scientific approach to microbial management is basically to inoculate microbial strains or consortia to make limiting nutrients bioavailable, or to implement biological control. But many questions remain about the sustainable deployment of these inoculants, and specifically their persistence, their non-target effects and the proliferation of potential invasive microorganisms.

Objectives

The main objective of this project is to manage the soil microbiota associated with the nitrogen cycle through the plant strategies developed by plants of agronomic and/or horticultural interest. The idea is to promote the production of specific plant metabolites (procyanidins in this case) and implement a biological denitrification inhibition (BDI) strategy as new levers for managing soil microbiota.

This exploratory project tackles three major scientific challenges:

1. Define the plant orders/families and species of interest that can produce procyanidins at root level in the angiosperm phylogeny;
2. Demonstrate how microbiota associated with the nitrogen cycle induced by procyanidin production can be managed using a BDI strategy;

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3. Explore the intraspecific variation (on a varietal scale) of these plant capabilities. With the results of this research, and the associated exploratory project, we will be able to lay the groundwork for an ambitious project involving plant strategies as levers in the microbial management of soils.

Partners

INRAE unit	Expertise	INRAE division
IRHS	Microbiology and molecular biology; diversity/ characterization of bacterial and fungal microbiota; bioinformatics	SPE
LEHNA	Plant biology; plant functional traits; phytochemistry; plant physiology and plasticity; sowing and plant growth	ECODIV
LEM	Microbial ecology; nitrogen cycle; microbial activities; ecosystem functioning; abundance analyses of microbial communities	ECODIV

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