



HAL
open science

Interplay between lateral gene transfer and rhizosphere functioning

Caroline Choufa, Abdoul-Razak Tidjani, Claire Veneault-Fourrey, Vos Michiel, Cyril Bontemps, Pierre Leblond

► **To cite this version:**

Caroline Choufa, Abdoul-Razak Tidjani, Claire Veneault-Fourrey, Vos Michiel, Cyril Bontemps, et al.. Interplay between lateral gene transfer and rhizosphere functioning. Functional ecology conference 2018, Dec 2018, Nancy, France. <hal-03060574>

HAL Id: hal-03060574

<https://hal.science/hal-03060574v1>

Submitted on 14 Dec 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



HAL Authorization

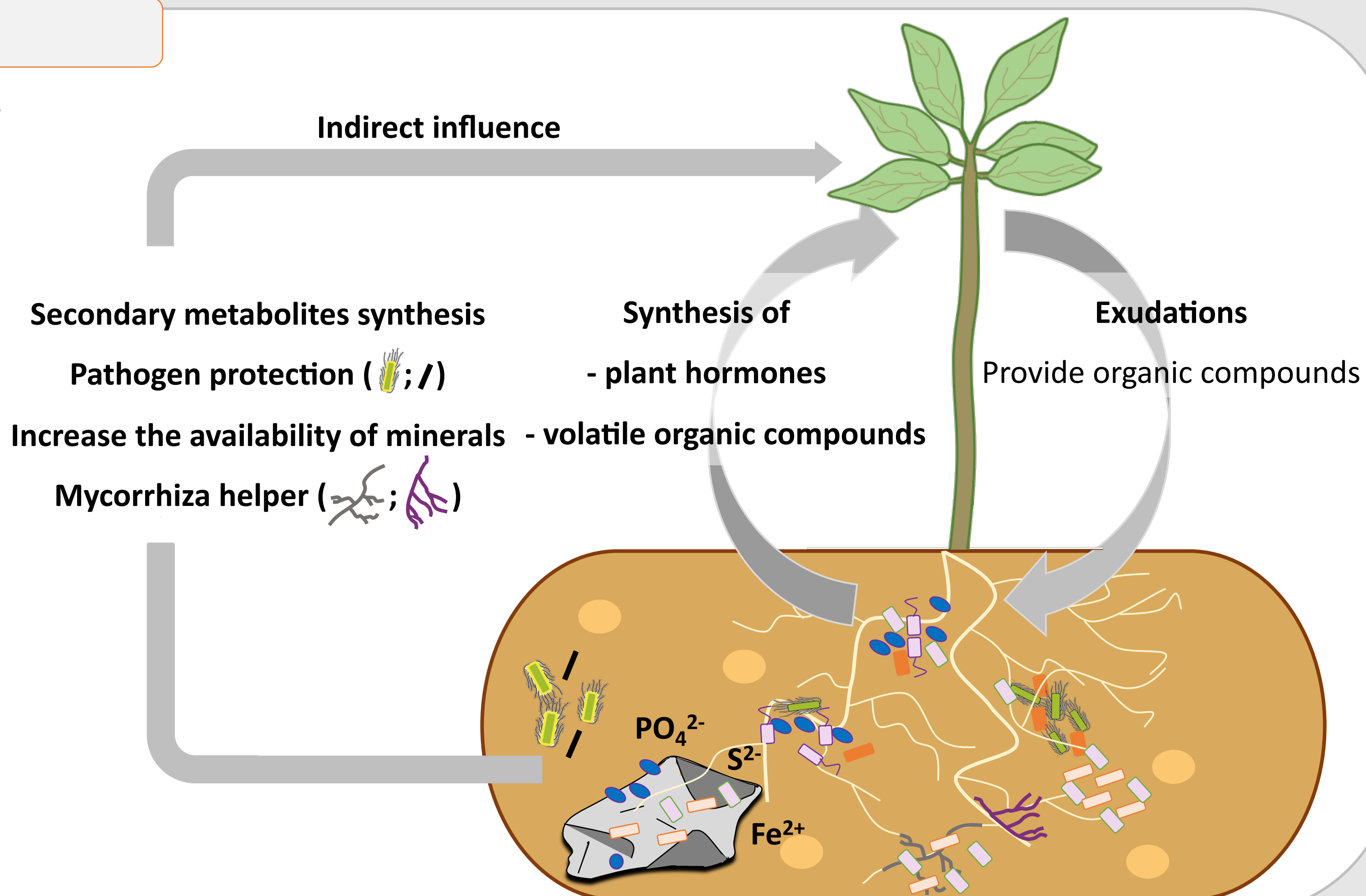
Interplay between lateral gene transfer and rhizosphere functioning

Caroline CHOUFA¹, Abdoul-Razak TIDJANI¹, Claire VENEULT-FOURREY², Michiel VOS³, Cyril BONTEMPS¹, Pierre LEBLOND¹

¹Université de Lorraine, Inra, DynAMic, F-54000 Nancy, (Fr) ; ²Université de Lorraine, Inra, IAM, F-54000 Nancy, (Fr) ; ³European Centre for Environment and Human Health, University of Exeter, (UK)

The rhizosphere and its microbiota

The **rhizosphere microbiota** contributes to the **growth, health** of plants and **resilience** of forest ecosystem [1]. In the rhizosphere, bacteria can influence the **plant directly** or **indirectly** and take advantage from **root exudates** in return [2;3]. Until now, it was considered that a bacterial species isolated from a given environment is a homogenous related cells characterized by identical functions. Yet, bacteria in soil are not single clones, but are structured in **populations (sympatric strains of the same species but with different functions)** that might act in **synergy** to achieve a function.



Genus *Streptomyces* : a model of rhizospheric bacterium

Genome:

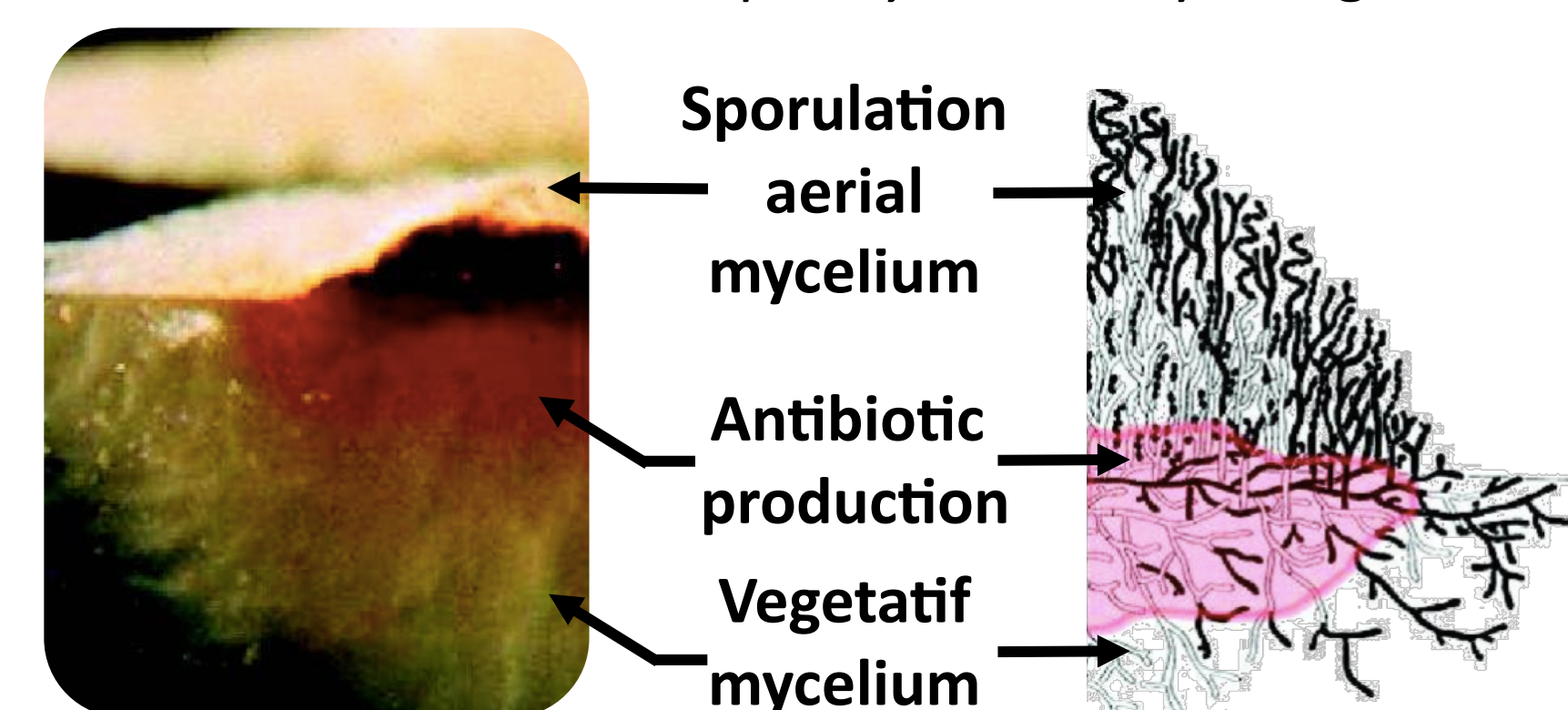
Plasticity: chromosomal rearrangements, linear and circular plasmids [4]

Phylum: Actinobacteria

Habitat: soil and rhizosphere

In the lab: collection of natural populations (rhizospheric and bulk soil)

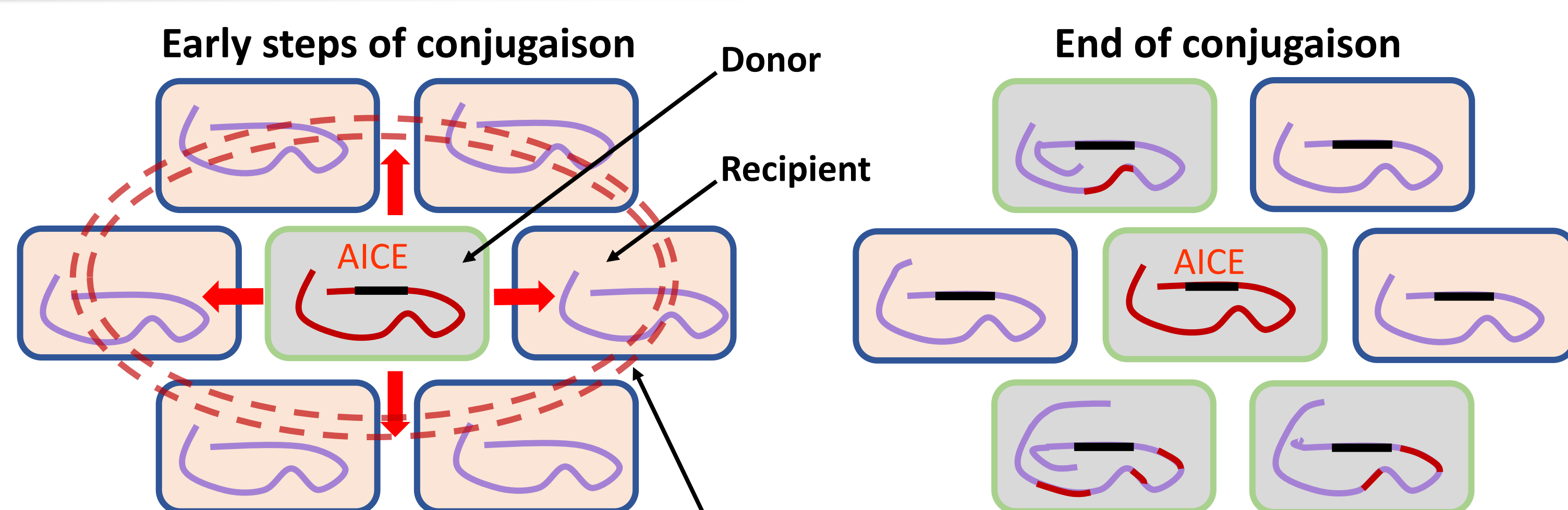
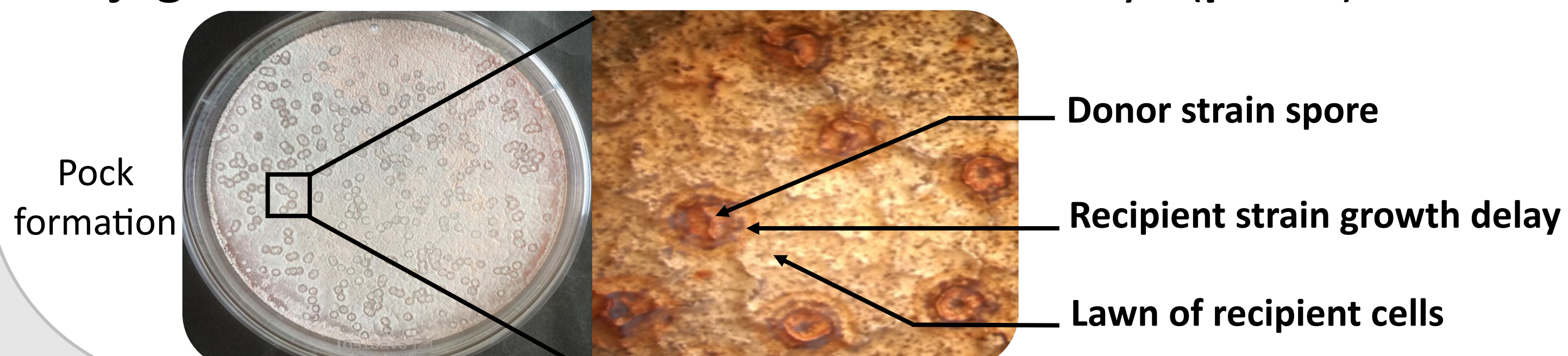
Vertical sections a *Streptomyces* colony on agar [3].



Horizontal gene transfer (HGT) promotes functional diversity.

- **AICE** = Actinobacteria integrating conjugative element
- Mobilization of chromosomal locus (↪)

Conjugative DNA transfer visible to the mere eye (pocks)

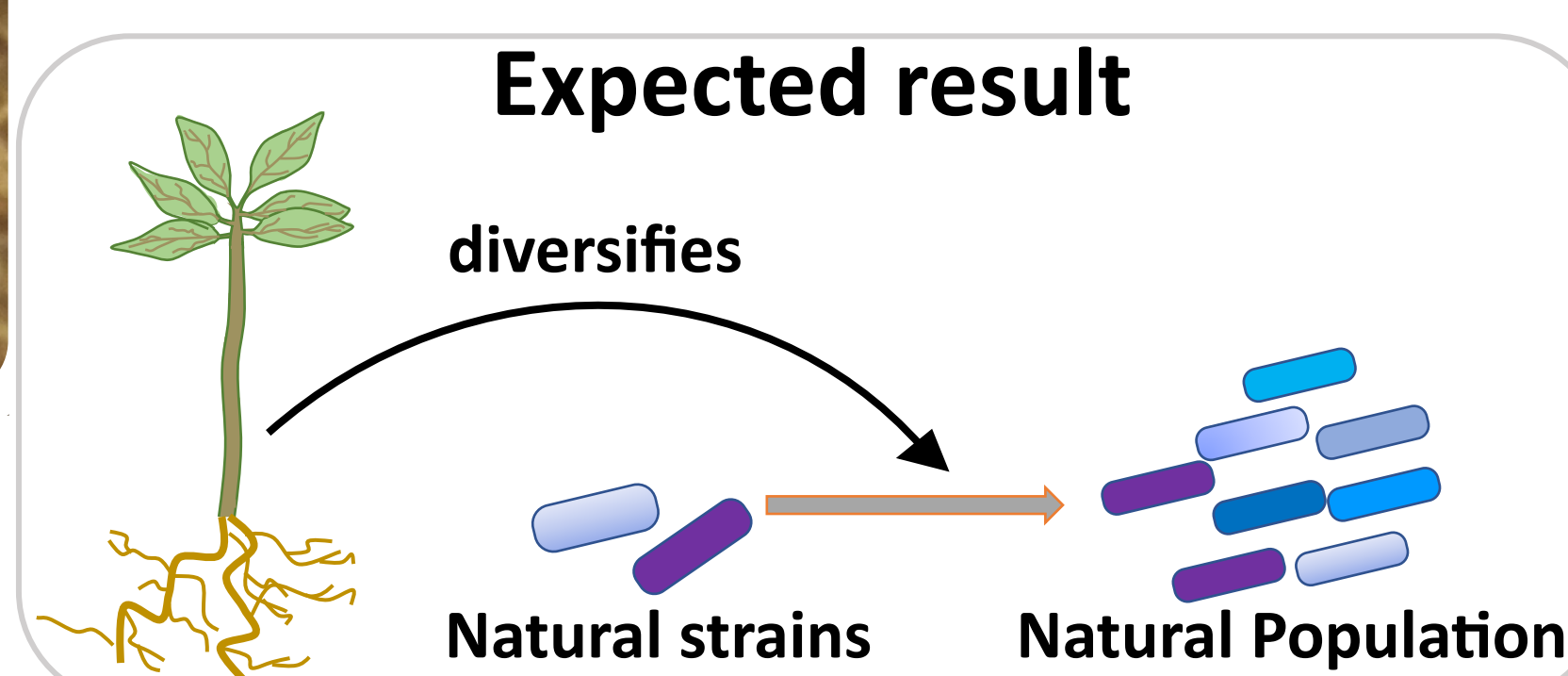
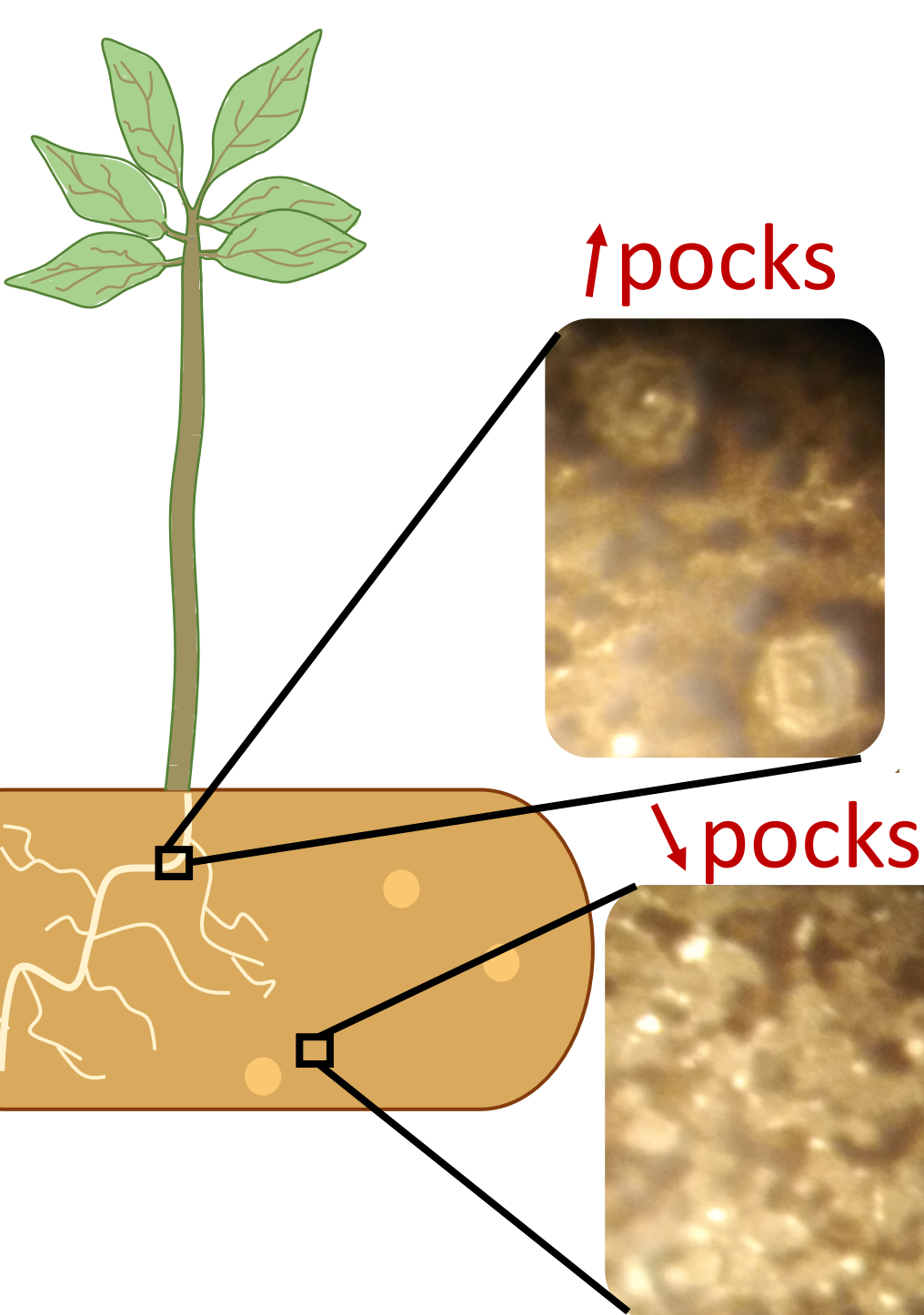


The transfer of AICE triggers a growth and sporulation delay (pock) in the recipient cell [4].

What are the drivers of HGT in rhizospheric *Streptomyces* populations?

Effect on the HGT in presence of:

- root system
- exudates
- specific compounds (trehalose, flavonoids, chitin, cellulose ...)

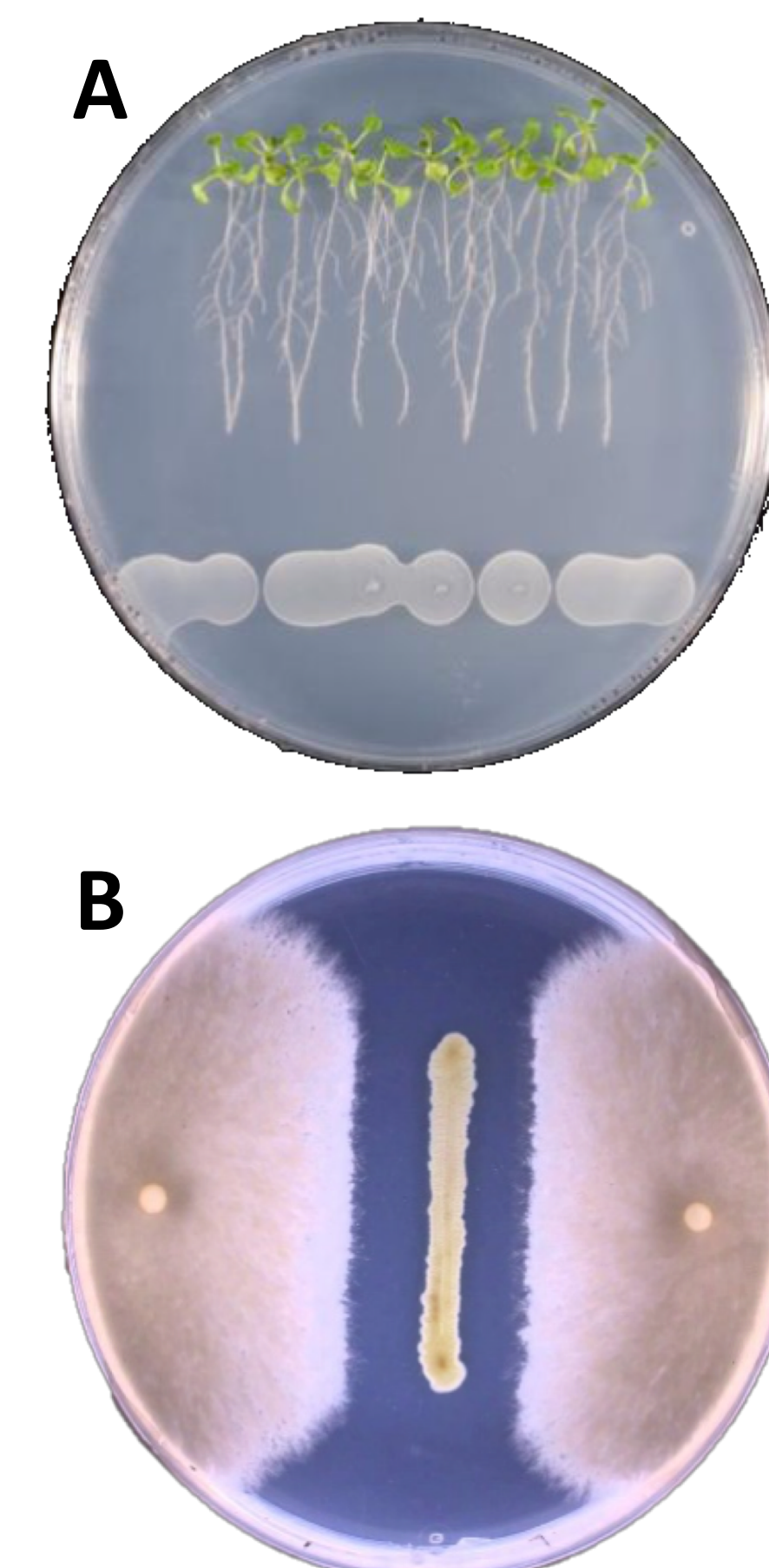
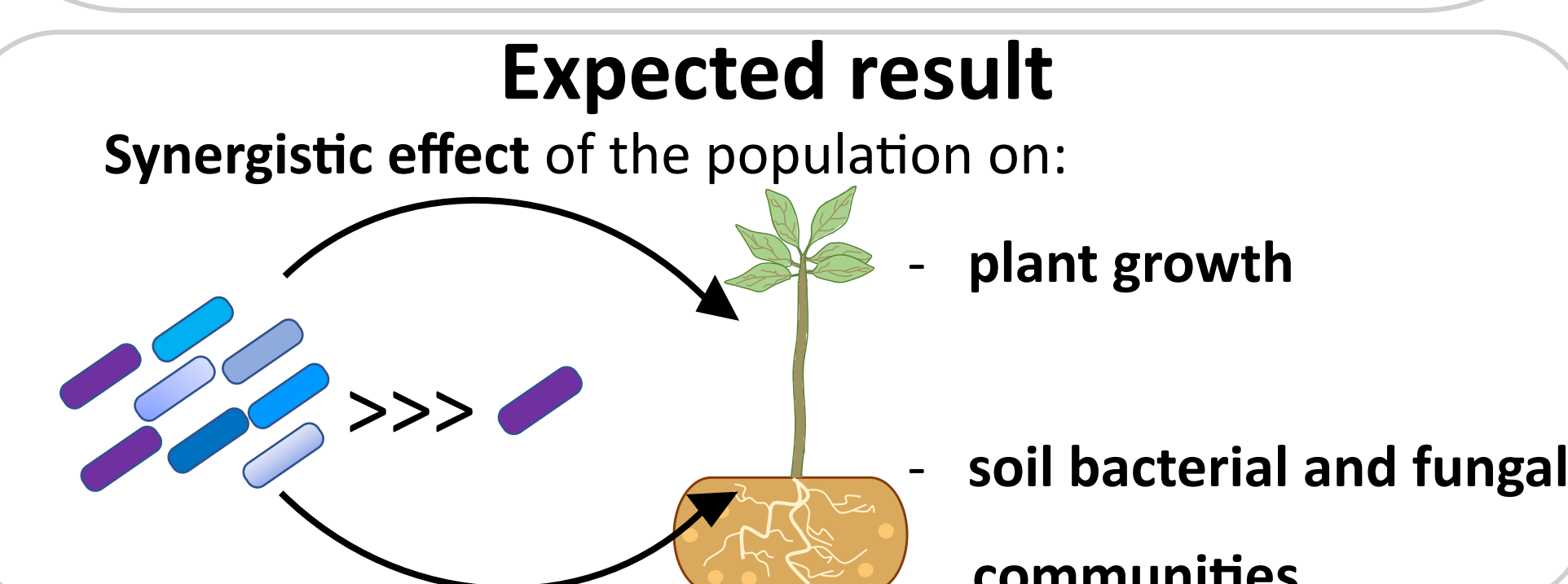


What are the impacts of HGT on the sharing of labour in natural populations of soil bacteria?

Tests on the plant:

- **direct effect:** measure of the root and/or plant development (A)
- **indirect effect:** interaction with other rhizospheric microorganisms (B)

Comparison between the effect of natural single strains versus populations



Prospects

This project will provide an overview of the effects of plant/rhizospheric microbiota interactions with two main objectives:

- understanding if a bacterial population constitutes an efficient ecological unit for plant interaction
- explaining how the plant can affect bacterial genomic diversity.

Furthermore, this project will reveal if gene transfer allows rapid microbiota and plant adaptation to environment changes.

[1] Backer R, Rokem JS, Ilangumaran G, Lamont J, Praslickova D, Ricci E, Subramanian S and Smith DL (2018) Plant growth-promoting rhizobacteria: context, mechanisms of action; and roadmap to commercialization of biostimulants for sustainable agriculture. Front Plant Sci. doi:10.3389/fpls.2018.01473
 [2] Viaene T, Langendries S, Beirinckx S, Maes M and Goormachtig S (2016) *Streptomyces* as a Plant's Best Friend? FEMS Microbiol Ecol. doi:10.1093/femsec/fiw119
 [3] Chater, KF (2006) *Streptomyces* inside-out: A new perspective on the bacteria that provide us with antibiotics. Philos Trans R Soc Lond B Biol Sci. doi:10.1098/rstb.2005.1758.
 [4] Thoma L and Muth G (2015) The conjugative DNA-transfer apparatus of *Streptomyces*. Int J Med Microbiol. doi:10.1016/j.ijmm.2014.12.020