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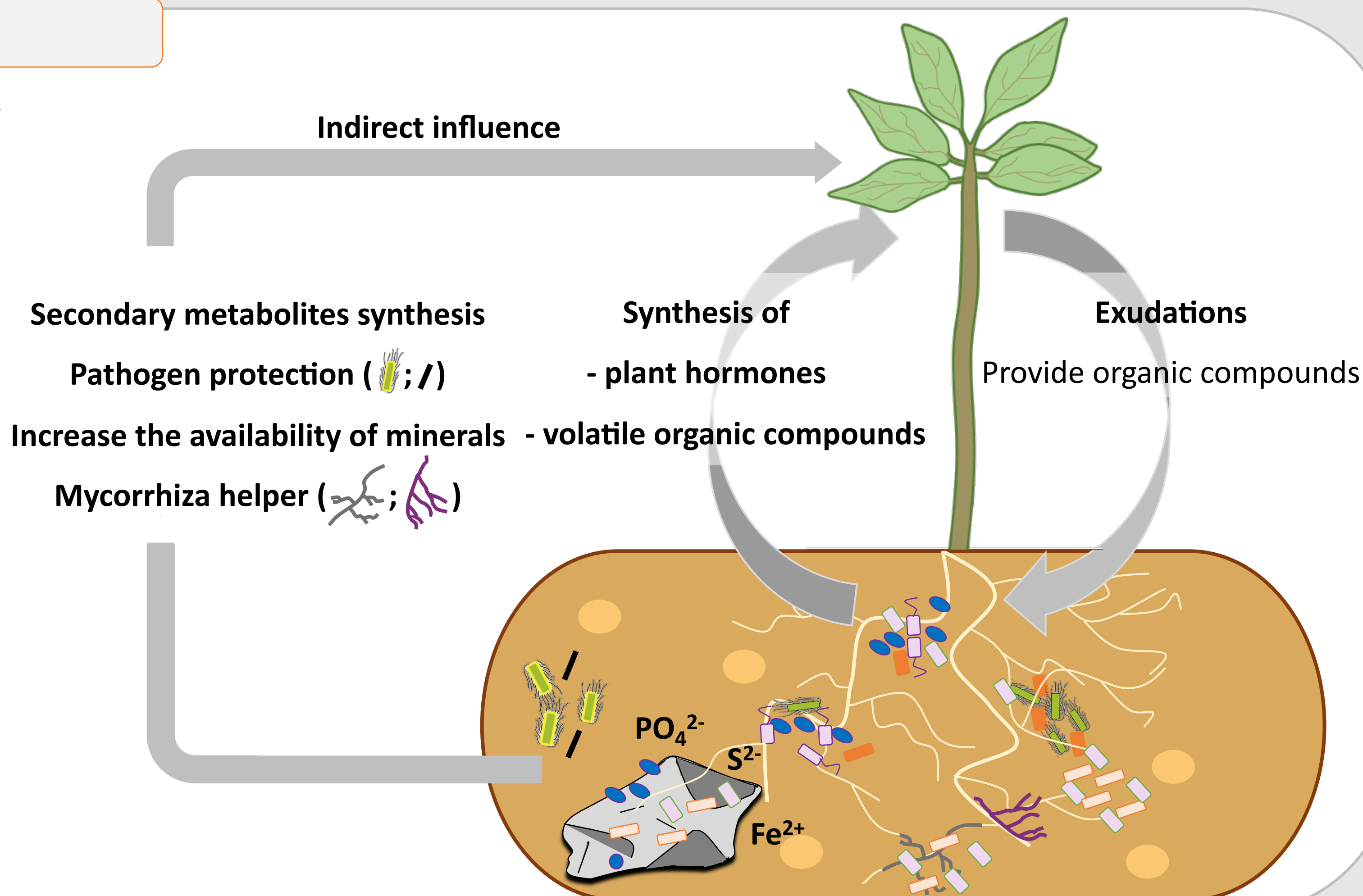
Interplay between lateral gene transfer and rhizosphere functioning

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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:

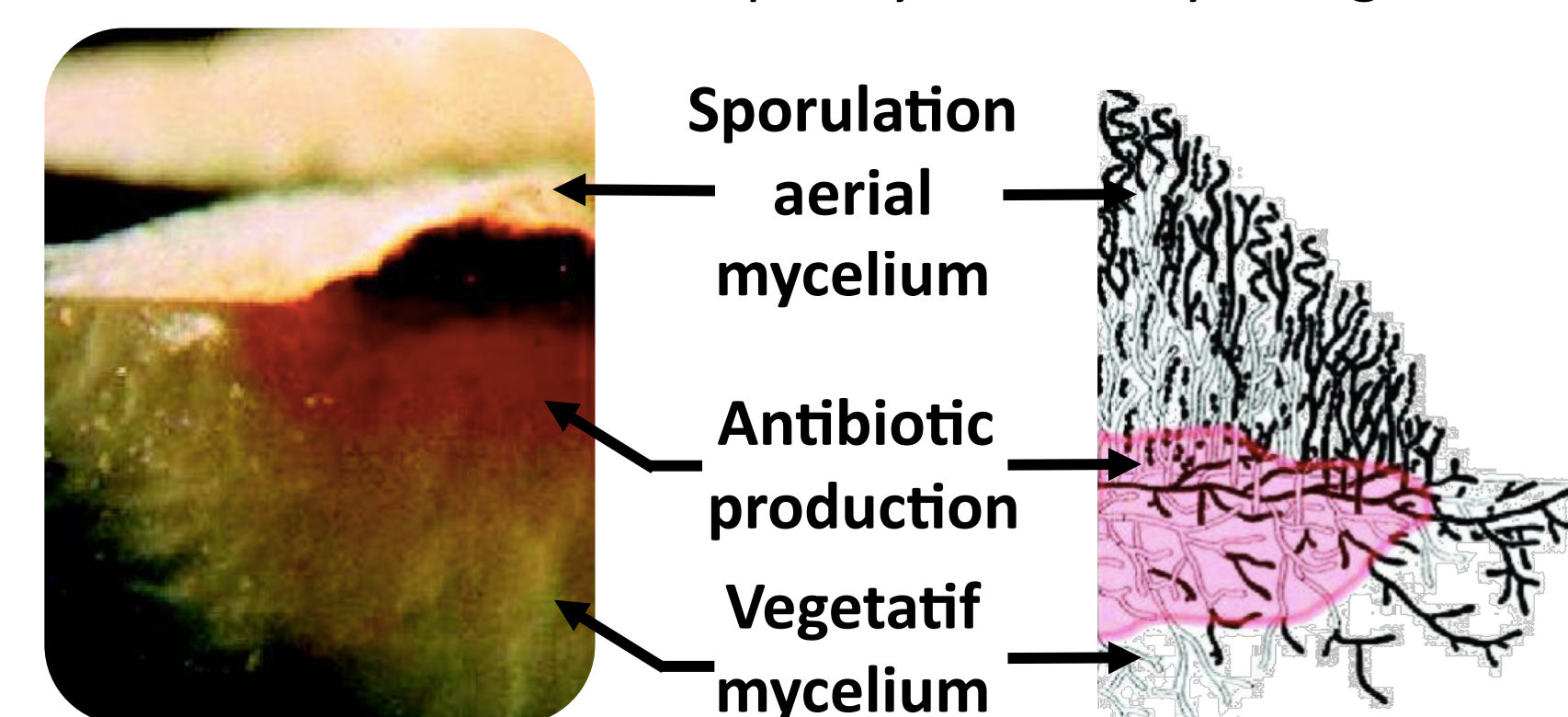
Plasticity: chromosomal rearrangements, linear and circular plasmids [4]

Phylum: Actinobacteria

Habitat: soil and rhizosphere

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

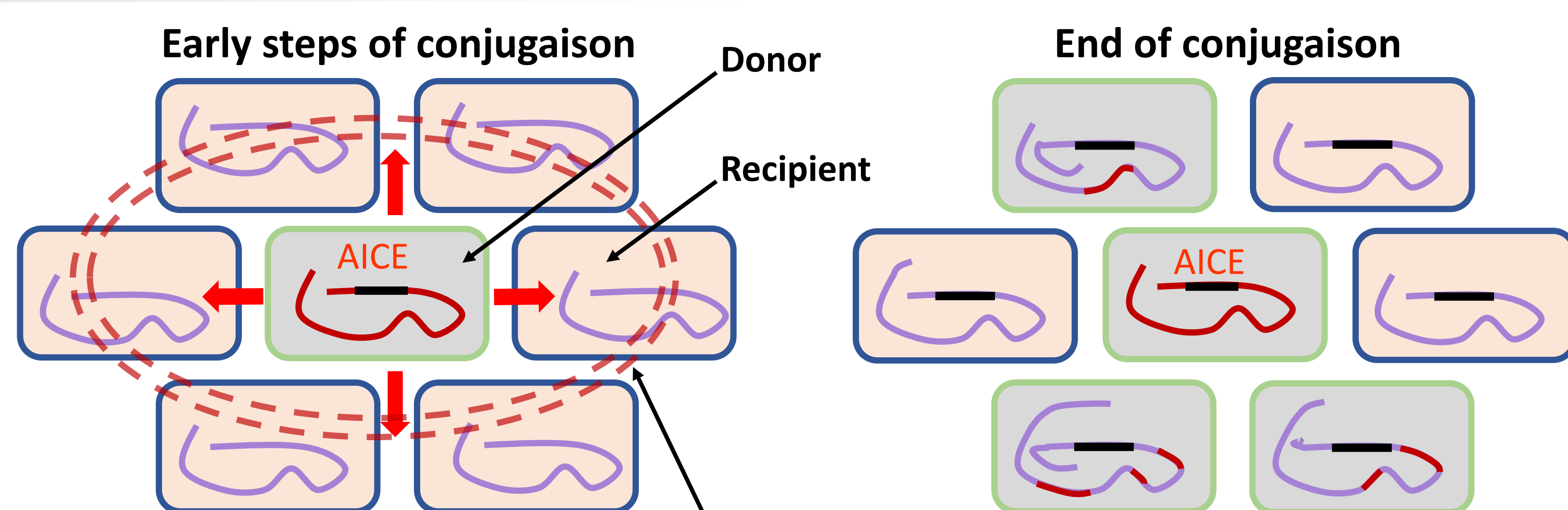
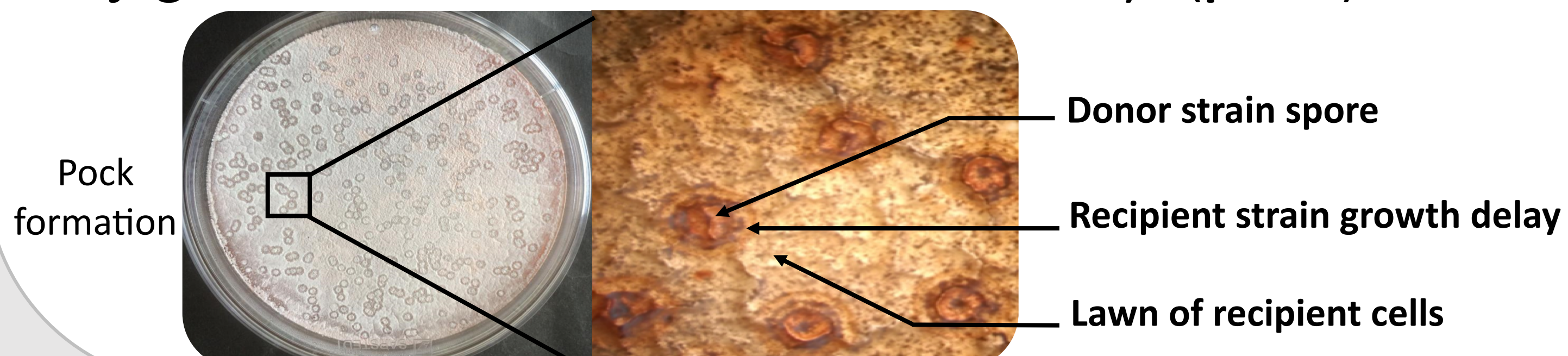
Vertical sections a *Streptomyces* colony on agar [3].



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)



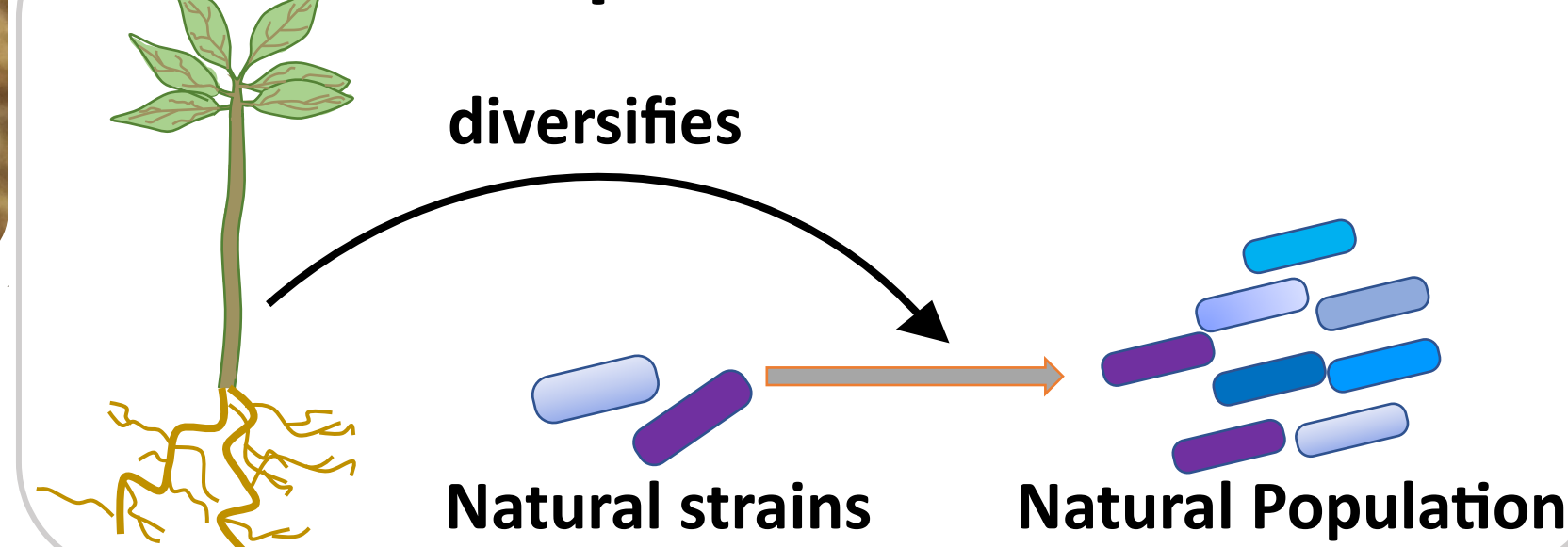
The transfer of AICE triggers a growth and sporulation delay (pock) in the recipient cell [4].

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 ...)

Expected result

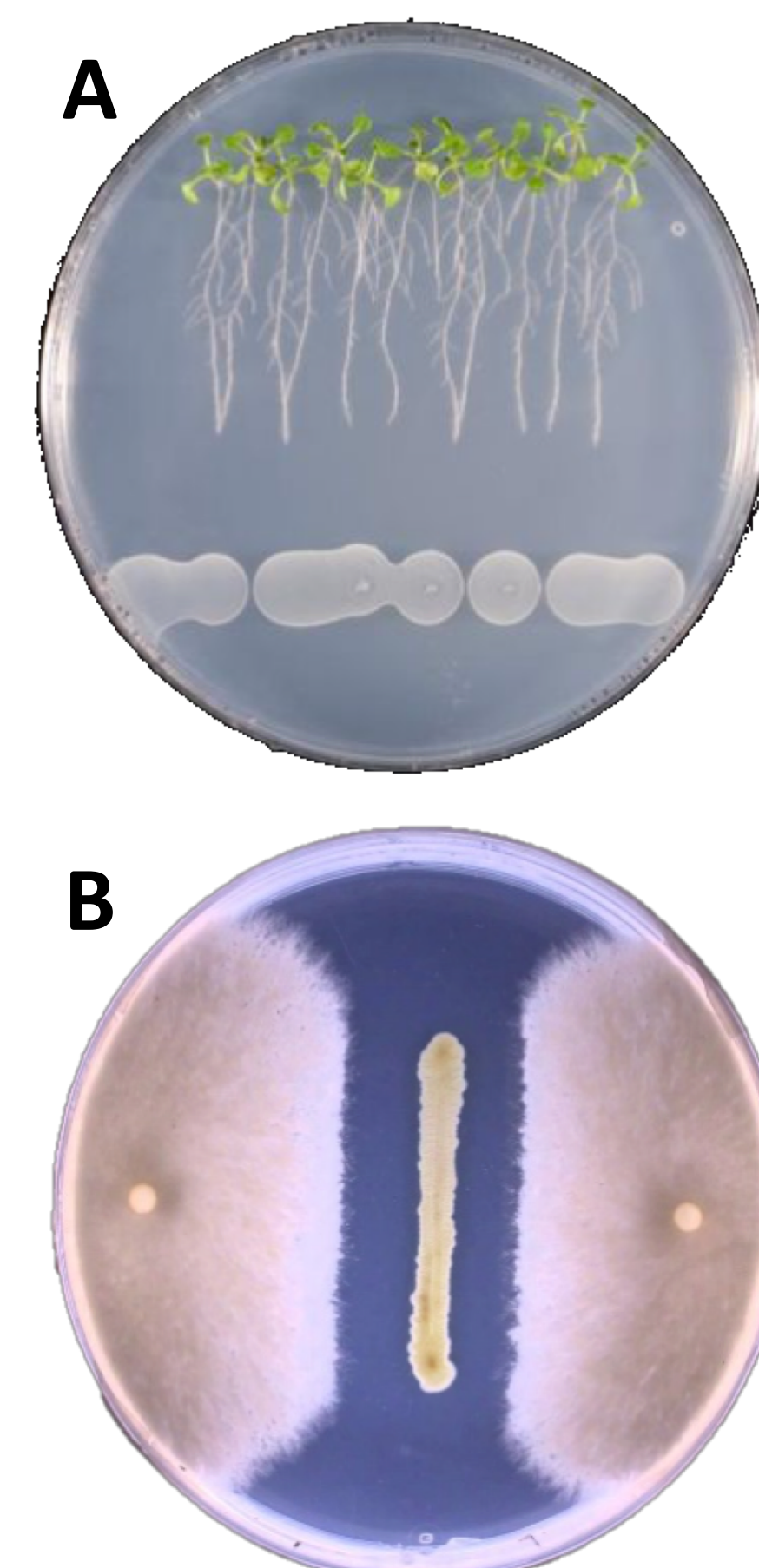
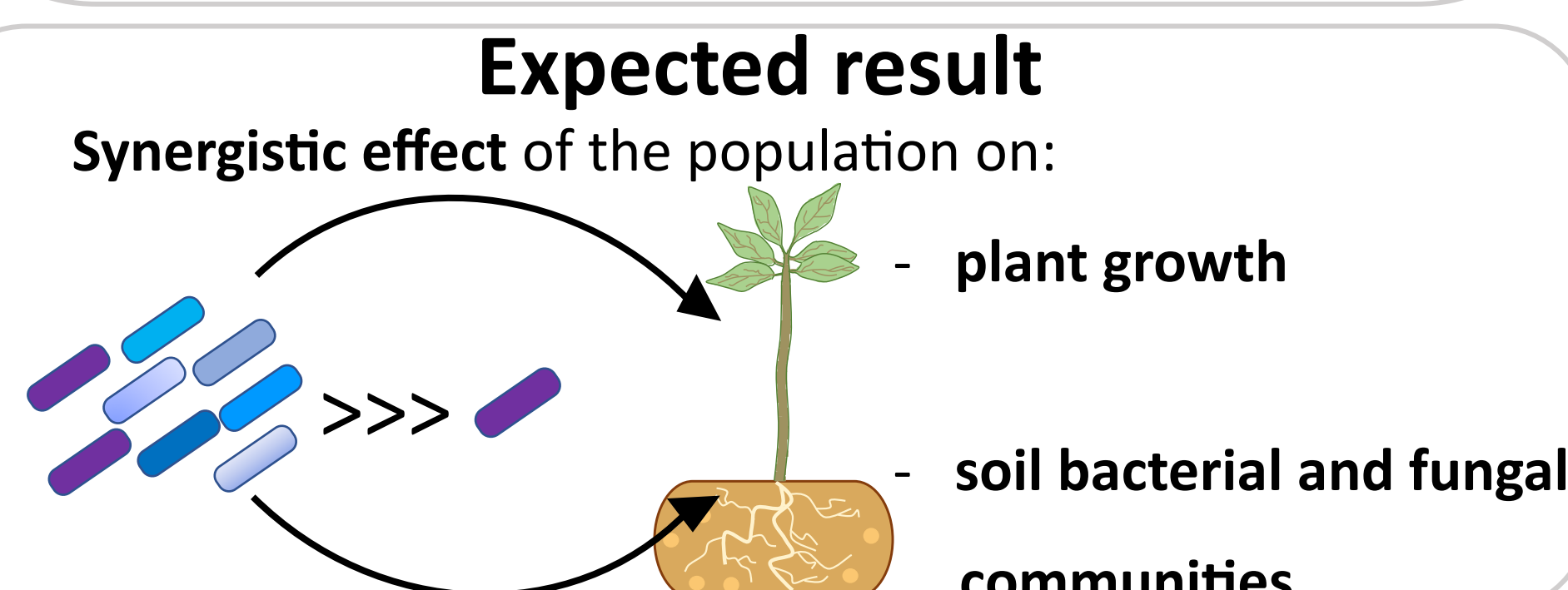


What are the impacts of HGT on the sharing of labour in natural populations of soil bacteria?

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