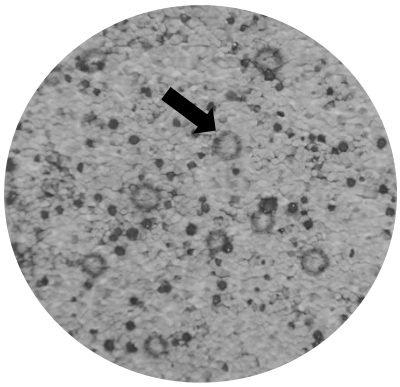
GENTRHI (Intermediate report)



Interplay between Lateral Gene Transfer in Bacteria and Rhizosphere Functioning

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Context — The plant microbiota has a major role in the health of trees by participating, for example, in their growth or defence against pathogens. Generally speaking, the more diverse a microbiota is, the more effective it is for its host. Results suggest that one level of organization of this diversity could be at the level of bacterial populations, i.e. in sister strains that interact with each other in the niche, but with potentially different capacities. These variable functions, linked to the genetic diversification of the population, would lead to the production of public goods and synergistic action. In return, the plant's root exudates would influence the microbiota by increasing the frequency of gene transfer and enable the emergence of new functions within the population.

The first objective of this project is to measure the effect of the rhizosphere on gene transfer and its consequences on the diversification of a *Streptomyces* population. The second is to compare the influence and efficiency of *Streptomyces* populations compared to single isolates for functions related to tree health and growth.

Approach — A population of *Streptomyces* from a tree microbiota is available in the laboratory. The genome of some strains is sequenced and comparison of these strains has revealed a great genetic and potentially functional diversity. Conjugative elements have been associated with the genesis of this diversity (Tidjani *et al*., 2019). In *Streptomyces*, their transfer results in growth retardation of the recipient strain observable with the naked eye in a Petri dish (see illustration). This phenomenon will enable to quantify directly the influence of the plant (rhizosphere, exudates) on the intensity of gene transfer within the population. The conjugative elements of *Streptomyces* could transfer other portions of the genome concomitantly with their own transfer. In order to see if this mechanism is at the origin of the high genetic diversity observed in our population, conjugations will be performed with strains labelled at different chromosomal loci and the transconjugates will be analyzed by resequencing. Concerning the second objective, our strains will be tested in interaction with root systems or in systems mimicking the rhizosphere for the direct or indirect growth of model plants (root development, mineral solubilization, pathogen inhibition). For these different functions, we will compare the potential synergistic effect of the population compared to the strains alone.

Key results —

- A mapping of sequenced strains able to conjugate with each other (121 pairs) was carried out.
- Different transfer couples have been selected and labelled strains are being constructed or are in the process of being constructed in order to measure the extent of chromosomal marker transfer during conjugative transfer.

Main conclusions including key points of discussion — During this first year we have capitalized on a large number of biological material (labelled strains) and our initial results reinforce i) the hypothesis that conjugation is an important driver of the rapid evolution of *Streptomyces* genomes and ii) that the transfer of chromosomal markers is effective during conjugation.

Future perspectives — Poplar plants are being cultivated (collaboration with Claire Fourrey) to see their potential influence on transfers and the impact of *Streptomyces* on their growth. *In fine*, this project will provide a better understanding of the interconnections between trees and their microbiota, a crucial parameter for the homeostasis of the forest ecosystem and its resilience.

Valorization —

Oral presentations

Caroline Choufa*, Abdoul Razak Tidjani, Michiel Vos, Cyril Bontemps, Pierre Leblond. Diversité et mobilité des éléments conjugatifs au sein d'une population de Streptomyces issue d'un micro-habitat rhizosphérique. 15ème congrès de la Société Française de Microbiologie, Sep 2019, Paris, France.

Posters

Caroline Choufa, Abdoul Razak Tidjani, Claire Veneault-Fourrey, Michiel Vos, Cyril Bontemps, Pierre Leblond. Interplay between lateral gene transfer and rhizosphere functioning. Functional Ecology Conference. Nancy, France Dec 2018.