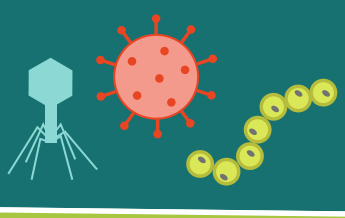
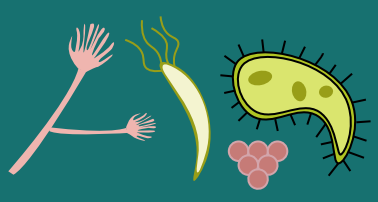
Analysis of the impacts of nanoparticles (NPs) on the microbiota

WHAT IS A MICROBIOME?



It is the **community of microorganisms** (bacteria, fungii, viruses...) living together in a **particular habitat** which can be an animal, a plant or an ecosystem (soil, ocean...). It contributes to the **growth of organisms** and to the **good health** of organisms and ecosystems.



A DYNAMIC CRITERION

Microbiome is very **diverse** and **dynamic**. How can a change in microbial composition reflect evidence of toxicity?

A way to produce a robust analysis is to focus on **core microbiome**.

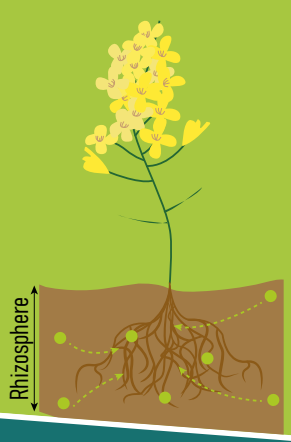
It is defined as all microorganisms present **consistently** and more likely to be important for the development, health and functioning of its host. It may have a **stronger ability** to **resist perturbation**.

SELECTION OF BACTERIA

Bacteria needed for the microbiome **are selected** by metabolites secreted by the roots of the plant in the rhizosphere.

These metabolites **favor the growth of some bacteria** and limit the development of others.

This selection works in the long term: **the roots can now attract the bacteria needed later!**



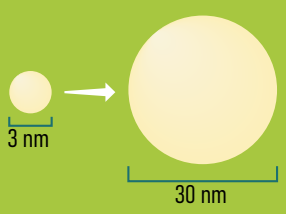
OBJECTIVE

- Finding out if it is possible to **highlight the impacts of nanoparticles on bacterial communities using the core microbiome**
- Analysing the possible **impacts of nanomaterials on the selection of bacteria by the plants**

IMPACTS OF SPECIFIC NPs

CeO_2 nanoparticles (NPs) are used as **fuel additive** and **wood coating** and **are released in the environment.** Commercial NPs have a mean diameter of **3 and 30 nm.**

Extending the mean diameter **from 3 nm to 30 nm** causes:



reduction of the specific surface area by **5 times**

RAPESEED, A PLANT OF INTEREST

Experiments focus on rapeseed (also known as canola), a plant of interest for **oil production** and **animal feeding.**

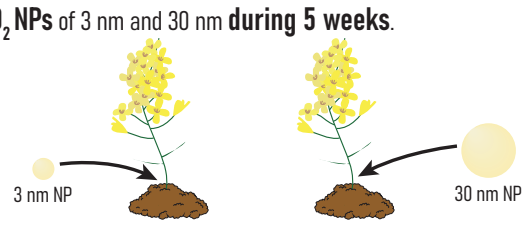
How do these changes in size and reactivity modulate the impacts of CeO_2 NPs on the **composition** and **functions** of the **microbiomes of rapeseed**?

SOME RESULTS OF THE PROJECT

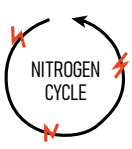
After extraction, the **composition of the core microbiome of the rapeseed** have been revealed: it contains **more than 80 taxa** at the genus level.

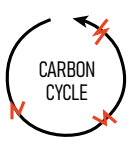
Impacts of NPs size on the microbiome of rapeseeds

Rapeseed have been exposed to **1 mg/kg** (an environmental concentration) **of CeO_2 NPs** of 3 nm and 30 nm **during 5 weeks**.



Microbiome analysis show that the **core is not modified** when exposed to NPs of **3 nm**. However at **30 nm**, more than 13 major taxa, which represent 40% of the core microbiome, are **altered**. Hence the alteration of microbial functions:





- no more synthesis of antibiotics
- no more degradation of toxic molecules

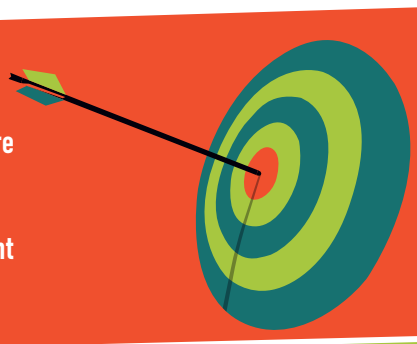
Impacts of NPs on the interactions between rapeseeds and bacteria

To analyze the **impacts of NPs of 30 nm mean diameter,** diversity of bacteria (green circles) shared between the root and the rhizosphere have been investigated. **The more diverse the microbiota recruited by the plant, the better**.

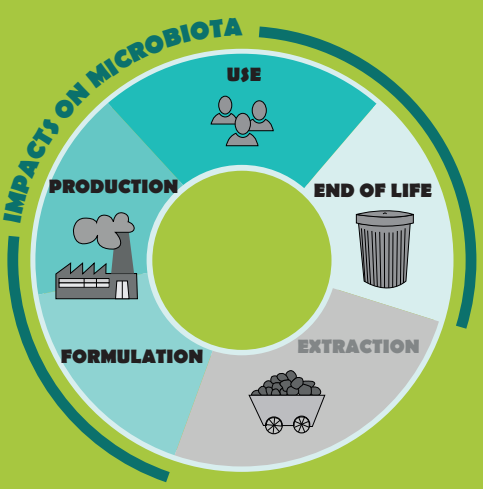
Control Exposed to NPs

There are few bacteria shared for rapeseed exposed to 30 nm NPs. **The interactions between the plant and the bacteria have been limited**. This suggests an **alteration of the communication**.

- Compared to 3 nm CeO_2 NPs, **30 nm ones alter the composition of the core microbiome and the microbial functions**.
- The **presence of NPs limits interactions** on the rizhosphere, it **may alter plant communication and the selection of bacteria.**



LIFE CYCLE STAGES STUDIED



Serenade
Safe(r) Ecodesign Research and Education applied to ANanomaterial DEvelopment.

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