Towards a robust stimulation of plant growth with PGPR

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Figures 1 and 2 created in BioRender.com

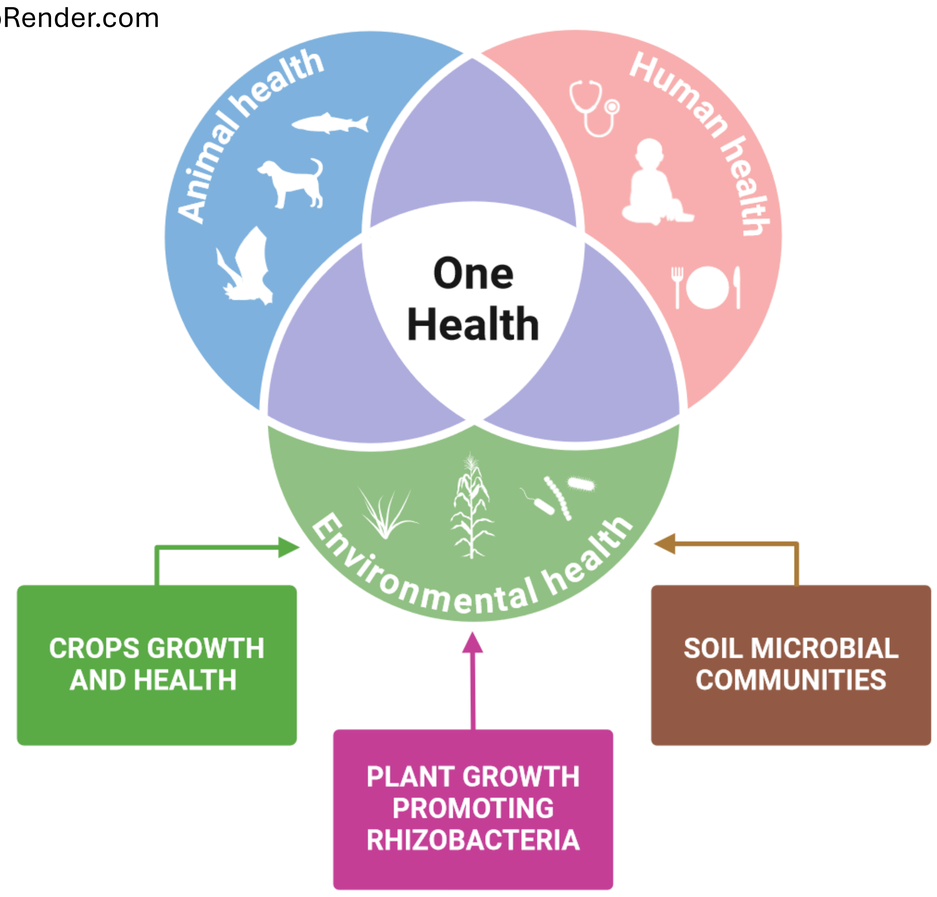

Figure 1 : Location of the project's key elements in the One Health approach.

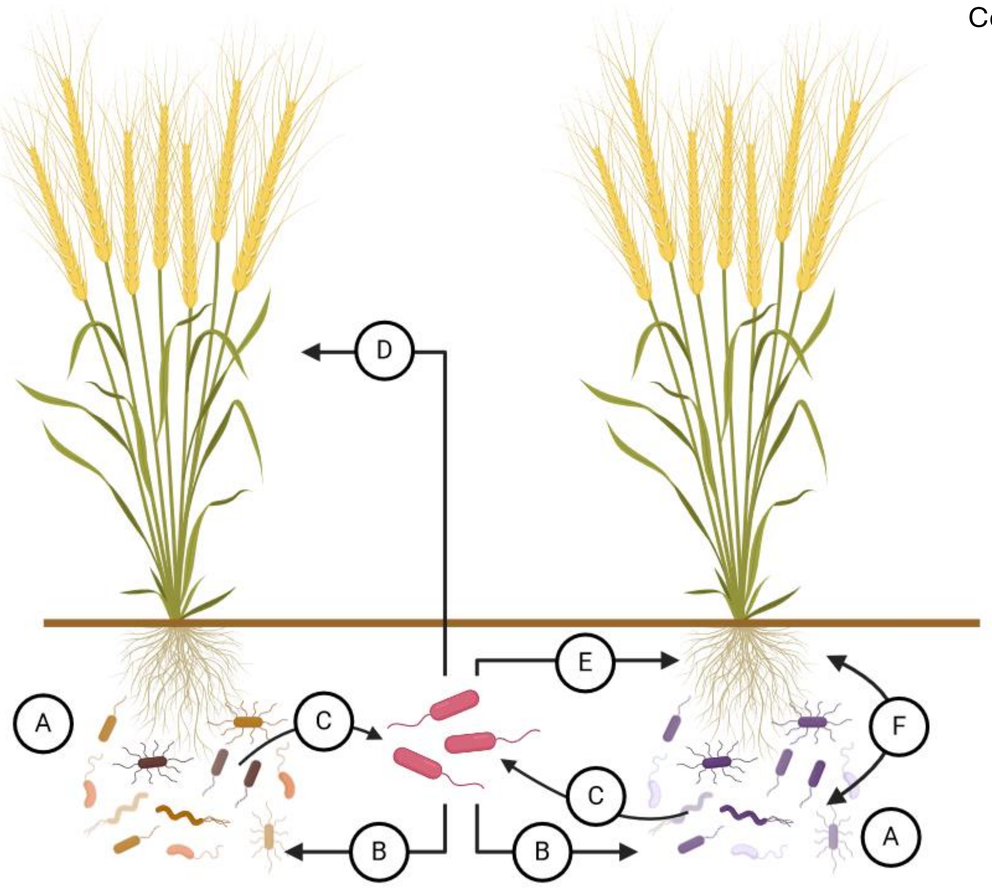

Figure 2 : Conceptual and graphical abstract of the project.

CONTEXT... AND CHALLENGES [1-2]

Root systems play a major role in the growth and health of cultivated plants, and they are in constant interaction with numerous microorganisms. On the other hand, the use of agricultural inputs such as **biostimulants** and biopesticides aims at improving the crops' development and natural defenses. However, the **efficacy** of biocontrol or biostimulation products varies depending on the pedoclimatic conditions, which may limit their widespread use, and **soil microbial communities** (microbiota) represent another factor of variability. We aim at **deeply understanding and leveraging** the impacts of microbiota on Plant Growth Promoting Bacteria (PGPR) with a world's key crop as a plant model, as part of the global environment health (fig.1)

PRELIMINARY RESULTS

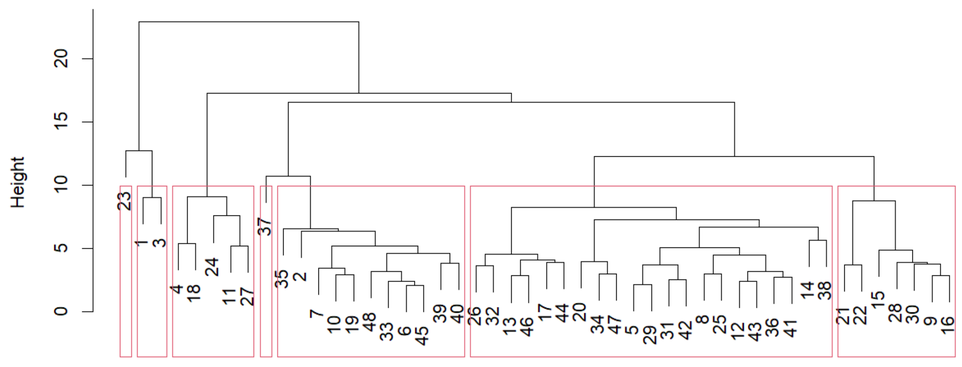

Figure 3 : Cluster dendrogram of the hierarchical clustering (Ward's method) of MicroSoilSystems soils. Numbers stand for soil sites.

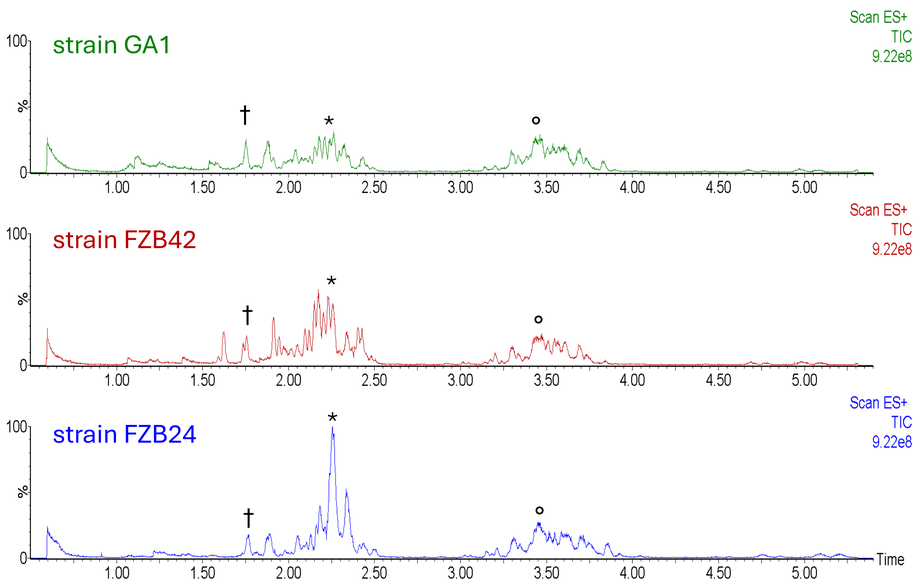

Figure 4 : Chromatogram of lipopeptides produced by *B. velezensis* strains. Substances : "†" = iturins, "*" = fengycins, "°" = surfactins.

STRATEGY AND METHODOLOGY ?

Soil collection and microbiota biobank

We already identified contrasted field soils in Wallonia, Belgium, with a dataset from the MicroSoilSystem project (fig. 3). The first step of our project will be to increase the number of physically and chemically characterized soils to obtain a large and representative panel of the diversity. Moreover, microbiota from each site will be isolated, taxonomically and metabolically characterized (see **A** in fig. 2) and preserved in a biobank for further experiments.

Microbes' ecology and competitivity

Three strains of *Bacillus velezensis* – GA1, FZB24, FZB42 – were selected because of their biostimulant and/or bioprotection properties [3-5]. Lipopeptides production by each strain were quantified and compared (fig. 4). The second step of the project will consist in co-cultivating PGPR strains with soil microbiota isolated from crop soils (biobank) to assess interactions and competition between microbes (see **B** & **C** in fig.2).

Analysis of the bioactivity robustness and the mechanisms of interaction

Finally, the bioactivity of a specific *B. velezensis* strain will be evaluated on a spring wheat (*Triticum aestivum* L.) variety with soil sampled in Wallonia as a substrate. It will consist in evaluating plant growth (see **D** in fig. 2) and root system architecture (see **E** in fig. 2). The results will be analyzed while considering the interactions between wheat plants and soil microbiota (see **F** in fig. 2).

As experiments progress and according to observations and results, we will obtain a reduced number of soils - with the associated microbiota - which show contrasted effect on the PGPR bioactivity (positive, neutral or negative influence). The mechanisms of interaction between the *B. velezensis* strain and these microbiota will be characterized with a multi-omics approach to deeply understand the microbiota functionality.

SHORT AND LONG TERM PERSPECTIVES !

The main objective of this project is to answer the question "**How does the soil microbiota influence the action of microbial biostimulant ?**". By deeply understanding the biological mechanisms which shape interactions in the plant-microbes system, we can leverage these knowledges to identify the most suitable conditions for the establishment of beneficial bacteria in the rhizosphere of crops. This will be useful to move towards a more sustainable and resilient agriculture.

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References
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Authorship
M. Quiévreux is the first author and S. Massart & P. Delaplace are the co-last authors.

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