Deciphering plant-microbe interactions underlying the use of compost soil amendment

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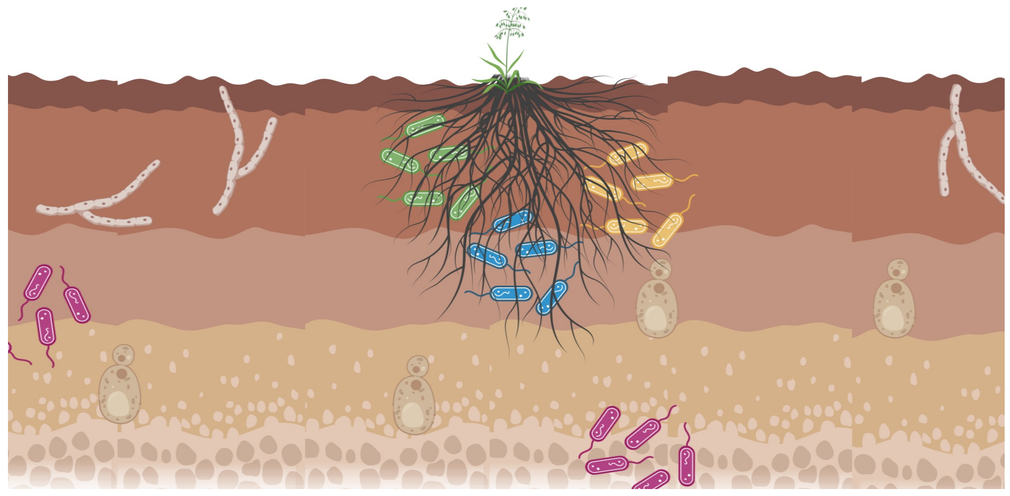
Introduction and aim of the project

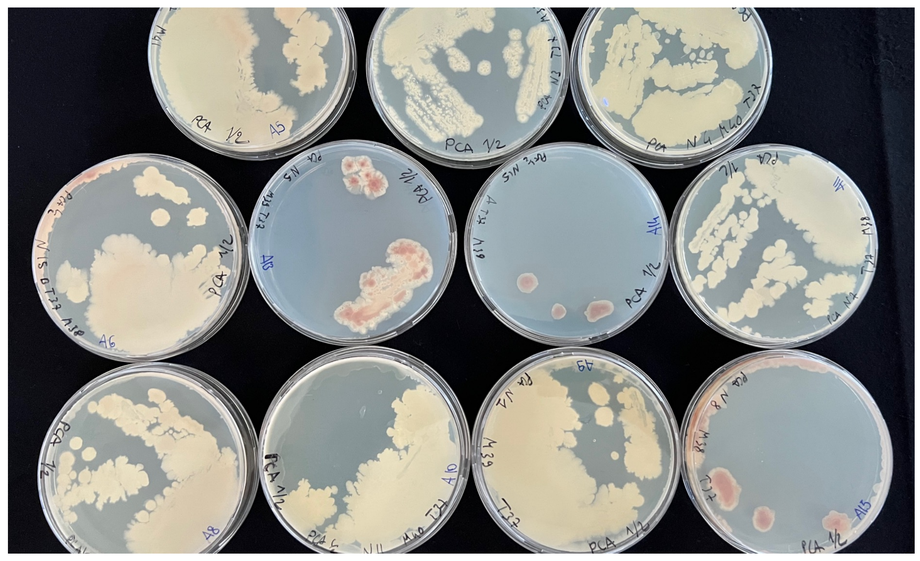
Plant roots are directly exposed to an environment with a great bacterial biodiversity, and they represent the site of numerous molecular interactions between the root cells and beneficial bacteria. Of key interest are those molecular interactions that occur between the plant root and the bacteria of the rhizosphere, a tiny portion of soil around the root. Some of these bacteria can also colonize the internal tissues of the root itself as endophytes. This process is highly regulated by the plant, which only attracts and hosts certain selected bacterial species. A central factor influencing the number and quality of these interactions is the soil bacterial biodiversity as a high soil biodiversity is a clear index of soil quality and fertility. Biofertilization is a recent strategy to improve plant associated microbial communities with selected bacterial strains that have biochemical activitis to sustain plant growth and act as biocontrol agents. In this project we explore the possibility to use compost, a material derived from aerobic fermentation of urban organic waste, as a source of microorganisms, and we investigate the molecular effect of some strains isolated from compost on tomato plants.



Compost is a source of bacterial strains with plant PGP properties

As the use of compost in agriculture is increasing to overcome the crisis of chemical fertilizers, we investigated if the compost produced from urban organic waste by the company SESA spa could be a source of bacterial strains with Plant Growth Promoting activities. These strains can be potentially able to interact with plants and able to have positive effects on plant growth and health. From the isolation and selection process we obtained a shortlist of isolates, listed in the table below. In this table the main plant growth biochemical activities are also listed.

Strain	Phosphate solubilization	Siderophores production	IAA production	IAA (µg/mL)
Bacillus subtilis	+	+	+	3,77
Bacillus licheniformis	-	-	-	0
Bacillus sonorensis	+++	+++	+	2,04
Kocuria rhizophila	++	++	+	7,36
Microbacterium sp.	-	+	+++	44,1
Glutamicibacter sp.	-	+++	++	34,69

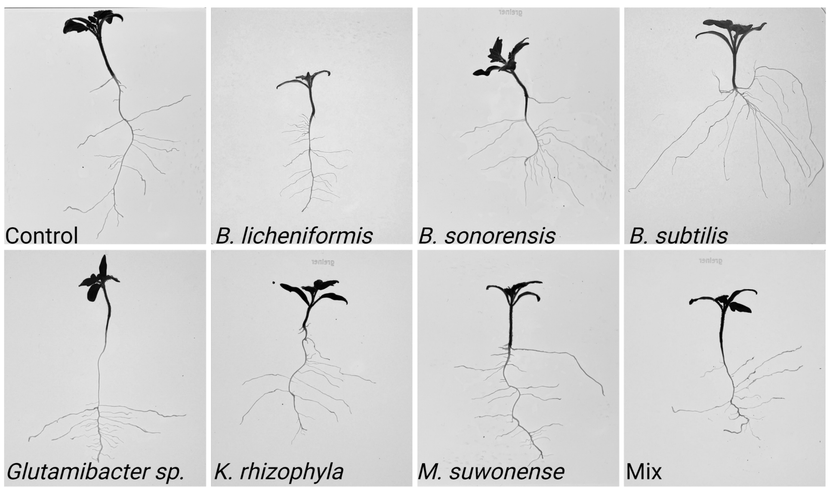


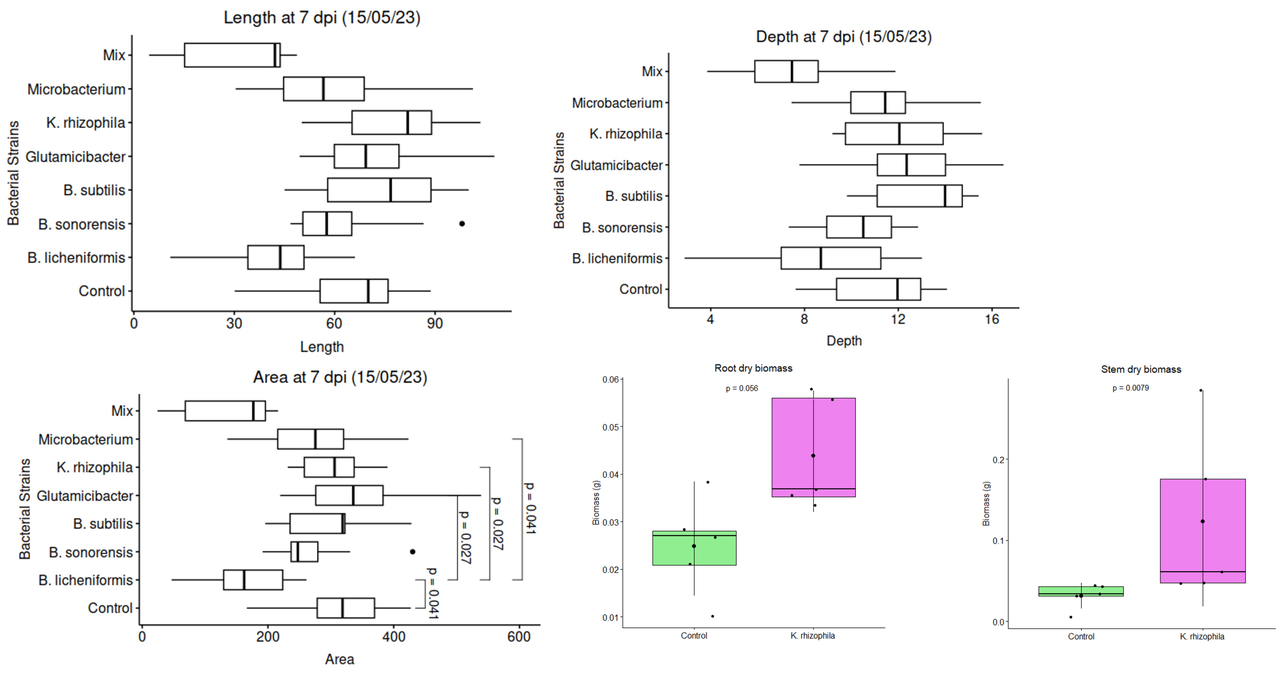
These strains will be tested in vitro and in controlled conditions to assess if they can alter the root architecture, improve the plant biomass and activate specific molecular pathways.

Effect of isolated strains on tomato plants

Plant phenotypic response

The effect of inoculation of the selected strains (10^8 CFU) on tomato seedlings (20 plants per treatment, sampling after 7 days) was investigated evaluating various phenotypic characteristics: root length, thickness (depth) and explored surface, in controlled conditions. Biomass of roots and shoots (dry weight) has also been recorded.

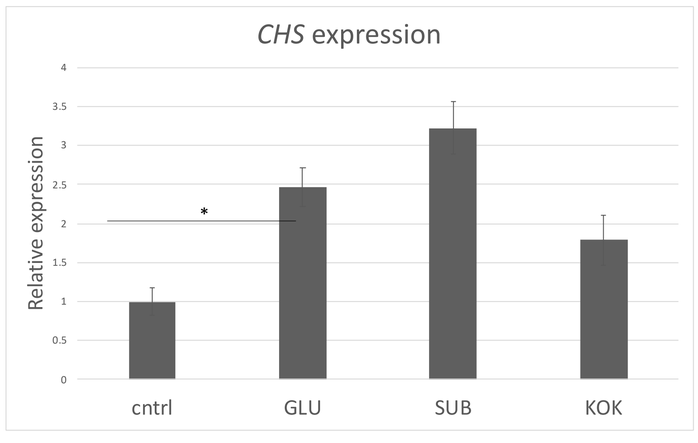


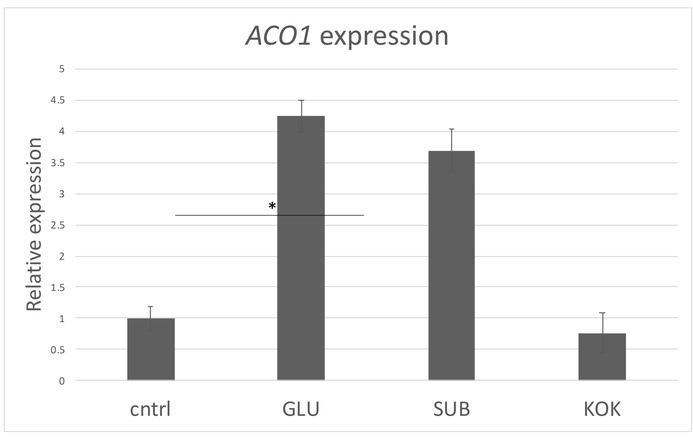


Inoculated strains don't have detrimental effect unless they are mixed all together. No significant positive effect have been measured on the roots when comparing inoculated plants with control plants, however a positive tendency has been observed, that worth to be investigated further. *Kokuria rhizophila* showed a positive and significant effect on increasing the shoot biomass.

Plant molecular response

The molecular response of the plant after the inoculation of bacteria is currently under investigation. The application of these bacterial strains can cause molecular responses and alterations of hormonal pathways and defense pathways. Among the tested isolated strains, *Glutamicibacter sp., Bacillus subtilis* and *Kokuria rhizophila* show effects on the expression of the genes *Chalcone synthase,* a gene involved in biotic interactions, and *ACO1*, a gene of the ethylene biosynthesis pathway. It is known that ethylene is a hormone involved in plant response to stress.





Conclusions

This study is investigating the biochemical activites of some bacterial strains isolated from compost material, in order to asses their plant growth promoting and biocontrol activity. Also the molecular responses of the inoculated plants will be investigated, as the inoculation of this bacteria to tomato plants led to healthy plants with some root modifications and in one case also a improved biomass. Different molecular pathways will be further investigated (ISR, hormonal pathways, root development mechanisms) is order to add knowledge about the molecular response of the plants during the interaction with beneficial bacteria.

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