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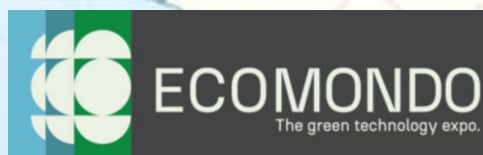
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Guild composition of rhizosphere bacteria exploitable for hydrocarbon bioremediation is driven by ecological interactions.

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ABSTRACT

Background information

Soil reclamation from pollution in large, historically contaminated sites presents several challenges, in particular the unsuitability of physical and chemical remediation approaches at affordable costs. Nature-based solutions such as phyto-rhizoremediation interventions could be preferable, however the study of ecological interactions behind these approaches is pivotal to guarantee their effectiveness in the target site. Here, we exploited the ‘cry-for-help’ concept (i.e., the plants’ ability to adjust root exudation for manipulating the rhizosphere microbiome structure, Rolli et al. 2021) to identify plant species, bacterial strains and communities with the final goal to lower hydrocarbons (HCs) concentration in polluted soils.

Main results

Among different tested plant species, sunflower was able to cope with the phytotoxicity of the target HCs polluted soil and was selected as species of interest for future bioremediation intervention. In this study, we compared biostimulation (i.e., plant effect) and bioaugmentation (i.e., plant inoculated with HC degrading strains) treatments to untangle the dynamics of sunflower rhizosphere bacterial communities during the process of plant recruitment. The results of 16S rRNA Illumina sequencing showed that the sunflower rhizosphere microbiome was shaped both by plant growth and the inoculation of allochthonous degrading strains (*R. jostii* B12 and *A. calcoaceticus* P320). Moreover, qPCR targeting HC catabolic genes analyses allowed to monitor over time the enrichment of degrading population in the sunflower rhizosphere. In a parallel experiment, sunflower was exploited to recruit and isolate HC-degrading and plant-growth-promoting bacteria through culturomics. A bacteria collection was established from the rhizosphere and characterized *in vitro*. The majority of strains was able (i) to grow using a range of aliphatic and aromatic hydrocarbons, (ii) to influence phytohormones balance and (iii) to increase the bioavailability of hydrophobic pollutants. Based on these results novel synthetic communities (SynComs) were designed and tested to alleviate plant stress in the target polluted soil.

Conclusions

Overall, our results highlight the importance of ecological interactions involving plants and soil microbiome for steering the assembly of specific microbial guilds that could provide plants with a wider portfolio of metabolic functionalities for HC degradation, thus enhancing bioremediation efficiency.

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References:

Rolli E., Vergani L., Ghitti E., Patania G., Mapelli F., Borin S. “‘Cry-for-help’ in contaminated soil: a dialogue among plants and soil microbiome to survive in hostile conditions”, *Environ. Microbiol.*, 23, 5690–5703 (2021).