SOIL TECHNOLOGY FACT SHEET

Rhizoremediation

University of Milan (UMIL) technology
developed under the EU-funded NYMPHE project

PROBLEM

SOILS CONTAMINATED WITH HIGH LEVELS OF PERSISTENT ORGANIC POLLUTANTS (E.G., HYDROCARBONS) ARE DIFFICULT AND COSTLY TO REMEDIATE USING CONVENTIONAL PHYSICAL OR CHEMICAL METHODS, HIGHLIGHTING THE NEED FOR SUSTAINABLE, LARGE-SCALE BIOREMEDIATION SOLUTIONS.

Target pollutants:

Persistent organic pollutants, with focus on hydrocarbons.

TECHNOLOGY

System setup:

- **Rhizoremediation relies on the cooperation of two key players:** plants and microbes.
- Sunflower plants selected for their tolerance to soil phytotoxicity.
- Native beneficial microbes isolated from the rhizosphere of sunflowers in contaminated soil.

Operation:

- Sunflowers planted in hydrocarbon-contaminated soil.
- Plants recruit and enrich beneficial microbes through root exudates (the “cry-for-help” mechanism).
- Sunflowers combined with hydrocarbon-degrading microbes to enhance soil remediation.

Function:

- Plants stimulate microbial activity and pollutant degradation via root exudates, including signal molecules, transcriptional inducers, and nutrients.
- Microbes degrade hydrocarbons and support plant growth through nutrient supply and phytohormone production.
- The integrated plant–microbe system accelerates bioremediation in polluted soils.

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INNOVATION

Ambition:
Rationally designing rhizoremediation strategies by engineering plant microbiomes in heavily polluted soils.

Novelty:
Integrating multi-omic analyses, microbial ecology, and plant–microbe engineering to develop site-tailored rhizoremediation, advancing ecology-based soil cleanup.

TRL:
4.

RESULTS

Bacterial collection characterized; strains with hydrocarbon-degrading ability identified.

- Microbial consortia tested with sunflowers → improved germination and growth in toxic soils.
- Enhanced hydrocarbon degradation observed in rhizosphere of inoculated plants vs. controls.
- Sunflower root metabolites under stress identified; potential future use as biostimulants for native microbiomes.

IMPACT

Demonstrates feasibility of sunflower–microbe systems for hydrocarbon remediation, aligning with circular and ecological approaches.

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