Petroleum hydrocarbon (PHC)-induced stress causes a shift in sunflower root exudation chemistry, potentially affecting recruitment and rhizocompetence of PHC-degrading bacteria

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Root exudation is a crucial mechanism of plant response to abiotic stress. In contaminated soils, plants shift root chemistry prompting a “cry-for-help” for recruiting pollutant-degrading microbial communities, thus mitigating phytotoxicity and sustaining plant growth.

Systematic studies comparing exudation patterns of plants grown in laboratory versus field-like conditions are lacking. In this study, the sunflower “cry-for-help” response to PHC was investigated through untargeted metabolomics: i) in an *in vitro* hydroponic system where plants were exposed to xylene and ii) in a historically PHC-polluted soil under outdoor conditions. The two experimental designs significantly impacted the detected exudation patterns, with a more complex profile in the soil setup, showing modified abundances of coumarins, terpenes and flavonoids, known for their role in plant stress response. DistLM analysis performed on the metabolome and 16S rRNA amplicon sequencing datasets highlighted that coumarins and pyrimidines significantly correlated with the structure of rhizosphere microbial communities in the polluted soil, with implications for degrading populations recruitment. Indeed, our results suggested that differentially exuded metabolites impacted rhizocompetence of PHC-degrading strains. Quinic acid and theophylline, upregulated under PHC stress, stimulated swimming motility and biofilm formation, important features for microbe establishment in the rhizosphere. Considering its inhibitory activity on the growth of selected strains, the decreased exudation of epicatechin gallate could instead represent a strategy to preserve degrading microorganisms in the rhizosphere.

Unravelling the “cry-for-help” to PHCs is crucial to identify molecules with biostimulant activity for degrading bacteria, facilitating their recruitment to boost plant fitness under stress and to improve bioremediation effectiveness.

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