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RECYCLES WORKSHOP

Metagenomics and metabarcoding approaches to describe ecological systems and infer their development

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The mycoremediation for the treatment of the dredged sediments

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European
Commission



GA: 872053 — H2020 - MSCA - RISE-2019

Aims



In Europe, about 200 million m^3 of sediments are dredged from ports and waterways every year, in order to maintain shipping traffic efficiency.

Although EU waste policy encourages the application of the circular economy to waste materials, through the production of high-quality resources (EU 2008), there are legislative limitations for the reuse of dredged sediments in agriculture sector (EU 2019).

In particular, the presence of a high level of contaminants (heavy metals and hydrocarbons) makes dredged sediment a waste material, with expensive costs for their disposal.

The classification of nutrient-rich recycled sediments as fertilizer is actually desirable in the new EU regulations.

Mycoremediation for sediment decontamination TRL 5 – technology validated in industrially relevant environment, case of key enabling technologies

ASSESSMENT 1

Poor attention to the toxicological aspects: since EU and national legislation on environmental matrices contamination are based upon total concentrations of contaminants.

ASSESSMENT 2

Mycoaugmentation



Restore of the correct ratio
C:N:P
100:10:1



10% w/w wood chips



3 Kg of polluted sediment
2964 ± 99 mg/kg



Inoculum of *Ciboria* sp.
10% w/w

T0

Sampling

T18

Sampling

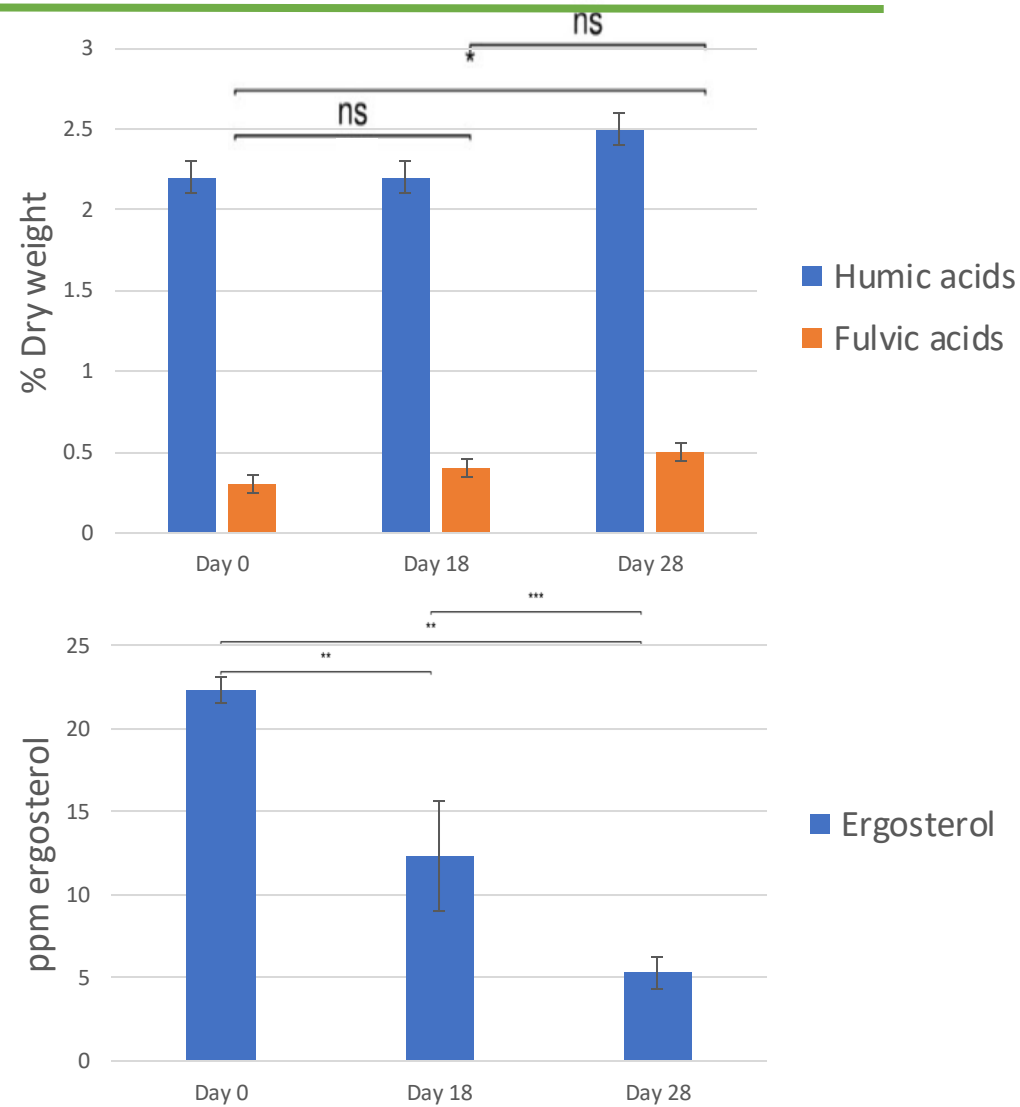
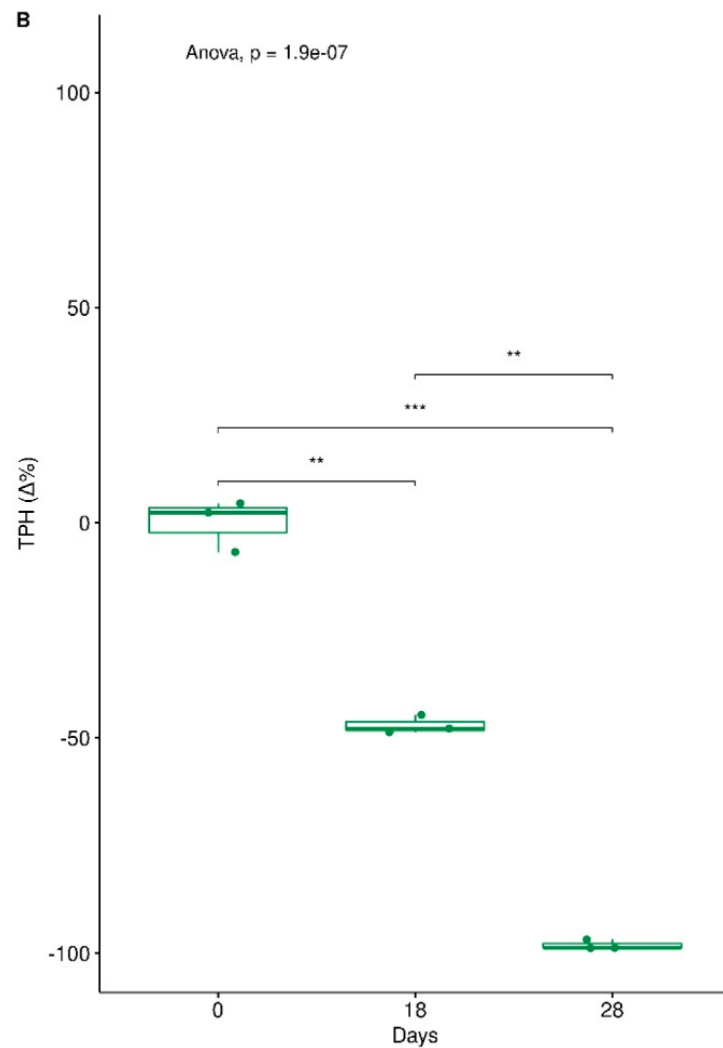
T28

Sampling

Treatment

Control

Autoclaved
Ciboria sp



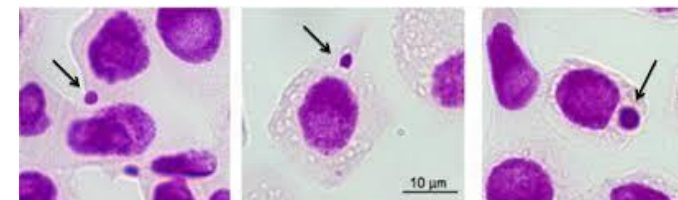
2. Toxicity Tests on *Vicia faba* Assessment 2



ISO 29200:2013 is the method for assessing genotoxicity and clastogenicity (**chronical toxicity**) effects (**chromosome breakage or dysfunction of the mitotic spindle**)

On secondary roots of a higher plant: *Vicia faba* (broad bean).

Micronuclei



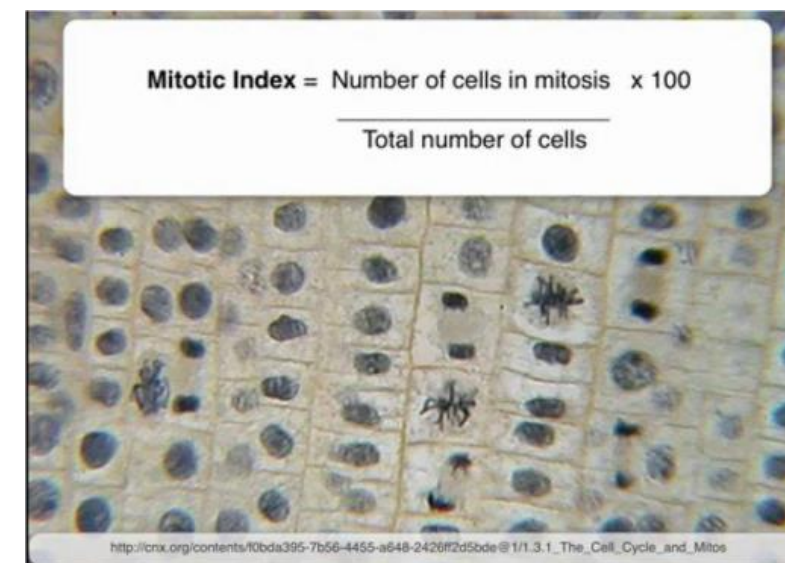
Two ways of exposure:

- to the soil (or sediment) which is relevant for the real genotoxic potential
- to a leachate for the detection of the mutagens which are not adsorbed to soils and which may be transferred to aquatic compartments

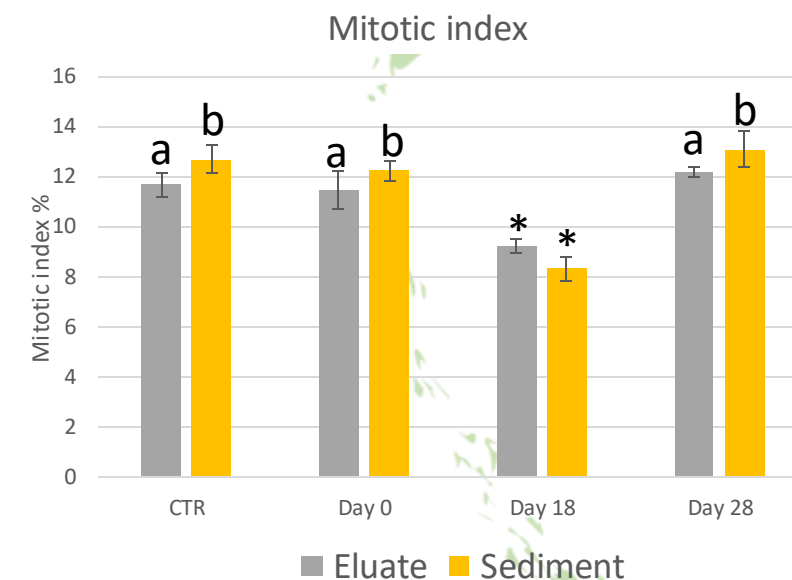
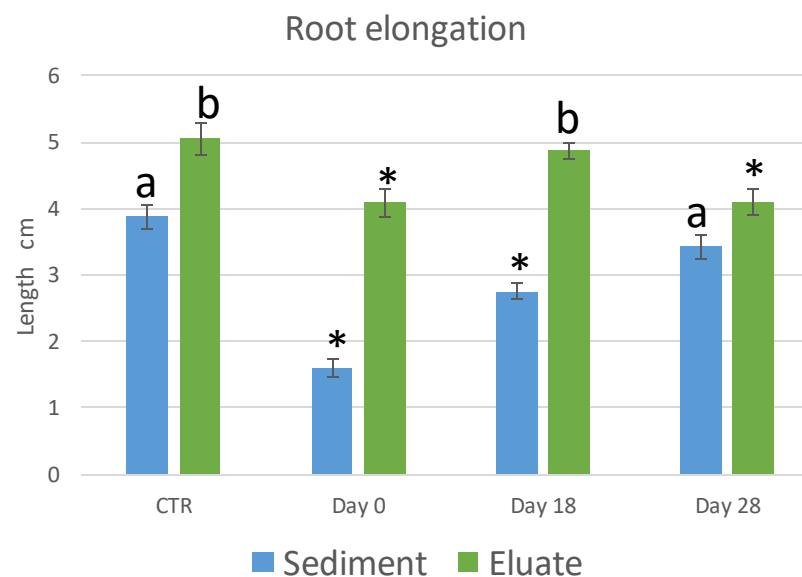
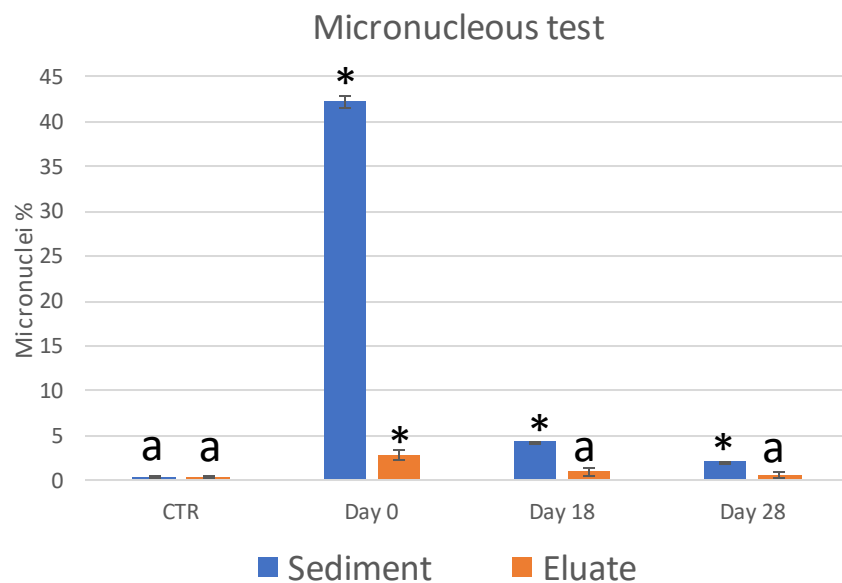
Root elongation -- phytotoxicity



Mitotic index -- cytotoxicity



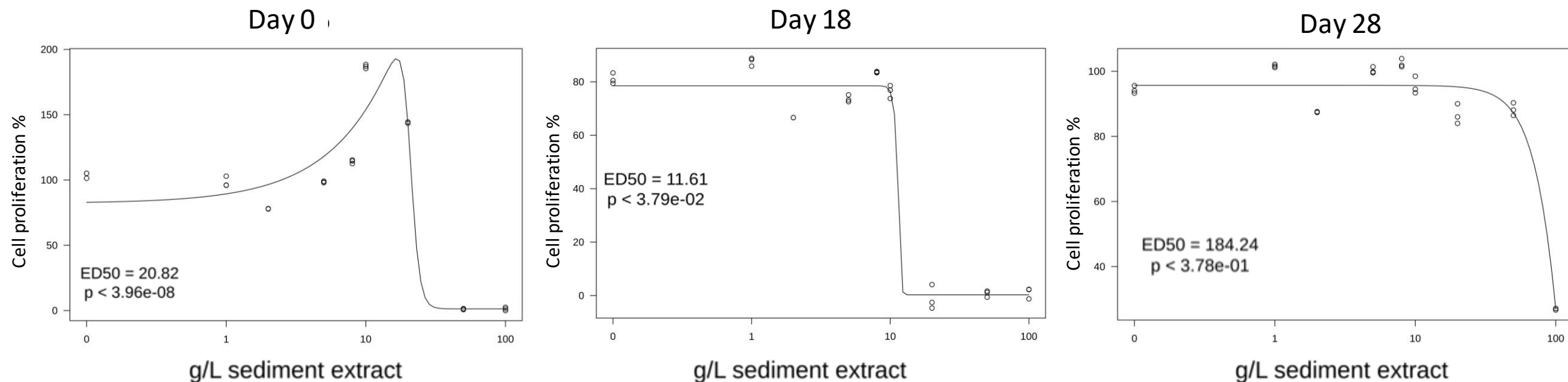
2. Toxicity Tests on *Vicia faba* Results



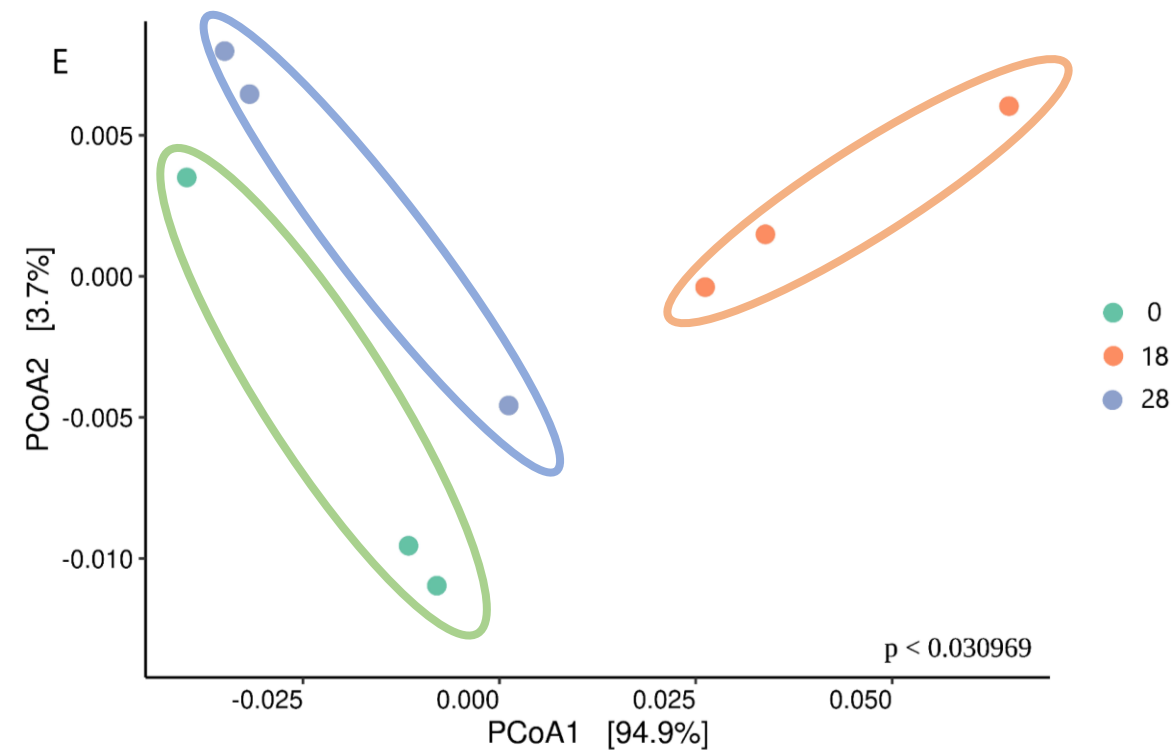
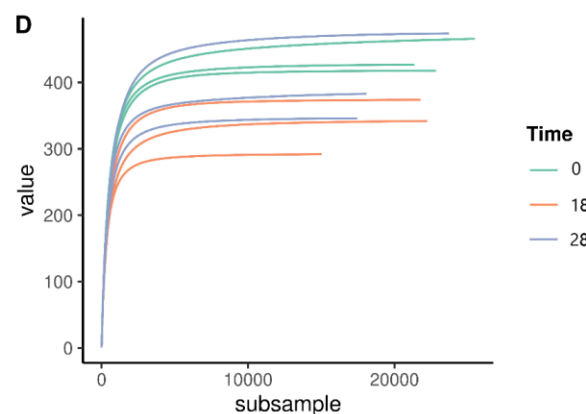
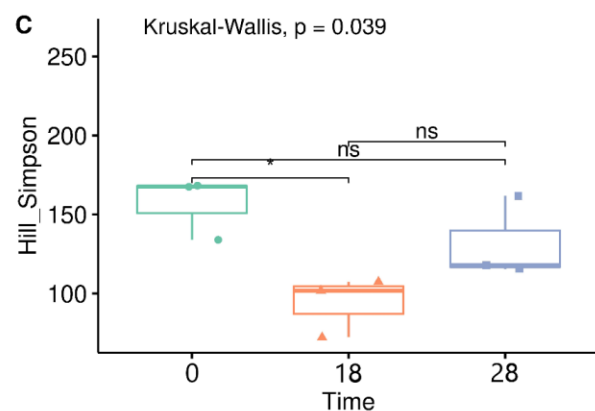
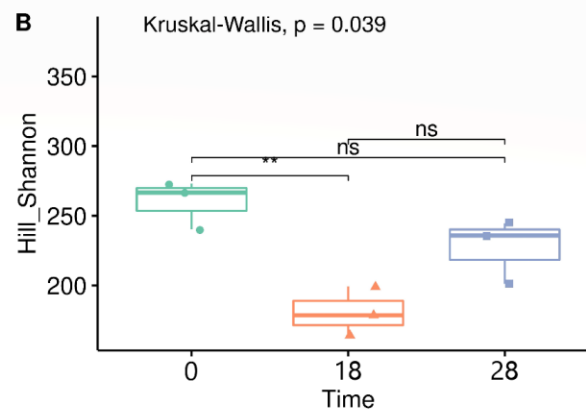
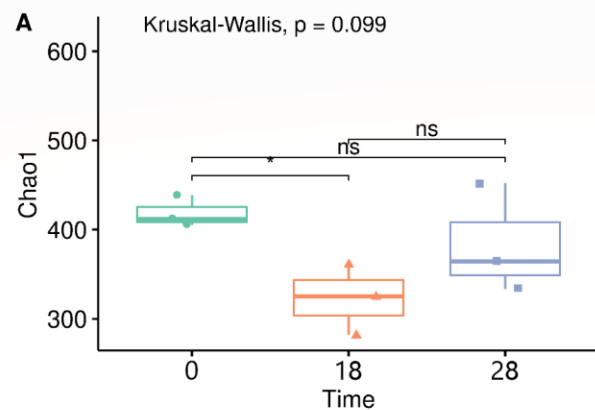
2. Toxicity Tests on CaCo2 cells



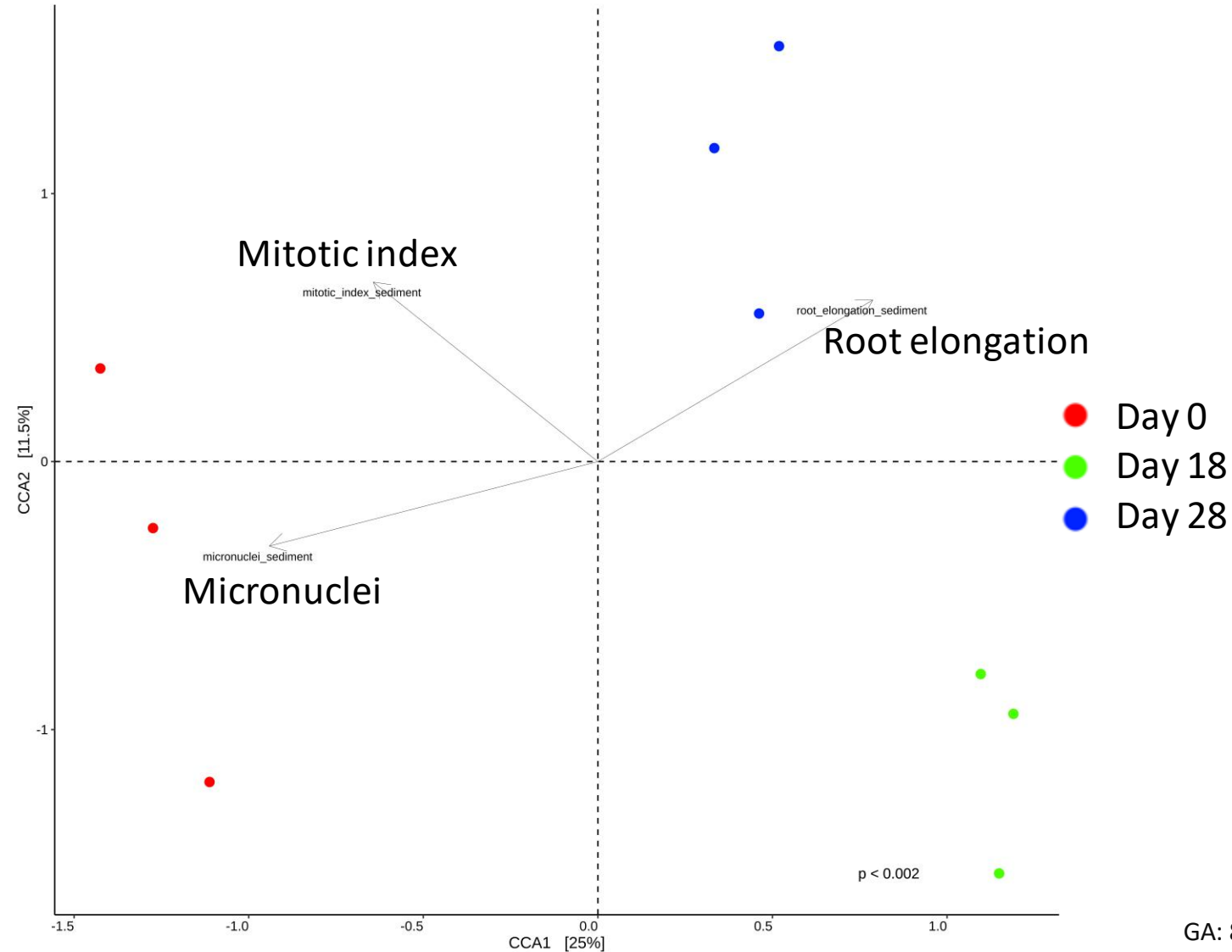
Caco-2 cell is a cell line derived from human epithelial colorectal carcinoma cells and are a general *in vitro* model for intestinal cells. Caco-2 cell have been adopted by other researchers for exploring the toxicity of contaminants (Es. pesticides) to the gastrointestinal system



1. Alpha & Beta Diversity



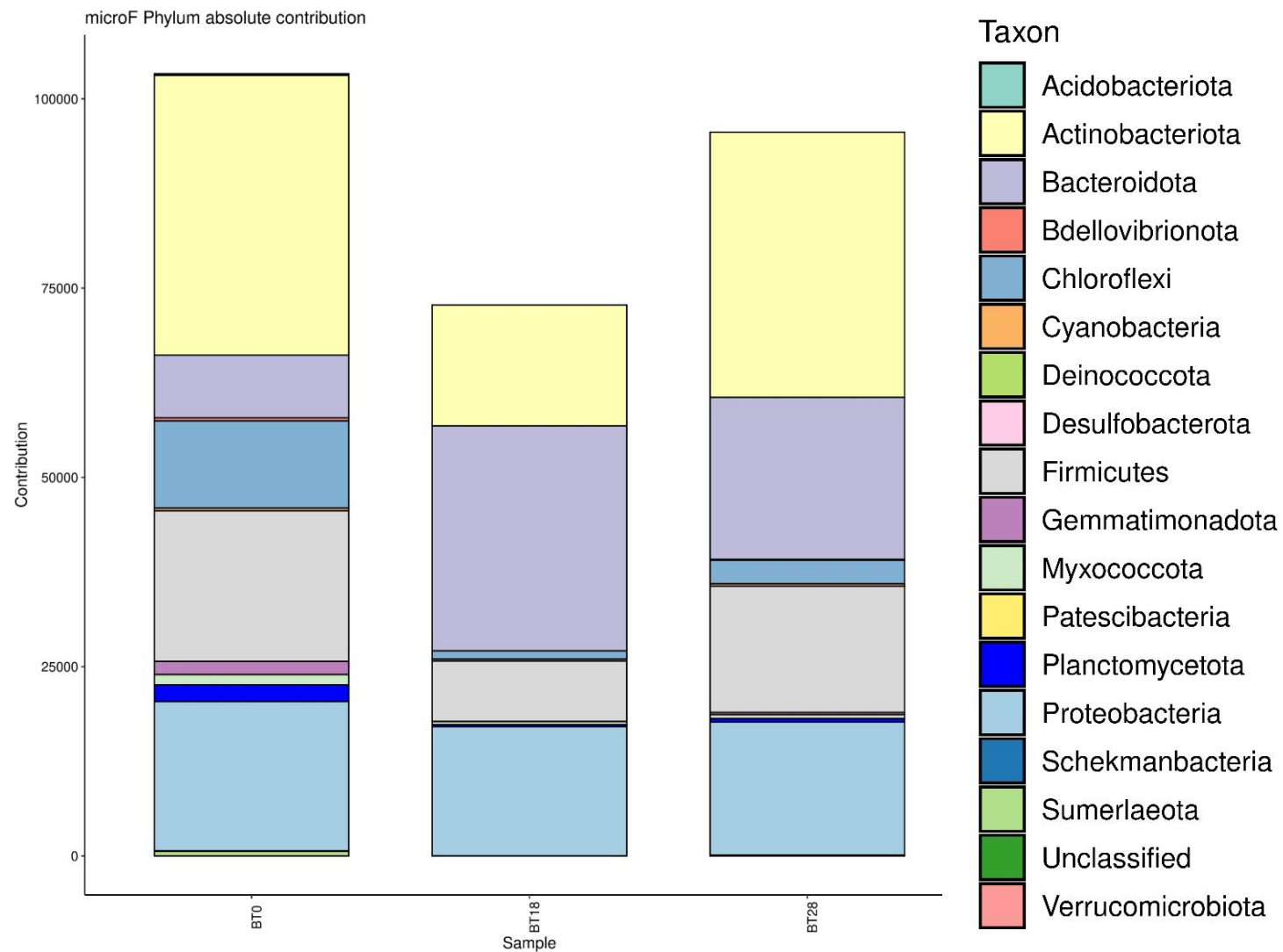
2. Canonical Correspondence Analysis



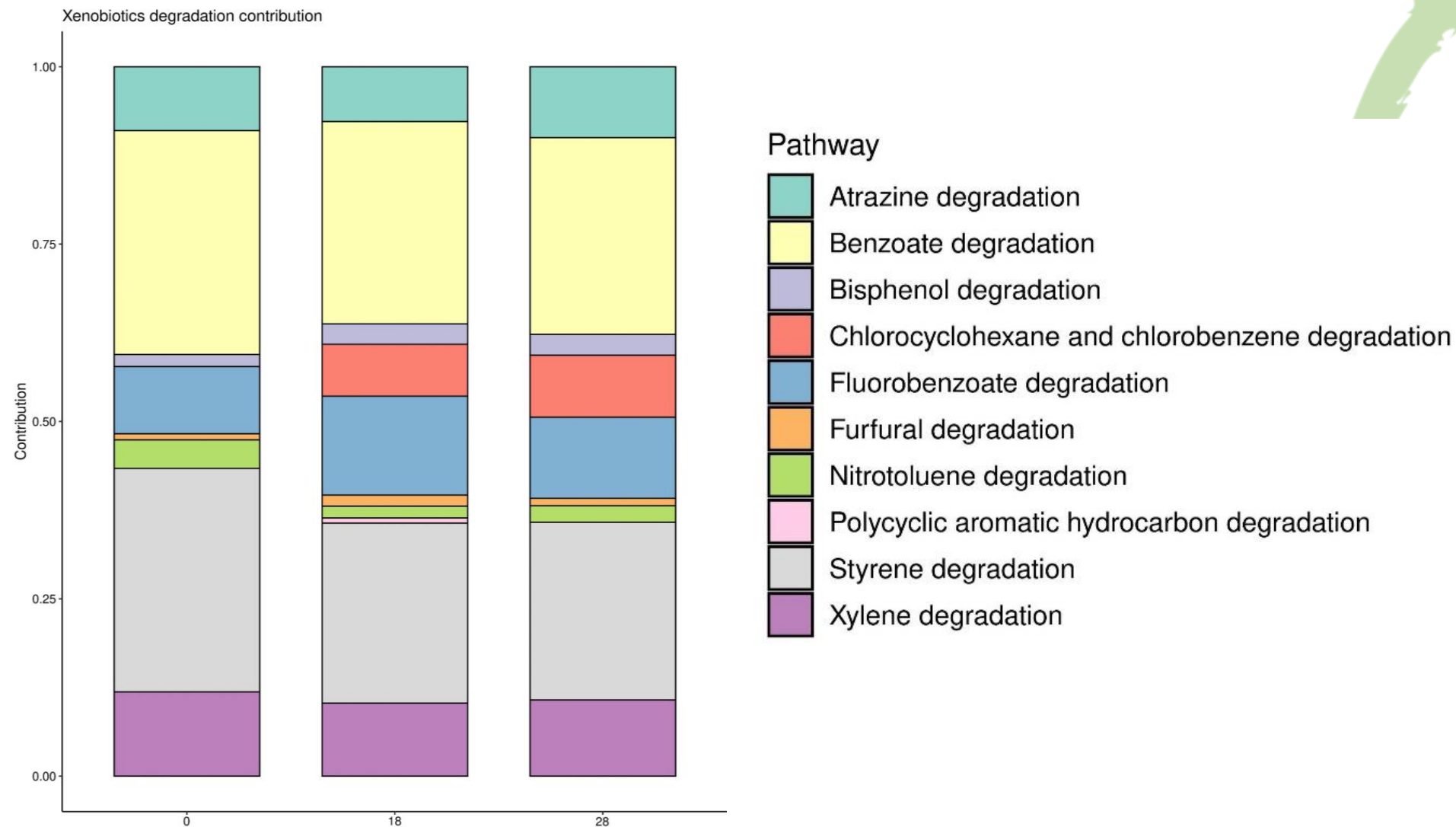
2. Taxonomic Results



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3. Functional Results



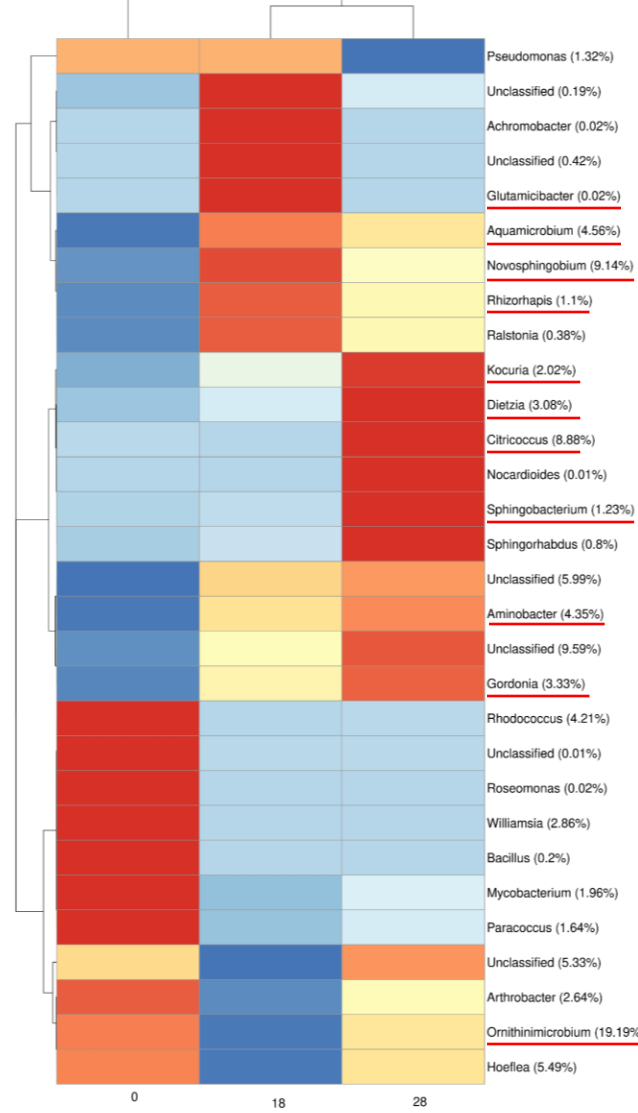
3. Functional Results



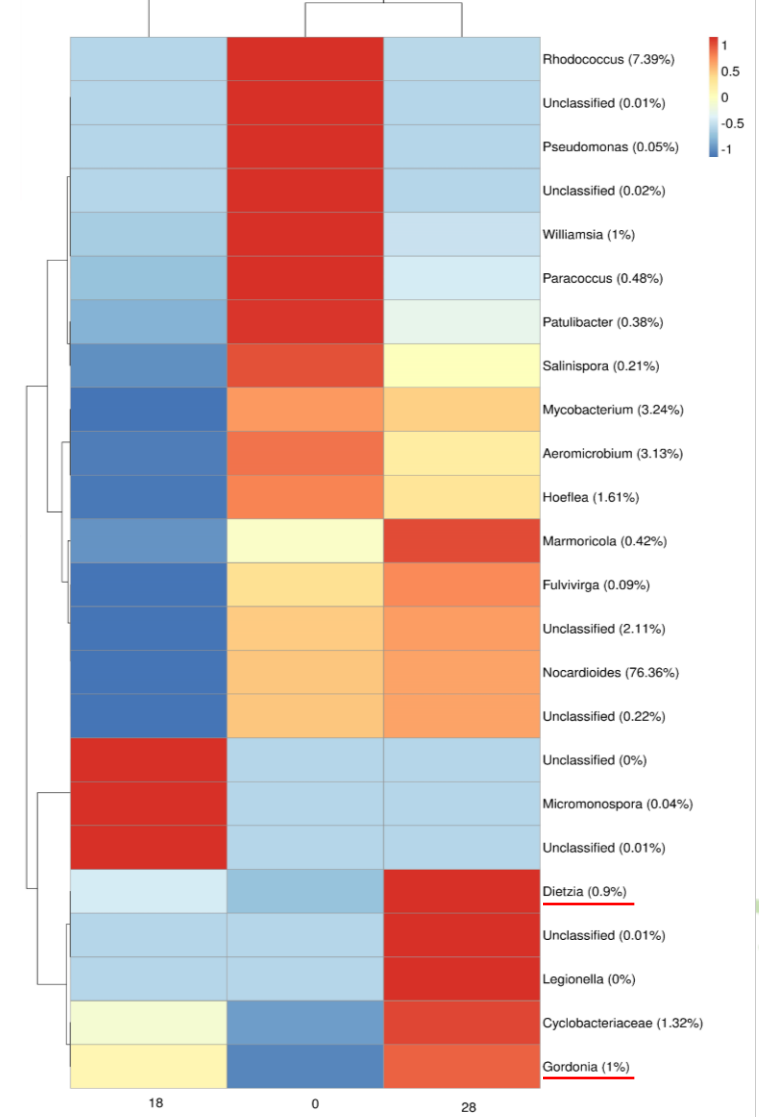
Benzoate 1,2-dioxygenase Genus heatmap



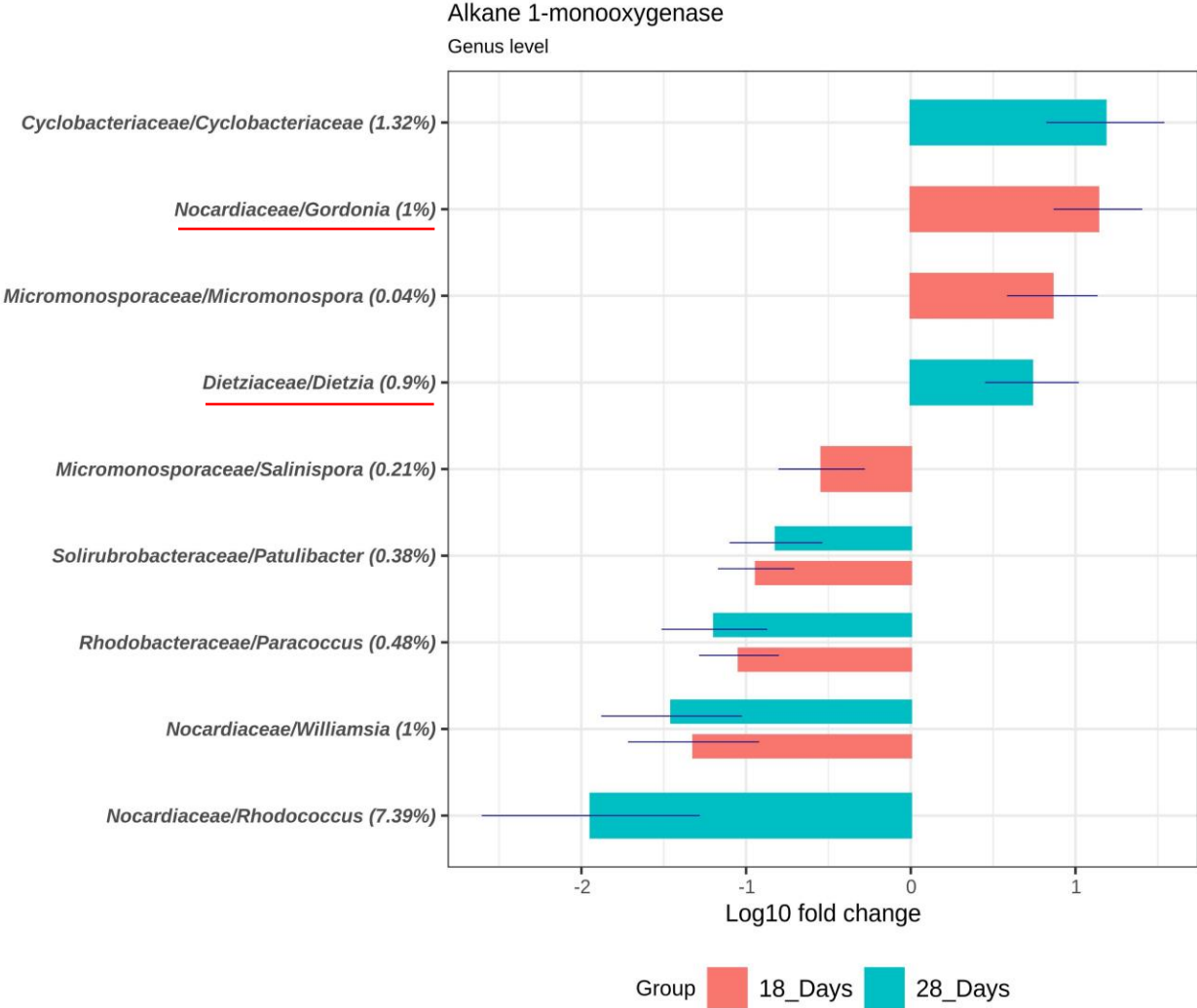
Catechol 1,2-dioxygenase Genus heatmap



Alkane 1-monooxygenase Genus heatmap



3. Functional Results TPH



4. Conclusion



Assessment 1 → Mycoremediation for sediment decontamination

- In 28 days we observed the complete TPH depletion
- *Ciboria sp* MUT 5852 is mandatory for the depletion of TPH
- TPH final concentration is below the CST (Contamination concentration threshold)

Assessment 2 → High attention to Toxicological aspects

Two different models for the toxicity tests: *Vicia faba* and CaCo 2 cells
After 28 days the sample shows less toxicity compared to the other days

- The sediment shows no phytotoxicity
- The elutriate shows no genotoxicity
- The sediment and the elutriate show no cytotoxicity
- They show the highest ED 50 value

What if we used
a microbiota?

... a very good result for a polluted sediment!

Thanks for your attention



Before

After

