

Restoration of trace element contaminated soils using Vetiver (*Chrysopogon zizanioides*) and a microbial-enriched hydrogel

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PORTO

Introduction

- ❖ Soil functions and health are adversely affected by several human activities, such as mining.
- ❖ Mining activities can release high concentrations of trace elements (TE), such as Cu and Cd, that cause negative effects on biodiversity and compromise human health.
- ❖ There is an urgent need for soil restoration, especially through sustainable technologies such as phytotechnologies.
- ❖ **Phytotechnologies** use plants and microorganisms, such as plant-growth-promoting bacteria (PGPB) and arbuscular mycorrhizal fungi (AMF), to recover contaminated systems. These microorganisms can be applied to plants using carriers like hydrogels to favor plants' growth and stress resilience. The use of organic amendments can also be useful by providing nutrients and stimulating plant growth and soil microbial activity.

Objective

- ❖ To evaluate the combined use of a TE-resistant plant – **Vetiver** (*Chrysopogon zizanioides* L.) - with a microbial-enriched hydrogel (Polyter©) and an organic compost (vermicompost), in the restoration of TE-contaminated soil collected from the tailings of Borralha mine.



Vetiver plants

<https://www.greenmeadowgrowers.com/plants/vetiver-grass/>



Borralha mine – tailing area

Methods

SITE DESCRIPTION

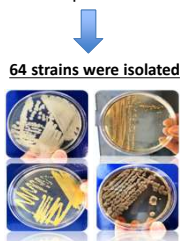
- Borralha mine is a deactivated tungsten mine located in northern Portugal that presents tailings that can benefit from the use of phytotechnologies in its remediation and requalification.

- The tailings have a high concentration of TE, such as Cu and Cd.

SELECTION OF PGPB

1. Isolation PGPB

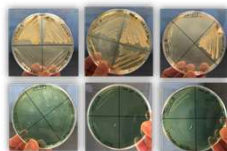
PGPB were isolated from the tailings of the Borralha mine: a composite soil sample was taken from the rhizosphere of the most abundant plants present in the area.



64 strains were isolated

2. Selection of PGPB

According to their metal tolerance to Cd, Zn, Cu and Pb, 4 strains were selected.



Metal tolerance test to 30 ppm of Cd (yellow plates) and 1500 ppm of Cu (green plates).

3. Characterization of growth-promoting traits of the selected PGPB



Phosphate solubilization: PGPB can help to solubilize P that is essential for plant growth



Extracellular enzymes (Lipases; Cellulases; Proteases; Pectinases)



NH₃ production: PGPB can help plant acquiring N



IAA (Indole-3-acetic acid) production: IAA can be produced by PGPB. This hormone promotes the growth of plants and increases their resistance to stress conditions.



ACC (1-Aminocyclopropane 1-carboxylic acid) deaminase production: PGPB can produce this enzyme that reduces the stress of the plant.



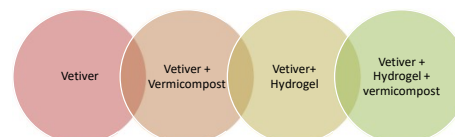
Siderophores: PGPB can produce siderophores that chelate iron and provide it to plants. Iron is an essential micronutrient.

The PGPB *Cupriavidus pauculus* showed the best results and was selected for the greenhouse trial with vetiver plants.

GREENHOUSE TRIAL

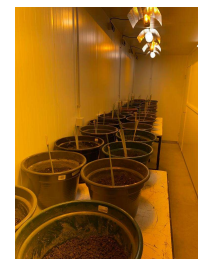
A greenhouse trial was established with vetiver plants and soil collected in the mine tailing (10 kg/pot).

Four treatments were applied to the plants and soil, as follows:



Hydrogel: the hydrogel was mixed with the selected PGPB – *C. pauculus* and with AMF spores (INOQ-Germany)

Compost: Commercial Vermicompost



Greenhouse trial with Vetiver plants

Ongoing work

- The greenhouse experiment is ongoing. Vetiver plants show to be able to grow in the tailings, especially in the treatment with hydrogel and vermicompost.
- At the end of the experiment, soil parameters such as enzyme activities, soil microbial composition, and TE concentration will be evaluated.

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