Myco-barriers as sustainable tool for port water decontamination from metals

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Introduction

Figure 1: Port of Genoa, Liguria, Italy

Ports can represent a collector for ecotoxic metals (EMs), and movement of sediments may promote EMs transfer and dissolution in the water column, mainly during dredging activities. Few biological methods for remediation of marine waters from EMs have been studied and developed: among these, mycoremediation exploits the capabilities of fungi to degrade or bioaccumulate toxic compounds.

Interreg MARITTIMO-IT FR-MARITIME

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Figure 2: Interreg Maritime Projects

This study reports the experimental procedures carried out for the realization of absorbent barriers containing fungi (myco-barriers), and their application for EMs bioremediation in the marine waters of the Port of Genoa (Liguria, Italy) and Cavo (Elba Island, Tuscany, Italy). All the activities were carried out within the Interreg ITA-FR Maritime 2014-2020 Projects GEREMIA and QUALIPORTI.

Results & Discussion

As concern the Port of Genoa, wild strains of *Pleurotus ostreatus* (Jacq.) P. Kumm. and *Trametes versicolor* (L.) Lloyd, and a strain belonging to the *Trichoderma harzianum* Rifai group native of the port waters, were used.

Regarding the Port of Cavo, the following species were employed: a wild strain of *Pleurotus ostreatus*, the *T. harzianum* strain native of the Port of Genoa - non-dangerous ubiquitous alien species -, a microfungal autochthonous strain belonging to the *T. harzianum* group and a mix of autochthonous strains belonging to the *Simplicillium* and *Trichoderma* genera.

Myco-barriers were prepared employing a sterilized mixture of vegetable, straw, and sawdust. The mixture was inoculated in bags with the selected fungal strains. After fungal growth, the myco-barriers were sewn and positioned in the ports.

Together with myco-barriers, commercial barriers and home-made barriers, filled only by the vegetable substrate without fungi, were also positioned in the ports, as control.

All the barriers were sampled 15 and 30 days after their positioning in the port's waters. The EMs bioaccumulation rate was measured by ICP-MS analysis.

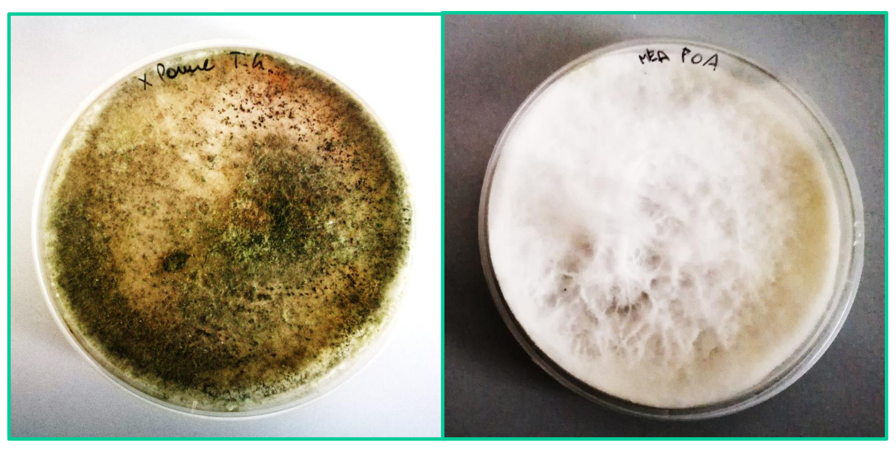

Figure 3: example of selected macro- and microfungal strains

Figure 4: Myco-barriers

Data from the Port of Genoa highlighted a higher bioaccumulation rate of Ni, Pb, and Cu after 30 d than 15 d for myco-barriers made with autochthonous *T. harzianum* group, while control barriers (commercial and vegetal) only showed Cu accumulation, in particular after 15 d. The highest bioaccumulation rates in myco-barriers inoculated with macrofungi was found after 15 d, for Zn, Cu, Pb and for Pb and Ni, in *T. versicolor and P. ostreatus* myco-barriers respectively; after 30 d the metals uptake is unchanged, and control barriers showed Pb and Cu accumulation only in vegetal barriers from the *T. versicolor* 15 d series.

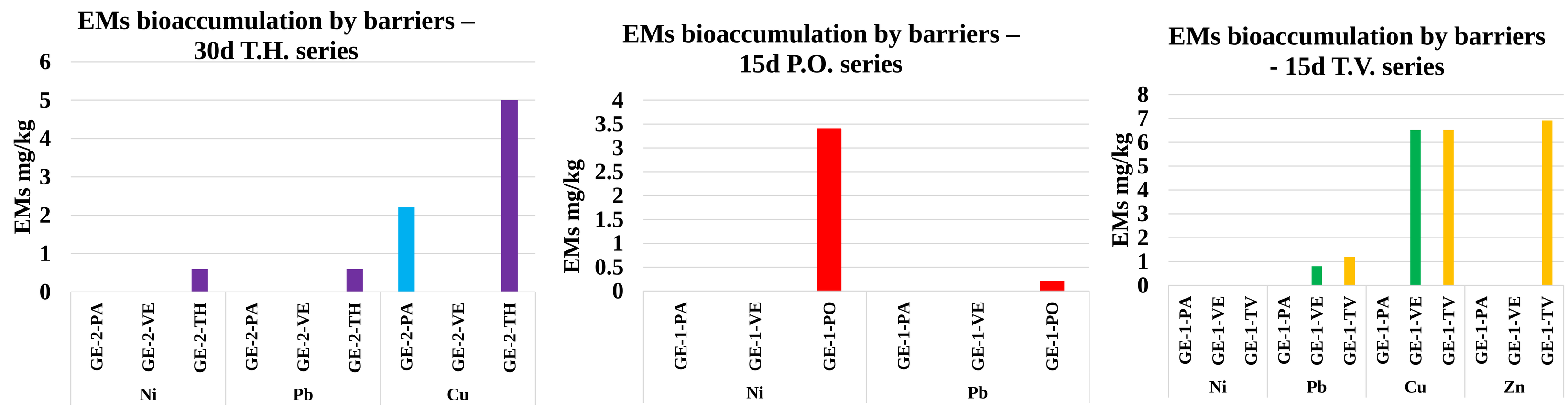

Figure 5: EMs uptake by *T. harzianum* (T.h.), *P. ostreatus* (P.o.) and *T. versicolor* (T.v.)

Data from the Port of Cavo showed no significant differences between the two sites selected in the port for the treatment. Myco-barriers filled with the allochthonous *T. harzianum* strain bioaccumulated Al, Cu and Fe during the treatment, reaching the highest values after 30 d, while vegetal barriers accumulated lower concentration of Al and Fe. The autochthonous strain of *T. harzianum* showed the capability to uptake Cu and Zn after 30 d, but myco-barriers inoculated with the mix showed the higher values.

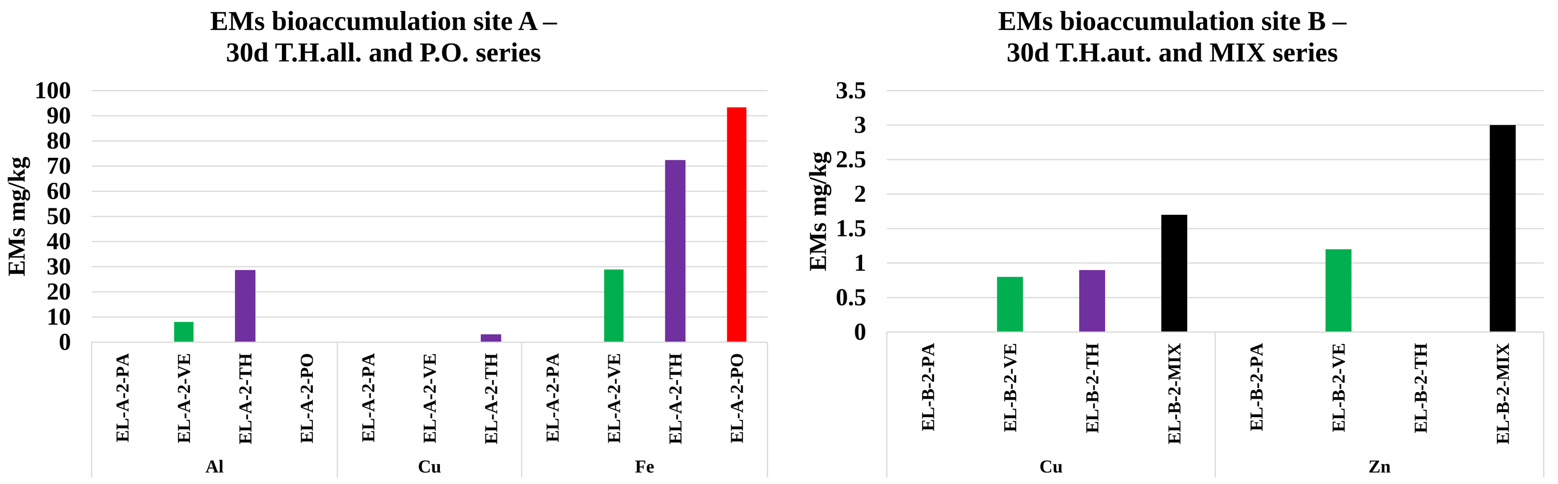

Figure 6: EMs uptake by *T. harzianum* allochthonous (T.h. all.), autochthonous (T.h. aut.), *P. ostreatus* (P.o.), and MIX

Conclusions

The *T. harzianum* strain isolated from Genoa seawater better tolerated and bioaccumulated EMs, and this is probably due to the fungal strains' adaptation to harsher environmental conditions. Myco-barriers were assessed to represent a significant eco-sustainable alternative to traditional chemical-physical reclamation techniques, while respecting the environment and biodiversity.