IOCXe 2026 Conference
The 1st International Online Conference on Xenobiotics
22–23 June 2026 | Online
MDPI

Innovative Integrated Platform Combining a Myco-Phytoremediation System with Portable Electrochemical Sensing for Sustainable Remediation of Heavy Metal-Contaminated Soils

Cristina FIRINCĂ[1,2], Lucian-Gabriel Zamfir[1], Mariana Constantin[1], Iuliana Răut[1], Ionuț Adrian Cepleanu-Pascu[3], Ioana Cătălina Gîfu[1], Mihaela Doni[1], Ana-Maria Gurban[1]*

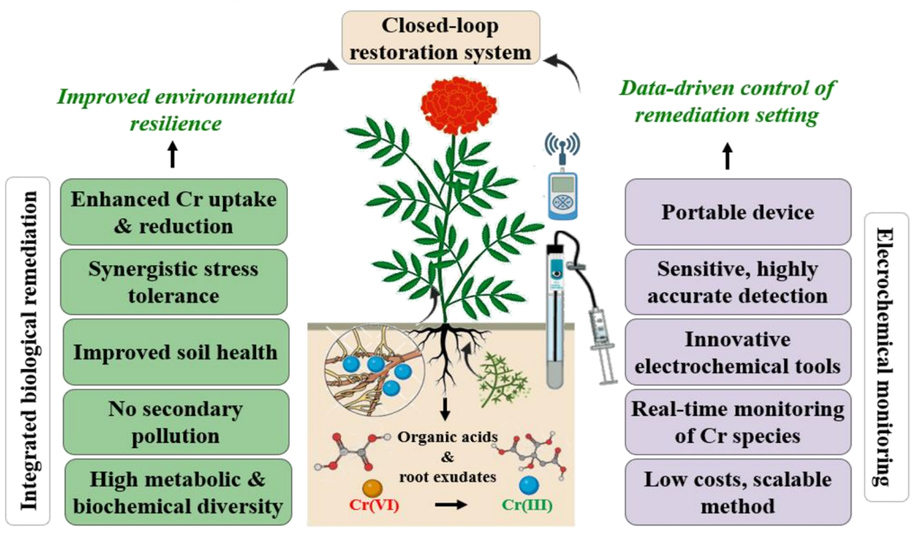
[1]INCDCP-ICECHIM Bucharest, Department of Biotechnology, Splaiul Independentei 202, Bucharest, Romania
[2]University of Bucharest, Faculty of Biology, Splaiul Independentei 91-95, Bucharest, Romania
[3]ALA BIOLAB S.R.L., Splaiul Unirii 313, Bucharest, Romania

E-mail address: cristina.firinca@icechim.ro ; ana-maria.gurban@icechim.ro

INTRODUCTION & AIM

Long-term anthropogenic activities have driven widespread soil contamination with persistent, bioaccumulative xenobiotics, among which hexavalent chromium Cr^{6+} is of foremost concern.

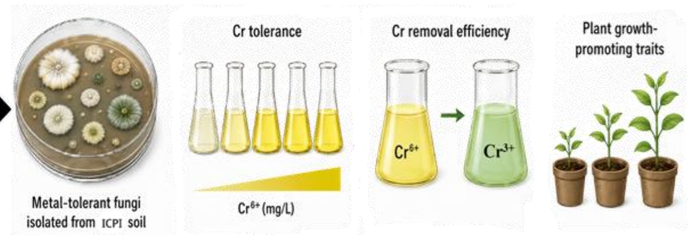
Our study presents an integrated system for Cr^{6+} reduction in contaminated soils using a synergistic myco-phytoremediation protocol, while monitoring its bioremoval with miniaturized electrochemical sensors based on innovative nanomaterials, allowing rapid, sensitive, and *in situ* detection.



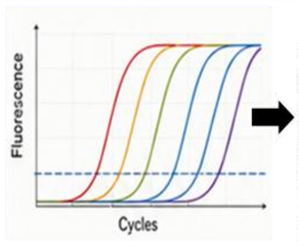
METHOD

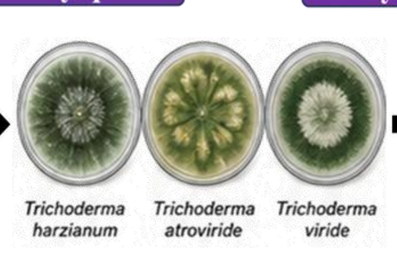
1. Soil sampling – Bucharest, Romania

2. Fungal isolation (from ICPI) & Screening

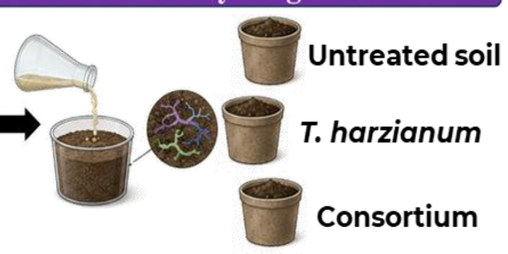


3. Strain identification by qPCR

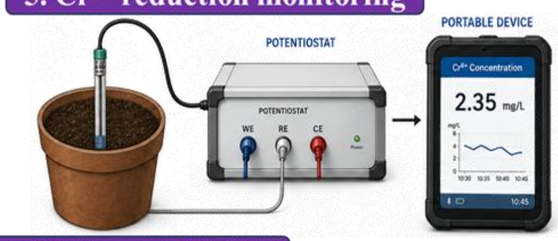


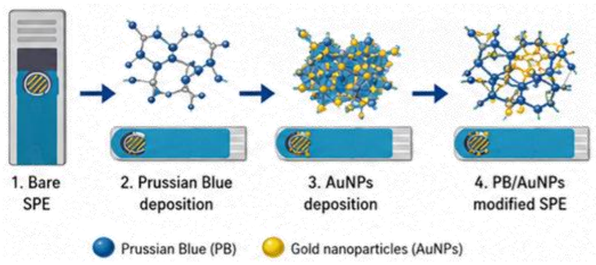


4. Mycoremediation by fungal consortium

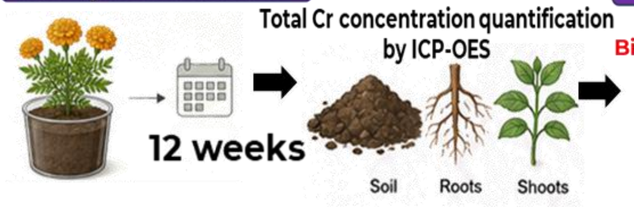


5. Cr^{6+} reduction monitoring





6. Phytoremediation



7. Phytoextraction efficiency assessment

Bioconcentration factor (BCF) $BCF = \frac{[Cr]plant}{[Cr]soil}$

Translocation factor (TF) $TF = \frac{[Cr]shoot}{[Cr]root}$

Hyperaccumulator criteria: BCF > 1 ; TF > 1

CONCLUSION

Our integrated system successfully attained Cr^{6+} reduction and phytoextraction from soil, with real-time, sensitive detection of Cr^{6+}, establishing a potential field-transferable myco-phytoremediation and monitoring framework for industrial Cr-contaminated sites.

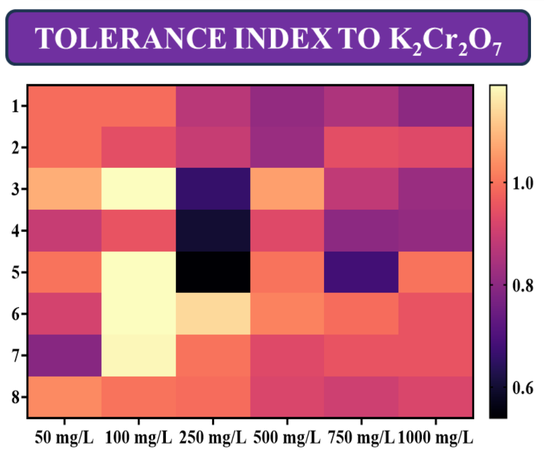
ACKNOWLEDGEMENTS &REFERENCES

This work was supported by the Ministry of Research, Innovation and Digitization through Core Program PN 23.06.01.01.03/2023

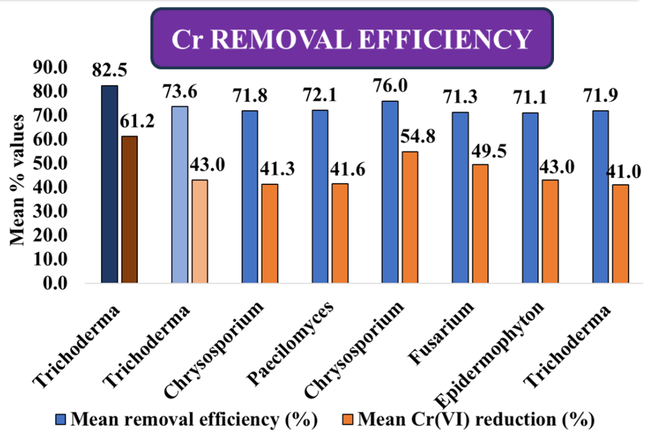
1. **Kumar V, Dwivedi, SK**. Ecotoxicology and Environmental Safety. 2019
2. **Firincă C**, et al., Journal of Xenobiotics. 2025; 15(3):63.

RESULTS & DISCUSSION

TOLERANCE INDEX TO $K_2Cr_2O_7$



Cr REMOVAL EFFICIENCY

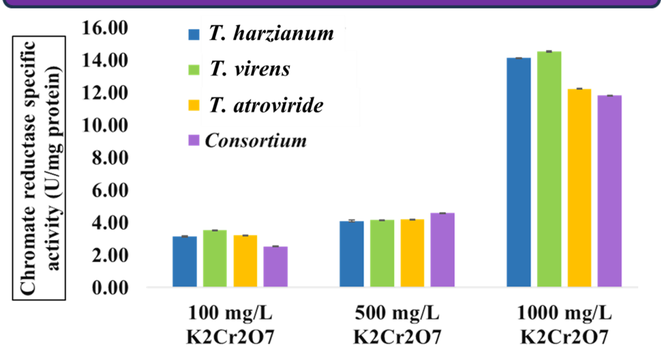


PLANT GROWTH PROMOTING TRAITS

	T. harzianum	*T. virens*	*T. atroviride*
IAA production	√	√	√
PO_4^{3-}solubilization	√	√	√
Zn solubilization	-	-	-
Siderophore production	√	√	√
N_2 fixation	-	-	-
Cellulase	√	√	√
Amylase	√	√	√
Protease	-	-	-
Laccase	√	√	√
Lipase	√	√	-

- Highly Cr tolerant strains (TI ≥ 1 g/L $K_2Cr_2O_7$) with high Cr removal efficiency and confirmed plant promoting traits formed the consortium

Cr REDUCTION BY CHROMATE REDUCTASE

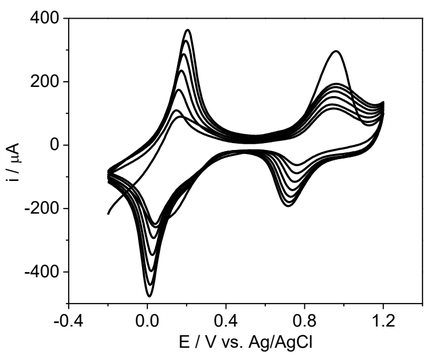


- Cr^{6+} reduction confirmed through increasing chromate reductase activity, proportional with increasing Cr concentration

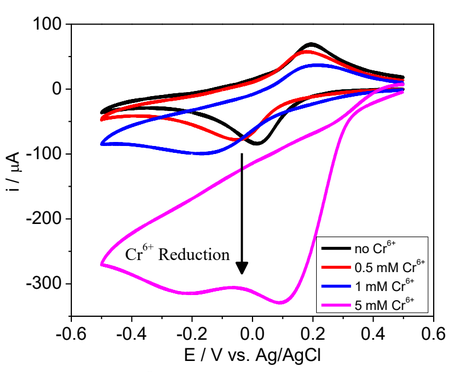
Cr^{6+} MONITORING BY ELECTROCHEMICAL DETECTION

Electrodeposition of Prussian Blue (PB) on SPE sensors:

- Amperometry at an applied potential of 0.4 V, for 400 s, in 0.1 M $K_3Fe(CN)_6$ containing 0.1 M $FeCl_3$, prepared in 0.2 M KCl + 0.2 M HCl.



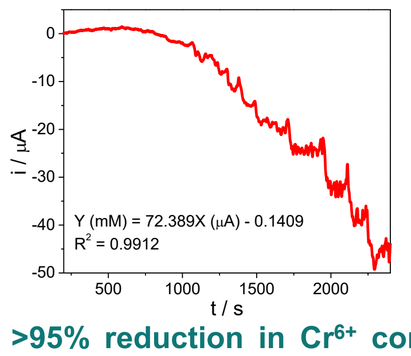
Cylic voltammetry activation of PB in 0.2 M KCl + 0.2 M HCl, 0,05 V/s, 8 cycles.

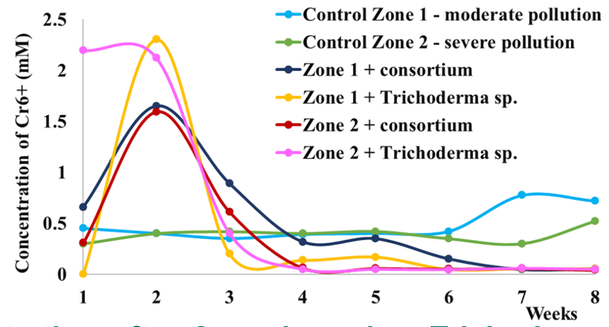


Cr^{6+} reduction at PB/SPE (0.1 M, v = 0.1 V/s)

Preparation of PB layer	Applied potential (V)	Specific sensitivity ($mA \cdot M^{-1} \cdot cm^{-2}$)	LOD (µA)
Direct precipitation	+0.3	336.8	0.56
Electrodeposition	**+0.1**	**585.24**	**0.33**

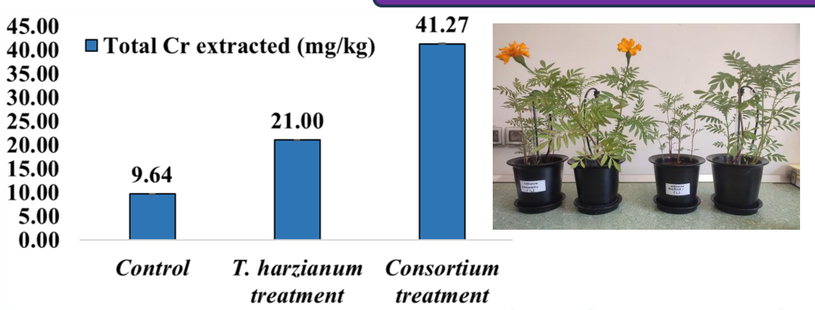
Amperometric detection of Cr^{6+} in soil solution , E = 0.1 V, in 0.1 M HCl + 0.1 M KCl solution

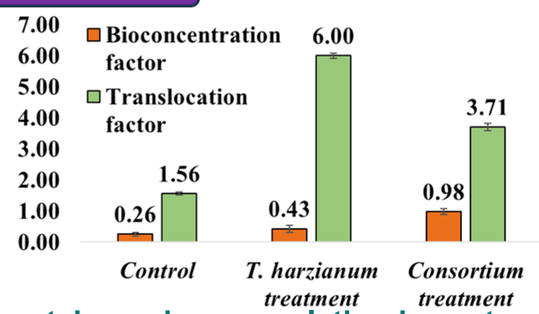




- >95% reduction in Cr^{6+} concentration after 8 weeks using *Trichoderma* consortium in all contaminated soil samples

Cr PHYTOREMEDIATION ASSESSMENT





- *Trichoderma* consortium significantly improved Cr uptake and accumulation in roots and shoots by *Tagetes erecta;*
- Improved growth, development and survival in contaminated soil.