

GOLD

Preliminary assessment of the use of biological agents to enhance Sorghum bicolor biomass production and phytoremediation capacity: greenhouse and field experiences

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Pietro Peroni, Walter Zegada-Lizarazu, Erika Facciolla, Andrea Monti



ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA



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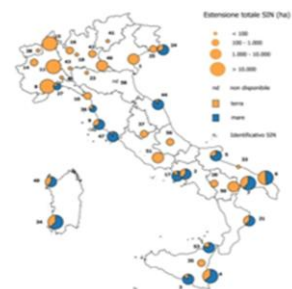
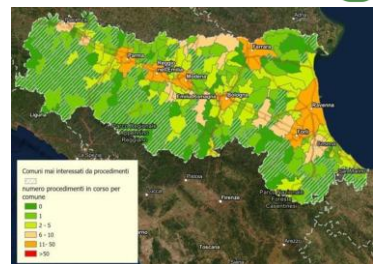
Context and objective



In the **Emilia - Romagna** region, contaminated sites are mainly located along the main communication routes and around the industrial poles close to large cities. Zn and Cu are generally the most common contaminants.

The main objective of the present study, as a part of the EU GOLD project, was to evaluate the productivity of three biomass crops, sorghum, miscanthus and hemp, for the phytoremediation of a contaminated urban land by heavy metals.

The results obtained on sorghum are presented as it provided the most evident differences in response to the use of biological agents



WHY BIOMASS SORGHUM



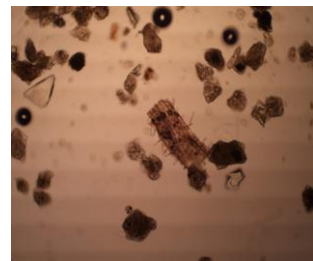
An affirmed biomass crop

- In northern Italy with a potential yield of 20-30 Mg/ha.
- Extremely resilient to various biotic adversities and abiotic stress and low input demanding



A potential phytoremediation species

- Capacity to extract different metals including Zn and Cu
- Positive interaction with biological agents (mycorrhizae)



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THE CONTAMINATED SITE: A FORMER LANDFILL



Parameter	Result	U.M.	Italian Legal Threshold
METALS TOTAL CONCENTRATIONS (ICP-MS)			
Lead (Pb)	159	mg/kg DM	100
Copper (Cu)	137		120
Nickel (Ni)	209		120
Zinc (Zn)	455		150
Tin (Sn)	8.8		1
METALS BIOAVAILABLE CONCENTRATIONS (DPTA)			
Lead (Pb)	33	mg/kg	/
Copper (Cu)	45		/
Nickel (Ni)	9.9		/
Zinc (Zn)	62		/
Tin (Sn)	Not detected		/

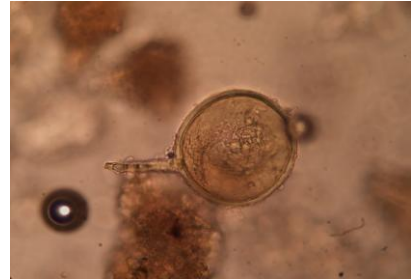
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GREENHOUSE TRIAL



-The following treatments have been evaluated:

- M: mycorrhiza
- F: foliar biostimulants based on amino acids and protein hydrolysates
- R: root biostimulants based on fulvic and humic acids
- MF: combination of M and F
- MR: Combination of M and R
- C: untreated control



- 3 pots (12 L) for each treatment randomized in a single block and rotated periodically
- Pots maintained at 75% of their water capacity
- The trial lasted 14 weeks (Oct 2021 – Jan 2022)
- At the harvest fresh and dry biomass have been measured, heavy metals concentration in the whole plants have been determined via ICP-MS and the total Cu and Zn uptake have been estimated



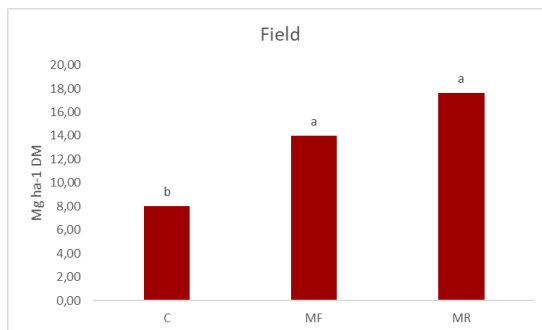
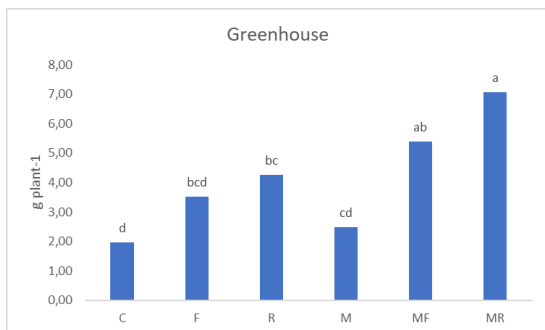
FIELD TRIAL



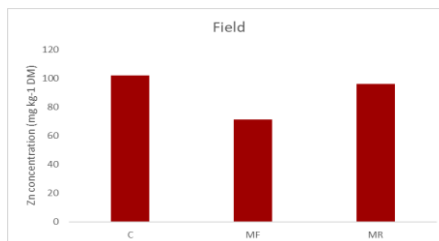
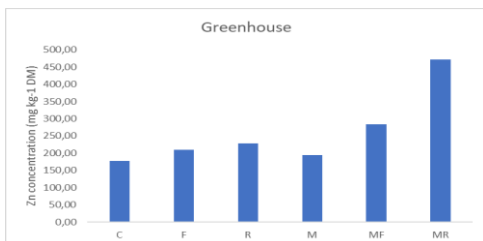
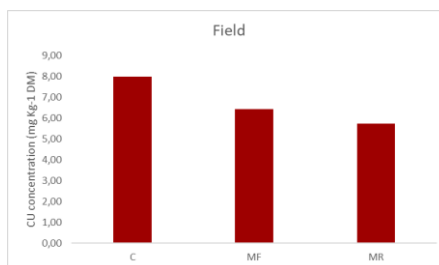
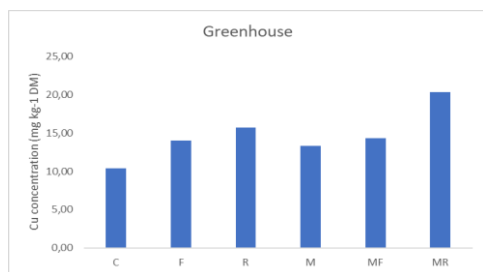
- MR and MF were therefore chosen to be tested in the field trial.
- Three plots of 10 m² for each treatment were arranged in randomized blocks (density 18 plants/m²)
- The trial took place between May and October 2022.
- The agronomic managed and the application of the treatments was done manually.
- Due to the extreme high temperature and the scarcity of water, irrigation have been performed to ensure a good establishment of the crop
- At harvest, the fresh weight and dry weight of the plants collected in a sample area (2 m²) was determined. Heavy metal content was determined and Cu and Zn uptake calculated.



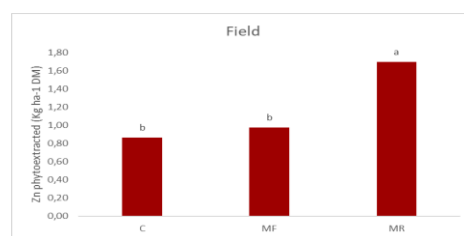
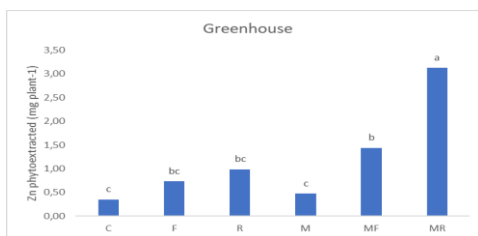
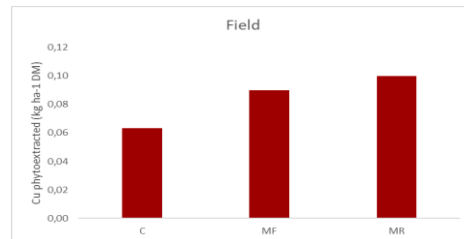
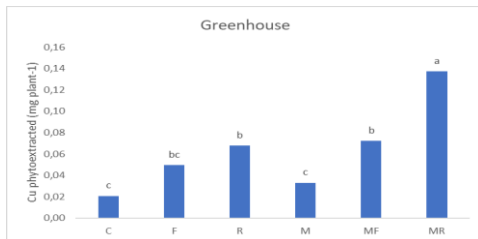
RESULTS: DRY BIOMASS



RESULTS: METAL CONCENTRATIONS



RESULTS: ESTIMATION OF METALS UPTAKE



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CONCLUSIONS



- Field test results were only partially consistent with greenhouse tests. The positive effects of biostimulants on biomass production and metal uptake were less evident in the field than greenhouse tests
- The use of mycorrhizae individually does not determine appreciable differences compared to the control, however, they can broaden the effectiveness of other treatments capable of acting on hormonal development (F) and on the absorption of nutrients (R)
- The use of mycorrhizae in combination with root biostimulants (MR) was found to be the most effective strategy to increase sorghum productivity and its metal uptake

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Thank you!

Website: gold-h2020.eu

Twitter: [@gold_h2020](https://twitter.com/gold_h2020)

E-Mail: info@gold-h2020.eu

walter.zegadalarazu@unibo.it

pietro.peroni2@unibo.it

Coordinated by:



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Imperial College
London



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