PHYTOMANAGEMENT STRATEGIES FOR A METAL-CONTAMINATED AGRICULTURAL SOIL TO PROVIDE BIOMASS FOR CLEAN BIOFUEL PRODUCTION – FEEDBACK FROM A FIELD TRIAL.

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Context

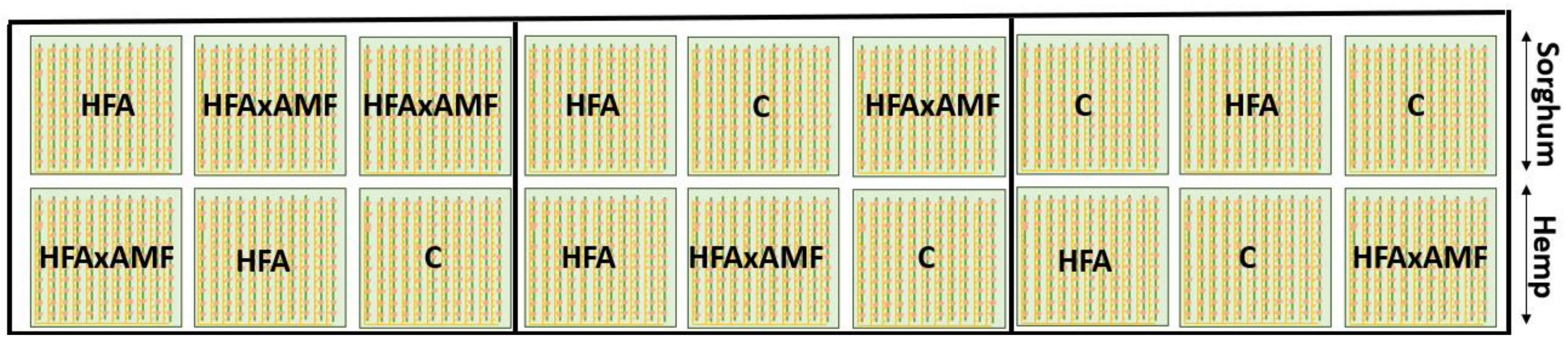
- High-yielding lignocellulosic crops are a promising alternative for phytomanaging contaminated soils to produce biomass for biofuels
- Humic/fulvic acids and mycorrhizae fungi can improve plant growth while ameliorating soil quality
- Strategies to intensify biomass production using mycorrhizal fungi, biostimulants, and their combinations have been studied for several plant species. However, their effects on selected lignocellulosic crops are not well documented

Objectives

- Study the effect of humic/fulvic acids as well as its combination with mycorrhizae fungi on
  - biomass production of industrial hemp and sorghum
  - plant Cd, Pb and Zn uptake
  - the $Ca(NO_3)_2$-extractable Cd, Pb and Zn concentration

Methodology

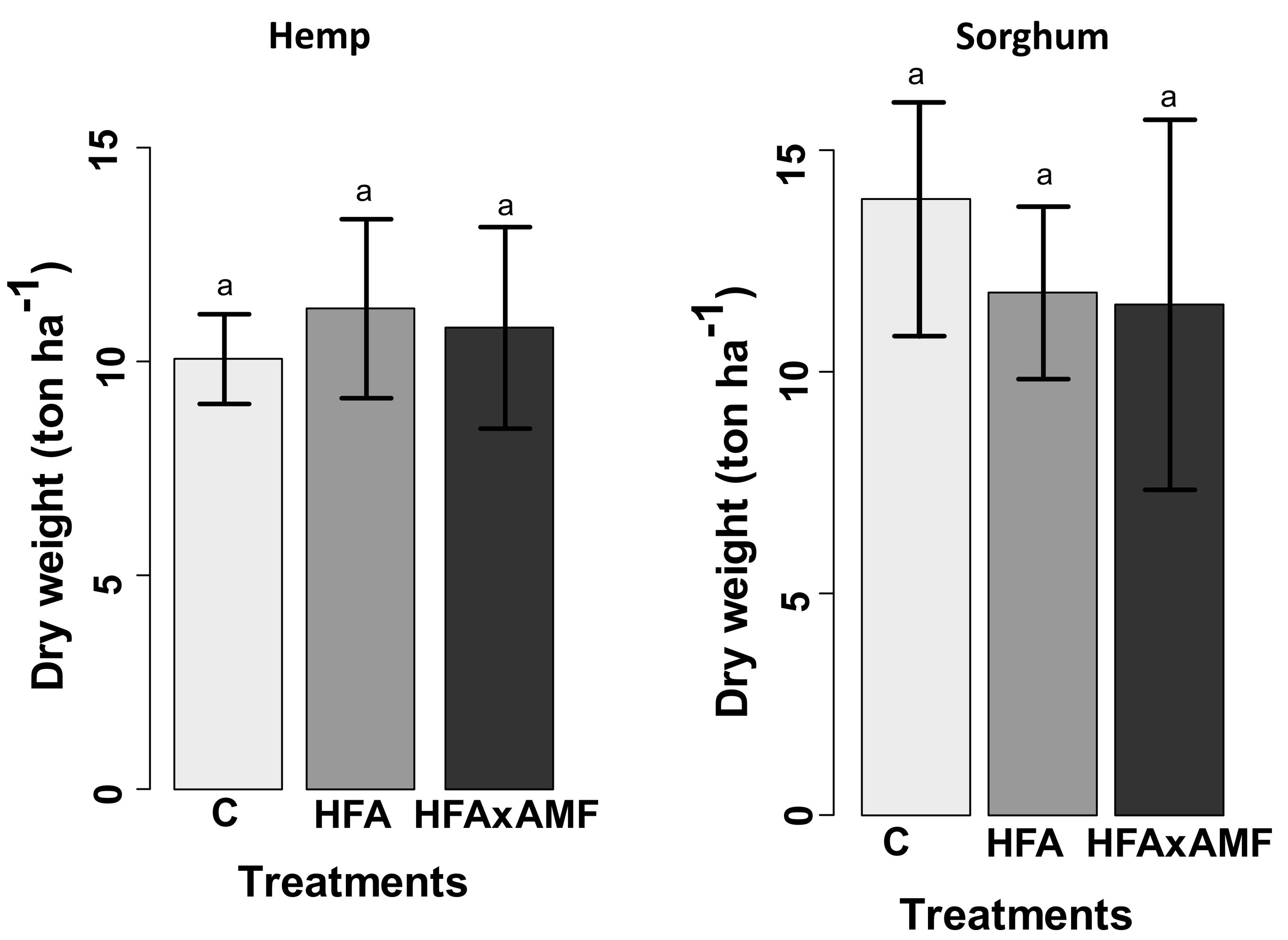
- The field trial was set up on a metal contaminated agricultural site (Cd, Pb and Zn (14.1, 731 and 1000 mg kg^{-1}, respectively))
- Lignocellulosic crops : *Cannabis sativa* L. and *Sorghum bicolor*
- Three treatments: control (C) (without treatment), humic/fulvic acids (HFA), and humic/fulvic acids x mycorrhizae (HFAxAMF)
- Growth period : 20 weeks
- Measurement and analysis: Biomass production, Cd, Pb, Zn concentrations in aerial plant parts and $Ca(NO_3)_2$-extractable metals in soil



Results

Effects of treatments on biomass yield and $Ca(NO_3)_2$-extractable metals

Biomass yield



$Ca(NO_3)_2$-extractable metals

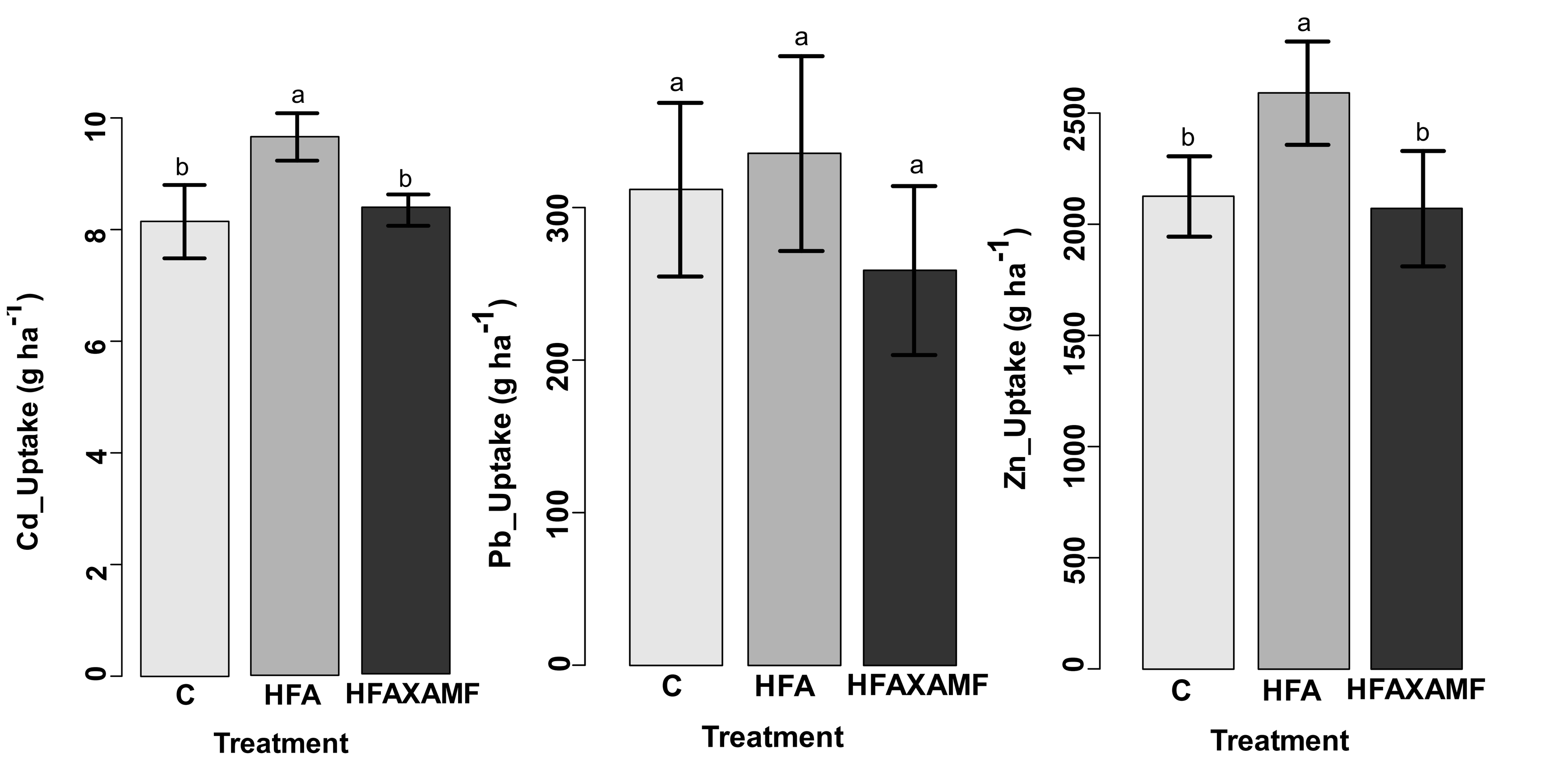
	Cd (mg kg^{-1})	Pb (mg kg^{-1})	Zn (mg kg^{-1})
Before cultivation			
	0.71 ± 0.16	5.13 ± 1.84	4.02 ± 3.22
Hemp (After cultivation)			
Control	0.041 ± 0.015 a	< DL: 0.05	0.10 ± 0.02 a
Lonite (HFA)	0.033 ± 0.001a	< DL: 0.05	0.09 ± 0.01 a
Lonite x Mycorrhiza (HFAxAMF)	0.029 ± 0.004a	< DL: 0.05	0.12 ± 0.06 a
Sorghum (after cultivation)			
Control	0.042 ± 0.008a	< DL: 0.05	0.09 ± 0.03 a
Lonite (HFA)	0.079 ± 0.059a	< DL: 0.05	0.13 ± 0.04 a
Lonite x Mycorrhiza (HFAxAMF)	0.041 ± 0.006a	< DL: 0.05	0.12 ± 0.06 a

DL: Detection limit

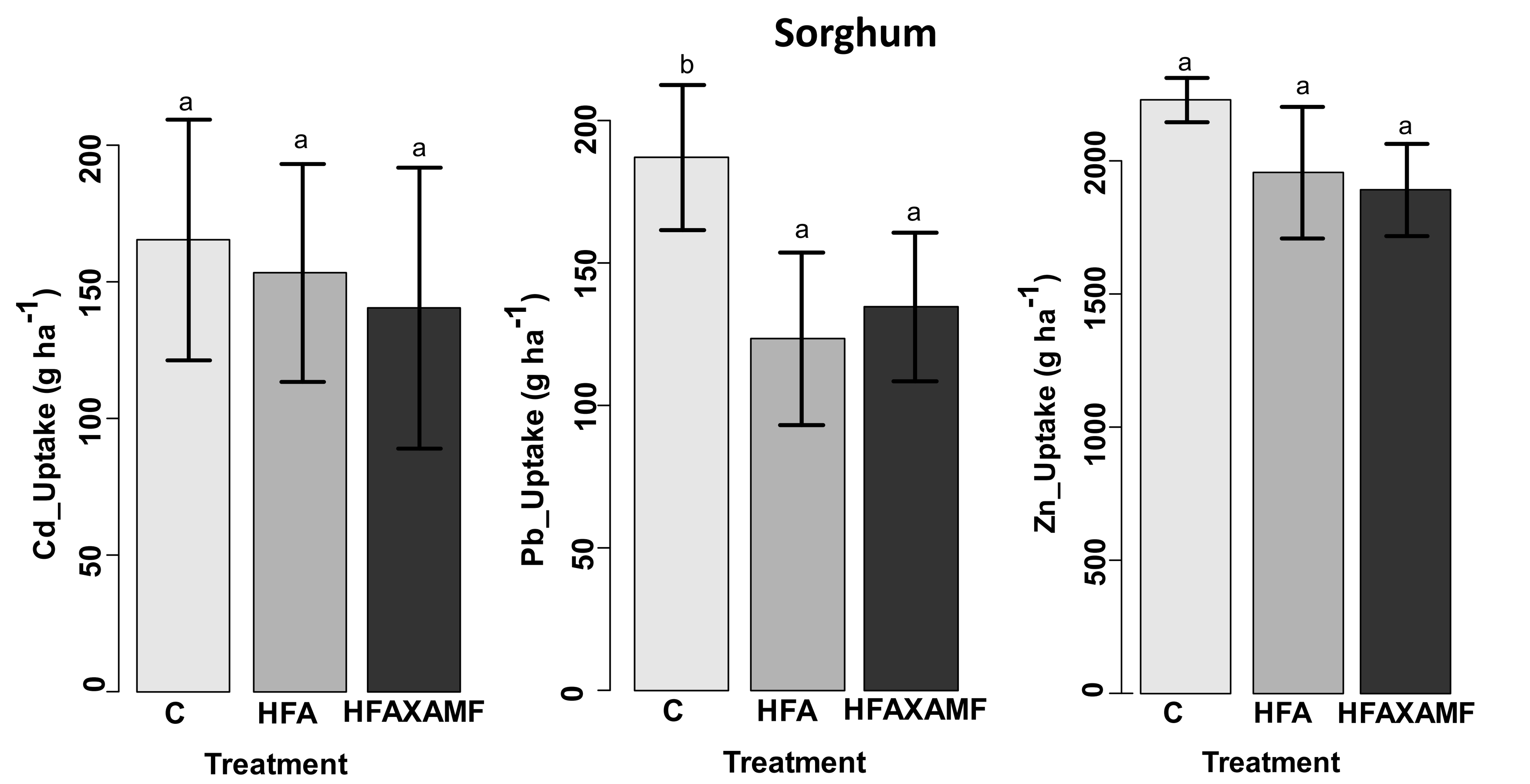
A decrease of $Ca(NO_3)_2$ – extractable metals after cultivation

Effects of treatments on metal uptake in plant shoots

Hemp



Sorghum



Conclusion & Perspectives

- The total DW yields of sorghum and hemp did not significantly differ across the treatments.
- The availability of Cd, Pb and Zn in soil decreased for both hemp and sorghum across all treatments after cultivation
- Uptake of Cd and Zn was significantly increased for HFA treatment for hemp as compared to the control
- The uptake of Cd was significantly higher for sorghum compared to hemp
- The results show that sorghum and hemp are relevant plants for phytomanaging metal-contaminated sites while producing biomass in drought conditions.

Acknowledgement

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