Using Brassica napus phytoremediation biomass for sustainable biofuel production

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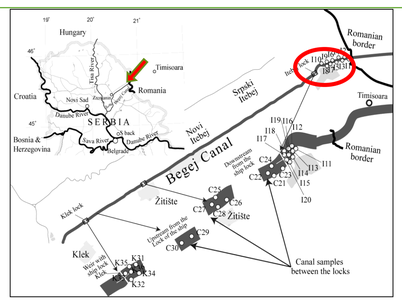
This work was conducted within the H2020 Phy2Climate project which aims to develop phytoremediation solutions for contaminated lands worldwide and couple it with clean biofuel production. Our work's main objective was to assess Brassica napus's potential for phytoextractions of multi-element contaminated dredged sediment in a real environment and authentic natural conditions.

Field location

The site with dredged sediment is situated along Begej canal near Serbian-Romanian border. It covers a total area of app. 2000 m2. Sediment was dredged from lock on Begej canal in March 2021. Approximately 5900 m3 of sediment was deposeted on a field next to the lock.



Dredged sediment

Deposited sediment was highly heterogeneous so the landfill was divided into 10 subplots and each subplot was analysed separately (Figures 1 and 2).

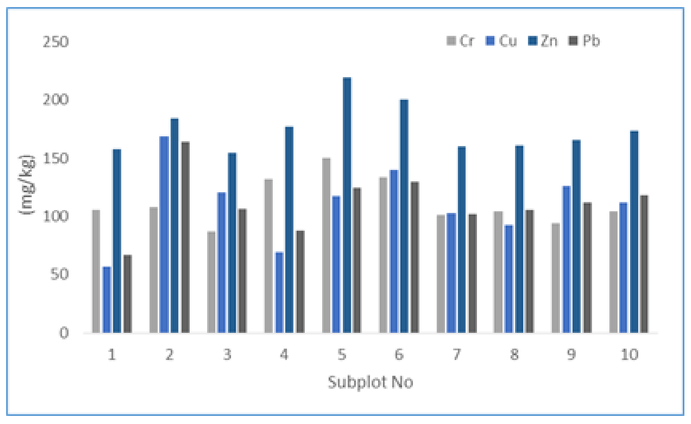


Figure 1. The concentration of Cr, Cu, Zn, and Pb in the surface layer (0-20cm) of subplots on the dredged sediment landfill

Figure 2. The concentration of Cd in surface layer (0- 0cm) of subplots on the dredged sediment landfill

For the field test, the winter variety of Brassica napus „Zlatna“ was selected and sown with a seeding density of 50 seeds/m2 in September 2022. and harvested at full maturity at the beginning of July 2023. The estimated seed yield was 380 kg (1,9 t/ha) and approximately 1600 kg of dry harvest residues were collected.

The average metal concentrations in seeds were Cr: 0,97 mg/kg; Cu: 6,78 mg/kg; Zn: 50,25 mg/kg; Cd; 0,19 mg/kg and Pb: 0,30 mg/kg and concentration of metals in aboveground biomass collected at each subplot is presented in the Figures 3a-3e.

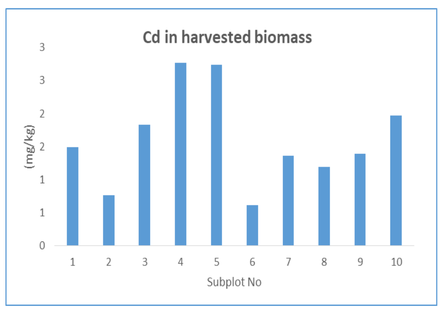


Figure 3a. The concentration of Cd in surface layer of subplots on the dredged sediment landfill

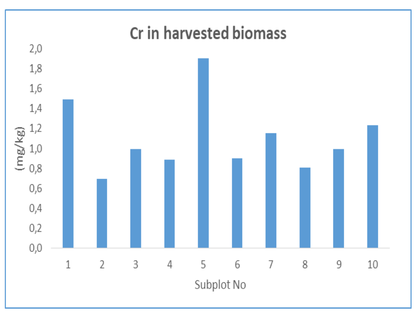


Figure 3b. The concentration of Cr in surface layer of subplots on the dredged sediment landfill

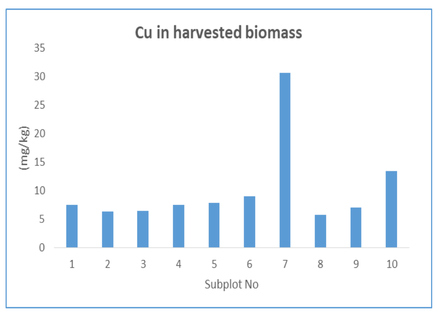


Figure 3c. The concentration of Cu in surface layer of subplots on the dredged sediment landfill

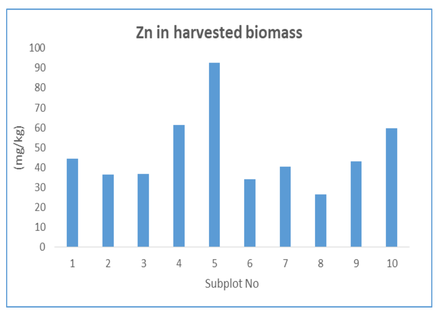


Figure 3d. The concentration of Zn in surface layer of subplots on the dredged sediment landfill

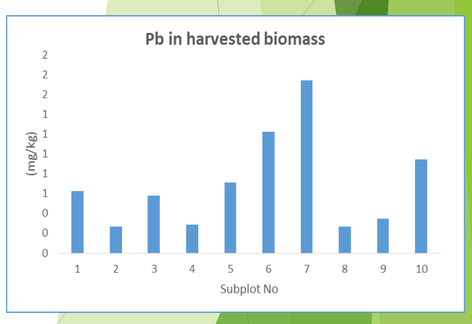


Figure 3e. The concentration of Pb in surface layer of subplots on the dredged sediment landfill

Besides the concentration of metals in plant tissue, the parameters used for the assessment of phytoextraction efficacy are bioconcentration and translocation factors. Brassica napus grown on the field, under natural conditions, demonstrated the highest average bioaccumulation factors for Cd (0,629), Zn (0,478), and Cu (0,451), and the highest translocation factors were measured for Cd (0,873), Pb (0,731) and Cu (0,762).

Although bioaccumulation and translocation factors for each separate metal are as high as in other studies conducted in pot tests, must be kept in mind that multi-contaminated soils present a challenging environment for phytoremediation due to complex interactions between metals and plants which can cause higher toxicity symptoms of metals to plants. Based on the achieved seeds and biomass yield, different metal concentrations in harvested biomass, bioaccumulation, and transfer factors it could be concluded that Brassica napus has the potential for phytoextractions of multi-contaminated sediments.

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