Energy Crop Summer Rape (*B. napus* L.) Phytoremediation Potential at Different Soil Moisture Content

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Introduction

- Phytoremediation is a great alternative to traditional waste treatment methods that can be used effectively to clean up polluted soil in situ using plants, consuming less energy, harvesting a valuable resource in the form of biomass and lowering treatment costs.
- It is expected that soil moisture content variation with continuous climate change will have an impact on plant biomass production and soil pollutant behavior, and it will affect phytoremediation. The sensitivity of phytoremediation to climatic factors, however, is not well understood.
- Our aim was to evaluate how soil moisture content affects the potential of the energy plant summer rape (*B. napus* L.) to phytoremediate Cd-contaminated soil.

Materials & methods

➢In order to evaluate the potential of rapes to remediate Cd-contaminated soil under different soil water contents (SWC), a growth chamber experiment using pot-grown rapes was carried out in this study for a duration of 64 days in a controlled environment.

➢46 days after sowing (46 DAS), plants were subjected to 3 different SWC: normal (control) SWC 30±2%, reduced SWC 10±2% and elevated SWC 40±2%.

➢Cd treatment: 0 (control), 1, 10, 50, 100, 250 mg Cd kg 1 kg^{-1} as $CdCl_2$ in soil

➢Growth chamber conditions: 21/14°C day/night temperature, 14 h/10 h photoperiod, 400 ppm CO_2 concentration, 55-60/65-70% day/night relative humidity and photosynthetically active radiation of ~300 µmol m^{-2} s^{-1} photon flux density.

➢Cd concentration in mineralized samples was determined using ICP OES.

Results & discussions

➢*B. napus* demonstrated strong resistance to Cd toxicity as well as the capacity to phytoextract Cd from the soil. While removal effectiveness was determined by rape growth and Cd soil concentrations, Cd accumulation in oilseed rape increased with Cd soil concentration.

➢*B.napus* coped well with low and moderate Cd pollution (with tolerance index TI>0.69), whereas high Cd soil pollution had a significant negative impact on plant growth (it was reduced by up to 90%), resulting in low Cd removal efficiency.

➢Plant growth, Cd accumulation, and removal from the soil were all influenced by SWC. Oilseed rapes grown in elevated SWC had higher biomass (18%) than those grown in reduced SWC, despite the fact that the adverse effect of Cd was more severe at higher SWC.

➢Reduced SWC led to decreased Cd uptake, conversely elevated SWC promoted Cd uptake. The optimal SWC ensures the highest Cd removal efficiency, whereas soil water deficit or excess restricts potential to remove Cd from the soil and prolongs remediation.

Table 1. Tolerance index (TI) of *B. napus grown* in different Cd treatments under different SWC.

SWC	Treatment				
	Cd 1	**Cd 10**	**Cd 50**	**Cd 100**	**Cd 250**
Control	1.10 ± 0.02^{a}	0.90 ± 0.02^{bcd}	0.55 ± 0.11^{f}	0.31 ± 0.02^{h}	0.12 ± 0.04^{ij}
Drought	0.83 ± 0.01^{cde}	0.95 ± 0.13^{abc}	0.76 ± 0.12^{de}	0.36 ± 0.11^{gh}	0.13 ± 0.01^{ij}
Flooding	0.69 ± 0.00^{ef}	0.78 ± 0.04^{cde}	0.53 ± 0.07^{fg}	0.25 ± 0.01^{hi}	0.09 ± 0.01^{j}

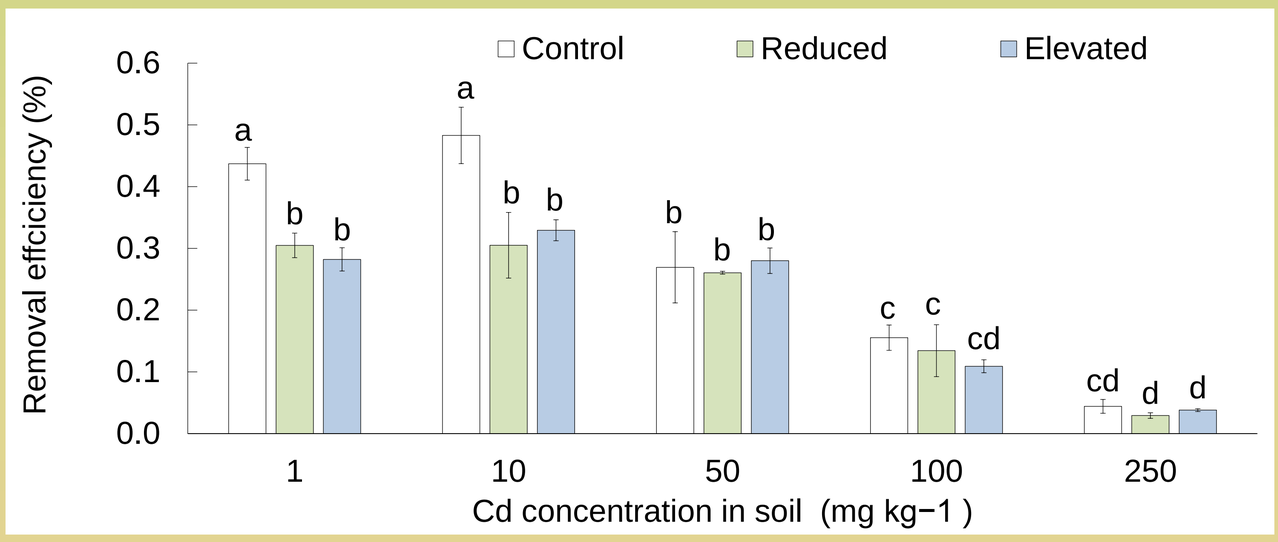

Fig. 2 Cd removal efficiency (%) from soil by *B. napus* grown in Cd polluted soil under different SWC.

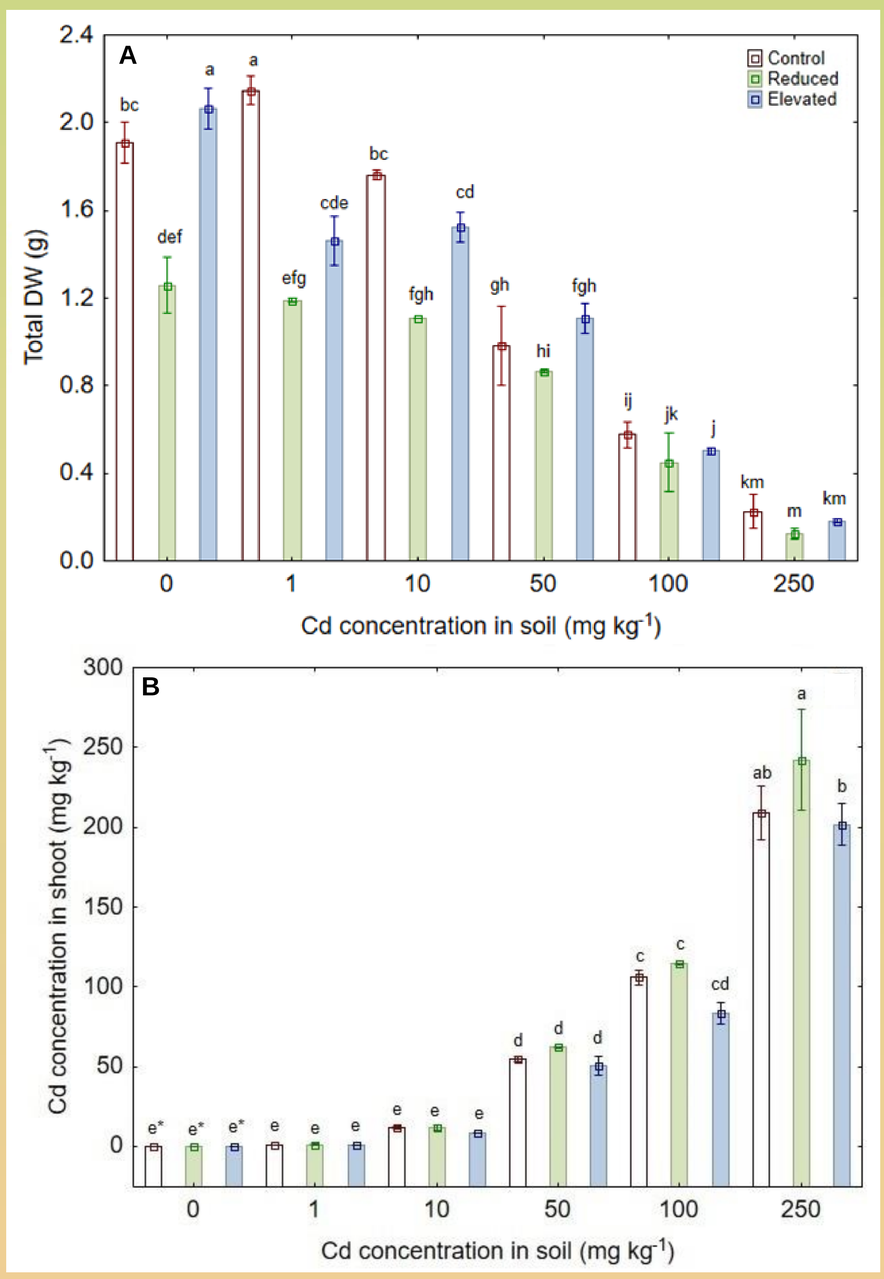

Fig. 1. *B. napus* total biomass DW (A) and Cd concentration in shoot (B) at different SWC. Error bars represent standard errors (SE). Different letters indicate significant difference ($p<0.05$) among the treatments (LSD test).

Concluding remarks

- ✓ Energy crop summer rape has a good potential to be used in the phytoremediation as phytoextractor. Higher biomass production is visible for some Cd concentrations in soil which is a big advantage in the use of energy crops.
- ✓ SWC has a significant effect on plant tolerance and growth in Cd contaminated soil.
- ✓ Elevated SWC increased Cd bioaccumulation, whereas reduced SWC resulted in decreased Cd bioaccumulation. The highest Cd removal efficiency is guaranteed by the ideal SWC, whereas a lack of or excess of soil water limits B. napus' phytoremediation potential and prolongs removal process.

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