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Use of filter cake and peat for mitigating soil multicontamination in conjunction with castor oil plant as phytoextractant

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Phytoextraction has been increasingly used to recover polluted soils, as it causes minimum disturbance to the soil, when compared with other techniques, and is considered cost effective. So far, most of the plants used to recover polluted areas are used also for human feeding or for reforestation. The objective of this work was to evaluate the potential of the castor oil plant (*Ricinus communis* L.) to tolerate and accumulate high levels of heavy metals and boron in conjunction with the use of filter cake (a sugar cane byproduct) and peat to mitigate excessive contents of those elements in the soil. The studied soil was contaminated by scrap metal residue rich in B and received the application of 10 t ha^{-1} of limestone. Soil pH was 7.5. The total contents of B and heavy metals, expressed as mg kg^{-1}, were: B=62, Cu=335, Fe=38,651, Mn=578, Zn=2.998, Cd=4.3, Cr=88.2, Ni=54 and Pb=332. The experimental design was randomized in a factorial 2 x 4 design, with three repetitions. The doses of each added organic matter were based in the content of C, being equivalent to 0, 20, 40 and 80 t C ha^{-1}. The experiment was performed in pots containing 5.0 kg of polluted soil, cultivated with three plants of castor oil during 74 days. The plants did not show toxicity symptoms for B and heavy metals, although the content of B in the aerial part have been high (filter cake-626 mg kg^{-1} and peat-536 mg kg^{-1}). Organic matter addition influenced only soil phosphorus content, as it was 427 mg kg^{-1} for soil amended with filter cake and 322 mg kg^{-1} when peat was applied. The production of dry mass of the shoots and roots were not affected significantly by the type of added organic material, only by the doses, although the roots have shown an increase of 10% in the production of dry mass due to the addition of cake filter. For the micronutrients the average values in the shoots of the castor oil plant in the presence of peat and cake filter were respectively: Cu = 5.2 and 5.5; Fe=30 and 40; Mn=11 and 13; Zn=102 and 107 mg kg^{-1}. Heavy metals (Cd, Cr, Ni, and Pb) concentrations in the shoots part of the castor oil plant were below 0.5 mg kg^{-1} in all of the treatments. The translocation index followed the order: B>Mn=Zn>Cu>Fe with the following average values, as %: 98> 70.9 = 68> 46.2> 9, respectively. In the roots there were larger accumulations of Fe and in the shoots of B, independently of the type of organic matter added. The higher transfer factor and translocation index for B, allowed the calculation, in years, of the time needed to remove 50% of the total B content of the soil. Without applying organic matter 14.9 years would be necessary, whereas applying filter cake this figure was 16.3 years and with the use of peat it was 12.2 years. It was concluded that the castor oil plant has potential to be cultivated in the polluted area and that the application of filter cake and peat were not efficient to further mitigate heavy metal or boron levels.