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Geochemical signature and phytoremediation of urban soil: a case in Barcelona city

Javier Rodríguez-Bocanegra, Núria Roca, Anna Febrero, and Jordi Bort

Departament Biologia Vegetal, Facultat Biologia, Universitat de Barcelona, Av. Diagonal 643, 08028 Barcelona, Spain (xavibcn_@hotmail.com; nroca@ub.edu)

The cleanup of contaminated places with heavy metals is necessary, but environmental remediation strategies are often expensive and energy consuming. Thus, it is important to develop low-cost and environmentally friendly strategies. Phytoremediation-based technologies could provide a long-lasting solution. The study area is located in Sants, a neighbourhood in Barcelona city (Catalonia, Spain). This place was an industrial area in the last century, which was occupied by a metal smelting industry. Nowadays, the neighbours want to cultivate vegetables in this location, but the history of this area suggests that the soil is polluted by elevated concentrations of heavy metals. The aim of this work was to determine heavy metal concentration in: a) soil, to know the degree of the soil pollution; b) roots and leaves of two plant species, Brassica juncea as an accumulator plant and Solanum lycopersicum as a crop plant, to know the capacity of each species to accumulate metals, and c) drainage water, to evaluate the heavy metal mobility.

The main pollutants are Cu, Pb and Zn with topsoil total concentrations about 1355, 2230 and 6239 mg•kg-1, respectively. The established background upper limits in this area in mg•kg-1 were: Cu 145, Pb 91 and Zn 326. The same soil elements for available fractions, extracted with DTPA, were slightly elevated (9.6, 5.8 and 6.7 % of total concentration). The environmental pollution implies great extractability, suggesting the plants in these soils have facility with potentially toxic elements absorption. Instead, the concentrations in subsoil are lower than in topsoil. The concentrations of Cu, Pb and Zn in the plants' leaves are greater in B. juncea 170 $\pm$ 52.7, 137 $\pm$ 46.3 and 2365 $\pm$ 860.4 mg•kg-1, than in S. lycopersicum 102.5 $\pm$ 7.1, 22.5 $\pm$ 1.3 and 1002 $\pm$ 85.2 mg•kg-1 respectively. Furthermore, they are also greater in roots than in leaves. All of them are lower than the threshold to be considered like a hyperaccumulator species. However, Pb concentrations in a crop plant exceeded the 0.10 mg•kg-1 limit established for vegetables devoted for food in the European legislation.

Part of these heavy metals were transferred to the drainage water. The range of topsoil with B. juncea drainage water values in μg•L-1 is as follows: Cu 115-162, Pb 23.0-32.0 and Zn 613.8-759.7. Unusual elevated concentrations of Pb (over 10 μg•L-1) were detected in drainage water. These values exceeded the acceptable toxic concentrations in waters, according to the Spanish legislation. Furthermore, the values for subsoil drainage water in μg•L-1 were also elevated (Cu 293-298, Pb 15.6-4.84 and Zn 189.5-120.0).