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Arsenic transfer in plants from naturally enriched soil

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Arsenic (As) is an ubiquitous trace element which occurs naturally in low concentrations, e.g., 5 parts per million (ppm) in the lithosphere. Usually, it is assumed that As concentrations in soil above 20 ppm is too high and is consequently of concern to the public health. Two inorganic As forms dominate in soils: arsenate $[AsO_4]^{3-}$ (+5) and arsenite $[AsO_3]^{3-}$ (+3), this latter being more mobile and toxic. Arsenate and phosphate (PO_4^{3-}) are chemically similar and so tend to compete for potentially As-bearing phases of soil.

Most studies on As dynamics were performed on anthropogenically polluted soils or artificially As-enriched soils. In our study, we evaluate As bioavailability and transfer from a soil showing a geogenic contamination (174.4 $\pm$ 1.9 ppm, Jura Mountains, Switzerland) to two different plants - *Pteris vittata* L., a fern which hyper-accumulates As in fronds with a high translocation factor and *Lycospersicon esculentum* Mill., a plant with an agronomic interest and a well studied genome.

In this specific context, our integrative study was divided into two approaches: firstly, we characterized the soil and estimated the distribution of As in the naturally enriched soil using a chemical sequential extraction procedure; secondly, we investigated the transfer and distribution of As in plants with and without addition of phosphate under experimental conditions (using rhizoboxes which consisted of two transparent Plexiglas plates separated by Plexiglas spacers of 1 cm).

Chemical sequential extractions performed on soil samples showed that As was mainly present in the residual phase (86.2 $\pm$ 8.1%) and in a lower but still significant amount in the exchangeable phase (1.1 %). Our experiments show a significant As accumulation in plants. Literature on the uptake of As by plants showed that the

typical soil-plant transfer coefficients for As ranged from 0.01 to 0.1. In our case the bioconcentration factors are the highest in all treatments (with or without phosphate addition). Furthermore, in all cases, shoots always contained more As than roots and continuous phosphate addition seems to decrease the As transfer from *L. esculentum Mill.* roots to shoots.

To conclude, although the naturally present As in this soil seems to be slightly bioavailable, As bioconcentration factors are quite high in comparison to literature data.