

## **A simplified soil extraction sequence to monitor the main and trace element speciation in soil after compost and mineral fertilizer additions upon the composition of wheat grains**

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High quality biological waste treatment aims at producing compost in order to maintain a clean environment and to sustain soil organic carbon levels. Fertilization with compost as a source of organic carbon, nutrients, and accessory elements, as well as fertilization with mineral N- and PK fertilizer have been tested in a field experiment on a calcareous Fluvisol in the Danube wetlands, at 4 levels each. Yields of wheat were recorded, and grains and soils were sampled from each treatment, and analyzed for main and trace element composition. The corresponding soils were characterized by mobile phases, obtained by leaching with 0,16M acetic acid to cover exchangeables plus carbonates, and subsequently by 0,1M oxalate buffer pH 3 to dissolve the pedogenic oxides. Total amounts were obtained from digests with perchloric- nitric-hydrofluoric acid. For quasi-total amounts, aqua regia was replaced by pressure decomposition with  $\text{KClO}_3$  in dilute nitric acid. The proposed extraction sequence permits to analyze and interpret soil for main elements, trace elements, nutrients and anions simultaneously.

Factor analyses of soil extracts obtained from dilute acetic acid revealed Ba-Be-Cd-Cu-Li-S (traces), Ca-Mg-Mn (main carbonates), Al-Fe-B, Y, and P-K (nutrients) as chemically feasible principal components. Subsequent soil extracts from oxalate contained Al-B-Co-K-Na-Pb-Si-V-S (maybe acid silicate weathering), Cr-Li-Ni-Sr-Ti (maybe basic silicate weathering), Be-Cu-Fe-P, Co-Mg-Mn-Zn (Mn-oxides) and Ba-Sc as principal components. Factor analyses of total element data distinguished the principal components Ce-La-Li-Sc-Y-P (rare earths), Al-Ca-Fe-K-Mg-Na-P (main elements), Cd-Co-Cr-Cu-Ni-Zn (trace elements), As-Pb (contaminants), Ba-Mn-Sr, and Ti, which looks chemically feasible also.

Factor analyses of those soil fractions which presumably form the main fractions of exchangeables, carbonates, pedogenic oxides and silicates, showed no cross connections, except for P. Oxalate-soluble Fe together with P and S was independent from oxalate-soluble Al-Mn-Si.

In the crops, all element levels were within a non-contaminated and non-deficient range, therefore correlations with concentrations as well as loads in the wheat grains were largely not pronounced. Maximum correlations between plant and soil data were obtained with Li and Be. The load data (concentration times yield, given in g/ha) were much more intercorrelated than the concentrations. Regarding the same element, correlation coefficients between loads and respective concentrations were larger than 0,800 for Al, Ba, Cd, Co, Cr, Li, Mo, Na, Ni, Se, and Sr, which means the transfer remained independent from the load. In case of Ca, Mg, P, S, Zn, however, correlation coefficients between loads and concentrations were  $< 0,500$ , thus the transfer was not constant because of obvious metabolic influences.

The proposed method of soil characterization was applied at a field trial here for the first time, and offers new possibilities of intercorrelations between plant uptake and geochemical soil fractions.