

Editorial

Heavy Metal Pollution and Its Effects on Agriculture

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The contamination of agricultural soils by heavy metals is one of the most important methods of soil degradation (EU Soil Thematic Strategy). Soil contamination by heavy metals presents many problems for soil functions, the environment, agriculture production, food chains or even human health [1]. The maintenance of a suitable state of soil load by heavy metals should be the interest of every society. The evaluation of soil load by heavy metals must be supported by the knowledge of heavy metals' background values, their inputs into soils, their behaviour and fate in the soil environment and their transfer into the plants or groundwater [2]. The methodologies and the approaches for the evaluation of soil load by heavy metals can differ between individual countries not only in the world, but in also in a European context [3].

The increased soil content of heavy metals can be caused by natural or anthropogenic sources. The knowledge of heavy metals content in parent rocks and soil substrates is a crucial factor for soil background values of heavy metals assessment [4]. The heavy metals background values in soils can be derived from natural heavy metals concentrations in geological substrates only, or diffuse anthropogenic load (immission outputs predominantly) can also be calculated [5]. The anthropogenic inputs of heavy metals into the environment via emission outputs (industry, traffic, use of fossil combustibles), agrochemicals use, sludge application, wastewater, etc., can have a very negative effect on increased content of heavy metals in agriculture [6]. The methodological approaches, technical solutions, legislation tools or remediation techniques reducing heavy metals inputs into the soils and their negative effects in the soil and environment or reducing direct risks of human health on contaminated soils are developed [7,8]. The efficiency of these approaches is strongly dependent on the state of knowledge on the field of interest [9].

The inputs of heavy metals into agricultural soils by application of sewage sludge and bottom sediments are the topic of two contributions in this issue. The application of sewage sludge and liming and the effect on total Co content and its speciation in soil are described by Malinowska and Jankowski [10]. The sequential analysis of Co in soil after application of different doses of sludge and liming observed Co content in a defined soil fraction in an incubation experiment. The use of bottom sediments on agricultural soils is presented in the article of Kazberuk et al. [11]. The effect of its application on yield and quality of white mustard (*Sinapis alba*) is observed. The topic of heavy metals analysis in soil is presented in the study of Mensik et al. [12]. The authors compare concentrations of risky elements in alluvial soils using the analysis by pXRF (Portable X-Ray Fluorescence Spectroscopy) method in situ with the spectrometric method ICP-OES (Inductively Coupled Plasma-Optical Emission Spectrometry) in laboratory conditions.

Pikula and Stepień [13] deal with heavy metals mobility in the soil profile. The behaviour of Cd, Cu, Pb and Zn depending on selected soil conditions was studied in a long-term microplot experiment. The mobility of heavy metals was defined for light texture soil and medium texture soil.

The transfer of Cd from soils with different Cd contents caused by agricultural techniques in the Amazonian area into cocoa plants was observed in the article of Rosales-Huamani et al. [14]. The increased Cd load in cocoa beans complicates the husbandry of farmers in the area and the study shows the main principles of the problem. The content of



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Cd in the leaves of maize (*Zea mays*) was studied by Franič et al. [15]. The authors compared different maize genotypes and the effect of Cd on photosynthesis through chlorophyll fluorescence in selected plants.

Skála et al. [16] observed the contamination of soil and plant by zootoxic elements (As, Cd and Pb) loaded by increased heavy metals contents in fluvial zones. The main soil characteristics influencing the transfer of risky elements from soil into selected plants, barley (*Hordeum vulgare*) and triticale (*Triticosecale*) or individual parts of the plant, shoots and grain of oat (*Avena sativa*) were defined using statistical tools. The single correlation analysis compared risky elements uptake by plants with its mobile fractions in soil (extracts by NH_4NO_3 , CaCl_2 and Na_2EDTA).

Kuziemska et al. [17] present a study focused on gentle remediation techniques. The organic soil amendments available in agriculture (cattle manure, chicken manure and spent mushroom substrate) were applied into soil contaminated by increased content of Cu to decrease phytotoxic effect.

Jakubus and Graczyk [18] studied the immobilisation effect of compost and fly ash on Pb uptake by narrow-leaved lupine (*Lupinus angustifolius*), camelina (*Camelina sativa*) and oat (*Avena sativa*). The Pb contents in the soil and plants were used to calculate the risk assessment code (RAC), individual contamination factor (ICF), bioconcentration factor (BCF) and contamination coefficient level (CCL). The higher immobilisation effect of fly ash compared to compost was observed in the study.

The Agronomy Special Issue “Heavy Metal Pollution and Its Effects on Agriculture” brings original scientific articles dealing with important topics meeting the inputs of heavy metals in soils, heavy metals analysis, behaviour of heavy metals in the soil and transfer into the plants and possible use of gentle remediation techniques in agriculture. I believe that the Special Issue “Heavy Metal Pollution and Its Effects on Agriculture” will be a beneficial contribution to the problem of heavy metals in agriculture.

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