

Content of macroelements in plants after contamination of soil by copper and zinc *

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Abstract

The aim of the study was to determine the effect of copper and zinc contamination on macroelements content in *Avena sativa* L., *Brassica napus* var. *oleifera* and *Lupinus luteus* L. Research was located in the greenhouse of the University of Warmia and Mazury in Olsztyn (Poland) on two alkaline soils which in natural conditions were formed with loamy sand and sandy loam. Soil material used for the trials was taken from the arable humus soil horizon. The experiment was carried out in polyethylene pots (in 5 repetitions) which were filled with 3 kg of soil. The soil was contaminated with copper (Cu) and zinc (Zn) at the following rates: 0, 150 and 450 mg kg⁻¹ of soil. Oats (*Avena sativa* L.), oil seed rape (*Brassica napus* var. *oleifera*) and yellow lupine (*Lupinus luteus* L.) were the experimental crops. Copper was applied as CuCl₂ and zinc as ZnCl₂. Prior to the establishment of the experiment, macro- and microelements were dissolved in water and introduced in a single treatment by thoroughly mixing the chemicals with the whole amount of soil for filling one pot. Moreover, equal amounts of macro- and microelements were applied to all pots. During the vegetation of plants constant soil moisture was maintained at 60% of the capillary water capacity. The harvest of plants was carried at 50th day of vegetation. In these moments plants samples were collected.

The effect of metals contaminations on the chemical composition of plants was related to the plant species, soil quality, kind of metal and metal dose. The effect of contamination on the content of majority macroelements in plants was clearer on loamy sand than on sandy loam. The positive correlation between copper doses and content of macroelements was observed in content of sodium, calcium and magnesium on loamy sand and in content of nitrogen, sodium and calcium on sandy loam in *Avena sativa* L., in content of all macroelements on loamy sand and in content of nitrogen, potassium, calcium and magnesium on sandy loam in *Brassica napus* var. *oleifera*, as well as in content of nitrogen on loamy sand and in content of nitrogen, phosphorus, sodium and calcium on sandy loam in *Lupinus luteus* L., in comparison with objects without additions. The opposite relations were confirmed in content of nitrogen and phosphorus on loamy sand and in content of phosphorus, magnesium and potassium on sandy loam in *Avena sativa* L., in content phosphorus on sandy loam in *Brassica napus* var. *oleifera*, in content of phosphorus, potassium, sodium and magnesium on loamy sand and in content of potassium and magnesium on sandy loam in *Lupinus luteus* L. Contamination of soil with zinc caused an increase in content of calcium on loamy sand and in content of calcium and nitrogen on sandy loam in *Avena sativa* L., in content of nitrogen, sodium and especially magnesium and calcium on loamy sand and in content of nitrogen, calcium and magnesium on sandy loam in *Brassica napus* var. *oleifera* and also in content of sodium, phosphorus, nitrogen and calcium on loamy sand and in content of nitrogen, phosphorus, sodium and calcium on sandy loam in *Lupinus luteus* L. On the other hand the content of nitrogen, potassium and magnesium on loamy sand, phosphorus and sodium on sandy loam in *Avena sativa* L., phosphorus and potassium on sandy loam in *Brassica napus* var. *oleifera*, potassium on sandy loam in *Lupinus luteus* L. diminished under the influence of the largest zinc contamination.

Keywords: soil contamination; copper; zinc; plants; chemical composition.

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