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**MACROELEMENT CONTENT IN YIELD
OF OATS (*Avena sativa* L.) CULTIVATED ON SOILS
CONTAMINATED WITH COPPER, ZINC, TIN,
COBALT AND MANGANESE**

**ZAWARTOŚĆ MAKROPIERWIĄTKÓW
W PŁONIE OWSA (*Avena sativa* L.) UPRAWIANEGO NA GLEBACH
ZANIECZYSZCZONYCH MIEDZIĄ, CYNKIEM, CYNĄ,
KOBALTEM I MANGANEM**

Abstract: The aim of study was to compare the effect of contamination of soil with copper, zinc, tin, cobalt and manganese applied in the following doses: 0 (control), 20, 40, 80, 120, 240 and 480 mg · kg⁻¹ of soil on macroelement content in the aboveground parts of oats (*Avena sativa* L.). The effect of heavy metals on macroelement content in oats depended both on the element and on its dose. The greatest changes were observed in calcium content. Copper increased the content of magnesium, nitrogen and, more than others, calcium, in the aboveground parts of oats. A similar relationship was observed for phosphorus, potassium and sodium, but only after relatively low doses of copper were applied; the effect of high doses was distinctly negative. Contamination of soil with high doses of zinc increased the content of phosphorus, but not nitrogen, sodium, magnesium, potassium or calcium, in oats. Tin favoured the accumulation of sodium and, when applied in low doses, also phosphorus, nitrogen and calcium, in plants; in addition, it reduced the content of magnesium and potassium in oats. Cobalt had a significantly negative effect on potassium content in the aboveground parts of oats and on the other hand positively affected the content of phosphorus, sodium, magnesium and, especially, calcium. Manganese generally increased the accumulation of the macroelements under study in plants, but its higher doses reduced the content of sodium and, partly, potassium and magnesium. A strong effect of soil contamination with heavy metals on content of some macroelements in oats was connected with toxic impact of copper, cobalt and, in a smaller degree, manganese on the growth and development of plants.

Keywords: contamination, copper, zinc, tin, cobalt, manganese, oats yield, macroelements content