Cu and Zn bioaccumulation in legume seeds

Cu i Zn bioakumulacja w nasionach roślin strączkowych.

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The potential of plants to collect elements from subsoil determines the bioaccumulation factor (BAF) [Fitamo et al. 2011]. The aim of the study was to evaluate the effect of selected legume crops grown in a pure culture and in mixtures with cereals on sandy and silty soils, on the Cu and Zn bioaccumulation factor.

The strict field experiment in the triple-factorial system by means of randomized sub-blocks (split-split-plot) in 4 replicates was carried out in Lubliniec Nowy near Lubaczów (sandy soil) and Krasne near Rzeszów (silty soil) in 2003-2005. Experimental factors were following:

(I) – species of legume crop: on sandy soil: colorful-blooming pea ('Sokolik' cv. at density of 125 plants·m^{-2}), narrow-leafed lupin ('Sonet' – 125 plants·m^{-2}); on silty soil: white-blooming pea ('Kujawiak' cv. at density of 125 plants·m^{-2}), faba bean ('Titus' – 80 plants·m^{-2});

(II) – methods of legumes tillage: legumes in pure culture and in mixture (at proportion of 50% of norms recommended for their pure culture) with naked oats on sandy soil ('Bajka' cv. – 550 plants·m^{-2}) and spring barley on silty soil ('Rataj' cv. – 320 plants·m^{-2}).

The contents of Cu and Zn in seeds and soils was determined by flame atomic absorption spectrophotometry. Seeds was after prior digested in mixture HNO_3, $HClO_4$ and H_2SO_4, soil in concentrated $HClO_4$. Bioaccumulation factors (BAF) calculated as dividing the contents of the element in dry mass seeds to its contents in the soil [Fitamo et al. 2011].

Lupine seeds characterized the highest values BAF for Cu (an average 2.52 in pure culture and 1.67 in mixed) (Table 1). In contrast, pea seeds grown on sandy soil were distinguished by the highest coefficients of bioaccumulation of zinc (2.28 and 1.55 respectively). That plants with high BCF have the potential for phytostabilization, which can be employed to reduce the migration of contaminants in soils [Szatanik-Kloc, Ambrożewicz-Nita 2015]. Legumes seeds grown on sandy soil were characterized by higher values of average coefficients of bioaccumulation of copper and zinc (both in pure culture and in mixtures with cereals too) compared to seeds collected from the silty soil. Silty soil characterized by a significantly higher content of both metals compared to sandy soil. In research Szatanik-Kloc and Ambrożewicz-Nita [Fitamo et al. 2011] the highest values BAF_{Al} and BAF_{Cu} were noted for the experimental variants with the lower doses of metals. In the case of both micronutrients average rates of bioaccumulation in the variant pure sowing were higher than in the cultivation of mixtures with cereals.

Table 1. Mean bioaccumulation factors of Cu and Zn in the plants grain yields of depending on Papillonaceous plant species and tillage mode [-]

Element	Sandy soil			Silty soil		
	Pea	Lupin	Mean	Pea	Faba bean	Mean
Cu	1,94/1,45*	2,52/1,67	2,23/1,56	1,71/1,21	2,33/1,42	2,02/1,32
Zn	2,28/1,55	2,00/1,46	2,14 /1,51	1,12/0,86	1,39/0,94	1,26/0,90

* in pure culture/in mixture with cereals

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Szatanik-Kloc A., Ambrożewicz-Nita A., 2015. Assessment of aluminium and copper contamination level in selected crops. Acta Agrophysica, 22 (4), 471-482.