



Phytoremediation: Fertilization impact on heavy metal translocation from soil to triticale shoot (x *Triticosecale* W.)

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Engineered plants have moulded a great diversity of genetic adaptations to handle the accumulated heavy metals that occur in the soil. Growing, and in some cases, harvesting crops on a contaminated site as a remediation method is a passive technique that can be used to clean up sites with shallow, low to moderate levels of contaminants. A trial was set up in autumn 1962 on brown forest soil, acid sand with thin interstratified layers of colloid and sesquioxide accumulation. The soil saturation percentage was 25-30, pH (H₂O) 5.4, pH (KCl) 4.3, humus 0.5-0.8%, CEC 3-5 meq 100 g⁻¹. The site is situated about 100 m above sea-level with yearly precipitation of 550-600 mm and sunny hours 1900-2000 h year⁻¹. The min/max temperature was about -25 Cž and +35 Cž interval, the watertable level found at a depth of 2-3 m. The site is extremely drought sensitive. The trial has 32 treatments x 4 replication = 128 plots with 5 x 10 = 50 m² plot size and randomized block design. The applied nutrient was N: 0, 50, 100, 150 kg ha⁻¹ year⁻¹; P₂O₅ and K₂O: 0, 60, 120, 180 kg ha⁻¹ year⁻¹; CaCO₃: 0, 250, 500, 1000 kg ha⁻¹ year⁻¹; MgCO₃: 0, 140, 280 kg ha⁻¹ year⁻¹. The forms of fertilizers applied were Ca-ammonium nitrate, superphosphate, muriate of potash, powdered limestone and dolomite. The crop sequence was potato-rye in the first 10 years, than potato-winter wheat (8 years), than followed different crops the next 10 years (like white lupine, sunflower, grasses, spring barley, tobacco). In 1991, the 29th year of the trial, a triticale monoculture was established. The composite soil samples per plots were made of 20 subsamples, the composite plant samples were made of 1 m² plant material per plot. The plant material was analysed after wet ashing with cc.HNO₃ + cc.H₂O₂. The soil samples were analysed using NH₄-acetate + EDTA method. All

the mineral elements were measured using ICP technics. Actual translocation indexes (ATI= plant metal c./soil metal c.) were determined by Márton (2004). The paper reports results achieved in 2006, when the experiment was a 44-year-old. The main results are as follow: i., On the unfertilized plots (control) the “ATI” values stabilized of Al 1.72, Ba 3.32, Pb 1.23, Sr 13.30, Ni 4.50, and Cd 1.75. ii., As the result of the N fertilization the triticale shoot “ATI” value was of the Al 1.78, Ba 5.99, Pb 1.05, Sr 29.73, Ni 7.79, and Cd 5.22, that presented plant uptake of the Al 3.49%, Ba 80.32%, Pb -14.36%, Sr 123.55%, Ni 73.19%, and Cd 198.10% in an interrelation with control. iii., The P₂O₅ fertilization caused shoot “ATI” value had of the Al 1.69, Ba 3.74, Pb 0.86, Sr 25.08, Ni 7.63, and Cd 4.55, that resulted uptake of the Al -1.74%, Ba 12.65%, Pb -30.08%, Sr 88.60%, Ni 69.63%, and Cd 160.00% compared to control. iv., Due to the K₂O nutrition the shoot “ATI” value was of the Al 2.37, Ba 4.16, Pb 0.87, Sr 25.72, Ni 10.70, and Cd 5.62, that yielded uptake of the Al 37.94%, Ba 25.20%, Pb -29.54%, Sr 93.38%, Ni 137.80%, and Cd 220.96% paralleled with control. v., NPK fertilization had an effect on shoot “ATI” value of the Al 1.17, Ba 3.91, Pb 0.65, Sr 24.20, Ni 3.53, and Cd 3.95, that issued uptake of the Al -31.98%, Ba 17.77%, Pb -47.16%, Sr 81.96%, Ni -21.56%, and Cd 125.70% make a comparison with control. vi., NPKCa load influence on the shoot “ATI” value was in case of the Al 2.40, Ba 3.06, Pb 0.45, Sr 12.21, Ni 2.63, and Cd 1.93, that outcomed uptake of the Al 39.53%, Ba -7.80%, Pb -63.41%, Sr -8.20%, Ni -41.56%, and Cd 10.29% to the control. vii., NPKMg combination impact on the shoot “ATI” value was of the Al 1.89, Ba 0.60, Pb 0.21, Sr 8.19, Ni 2.22, and Cd 1.17, that consequenced uptake of the Al 9.9%, Ba -81.93%, Pb -82.93%, Sr -38.42%, Ni -50.67%, and Cd -33.14% for the control. viii., NPKCaMg treatment upshoted on the shoot “ATI” value had of the Al 1.68, Ba 1.99, Pb 0.28, Sr 6.57, Ni 1.91, and Cd 0.93, that shown uptake of the Al -2.33%, Ba -40.06%, Pb -77.24%, Sr -50.60%, Ni -57.57%, and Cd -46.86% in a relation with control.

Keywords: phytoremediation, triticale, fertilization, heavy metal translocation