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Changes in the distribution of Zn applied as a mixture of synthetic chelating agents in two successive flax crops grown in a calcareous soil.

P. Almendros, D. Gonzalez, A. Obrador, and J.M. Alvarez

Dpto. Química y Análisis Agrícola, ETSI Agrónomos, Universidad Politécnica de Madrid (UPM), Ciudad Universitaria, s/n. 28040 Madrid, Spain (p.almendros@upm.es)

Zinc (Zn) is an essential element for normal crop growth and Zn deficiencies can severely impair crops. The aging of this metal in soils could cause a change in its availability. Over time, the most labile forms of Zn could therefore undergo reductions in both their activity and extractability, as they change to more stable forms. The speciation of metal plays a fundamental role in the way in which transfers between different soil compartments take place and soil minerals migrate toward plants. Sequential extraction is considered an appropriate way to evaluate the different forms and associations of metals present in soil. The objective of this study was to determine the changes that took place in Zn fractions in soil during two successive flax crops to which a synthetic chelate had been applied.

An experiment was conducted in a Typic Calcixerept [pHw (1/2.5, w/v), 8.2; oxidizable organic carbon 0.75%]. Before the first flax crop, this soil was treated with a synthetic chelate, Zn-DTPA-EDTA-HEDTA (Zn-D-H-E) [Zn-diethylenetriaminepentaacetate (Zn-DTPA), Zn-N-2-hydroxyethyl-ethylenediaminetriacetate (Zn-HEDTA), Zn-ethylenediaminetetraacetate (Zn-EDTA)], applied at different rates [0 (nil-Zn), 5 and 10 mg Zn kg-1 soil]. The distribution of the Zn fractions was estimated by selective sequential extraction. The different geochemical compartments targeted were: water soluble (WS), exchangeable (EXC), carbonate bound (CAR), easily reducible Zn or Mn oxide bound (MnOX), oxidable (OM), Fe oxide bound (FeOX) and residual (RES).

The results obtained showed the evolution of the distribution of Zn in the soil during two successive flax crops. Statistical interactions between the flax crop and treatment were obtained for Zn associated with WS, EXC, CAR and OM fractions. The Zn concentration associated with the most labile form (WS) only showed a significant decrease with Zn-D-H-E applied at the rate of 10 mg kg-1. The Zn concentration associated with the EXC form showed significant decreases in both the Zn-D-H-E treatments, with reductions ranging from 38.1 to 52.6% of the initial Zn values (Zn-D-H-E applied at 5 and 10 mg Zn kg-1, respectively). Similar behaviour was also observed in Zn-MnOX with both the Zn-D-H-E treatments, with the reductions ranging from 36.6 to 43.5% of the initial Zn values (Zn-D-H-E at 5 and 10 mg Zn kg-1, respectively). In contrast, the Zn concentrations associated with the CAR and FeOX forms showed significant increases between the two successive flax crops for all the treatments, including that of Nil-Zn. These increases in Zn-CAR ranged from 41.0 to 43.6% of initial Zn (Zn-D-H-E at 5 mg Zn kg-1 and Nil-Zn and, respectively). For Zn-FeOX, the corresponding increases ranged from 56.0 to 186.8% of initial Zn (Zn-D-H-E at 10 mg Zn kg-1 and Nil-Zn, respectively). Zinc concentrations associated with OM and RES fractions did not show any significant differences between the two flax crops for the different treatments. Finally, the residual effect of this calcareous soil produced a change in the distribution of Zn fractions, mainly from water soluble, exchangeable and easily reducible Zn to carbonate bound and Fe oxide bound Zn.