Abstract

Cadmium is of environmental concern because of its potential toxicity to ecosystem. The objectives of this study were to investigate (1) the Cd status and speciation and the fate of applied Cd in selected tropical soils in Kenya and (2) the effect of soil properties, Low-Molecular-Weight Organic Acids (LMWOAs), MonoAmmonium Phosphate (MAP) and potassium chloride (KCl) fertilizers on the kinetics of Cd in the soils. The total Cd and the Cd availability index (ammonium acetate-acetic acid-ethylene diamine tetraacetic acid extractable Cd) generally decreased with depth and varied with the soil. Exchangeable and carbonate-bound Cd were not detected in the natural tropical soils studied. Metal-organic complex bound-Cd was the most predominant in the surface soils. In the subsurface soils, Cd was present mainly as residual form. Cadmium present in the Idaho MAP-fertilizer was transformed in the soil to a series of particulate-bound Cd species with residence time. The M NH_4Cl extractable Cd decreased with the residence time and the extent of the decrease depended upon the soil type. Cadmium was released by LMWOAs from the natural soils and the treated soils to solution as Cd-LMWOA complexes. The LMWOAs were effective in mobilizing soil Cd, especially in the phosphate treated soils. The KCl fertilizer promoted the release of Cd from the soils particularly after treatment with the phosphate fertilizer. The KCl-enhanced release of Cd was attributed to the combined effects of Cd-chloride complexation, ionic strength and the competing K^+ ions. The Idaho MAP-fertilizer greatly enhanced Cd released from the soils. Ammonium-taranakite was identified as a reaction product in the MAP treated soils using X-ray diffraction analysis. The formation of ammonium-taranakite may be perturbed by Cd, if the applied MAP fertilizer contains sufficiently high Cd as an impurity. The findings of the present study are fundamental for establishing a Cd database and are of significance in interpreting the importance of dynamics, speciation and fate of Cd in its bioavailability in tropical soils. The impact of farming practices such as crops and cropping systems and application of fertilizers on Cd contamination to the food chain deserves attention.

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