

Metal chemistry and bioavailability in a biosolids-amended forest soil following conversion of the land for agricultural usage

R G McLaren and L M Clucas

Centre for Soil and Environmental Quality, Agriculture and Life Sciences Division, PO Box 84 Lincoln University, Lincoln 7647, Canterbury

Abstract

Application of biosolids to forests as a method of disposal is currently being used by authorities around the world, including New Zealand.

This practice can lead to a build up of metals (from the biosolids) within the forest litter layer. However, as long as the land remains under forest, the chance of these metals entering the human food chain is low. This may cease to be the case if the forest is cleared for conversion of the land back for agriculture.

This study, using incubation and plant growth techniques, examines the fate of metals in a *Pinus radiata* plantation forest treated with metal-spiked biosolids, following simulated conversion of the land back for agricultural use. Mixing of the biosolids-treated forest litter into the underlying mineral soil resulted in high concentrations of metals (Cu, Ni and Zn) in easily extractable forms, and there was also very little change in these concentrations during a subsequent 2-year incubation of the samples. Soil solution concentrations of the metals were also enhanced substantially by the various original biosolids treatments.

Chemical speciation of the soil solutions using WHAM 6 showed that whereas solution Cu was dominated by organic complexes, most Ni and Zn was present at Ni^{2+} and Zn^{2+} , with generally less than 5% of these elements present as organic complexes. Addition of lime to the soils substantially decreased both readily extractable and soil solution metal concentrations, however, even in their unlimed state there were no adverse effects due to the metals on plant growth as determined in a wheat germination and seedling growth test. Nevertheless, metal concentrations in the wheat seedlings were increased by the various original biosolids treatments.

Plant metal concentrations showed strong correlations with either soil solution metal ion activities, or effective soil solution concentrations as determined by diffusive gradients in thin films (DGT). The results from this study are discussed in relation to the possible consequences of growing agricultural crops on land converted from forest soils that have previously received applications of biosolids.