Mobility of Trace Elements from Organic Amendments of Submerged Alfisols

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Incorporating organic amendments into submerged soils alter soil properties, thus impacting trace element mobility. We assessed the effect of rice straw, cattle manure compost, municipal solid waste compost, and rice husk biochar on the mobility of As, Cd, Cu, Pb, Se, V, and Zn in a submerged-alfisols commonly used for rice cultivation in Sri Lanka. An incubation study was conducted using the soil (Typic Rhodustalfs) collected from a paddy field in Maha Illuppallama. Air dried and sieved (<2mm) soils (1.3kg) were mixed with each amendment (2.38g/kg), separately. The soil in the vessels was submerged with a 2cm waterhead for 13 weeks. Porewater samples were collected and analyzed biweekly for concentrations of trace elements (Total As, Cd, Cu, Pb, Se, V, Zn), major anions (Br^-, Cl^-, F^-, NO_3^-, SO_4^{-2}) and cations (Total Ca, Fe, Mg, Mn, Na). The geochemical modeling software, Visual MINTEQ 3.1 was used to model speciation changes at 1, 7 and 13 weeks after submergence (WAS). Porewater pH (6.98 to 8.82), redox potential (-251.7mV to +296.1mV), and concentrations of trace elements in porewater were not significantly different among the treatments. Concentrations of all the trace elements in porewater increased with WAS, except for V and As. The concentration of V in porewater was reduced with WAS and this was supported by geochemical modeling showing V(V) converting into less mobile V(III) through reductive dissolution. The concentration of As in porewater was below the detection limit (1.74µg/L) throughout the experiment. Geochemical modeling revealed As reduction from As(V) to more mobile As(III) was delayed by the amendments. The addition of organic amendments did not change the trace element mobility in the soil. The time of submergence (by average pe+pH=4.6) had a significant effect on increasing mobility of Cd, Cu, Pb, Se, and Zn and decreasing V.

Keywords: Trace element mobility, Organic amendments, Submerged soil

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