Adding Peat and $Fe(NO_3)_3$ Can Immobilize As and Cd in Paddy Soil

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Peat is often used as organic fertilizer for improving physical and chemical properties of soil. Previous studies indicated that peat can immobilize heavy metal(loid)s and its efficiency is affected by the presence of metal oxides and/or hydroxides. Here we hypothesized that simultaneous applications of peat and Fe-containing compounds may immobilize heavy metal(loid)s in paddy soil. We grew rice plants in pot soils amended with woody peat and varied quantities of $Fe(NO_3)_3$, with control tests conducted similarly using unamended soil. Samples of soil, porewater, rice plant (grain, straw, and root fractions) and Fe plaque on roots were collected at each of the three rice growth stages (tillering, filling, and maturation). They were analyzed for contents of both As and Cd. The results showed that, compared to the control tests, the combined applications of woody peat and $Fe(NO_3)_3$ significantly decreased the total contents of As and Cd in brown rice, straw, and root, and such decreased As and Cd contents were more pronounced as added $Fe(NO_3)_3$ increased. Meanwhile, the co-amendment also decreased Fe(II), As(III) and Cd in soil porewater and increased porewater pH, and such effects were elevated with increasing of added $Fe(NO_3)_3$. Soil analysis showed that co-amendment significantly decreased mobile portions of As (nonspecifically and specifically sorbed fractions) and Cd (the exchangeable and carbonate bound fractions), and significantly increased their immobile portions (Fe-Mn oxide-bound fractions). Such immoblization of As and Cd was also enhanced with increasing of $Fe(NO_3)_3$ addition. Significantly negative correlations between pH and the concentrations of As(III), Fe(II) and Cd in porewater were found. It is likely that the co-amendmentthe increased local pH and enhanced adsorption of As(III), Fe(II) and Cd on soil particles. It also increased the formation of iron plaques on rice roots and poorly crystalline Fe oxides in soils, hence further promoted immobilization of both As and Cd and reduced their accumulation in rice plant. Overall, the study showed that the co-amendment is an effective strategy for simultaneously immobilizing As and Cd in paddy soils.