

Formulation of coal fly ash and sewage sludge mixtures to reduce impacts on the environment when used as soil ameliorant for acidic Tropical soils.

ABSTRACT

Use of coal fly ash (CFA) as a soil ameliorant is hindered by the lack of macronutrients in the ash, besides, there are also concerns about its high concentration of microelements, especially boron. Sewage sludge (SS) on the other hand, has a high amount of macronutrients especially nitrogen. However, it also contains high concentrations of micronutrients especially Zn. This study was carried out to evaluate the potential of CFA as a soil ameliorant to immobilize heavy metals from SS-treated soil and whether the SS could provide supplementary macronutrients for maize growth requirement. A laboratory soil incubation study was conducted using 3 kg mixture of soil, SS and CFA. In all treatments, the SS was applied at 5% w/w. The rates of coal fly ash varied from 0, 2.5, 5, 10, 20 and 40% w/w. The soil solution was collected and analyzed weekly for pH and soluble Zn, Cu and B. A similar experiment was conducted in a glasshouse but using CFA at rates up to only 20% w/w on maize as a test plant. Although the acid neutralizing capacity of this CFA is only 0.50% of calcium carbonate equivalent (CCE), the high rates of CFA application increased the soil solution pH. Treatments of CFA at 10% and above reduced Zn concentrations in soil solution to less than 1 mg L⁻¹. The reduction in Cu and B concentrations in the soil solution were not apparent in this study. Uptake of Zn by the maize plants was found to significantly decreased in treatments of 10% CFA and above. Nitrogen uptake by maize decreased in the treatment using more than 10% CFA. Only the highest treatment of CFA (20% w/w) exceeded the B toxicity level for maize (98-100 mg kg⁻¹). Coal fly ash and sewage sludge mixture can be used as a soil ameliorant provided attention is given to the B toxicity and P and K deficiency problems that might be faced by plants such as maize.

Keyword: Acidic tropical soil; Glasshouse study; Maize plants; Soil solution study.