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Nitrogen availability in biochar-amended soils with excessive compost application

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Taking into consideration economic viability, the doses of manure compost in Taiwan are recommended as 1% to 2%; however, some farmers apply more than 2% to 5% in intensive cultivation periods for short-term leafy crops, to add more N. Although many studies report positive effects of a biochar-compost mix on soil properties and plant growth, but there are no studies that have determined the changes in N availability over time after biochar (BC) application in compost over-applicated soil. In the present study, in vitro N mineralization kinetics were examined in further. We tested the hypothesis that BC addition may diminish mixed-soil N mineralization, enhance ammonium retention, reduce nitrate leaching, and decrease P and nutrients loss in compost over-applicated soils. The aim of our research was to evaluate the N and nutrient regulation or enhancement role of different BC addition rates in three compost over-applicated soils over time. The effect of four rates (0%, 0.5%, 1.0%, and 2.0% w/w) of BC co-applied with swine manure compost (5.0% w/w) on three Taiwan rural soils (topsoil, slightly acid Oxisols (SAO), mildly alkaline Inceptisols (MAI), and slightly acid Inceptisols (SAI)) was investigated during 371-d incubation study. BC was produced from lead tree (Leucaena leucocephala (Lam.) de. Wit) at 750 degree C. The incubation results indicated that soil, rate and interaction between soil and rate significantly influenced soil NO3-N and total inorganic N concentrations, but only soil significantly influenced soil NH4-N concentration. Soil NH4-Nand NO3-N concentrations on average during a 371-day incubation followed the order: SAO soil > SAI soil > MAI soil. In most cases the effect was insignificant and inconsistent in terms of time and rate of BC application, rendering it difficult to summarize the effects of BC on ammonium of our investigated soils. The negative effect of BC was prominent almost in all investigated soils during the incubation period and the amount of decline increased as the rate of BC application increased from 0.5% to 2%. In addition, only soil significantly influenced all Mehlich 3-extractable nutrient concentrations, and rate significantly influenced M3-K concentration. At the end of the incubation, adding 0.5% BC and 1.0% BC in SAI soil and 1.0% BC and 2.0% BC in MAI soil both had positive improvement on the nutrients (P, K, Mg, Fe and Mn), and application of BC in SAI soil led to improvement in Cu and Pb (2.0% BC), Zn and N mineralization (0.5% BC and 1.0% BC). In conclusion, the studied results confirmed the potential of biochar-compost blend is promising for preventing excess N and nutrients loss in compost over-applicated soil, as well as maintaining SOC. As adding a large amount of biochar in open fields would be unrealistic and not economically sustainable, we suggested that adding 0.5%~1.0% woody BC to three studied soils should be reasonable and appropriate.