Low-cost carbonaceous amendments to reduce nitrogen fluxes from biosolids

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Biosolids are the solid by-product of wastewater treatment plants. Humanity produces some 50 kg/person/year, with global output exceeding 10 M t/year. Disposal of biosolids costs New Zealand (NZ) around 33×106 dollars/year. Biosolids are mostly organic matter and contain high concentrations of plant nutrients. Biosolids can also contain contaminants, which is why they are not typically applied to NZ's high value soils. However, in NZ and elsewhere, biosolids are used to rebuild degraded soils for the production of non-food crops. Applying biosolids to soil improves plant growth, but may result in high levels of nitrate (NO3-) leaching. I aimed to determine the effect of mixing biosolids with sawdust and charcoal on NO3- leaching from biosolids-amended soil. Sawdust/wood-waste was derived from Pinus radiata (D. Don), a common forestry species. Charcoal was made by pyrolysis as P. radiata, waste at temperatures between 350oC and 550oC. The capacity of the amendments to sorb ammonium (NH4+) and NO3- was measured using batch experiments. Solutions containing 100 mg/L of NH4+ or NO3- were separately mixed with the amendments in 1:10 materials: solution ratio. Columns (50 cm3) containing biosolids mixed with charcoal or sawdust at various ratios were irrigated with 5 mL of deionised water and the resulting leachate was collected weekly. Batch experiments revealed that none of the amendments adsorbed significant amounts of NO3-. Charcoal adsorbed significant amounts of NH4+, giving sorbed/solution NH4+ concentration quotients of up to 33. Increasing pyrolysis temperatures resulted in charcoals with an increased ability to sorb NH4+. Unpyrolysed sawdust did not adsorb significant amounts of NH4+, however, sawdust almost eliminated NH4+-N leaching and reduced NO3--N leaching by >40%. Low temperature charcoal reduced NH4+-N leaching from the columns by 40 - 80%. Overall, dry (but not wet) sawdust and low temperature charcoal have potential to mitigate N leaching from biosolids.