Plant P uptake from organic amendments: understanding soil chemical and biological processes for better management

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Understanding the biogeochemical cycling of nutrients through soil is vital for effective nutrient management. Phosphorus (P) is an important nutrient for plant growth; however, phosphate rock is becoming increasingly expensive and therefore innovative alternative ways to supply crops with P are strongly needed. Organic amendments (OA) such as manures and sewage sludge usually contain high concentrations of P (5-40 g/kg), although this P is often not immediately available to plants. Furthermore, thermal conversion processes such as gasification and pyrolysis can increase the P concentration of OA (sometimes up to 95 g/kg) but also affect P bioavailability. Both soil and OA chemistry and soil microbial communities play important roles in determining when, and how much, of the P from OA becomes available to plants. A better understanding of both the chemical nature of the P in OA, and how OA affect soil chemical and biological processes, will help us to best manage their use as P amendments. We discuss work undertaken over the last three years at the University of Adelaide and the University of Copenhagen. A suite of techniques were used to characterise a range of raw and processed OA and how the P they contain cycle through soils and crops. These techniques include nuclear magnetic resonance spectroscopy, radioactive isotope pool dilution studies and next generation sequencing. A series of plant growth studies with wheat and lab incubation studies using cropping soils has been carried out. This work provides new insights into soil and plant responses to OA which could help in the development of sustainable food production systems.