Report for 2002ID14B: Factors Controlling the Availability of Phosphorus for Transport into Surface Water from Manure Amended Soils in Southern Idaho

- Water Resources Research Institute Reports:
  - NA
- Conference Proceedings:
  - Reaction Processes of Phosphorous in Manure-amended Alkaline Soils, Daniel G. Strawn, Jeremy C. Hansen, 2003.
- Articles in Refereed Scientific Journals:
  - In preparation: Phosphorus Speciation in Manure-Amended Alkaline Soils, Jeremy C. Hansen, Daniel G. Strawn, Barbara Cade-Menun. Kinetics of P Release from Manure-Amended Alkaline Soil, Jeremy C. Hansen and Daniel G. Strawn.
- Dissertations:
  - In preparation MS Thesis. Phosphorus reactions in manure-amended alkaline soils, Jeremy Hansen, 2003.
- Book Chapters:
  - NA
- Other Publications:
  - NA
- unclassified:
  - In preparation Phosphorus Speciation in Manure-Amended Alkaline Soils, Jeremy C. Hansen, Daniel G. Strawn, Barbara Cade-Menun. Kinetics of P Release from Manure-Amended Alkaline Soil, Jeremy C. Hansen and Daniel G. Strawn.

Report Follows

Problem and Research Objectives:

The goal of this study is to investigate the availability of P as a function of its molecular form and soil type. There are two species of P that are commonly found in soils, inorganic (Pi) and organic (Po). Most research has focused on Pi. Recent research suggests that the two P forms have unique sorption and transport properties. Since manure is a significant source of Po, and Idaho has an intensive cattle industry, it is imperative that the factors controlling P availability from manure amended soils be understood. In southern Idaho precipitation of Ca-phosphates are important P retention mechanisms, however, the factors that affect the formation and dissolution of these minerals are poorly understood. Thus, the results from this study will provide valuable information that can be used to better manage manure application to soils and reduce non point P pollution.

Methodology:

We have made measurements of P release kinetics from soils using two different methods, batch desorption experiments and continuous replenishment experiments. The batch desorption experiments involve incubating the soil with a weak electrolyte solution and measuring the time necessary for the system to come to steady state. The continuous replenishment experiments refresh the soil suspension with new electrolyte solutions. We have also done speciation experiments on extracts from the soils and manures using NMR spectroscopy. We used both a weak background electrolyte and an EDTA-NaOH solutions to extract the soils.

Principal Findings and Significance:

The goal of the research presented in this paper is to investigate the desorption behavior and speciation of P in manure-amended alkaline soils. Desorption behavior was measured on a soil that received two separate treatments, one treatment was solid-dairy manure applied prior to the growing season, the other was liquid manure byproduct held in lagoon ponds and applied throughout the growing season. The P desorption rate from both treatments was similar, initially fast followed by a slower reaction. The total amount of P available for desorption in the surface soils was similar for both treatments, while in the subsurface soil P from the liquid lagoon manure was much more available for desorption than the solid-manure treatment. When applied to various kinetic models it was found that the data were best fit with a modified Elovich equation. The speciation results showed that the soluble-organic P being desorbed is insignificant. However, total organic and inorganic P measurements on the soil and manure samples showed that there are significant amounts of organic P present. NMR spectroscopy results revealed that the predominant species of P in the extracts was orthophosphate, and that organic P is present as predominantly monoester P compounds, with lesser amounts of diester P compounds and polyphosphates. Results from this study provide new insights into P desorption rates and mechanisms in manure-amended alkaline soils that can be used to improve the accuracy of predicting P availability for leaching and runoff into ground and surface waters.