

The influence of soil and manure variables on phosphorus leaching from Swedish agricultural soils

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The Baltic Sea Action Plan requires participating countries to reduce phosphorus (P) pollution in order to mitigate Baltic eutrophication (HELCOM, 2007). Agriculture is Sweden's primary source of P to the Baltic Proper (Brandt and Ejhed, 2003), with leaching of P through agricultural soils a major concern (Ulén et al., 2007). We conducted two rainfall simulation studies to examine the role of soil and manure sources of P on P leaching. In the first study, intact soil cores (20-cm diam. x 20-cm deep) were collected from three different long-term (>50 yrs) field trials in which varied fertilizer rates produced a range of soil P levels (ammonium lactate P = 0.15-1.83 mg kg⁻¹). This study was intended to shed light on the role of P desorption on P leaching from top soils. In the second study, dairy (*Bos taurus* L.) manure was added at a rate of 30 kg P ha⁻¹ to the soil columns to determine the relative role of soil and manure P on P leaching. We found clear, strong (R² = 0.82-0.94) linear relationships between ammonium lactate P (AL-P) in the soil and dissolved reactive P in leachate. However, relationships varied significantly between the three soils with regression slopes differing by an order of magnitude. These findings contrast with previous work in Sweden examining deep soil cores (90 cm) in which no relationships were apparent (Djodjic et al., 2004) suggesting that topsoil P leaching is modified by subsoil properties. When manure was applied to soil columns, antecedent AL-P appeared to affect manure P leaching, with the interaction more pronounced in some soils than others. Phosphorus leaching from intact soil columns increased from 26 to 4647% with the addition of manure. Results seem to be consistent with the hypothesis that greater P sorption saturation in soils with elevated AL-P results in lesser sorption of applied manure P and therefore greater risk for leaching losses. Findings from this research will be used to inform P management recommendations in Sweden.

- Brandt, M., and H. Ejhed, 2003. Transport, retention och källfördelning – Belastning på haven. Swedish Environmental Protection Agency. Report 5247.
- Djodjic, F., K. Börling, and L. Bergström. 2004. Phosphorus leaching in relation to soil type and soil phosphorus content. *J. Environ. Qual.* 33:678–684.
- HELCOM. 2007. HELCOM Baltic Sea Action Plan. Krakow, Poland.
- Ulén, B., M. Bechmann, J., Fölster, H., Jarvie, and H. Tunney, H. 2007. Agriculture as a phosphorus source for eutrophication in the north-west European countries, Norway, Sweden, United Kingdom and Ireland: A review. *Soil Use Manage.* 23, Suppl.1, 5-18.