IDENTIFYING PHOSPHORUS LEACHING SOILS USING A SIMPLE LANGMUIR-BASED MODEL

Jonas Rolighed[a], Goswin J Heckrath[b], Gitte H Rubæk[b], E M P M van Boekel[c], Piet Groenendijk[c], Oscar F Schoumans[c] and Hans E Andersen[a]

Department of Bioscience, Aarhus University, Denmark
[b]Department of Agroecology, Aarhus University, Denmark
[c]Alterra, Wageningen University, The Netherlands
Email: jro@bios.au.dk

During the past century, phosphorus (P) in fertilizers has exceeded the output of P in agricultural products resulting in an accumulation of P in Danish agricultural soils. This is especially true on livestock farms due to the high P content in pig and cow slurry. Long-term accumulation of P may exceed the soils' phosphorus sorption capacity, causing P to leach through the soil matrix and increase the risk of P losses to surface waters.

In order to identify soils with a high risk of subsurface P leaching, we investigated whether the soil solution P concentration could be estimated by a simple model describing the kinetics of the reversible P sorption and desorption based on Langmuir adsorption theory, using water extractable P and soil P sorption properties as model input.

We selected 276 samples of top soil from the Danish national 7 km sampling grid in combination with 78 soil samples from the Danish Agricultural Monitoring program and another 27 samples from livestock farms scattered around Denmark.

All soil samples were analyzed for oxalate extractable phosphorus, iron and aluminum, as well as water extractable P. For a subset of samples, the phosphorus equilibrium concentration (ortho-P and total P) was determined in extractions with 0.01M $CaCl_2$ in a soil-to-solution ratio of 1:4 (w/v) in order to approximate phosphorus content in the soil solution.

Predicted concentrations were compared to observed equilibrium concentrations, concentrations in suction cups as well as in tile drains.

Combined with knowledge on local drainage and hydrological pathways, the model could help identify areas with particularly high risk of phosphorus leaching.

Editor's Note: An extended manuscript has not been submitted for this presentation.