Adapting agricultural practice to minimize P leaching

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In Denmark 1400 kg P per ha have accumulated in agricultural soils during the last century, which have raised the potential for P export to the aquatic environment and leaching of P through soil to tile drains is considered an important contributor to the diffuse P losses. Factors controlling P loss from agricultural land may conceptually be distinguished into transport factors and source factors. Source factors are functions of soil, crop and management and describe an area's potential to contribute to P export from the area. Phosphorus is leached as both dissolved and colloidal P. However, the relative importance of these P forms and how their losses are affected by tillage, soil P status, liming and manure application method on different soil types is poorly understood. The objective of this series of studies was therefore to investigate the P leaching potential from the plow layer and how leaching depended on agricultural practice and soil type.

Intact soil cores (20 by 20 cm) were sampled from the plow layer of soils with different texture, P status or liming status. The experimental setup was designed to study solute and colloid P leaching at unsaturated conditions, with possibilities to gain detailed insight into the governing processes and key factors controlling P mobilization and leaching.

Leaching of total P increased with increasing P status, demonstrated by a strong relationship between Olsen P in soil and cumulated amount of TP leached in all soils textures under reference conditions (i.e. soils which had not received experimental treatments like slurry application or tillage prior to sampling). The proportion of dissolved P increased significantly with increasing soil P status and desorption of P from plow layer soil with sufficient to high P status, seemed to support a relatively constant and high concentration of dissolved P in the effluent (1-8 mg l^{-1}).

Studies on management practices (slurry application method, tillage and liming) were carried out to establish the mitigation potential offered by these practices. Timing and method of slurry application is generally considered as critical management practices. Our results demonstrated that surface application of slurry at field capacity increased TP leaching especially in fine textured soils, while slurry injection significantly reduced TP leaching in structured soils with low P status. Furthermore the P leaching reduction offered by injection was greater for particulate and organic P forms than MRP indicating an additional physical protection of these forms. Autumn plowing along a textural gradient increased TP leaching from fine textured soils, mainly due to mobilization of soil colloids and increased leaching of particulate P. Investigations on soil lime gradients demonstrated that increasing the liming status of the soil had some potential for reducing P leaching.

We conclude that while management practices such as slurry application method, tillage and liming offers some potential for mitigating the P leaching losses, soil P status seemed to be the main factor controlling P leaching losses from the plow layer.

Glæsner, N., Kjaergaard, C., Rubæk, GH., Magid, J. 2010. Leaching processes in soils of different texture after injection or surface application of diary slurry (two papers in prep).

Kjaergaard, C., Rubæk, GH. and Heckrath, G. 2010.Autumn tillage increases phosphorus leaching from fine textured soils (Poster presentation at this workshop).