The importance of subsoil properties for P leaching and selection of effective mitigation strategies

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Eutrophication is a major problem in the Baltic Sea, to a large extent due to large phosphorus (P) loads from agriculture. The Baltic Sea Action Plan obligates the participating countries to reduce their load of P to the sea. Focus on the research project presented here is to investigate the differences in P leaching from agricultural soils with emphasis on understanding the role of the subsoil as a source or sink for P losses. Undisturbed soil columns (0.295 m inner diameter and 1.18 in length) were taken out from four Swedish agricultural soils (two clayey and two sandy soils) with and without the topsoil. The lysimeters were thereafter installed in an outdoor station where they will be subjected to natural precipitation for approximately three years when P leaching will be measured. Previous work in Sweden, made on lysimeters of the same size as those used in this project, did not show any clear correlation between P content in the topsoil and P leaching, and pointed out the importance of subsoil properties for P leaching (Djodjic et al., 2004). A calcium based amendment placed on the upper boundary of the subsoil will be tested as a mitigation strategy to reduce P losses from soils prone to P leaching. The soils have been characterized based on their chemical and physical properties. Plant available P extracted with ammonium lactate/acetic acid solution at pH 3.75 (P-AL) and P extracted with water show somewhat contradictory results for the clay soils, especially in the bottom two layers. At 50-70 and 70-100 cm depths in the clay soil Lanna, P-AL were 15.4 and 21.5 mg 100 g^{-1}, respectively. At the same depths in the clay soil Bornsjön, P-AL were 0.2 and 1.8 mg 100 g^{-1}, respectively. However, P extracted with water at the same depths in the Lanna soil were 0.09 and 0.13 mg 100 g^{-1},respectively, and 0.27 and 0.16 mg 100 g^{-1} in Bornsjön. If P extracted with water is to be seen as an indication of the amount of P prone to leaching, these results indicate that P-AL values do not provide good measures of leachable P. Results from this project will shade light on the relationship between subsoil conditions and leachate properties, as well as opportunities to mitigate P leaching with new amendments, which in the end can yield management recommendations in Swedish agriculture.

Djodjic, F., K. Börling, and L. Bergström. 2004. Phosphorus leaching in relation to soil type and soil phosphorus content. Journal of Environmental Quality 33:678-684.