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The Interactions between Phosphorus Leaching and Lime Application in Undisturbed Soil Columns with Different Soil Textures

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Abstract : Phosphorus losses from agricultural fields through leaching is one of the main contributors to eutrophication of lakes in Quebec as well as North America. The main objective of this study is to evaluate the application of high calcium hydrated lime as a soil amendment in reducing the subsurface transport of phosphorus to water bodies by studying the interactions between phosphorus leaching and lime application in three common agricultural soil textures (sandy loam, loam and clay loam) in Quebec. For this purpose, 6 intact soil columns of 10 cm diameter and 20 cm deep were taken from each of the three different soil textured agricultural fields. Lime (high calcium hydrated lime) was applied to the top 5 cm of half of the intact soil columns while the rest were left as controls. The columns were leached with artificial rainwater in-consecutively at a rate of 3 mm h-1 over a 90-day period. The total amount of water added was equal to the average total rainfall of the region in fall. The leachate samples were collected daily and analyzed for dissolved reactive phosphorus, total dissolved phosphorus, total phosphorus, pH, electrical conductivity, calcium, magnesium, potassium and iron. The results showed that lime was able to significantly reduce dissolved reactive phosphorus concentrations in the leachates by 70 and 40 percent in sandy loam and loam soil columns, respectively, while phosphorus concentration in the clay loam soil leachates were increased by 40 percent. The calcium in lime has P-binding capabilities. Soil chemical properties in sandy and loamy soils can affect phosphorus leaching, whereas, transport mechanisms in clay soils with macropores dominate phosphorus leaching behaviors. The presence of preferential pathways and cracks in the clay soil columns has led to a quick transport of phosphorus through the soil and the less contact time with the soil matrix, therefore, causing less opportunity for P sorption and larger P release. Application of lime to agricultural fields can be considered as a promising measure in mitigating phosphorus loss from sandy loam and loam soils.

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