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Investigating factors impacting phosphorus dynamics and phosphate sorption capacity of manure amended soils of Ontario

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Phosphorus (P) in agricultural soil is an essential nutrient for plant growth. Manure application as an organic phosphorus fertilizer improves P supply to plants. Labile P from manure can be easily transported from agricultural fields through surface runoff. Excessive P fertilizer in amended soils change into more stable forms. These processes cause eutrophication of lakes. Understanding P dynamics and P compositions in manure and soils is important. This study analyzed how do the total P and bioavailable P fraction in manure-amended agricultural soils change over seasons, as well as what factors may contribute to these changes. Additionally, we tested P sorption capacity in two soils. This study was conducted with agricultural soils from Bay of Quinte area, Ontario, Canada.

Our results showed that the total phosphorus (TP) amount tend to decline with aging of applied manure. Soils amended by manure in 2019 summer have around 1.17 mg TP g^{-1} in average, while soils with manure application more than 6 years ago have approximately 0.97 mg TP g^{-1} in average. Compared to manure with 4.19 mg TP g^{-1}, the TP in soils was much less indicating low P fertilization efficiency. Comparing the concentration of TP and bioavailable P among seasons, both parameters showed an increasing trend with decreasing temperature. Reduced uptake of P by plants, the limitation of mineralization, and less rain events in winter contribute to the high values of P in winter. P sorption were examined by soil incubation experiments on two soil samples with potassium dihydrogen phosphate (KH2PO4) as inorganic fertilizer. Results indicated a negative correlation between adsorbed P and added P. Even with additional geothite as an extra iron oxide-hydroxide source, the same relation was observed. It signifies that these soils have low P-sorption capacity. The abundant amount of OM and Ca from manure and soils negatively correlated to P adsorption onto iron oxide-hydroxides. The degree of phosphorus saturation (DPS) of these two soils (95.78 and 82.46%) exceeded the threshold of P saturation level in agricultural soils (80%) and explained the release of P from solid phase.