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A critical evaluation of phosphate retardation and leaching in Hapludults

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Nutrients used in production agriculture, in particular bioactive phosphorus (P), continue to present challenges in trying to reverse the degradation of fragile aquatic ecosystems. Soils treated with large amounts of nutrient-enriched animal manure have elevated P levels in regions of intensive animal agriculture and the residual effects of past large P additions were found to be long-lived. Mathematical models are increasingly used in the evaluation and development of mitigation strategies and sustainable management practices. A large number of predictive tools are currently used in the U.S. for simulating phosphorus environmental fate, including models such AGNPS (Agricultural Non-Point Source), FHANTM Field Hydrologic And Nutrient Transport Model (Field Hydrologic And Nutrient Transport Model), SWAT (Soil & Water Assessment Tool), or APEX (Agric. Policy/Environmental EXtender). The P routines in these models have had limited changes in spite of the advances in our understanding of speciation and transport of various P forms in soil and water systems that have occurred over the last three decades. We conducted soil sorption isotherm experiments that yielded basic information for estimating the Phosphorus Sorption coefficient (PSP) a key parameter used to allocate mineral P into soil labile, active, and stable pools. We compare these coefficients to parameters derived from breakthrough curves (BTC) for determining the extent of retardation and transport of phosphate supplied as KH2PO4 under a constant hydraulic head. Sigmoidal and multi-reaction rate models were observed in the BTCs of the anion, which undermine the rationale for using an overall simple partition coefficient to describe the transport and dispersal of phosphate in soil. Minimizing such generalities used in estimating nutrient availability and transport gives a more accurate picture of status of P in soil to conserve nutrients and minimize loss of excess P inputs to the environment.