DEVELOPING PHOSPHORUS MANAGEMENT GUIDELINES FOR AGRICULTURE IN THE CONNECTICUT RIVER WATERSHED

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Problem and Research Objectives:

A summary of soil test phosphorus levels in New Hampshire soil samples submitted to the UNH Analytical Services Lab during the past 3 years indicates that greater than 70% of soils from participating growers are in the high or greater range (greater than 50 mg P kg^{-1} , Mehlich III extraction) (Buob, unpublished data). It appears that P in New Hampshire's agricultural soils could pose a greater risk to the environment than originally thought. Furthermore, it is important that high P soils be identified, as there should be little or no yield response (increase) to added P in these agricultural soils. There is currently a need to determine at what level of soil test P, and on which soil types, the risk of nonpoint source pollution from P in runoff, erosion, and leaching is greatest.

Several states are adapting an assessment tool, the Phosphorus Site Index, for determination of P contamination risks from agriculture. This approach considers environmental features controlling the fate of phosphorus at any location: site characteristics and transport factors such as soil texture, erosion, runoff potential and proximity to water bodies; chemical features such as the form of phosphorus and its association with soil components, and release of P into solution; and site management factors such as fertilizer types and application rates that influence soil P content (soil test P) (Lemunyon and Gilbert, 1993; NRCS, 1994). In 2002, New Hampshire will begin determining P Site Indices for agricultural areas. As in other states, this tool will be useful for community planners, soil surveyors, cooperative extension specialists, crop consultants, and growers.

Soil test phosphorus values must be included in the New Hampshire P Site Index, and it will be necessary to determine an appropriate test for "environmentally mobile" soil phosphorus. The most appropriate approach will be convenient, cost-effective, and accurate for New Hampshire soils. New Hampshire agricultural soils are dominantly Entisols, Inceptisols, and Spodosols. Spodosols can have relatively high P sorption capacities due to relatively high iron and aluminum sesquioxide contents (Simard et al., 1994). Due to the influence of soil pedologic characteristics on the relationship between soil test P and P sorption characteristics (Beauchemin and Simard, 1999), and the variety of soil test approaches proposed for use in environmental assessments of P in soils, this study was undertaken to determine the most appropriate soil test approach for P Site Indices in New Hampshire.

The objectives of this study were to:

- Chemically and physically characterize representative agricultural soils from the Connecticut River Watershed (CRW) in New Hampshire to allow comparison of soil types within the state and New England, and estimate the behavior of P in untested soils with known characteristics.
- Determine the relationships between soil test methods used in New Hampshire and Vermont (Mehlich 3, and Modified Morgan), using the CRW/New Hampshire soils.
- Determine the relationship between water-extractable P and soil test P for the CRW/NH soils. This relationship will provide information to help predict sites that may be "susceptible" to phosphorus due to a high or very high levels of P in the soil test results.

- Produce P sorption and desorption curves for a subset of the soils. The curves (i.e., the equations describing them) will be used to help group soil types based on their native abilities to hold or release phosphorus.

Principal Findings and Significance:
A suitable approach for testing New Hampshire soils for environmentally-mobile P appears to include a combination of Mehlich III extractions for soil test P, PSI measurements to determine sorption capacities, and water/calcium chloride extractions to estimate P concentrations released to soil solutions. Rather than a single soil test P value as is typical in Phosphorus Site Indices, all three of the parameters could be considered as P quantity, P capacity, and immediate P release terms, respectively.

The Spodosols examined had both the highest sorption affinity for P, and currently the lowest extractable P (including water/calcium chloride-extractable P). If agricultural management of P does not change on these soils, assuming that the soils obtained for this study are representative of all agricultural Spodosols in New Hampshire, P associated with Spodosols may pose minimal threat to the environment. If, however, additional P is added to these soils in the future, they could pose a threat to the environment where erosion is an issue, because these soils can retain relatively high quantities of P that could be carried to surface water on soil particles. Seasonally-saturated Spodosols were not sampled in this study, and may not fit the pattern observed. Entisols and Inceptisols were variable with respect to sorption capacities and extractable P. The relatively lower sorption capacities of Entisols and Inceptisols, coupled with their higher P contents (especially for samples of the Hadley and Windsor soils) suggest that P runoff and leaching are potential considerations for these soil orders.