Soil and Water Science
Research Brief
University of Florida
Institute of Food and Agricultural Sciences

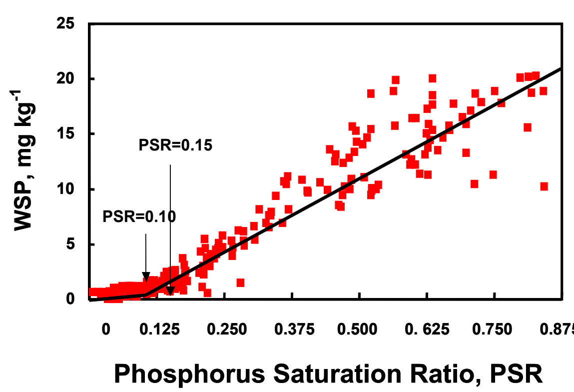
PREDICTING THE "SAFE PHOSPHOROUS STORAGE CAPACITY" OF SANDY SOILS

V. D. Nair, W. G. Harris, and D.A. Graetz

Sandy soils in the Suwannee River Basin (SRB) of northern Florida have little ability to adsorb phosphorus (P), and yet many dairies in the SRB routinely apply P-rich lagoon effluent onto permanent sprayfields for waste disposal and nutrient recycling. Increased P loading to these sites may lead to P loss through runoff and subsurface drainage, contributing to surface water degradation. Improved P management of these fields requires the evaluation of soil P concentrations relative to the soil's ability to adsorb P.

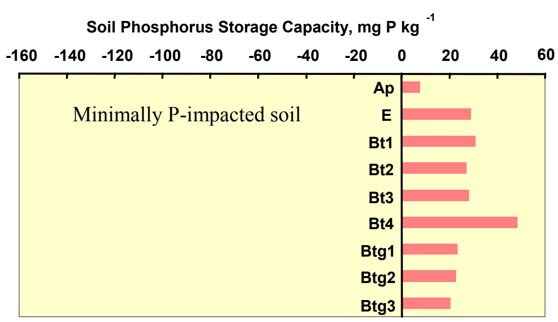
The finite capacity to retain P before increases in pore water concentrations are seen can be estimated by relating extractable P to extractable Fe and Al. That is because Fe and Al oxides correlate highly with P retention in Florida soils (SWS-03-04). The P saturation ratio (PSR) can be calculated as the molar ratio of P to Fe+Al.

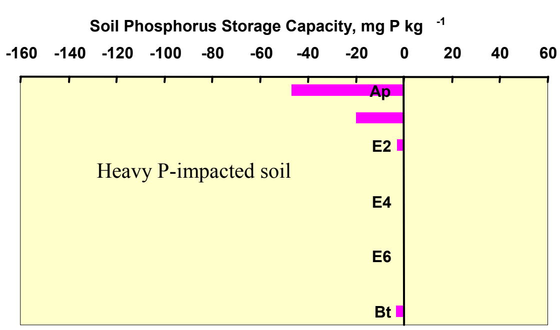
When water soluble P is plotted against PSR, there is a point of inflection at 0.10 (95% confidence interval limits 0.05 to 0.15). Taking the confidence intervals into consideration, a molar ratio of 0.15 was considered a critical PSR. If the molar ratio of P to Fe+Al is greater than 0.15, there is an elevated risk of P loss from the soil. For details on this concept, refer to Nair et al. 2004. Journal of Environmental Quality 33:107-113.



We are now extending our research findings to calculate the "safe P storage capacity (SPSC)" per unit volume of soil. The amount of P to reach this critical PSR can be calculated from the expression, (0.15-soil PSR) x (moles of Fe+Al). This SPSC can be expressed in mmoles P kg^{-1}, mg P kg^{-1} or kg P ha^{-1}.

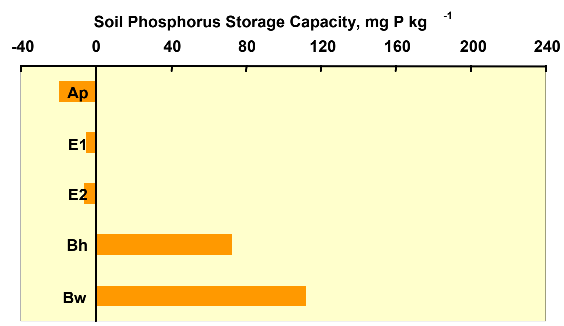
Standard soil test extraction methods (e.g. Mehlich 1) have been adapted for assessing environmental risks of phosphorus (P) loss from soils. However, a low Mehlich 1-P does not indicate that the soil has the capacity to retain significant amounts of P added as fertilizer or animal waste. For example, Spodosols of the Lake Okeechobee Basin, if not previously loaded heavily with P, would have a low soil test P value at the outset, but would quickly reach high-risk levels with P loading due to low P retention capacity. The SPSC, on the other hand, predicts directly whatever capacity is remaining for a soil horizon or profile.   Below are two examples of the SPSC for the soils of two dairy sprayfields within the Suwannee River Basin, a minimally P-impacted and a heavy P-impacted soil.





A soil profile in a minimally-impacted dairy sprayfield (new sprayfield) in the Suwannee River Basin showed that there was a large amount of remaining P storage capacity for this soil profile. On the other hand, a heavily manure-impacted sprayfield in the same basin does not have any remaining SPSC up to a 2-meter depth, and would be a P source.

Below is another example, showing a soil profile (Spodosol) from the Lake Okeechobee Basin. The surface A and E horizons have no remaining SPSC, but the underlying Bh and Bw horizons have appreciable SPSC left.



If P reaches down to the spodic (Bh) horizon, it is likely that the P would be retained. But, high water-table conditions in this basin would likely result in P loss via surface and subsurface drainage.

Based on the above, we are now considering including the SPSC in the Florida P-Index, (http://efotg.nrcs.usda.gov/popmenu3FS.aspx?Fips=12001&MenuName=menuFL.zip) as a more valid parameter for P risk assessment than a soil test P such as Mehlich 1-P.

AUTHORS

V.D. Nair, W.G. Harris, and D.A. Graetz
Soil and Water Science Dept.
P.O. Box 110510, University of Florida
Gainesville, FL 32611-0510
vdna@mail.ifas.ufl.edu
wghs@mail.ifas.ufl.edu
dag@mail.ifas.ufl.edu