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Soil and Water Science
Research Brief

University of Florida Institute of Food and Agricultural Sciences

# DEGREE OF PHOSPHORUS SATURATION (DPS) IN LAKE OKEECHOBEE BASIN SOILS

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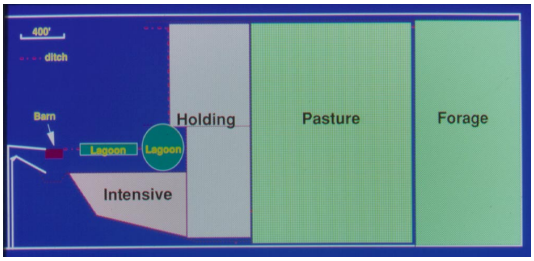
Phosphorus (P) becomes a pollutant if it moves from the site of its intended use to surface waters either via surface runoff or *subsurface drainage*. The Spodosols of the Lake Okeechobee Basin of Florida receiving significant loadings of animal manure would be one of the most likely sources where subsurface leaching of P would adversely affect the quality of surface waters.


The "Degree of P Saturation" (DPS) is expressed as the percentage of extractable P (in moles) to the P sorption capacity (PSC) of a soil. The PSC will be the maximum amount of P that can be retained by soils as determined by laboratory experiments and is the sum of oxalate-extractable Fe and Al, expressed in moles. The potential of using DPS as a tool for quantifying the environmental soil quality is now being examined in various parts of the US.

The use of DPS in preference to extractable P concentrations, such as Mehlich 1-extractable P for identifying soils vulnerable to P loss can be best illustrated by the use of an example. If two soils have the same Mehlich 1-P, say 50 mg P $kg^{-1}$, but different adsorption capacities, say 200 mg P $kg^{-1}$ and 500 mg P $kg^{-1}$, then the DPS for the first soil will be 25% while that for the second soil will be 10%. It is obvious that the first soil is more likely to release P than the second one, though they both have the same Mehlich 1-P concentration. Also, the second soil will have greater capacity to receive additional P compared to the first soil.

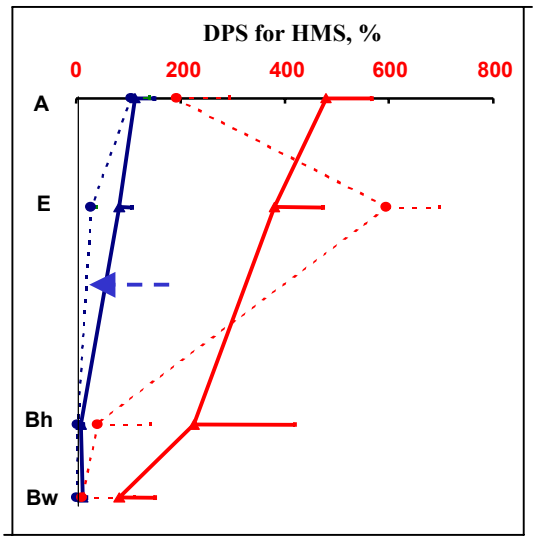
Manure loadings in the Florida Spodosols range from very high total P (TP) concentrations in the A horizon: from 2300 mg P $kg^{-1}$ from areas near the barn (intensive and holding areas or high manure-impacted soils, HMS) to about 25 mg P $kg^{-1}$ in the low manure-impacted pasture, forage, and unimpacted or native area soils (LMS).




For DPS evaluation, soil profiles were selected from three active and three abandoned dairies in the Okeechobee Basin. All four dairy components were selected from the active dairies, and only the intensive and holding components from the abandoned dairies. Native areas were also sampled to obtain background conditions. DPS was calculated as the percentage of Mehlich 1–extractable P to the P sorbing

capacity of the soil, expressed as the sum of oxalate-extractable Fe and Al.

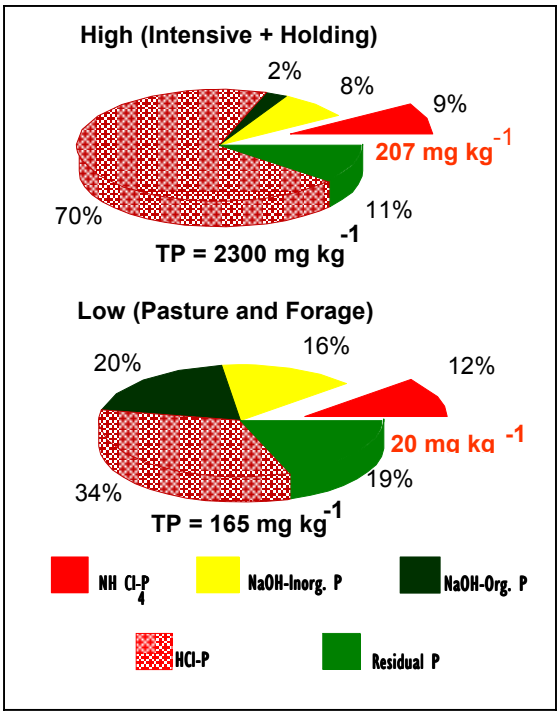
The HMS for both active and abandoned dairies generally had higher DPS values compared to LMS. The HMS had surface DPS ranging from 100% to 600% indicating that the P sorption capacity of the horizon had exceeded its maximum potential. The LMS had DPS values ranging from 20% in a beef pasture to 1% in a native area. Abandoned dairies generally had higher DPS values than active dairies throughout the soil profile, suggesting P movement through the soil profile with time.




The use of any parameter for assessing the potential for off-site movement of P should logically be related to some form of available P, usually determined by traditional soil test procedures. Previous research on Lake Okeechobee Basin soils had shown that the available P fraction depended on the total P concentration. Hence, we examined the relation between DPS and water-soluble P, the most readily available P form.

The HMS had exceeded their P sorption capacity and these soils certainly will contribute to off-site P movement. DPS calculations for LMS on Florida Spodosols (all horizons) gave a highly significant relationship with water soluble P (WSP).
WSP = 0.3430 + 0.0.0728 [DPS]

$R^2 = 0.3336$, n = 194, $P < 0.0001$




A method of DPS determination that is simple and yet applicable **to all Florida soils** including those sandy soils of the lower coastal plain of the U.S. is needed. The possibilities of developing a suitable DPS method is currently being explored with the aid of a FDEP grant (PIs: D.A. Graetz and V.D. Nair), and the possibility of introduction of the DPS factor in the Florida P-Index matrix is being explored with the aid of a recent USDA-IFAFS grant (PIs: W.G. Harris and V.D. Nair).

By the end of these studies, we hope to establish a threshold soil P level (establish a critical DPS value) and define critical sources within watersheds to protect water quality by reducing surface and *subsurface* runoff of P inputs to surface waters.

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