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INTRODUCING THE PHOSPHORUS RELEASE RISK FACTOR IN THE FLORIDA P-INDEX

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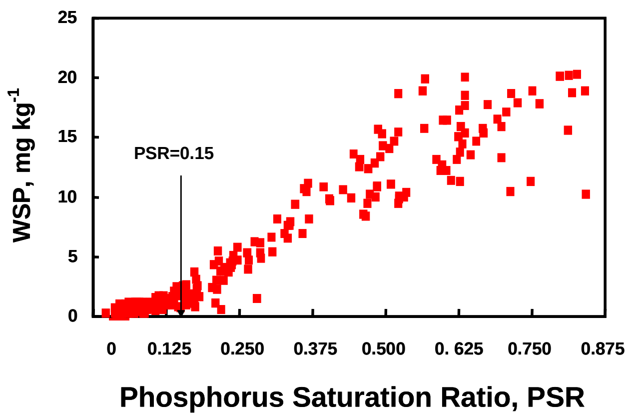
The use of a soil test P (STP) value such as Mehlich 1-P, as an environmental indicator of potential P loss from a farm, has the shortcoming of failing to indicate the capacity of a soil to retain added P. Thus soils with low STP values may nevertheless fail to retain added P, and soils with high STP values may have remaining capacity to retain P. The Florida P-Index, a tool to guide management decisions affecting P-related environmental risks, defines the Fertility Index as Mehlich 1-extractable P of a 0-15 cm (0- 6 inches) depth soil sample in ppm (parts per million) multiplied by 2 to convert to pounds per acre. In addition, a 0.025 multiplication factor is used to provide a value range similar to those for other parameters in the P-Index.

The P-Index is in a continuing calibration stage and one of the factors that may need additional evaluation is the "Fertility Index Value." A concept taking into account the P retention capacity of a soil would provide a more valid risk assessment. This can be achieved by using the phosphorus saturation ratio (PSR). The PSR can be calculated using the same STP data plus measuring iron (Fe) and aluminum (Al) in the same extract. Research has shown that above a PSR threshold of 0.15 (Nair et al., 2004), P concentrations in the soil solution abruptly increase. Since P concentrations in the soil solution are related to P losses from a field via surface and subsurface flow, the PSR can be used to determine when P release from a soil reaches the point of environmental concern.



Example of PSR calculations: Consider two soils with STP (Mehlich 1-P) of 1.5 mmoles kg^{-1} (approximately 46 mg kg^{-1}). Soil 1 has a Mehlich (Fe + Al) of 7.5 mmoles and Soil 2 has (Fe + Al) of 15 mmoles. The PSR of Soil 1 would be (1.5/7.5) = 0.20 and the PSR of Soil 2 would be 1.5/15 = 0.10. Therefore Soil 1 would be a greater environmental risk than Soil 2 though both soils have the same Mehlich 1-P concentration.

Note: the threshold PSR is 0.15, and therefore Soil 1 is a P source, whereas Soil 2 is a P sink.

This concept can be carried further, without obtaining additional data, by calculating a parameter related to the capacity of a soil to hold additional P (Nair and Harris, 2004). This Capacity Factor can be calculated as follows:

Capacity Factor *= (0.15 –* ***Soil PSR****) **

$$\left[\frac{Soil\,Test\,Fe}{56}+\frac{Soil\,Test\,Al}{27}\right]*31$$

where:

$$\textbf{Soil PSR} = \frac{\dfrac{Soil\,Test\,P}{31}}{\left[\dfrac{Soil\,Test\,Fe}{56}+\dfrac{Soil\,Test\,Al}{27}\right]}$$

A multiplication by 31 is necessary to convert Capacity Factor, in mmoles, to mg P kg^{-1}.

Using this protocol, we introduce the **P Release Risk Factor (PRRF)** to replace the Fertility Index value in the Florida P-Index.

The protocol for PSR and **PRRF** determinations is given below:

- The sampling scheme normally used for soil testing purposes should be used.
- Extract the soil with Mehlich 1-P (soil test P in Florida), and analyze for P, Fe and Al. Calculate the PSR of the soil using the above equation
- P Release Risk Factor = 5 – (0.1* Capacity Factor).

A high **PRRF** means that the soil has a high potential to release P due to previous loading or to minimal inherent P retention capacity. Note: A **PRRF** calculated with a capacity factor above 50 for sandy material would have a rating of "0". Negative ratings arising from higher capacity would be considered "zero". Neither STP nor PSR alone provides this means of assessing a relative magnitude of potential P retention or release. The calibration was based on data for Mehlich 1-P, Fe and Al from numerous Florida surface soils from recently completed projects supported by the Florida Department of Environmental Protection and the USDA-Initiative for Future Agriculture and Food Systems.

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