Soil P tests

In Australia, several soil extractions are used to determine available soil phosphorus. The Colwell test is recommended for soil water extract pH < 7.4 and the Olsen-P test is recommended when the soil pH in water is > 7.4. These are the standard tests in most laboratories. The Mehlich 3 P, Bray P, Resin P and especially water extractions can be used over a wide pH range.

It is important to note that interpretations for crop phosphorus requirements will differ, depending on which test is used. The amount of extracted phosphorus using one test does not always correlate to the amount of phosphorus extracted by another test method. One reason is that the different tests most likely extract different proportions of the soil P reserve. Variations also occur due to soil type, organic matter content, P application history and pH.

Soil test P levels should correlate to crop P uptake levels, if the test is relevant for the situation; unless the system is oversupplied with plant available P.

The Olsen test interpretation does not discriminate between soil texture (at the moment). However, the amount of P recommended to, for example, maintain the soil nutrient status in a dairy system at an optimum Olsen P level would be: 10kg/ha for sand, 20kg/ha for sandy loam, 25kg/ha for clay loam and 30kg for clay/red soil.

Soil tests P availability ranges

Soil test type	Soil test ranges				
	Very low	Low	Marginal	Optimal	High
Colwell P (mg/kg) sand-sandy loam	<10	10-30	30-50	50-100	>100
Colwell P (mg/kg) clay-clay loam	<10	10-30	30-70	71-120	>120
Colwell P (mg/kg) perennial crops					
Olsen P (mg/kg)	<5	5-10	10-17	17-25	>25
Mehlich 3 P (mg/kg)	<10	10-20	20-40	40-70	>70
Water P (mg/kg)	<5	5-10	10-17	17-25	>25
Bray 1 P (mg/kg)		<20	20-35	>35	
Resin test	<10	10-20	20-40	40-60	>60

In the Netherlands and Germany, a water extraction is used to estimate plant available P in the soil solution. It has been found to have the best correlation to plant P and is not influenced by pH or texture. In the USA, a Bray extraction is used in some states. It is said to produce results similar to the Mehlich 3 extraction, which is the analysis of choice in other US states and South American countries. The Mehlich 3 and Resin test have shown a good correlation with each other and to crop uptake.

(Extract from: "What you always wanted to know about phosphorus" by Doris Blaesing, Serve-Ag Pty Ltd, for RMCG Pty Ltd, August 2006)

Colwell P has been developed for acid soils and involves a 16hr extraction. The test is not considered the best for neutral to alkaline soils as it may overstate the amount of P available to plants in these soils. Hence we may find acceptable Colwell P levels in red soils and still find low NU-test® (plant sap) P. expressSoil™ uses the Mehlich extraction method to avoid the problems associated with soil pH. It is directly comparable with the Olsen method, and a comparison with Colwell P is above.

The Mehlich Phosphorus Saturation Ratio (M3-PSR)

The Mehlich-3 Phosphorus saturation ratio (M3-PSR) is a combination of the agronomic Mehlich-3 P soil test and the environmental aspects of a soil P saturation test (Khiari et al., 2000; Sims et al., 2002; Maguire and Sims, 2002).

The M3-PSR has initially been developed as an environmental management tool and is reportedly better at identifying soils susceptible to soluble P losses by leaching than Mehlich-3 P alone. As a gauge for P solubility, it has great value as an agronomic indictor of potential P availability to plant roots.

In general, a PSR <0.062 is considered to be below the agronomic optimum. At a PSR >0.23, P losses through leaching will most likely occur. Depending on site conditions i.e. the likelihood of surface run-off, rapid drainage (e.g. lack of plant cover) and vicinity to waterways, a range of 0.10 to 0.15 M3-PSR may already indicate a risk of P losses. Considering this, it is important to integrate any form of soil P testing with other site risk assessments to avoid P effects on water quality. This is especially important for water re-use schemes effluent and manure use.

While environmental soil limits are useful in identifying potential problems, a more comprehensive approach, e.g. using a phosphorus site index, will be more accurate at identifying the relative risk of P losses than soil P testing, including M3-PSR and other P buffer capacity indicators, alone.

References

Fortin. 2000. An agri-environmental phosphorus saturation index for acid coarse-textured soils. J. Environ. Qual. 29:1561–1567.

Maguire, R.O., and J.T. Sims. 2002. Measuring agronomic and environmental soil phosphorus saturation and predicting phosphorus leaching with Mehlich 3. Soil. Sci. Soc. Am. J. 66(6) (in press).

Sims, J.T., R.O. Maguire, A.B. Leytem, K.L. Gartley, and M.C. Pautler. 2002. Evaluation of Mehlich 3 as an agrienvironmental soil phosphorus test for the mid-Atlantic United States. Soil. Sci. Soc. Am. J. 66(6).