

# Influence of Recent Acidification on Available Phosphorus Indices and Sorption in Washington State Soils



Kyle E. Bair<sup>1</sup> and Joan R. Davenport<sup>2</sup>

<sup>1</sup> Soiltest Farm Consultants, Inc., Moses Lake, WA

<sup>2</sup> Washington State University, IAREC, Prosser, WA

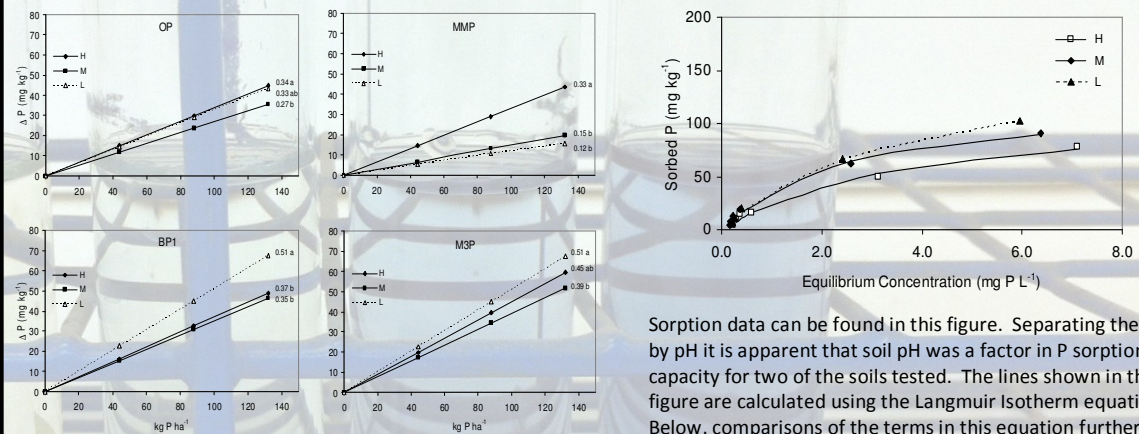
## Introduction

The Columbia Basin of Washington State has seen gradual soil acidification from continual ammoniacal nitrogen application. The Olsen (OP) method is established as the method of choice for available phosphorus (P) measure in the region.<sup>1</sup> Because the chemistry of this method assumes a dominant calcium (Ca)—P chemistry the validity and interpretation of the method comes into question. Alternative extraction methods include: Bray P1 (BP1), Morgan (MMP), and Mehlich III (M3P). The objectives of this research are to 1) to determine how soil pH influences the results of the soil P extraction after fertilization for soils with similar levels of plant available P and 2) to evaluate the P sorption capacity of soils with similar levels of available P at varying soil pH levels.

## Materials & Methods

For this evaluation, 10 soil samples from the Columbia Basin were collected in bulk from 0-12" representing three soil pH ranges (<6.0, 6.2-6.8, >7.0) and three OP levels (<10, 15-25, >30 mg P kg<sup>-1</sup>) within each pH range. Soil samples were moistened and fertilized with 0, 44, 88, and 132 kg P<sub>2</sub>O<sub>5</sub> ha<sup>-1</sup> (as MAP, 11-52-0). Following a 6-week incubation the samples were extracted with OP, BP1, MMP, and M3P.<sup>2</sup> Additionally, the untreated samples were analyzed for P sorption.<sup>3</sup> Briefly, the soil samples were added to solutions of known P concentration and shaken for 24 hours and then the solution is measured for P. The difference between what is analyzed following shaking and the initial known P concentration is the P sorbed.

## Results



This figure shows the change in tested P for each extraction method vs. the P fertilizer application. In practical terms the slope of this line is the expected change in tested P (mg kg<sup>-1</sup>) for each kg of P<sub>2</sub>O<sub>5</sub> applied per acre. For each extraction method the line slope is given for soils grouped as low (L), medium (M) or high (H) pH. Of the four extraction methods tests, OP shows the least amount of slope variability (0.14—0.17) across soil pH while MMP (0.06—0.16) exhibited the greatest differences.

Sorption data can be found in this figure. Separating the data by pH it is apparent that soil pH was a factor in P sorption capacity for two of the soils tested. The lines shown in the figure are calculated using the Langmuir Isotherm equation. Below, comparisons of the terms in this equation further show that sorption maxima across soil pH levels are comparable.

pH	Langmuir Constants		R <sup>2</sup>	P-value
	k mg P L <sup>-1</sup>	b mg P kg <sup>-1</sup>		
H	0.16 b	176 a	0.97	< 0.001
M	0.51 a	131 a	0.95	< 0.001
L	0.27 ab	175 a	0.98	< 0.001
LSD <sub>0.05</sub>	0.25	61.5		

## Conclusions

The results from this study showed that in the context of extraction consistency, the OP extraction proved the most reliable method across the soil pH range tested while MMP was the least reliable. Phosphorus sorption maximum was very similar for the range of pH tested. This is likely a result of the P chemistry existing as predominantly Ca-P form even when the soil pH low or if Fe/Al-P complexes exist, the amount of P extracted is similar to the assumed Ca-P state. The OP method appears to be a viable test for soils that have become acidified over time that are traditionally thought of as calcareous.



<sup>1</sup> R. Miller, Personal Communication, 2011.

<sup>2</sup> Gavlak, R.G., D.A. Horneck, and R.O. Miller. 2003. Soil, plant and water reference methods for the western region. 2nd ed. WREP 125.

<sup>3</sup> Nair, P.S., T.J. Logan, A.N. Sharpley, L.E. Sommers, M.A. Tabatabai, and T.L. Yuan. 1984. Interlaboratory comparison of a standardized phosphorus adsorption procedure. J. Environ. Qual. 13:591-595.