SOIL TEST PHOSPHORUS TRENDS IN OHIO

Melissa C. Herman, Robert W. Mullen, and Elizabeth Dayton
School of Environment and Natural Resources, Ohio State University,
Ohio Agricultural Research and Development Center, Wooster, OH 44691

Abstract

Agriculture is often sited as the primary factor for high P loads polluting Lake Erie and Ohio's watersheds, but its exact contribution is actually unknown. This project evaluated historical soil phosphorus (P) trends in the state of Ohio by collecting historical soil data from the three largest commercial laboratories servicing Ohio to determine if P levels at a county resolution are changing over time. This helps address to what extent widespread over-applications of P (either commercial or organic) are contributing to the high P loads. Of the 50 counties evaluated, trends did not show any county to have an increasing average P level, and 11 counties showed decreasing trends. Data was also evaluated for percentage of samples showing a P level above 60 ppm; only four counties in Ohio had soil test levels >60 ppm occurring greater than 40% of the time.

Introduction

In recent years, there has been growing concern surrounding dissolved reactive phosphorus (DRP) levels in Lake Erie and Ohio's waterways, as elevated phosphorus (P) levels in freshwater systems can cause algal blooms (Baker, 2008). Agricultural systems are often pointed to as the primary source of these increased P loads in Ohio's waterways (Baker, 2008), but our understanding of just how much of the total P load could be attributed to agriculture and what is driving it (over-application, poor application methodologies, etc.) is not entirely clear. Bruulsema et. al (201x) conducted a P balance study for Ontario, Michigan, and Ohio and found that, prior to 1990, there was a net P surplus. In more recent decades, P applications (both commercial and organic sources) roughly equaled the amount of P leaving the field every year in harvest grain and biomass. This "balance" can be attributed to increased yields over the past few decades, decreases in P applications, and lower animal numbers (Bast et. al, 2009; Fig. 1). For this project, soil test P data was collected from the three largest analytical laboratories servicing Ohio for the years 1995 through 2008 to determine if soil test P levels, evaluated at a county resolution, were generally following bulk calculations of an Ohio P balance.

Methods

Soil test information was collected from the digital databases of the three largest soil testing labs that service Ohio producers: A&L Laboratories, Brookside Laboratories, and Spectrum Analytic. In total, there were just over 1,000,000 data points collected going back to 1992, provided at a county level resolution. The information was delineated into years by county. Although soil test information was available for every county in Ohio, the only counties evaluated were the 50 that had significant sample numbers (>100) since 1995. The data was not coming from a true randomized sampling; however, it was conclude that the data was still a fair representation of

Ohio's soils at a county resolution because there were often over 1,000 samples for any given county per year. A greater variation in the data was observed when sample numbers were low, especially less than 500. For such situations, outlier points were discounted when determining trends in soil P levels over time.

All soil test P information was reported as Mehlich III extractable P in mg kg^{-1}. Only lab data from agronomic fields was reported. Thus, garden and turf soil analytical information was not provided for evaluation of soil test trends. A county was considered to be experiencing either an increase or decrease in soil test P levels if a change in P was greater than 10 ppm when examining the P levels over time.

Results and Discussion

Across the entire state of Ohio, mean and median soil test P levels did not increase from the period of 1995 through 2008 (Fig. 2). In fact, many counties have begun to show gradual declines in mean and median soil test P levels during this time period. Out of the 50 counties evaluated, 11 showed evidence of declining soil test P levels: Columbiana, Crawford, Darke, Defiance, Fulton, Henry, Medina, Miami, Paulding, Ross, and Van Wert. The remainder of counties revealed unchanging soil test P levels. There were no counties that showed an increasing soil test P trend.

Soil test P levels were also delineated into five ranges: <15, 15-30, 30-45, 45-60, and >60 ppm. Sixty ppm was used as the upper bound because there is no agronomic benefit to applying fertilizer when soil test P reaches this level. Of the fifty counties evaluated, nineteen had soil test levels >60 ppm occurring less than 20% of the time, 28 had soil test levels >60 ppm occurring between 20 and 40% of the time, and only 4 had soil test levels >60 ppm occurring greater than 40% of the time. These four counties were Columbiana, Mercer, Muskingum, and Wayne County, which are among the top six in the state in cattle numbers. Across the state as a whole, soil test phosphorus levels that are >60 ppm occur only 30% of the time (Fig.3).

Conclusion

The historical data provided by the analytical laboratories for this study shows that soil test P concentrations have not increased at the large, countywide scale. For some counties in Ohio, soil test P levels are actually declining. Trends of decreasing soil P levels can be expected in correlation with the decreasing trend of P sales and animal numbers. Because P shows high fixation within the soil, soil P levels would not be expected to drop in conjunction with decreases in P sales, but soil P levels can be expected to decline over time if P sales continue to stay low. This study is not able to evaluate the possibility of poor nutrient management practices that might lead to excessive P loading into waterways, but it does show that at the county level, P is not being over applied. Small scale, isolated areas of high soil test P and loss of recent fertilizer applications cannot be discounted as significant contributors to increased DRP in Ohio watersheds, but it does not appear that it is the result of gross over-application on a widespread basis.

Acknowledgements

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Figure 1. Calculated P balance per acre for the state of Ohio from 1975 to 2007.

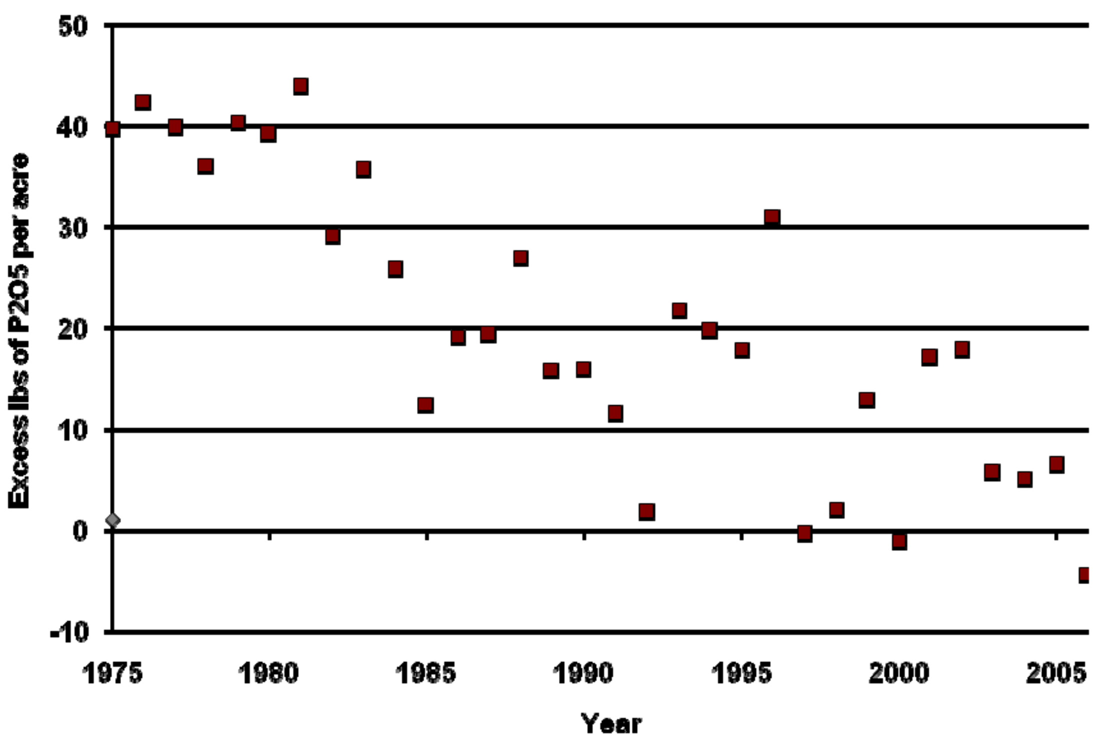


Figure 2. Soil test average and median P levels and number of soil samples (n) across the entire state of Ohio, 1995-2008.

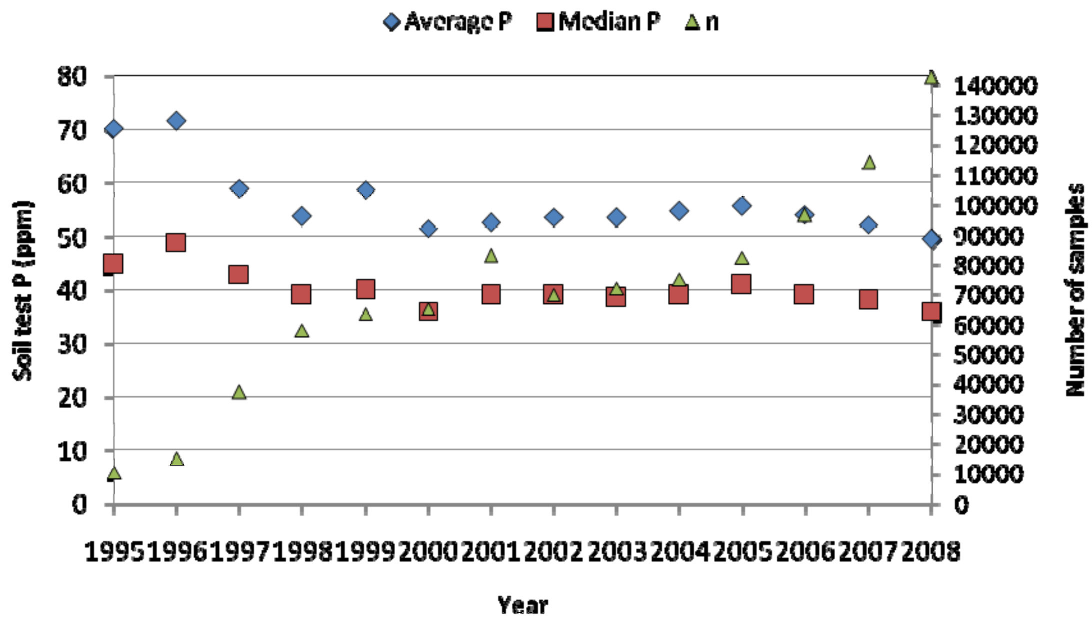
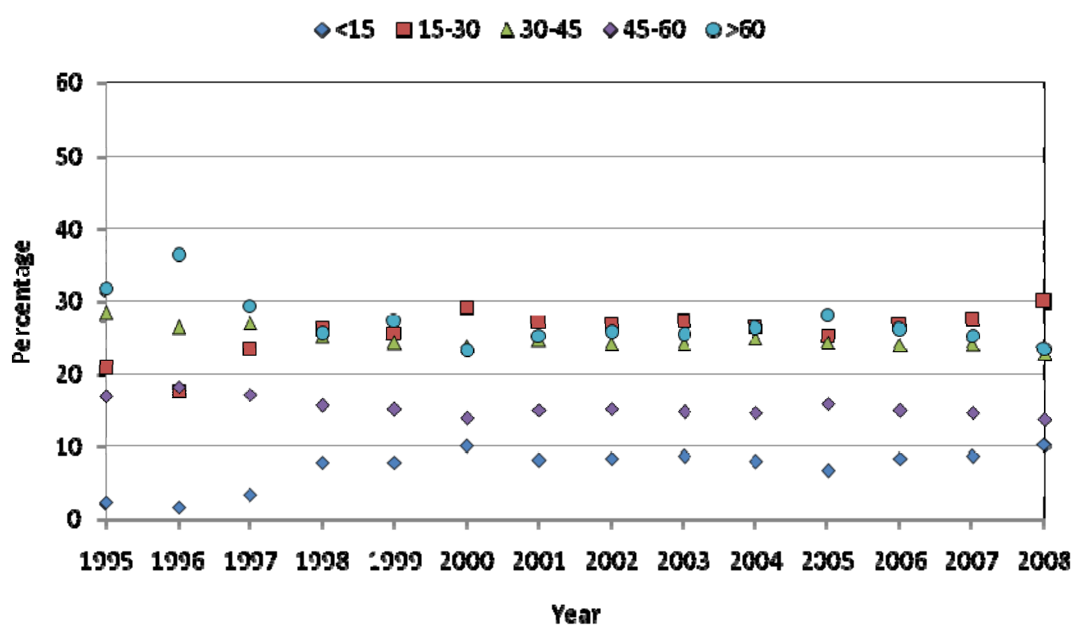


Figure 3.Percentage of soils testing within specified ranges soil test P levels (<15, 15-30, 30-45, 45-60, and > 60 ppm) across the state of Ohio, 1995-2008.



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Program Chair:

Richard Ferguson
University of Nebraska - Lincoln
Lincoln, NE 68583
(402) 472-1144
rferguson@unl.edu

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2301 Research Park Way, Suite 126
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