Reducing Labile Phosphorus in Agricultural Canal Sediment by Controlling Floating Aquatic Vegetation

Anne E. Sexton, Jehangir H. Bhadha, Timothy A. Lang, and Samira H. Daroub
Everglades Research and Education Center, Belle Glade, FL and Soil and Water Science Department, Gainesville, FL

Introduction

We hypothesize that floating aquatic vegetation (FAV) has a significant impact on the ability of agricultural canal sediment to retain and release phosphorus (P) in the Everglades Agricultural Area (EAA).

Expectations of FAV removal:

- Increased light penetration into the water column, possibly allowing for the co-precipitation of P with calcium and magnesium (Ca-Mg) into less labile minerals
- Increased dissolved oxygen increases redox potential and P sorption with iron and aluminum (Fe-Al) minerals
- Change in mineral composition of canal sediments from organic to inorganic
- Increase in recalcitrant Ca-Mg and Fe-Al bound P
- Decrease in labile P discharged from farm canals

Clean Canals

Filamentous Algae

Water Lettuce

Duckweed

Methods

Research is being conducted on eight farms in the EAA, with four treatment-control pairs. Treatment farms use spot-spraying of herbicide to prevent infestation of FAV, while control farms practice under normal canal management. Normal management can include reducing spray events to lower costs but allowing infestation.

Two measurement methods:

- Sequential P-Fractionation
- X-ray Diffraction Analysis

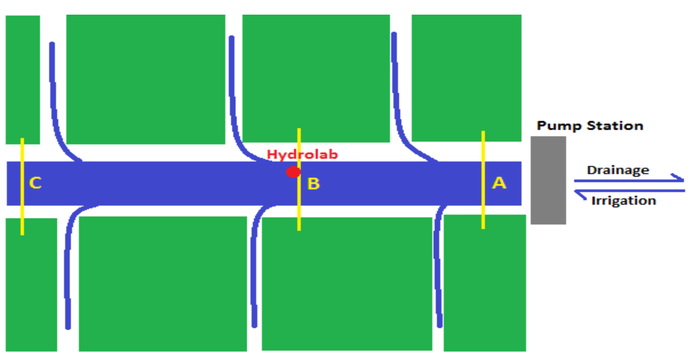


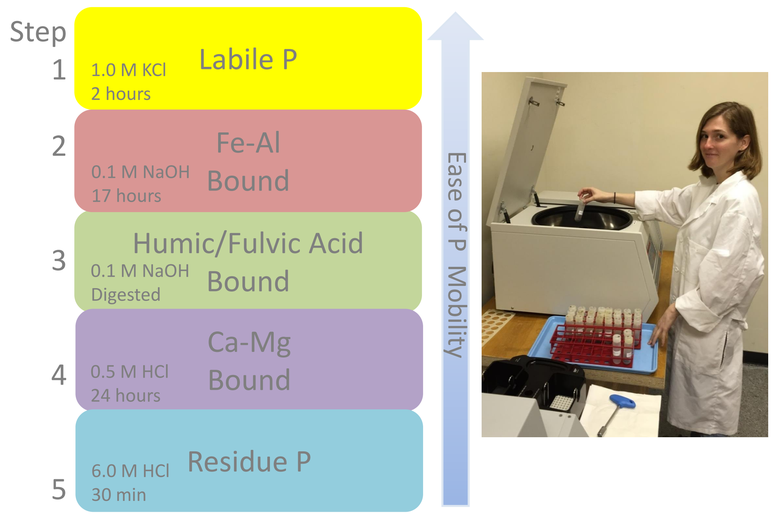
Figure showing schematic of farm canal sampling transects A, B, and C.

Sequential P-Fractionation

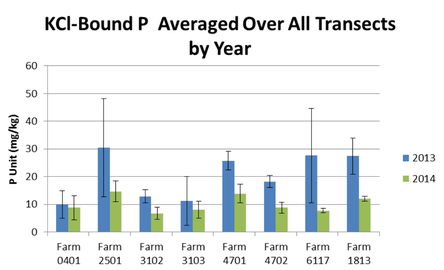
There are different pools of P in the sediment with varying rates of availability to microbial and plant communities (Reddy et al. 1998). P-fractionation measures the concentration of labile and recalcitrant P forms in sediment. Data from farms chemically treated FAV are expected to show differing P fractions from control farms over time. Results expected to show:

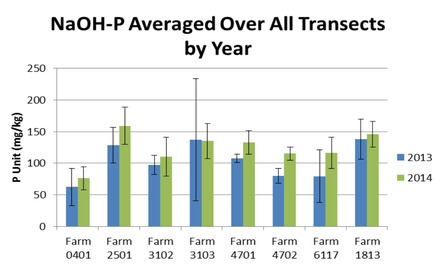
- Increase in recalcitrant P
- Decrease in labile P

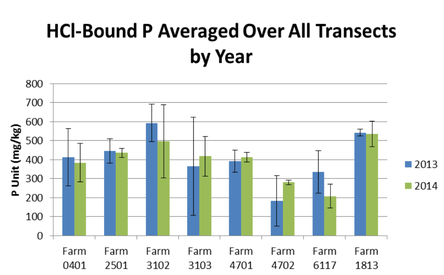
P-Fractionation Steps

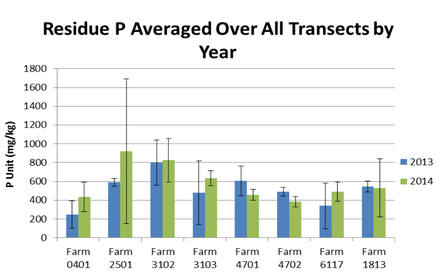


Preliminary Results









Figures are separated by type of bound P averaged over all transects of each farm for 2013 and 2014. KCl is the most labile form of P while residue P is the most recalcitrant. Note the difference in P-unit scale for each type of bound P between the different graphs.

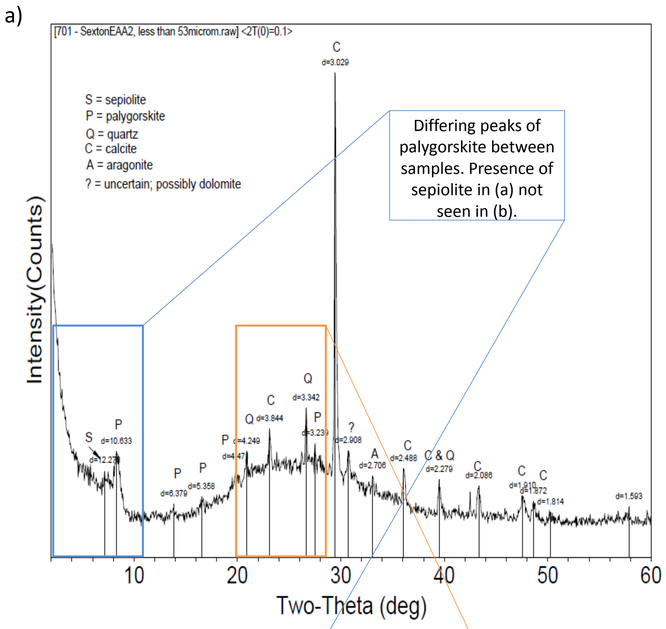
Key Terms

- Labile P: not strongly adsorbed to soil particles; enters soluble phase readily; extracted using KCl
- Humic/Fulvic Acid: fractions of organic matter that are resistant to further decomposition; extracted using NaOH
- Recalcitrant P: strongly adsorbed to soil particles or minerals; extracted using strong acids and bases
- Redox potential: reduction-oxidation potential of the system facilitating changes in P sorption capacity

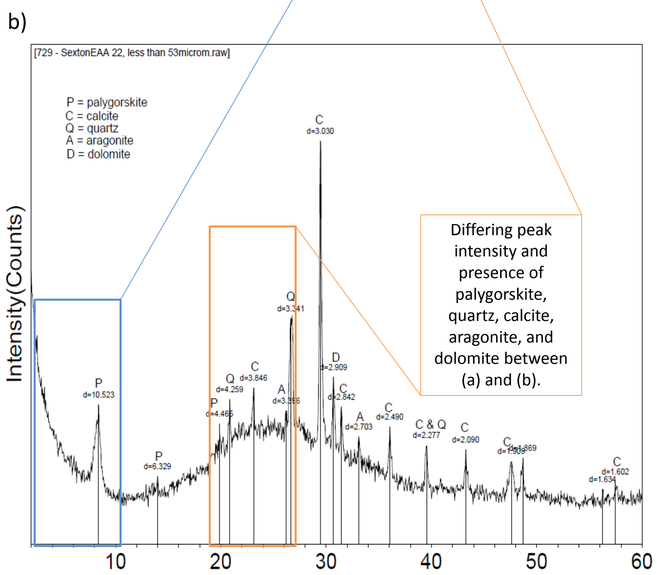
X-Ray Diffraction Analysis

We hypothesize that changing mineralization of P will be reflected by a change in the canal sediment mineral composition. Through x-ray diffraction (XRD) analysis, spatial and temporal changes in the presence of inorganic P of canal sediment will be evaluated.

a)



b)



Figures (a) and (b) show the results of XRD from two different sampling location. XRD results show the intensity (or counts) of diffraction angles of individual minerals and generates a peaked graph identifying prominent minerals. The blue and orange boxes highlight varying peaks and presence of dominant minerals.

First year XRD results are being analyzed to generate baseline mineralogy of both control and treatment sites.

Discussion

FAV removal is expected to produce denser, more recalcitrant inorganic P species that will reduce P transport out of farm canals. Suppression of FAV can potentially serve as an additional management practice in reducing P loads.

Future Work

In the future, untested methods utilizing submerged aquatic vegetation in tandem with Ca-saturated canal waters will be assessed for ability to remove dissolved P through plant uptake and co-precipitation with CaCO3.

References
Reddy, K. R., Wang, Y., DeBusk, W. F., Fisher, M. M., & Newman, S. (1998). Forms of Soil Phosphorus in Selected Hydrologic Units of the Florida Everglades. *Soil Science Society of America Journal, 62*, 1134-1147.