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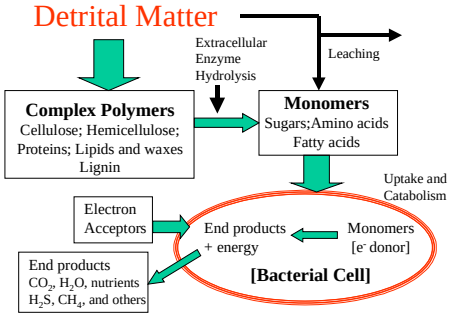
Soil and Water Science
Research Brief

University of Florida — Institute of Food and Agricultural Sciences

PHOSPHORUS LOADING EFFECTS ON EXTRACELLULAR ENZYME ACTIVITY IN EVERGLADES WETLAND SOILS

A. L. Wright and K. R. Reddy

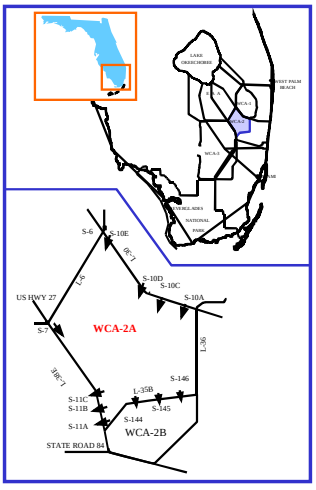
Wetland soils support a large diversity of microbial communities that play important roles in the decomposition of organic matter, nutrient cycling, and abating the toxic levels of contaminants. A majority of organic matter in wetlands is composed of high molecular weight, polymeric compounds, of which only a small portion is readily available to microbial communities. Complex structural compounds must be first hydrolyzed through the activity of extracellular enzymes into low molecular weight compounds. These low molecular weight compounds can be directly transferred to cells, oxidized, and used as an energy source.



Microbiological properties, including enzyme activities, can be potentially useful as indicators of soil and water quality. Many of these enzymes are affected by nutrient loading, as bioavailable nutrients can potentially decrease their activity. Thus, measurement of extracellular enzyme activities may be useful for predicting the impacts of P loading since they are important to organic matter degradation, nutrient regeneration, and various elemental cycles.

The objectives of the study were to determine; (1) the influence of P loading to a wetland on activities of various extracellular enzymes in detritus and soil, (2) the relationship between extracellular enzyme activities and selected microbial and soil physico-chemical parameters; and (3) to determine if these enzyme activities are useful as sensitive indicators of P impacts.

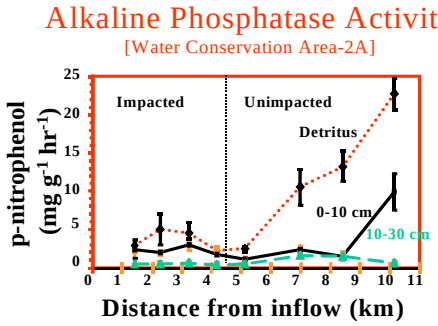
We measured the activity of various extracellular enzymes in detritus and soil samples collected along a soil phosphorus (P) enrichment gradient located in Water Conservation Area 2A (WCA-2A) of the Florida Everglades. The extracellular enzymes assayed were alkaline phosphatase (APA) (phosphorus cycle) , arylsulfatase (sulfur cycle), β-d-glucosidase, and phenol oxidase (carbon cycle), and protease (nitrogen cycle).



The study site is WCA-2A of the Florida Everglades. This 447 km^2 impounded wetland has received nutrient-laden drainage waters for the past several decades from the adjacent Everglades Agricultural Area (EAA). Inflow of these waters has been

implicated in contributing to increased P concentrations in the soil and water column. Historically, this system was P limited and contained a mixture of sawgrass (*Cladium* sp.) and slough communities. The addition of P laden waters and altered hydrology have been implicated as key factors in a vegetation shift from the indigenous sawgrass/slough communities to cattail (*Typha* sp.) dominated areas, resulting in increased peat accumulation and additional soil and water alterations . Soils near the inflow have the highest P concentrations, and P concentrations decrease with increasing distance from the inflow. Corresponding to changes in soil P concentrations, a gradient in vegetative type exists as well. Cattail is the dominant vegetative type in areas impacted by P, while sawgrass is prominent in unimpacted areas.

Alkaline phosphatase activity (APA) was the only enzyme affected by P loading and



was negatively related to soil P concentrations and microbial biomass C and P. Arylsulfatase, β-d-glucosidase, protease, and phenol oxidase were not affected by P loading and were not related to measured soil C, N, S, and P physical and chemical parameters. All enzyme activities were highest in the surface detritus layer and decreased with soil depth.

Phosphorus loading to an oligotrophic, P limited wetland had a significant influence on APA in detritus and soil but not on other measured extracellular enzyme activities. Extracellular enzyme activity markedly decreased with depth in the soil profile, and detritus was most responsive to changes in P concentrations. The APA appeared to be regulated by specific soil and microbial P parameters in detritus and the upper soil depths. However, relationships between soil and microbial physico-chemical properties and other measured extracellular enzyme activities seldom produced significant relationships. Alkaline phosphatase activity appears to be suitable for use as an indicator of wetland eutrophication.

Full text of this paper can be found at:
A. L. Wright and K.R. Reddy. 2001. Influence of phosphorus loading on extracellular enzyme activity in Everglades wetland soils. Soil Science Society of America Journal (in press).

AUTHORS

A. L. Wright
Soil and Water Science Dept.,
P. O. Box 110510, University of Florida,
Gainesville, FL 32611
Alwr@gnv.ifas.ufl.edu

K.R. Reddy,
Soil and Water Science Dept.,
P. O. Box 110510, University of Florida
Gainesville, FL 32611 krr@ufl.edu

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