Phosphorus Pool Dynamics in Riparian Vegetation

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Agricultural Riparian Zones

Riparian Zones are well implemented Best Management Practices for controlling Phosphorus (P) loading into waterways. These passive measures are far easier to implement in agricultural areas than more heavily engineered practices.

There is the potential for these areas to become sources of P to the waterway over time, as opposed to sinks as designed. This is most pronounced in areas with cold climates, and so we aim to answer these questions:

- Are these wetlands accumulating P from runoff?
- Where is the P held? Plants or Soils?
- Does frost cause plants and soils to release P?
- Do riparian zones loaded with P pose increased risks for leaching?
- What interactions between released P in soils and vegetation exist?

Objectives

By understanding the biogeochemical link between **soils** and **vegetation** in riparian areas, we can better understand the processes responsible for P losses. Better riparian management practices can then be implemented and investigated which benefit farmers and the environment.

Study Site & Methods

Site Characteristics

- Located in Southern Ontario
- Vegetated swale constructed to filter runoff water from concrete bunker silo
- Design allows separation of distinct soil P saturation zones

A: Zone A, upper swale, right at bunker silo effluent entry point.
B: Zone A, upper swale

1. Sample Collection
Surface soil (5cm)
Vegetation cuttings
From 3 soil zones:

- High P
- Medium P
- Low P

2. Freeze Treatment
Three freeze treatment temps for 5 days
Shake @ 250 RPM with deionized water and filtered

Filtering of WEP samples

3. Water Extractable Phosphorus (WEP)
Analyzed for available phosphorus released from freezing/ water extraction

Results & Discussion

Does P released from Vegetation get adsorbed by soils?

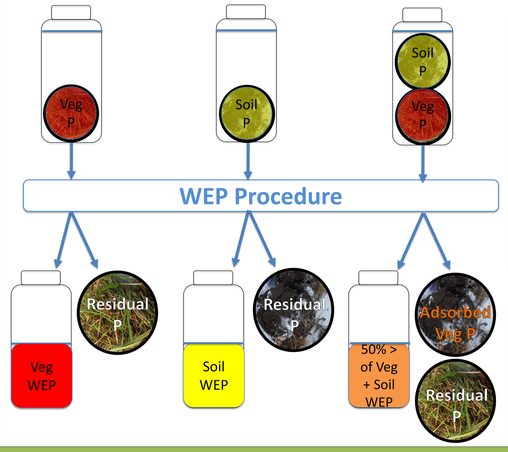
Samples of **vegetation** and **soil** treated together were investigated for **WEP** release.

Mix Sample

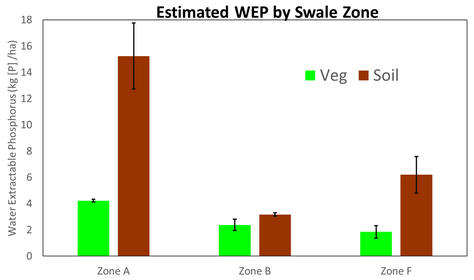
Based on **veg** and **soil** weights, the **mix** samples had decreased **WEP** concentrations of:

Zone A → 52% +/- 6%
Zone B → 81% +/- 18%
Zone C → 61% +/- 7%

This indicates that some **WEP** released by **vegetation** was taken up by **soils**



Water Extractable Phosphorus in a Vegetated Swale



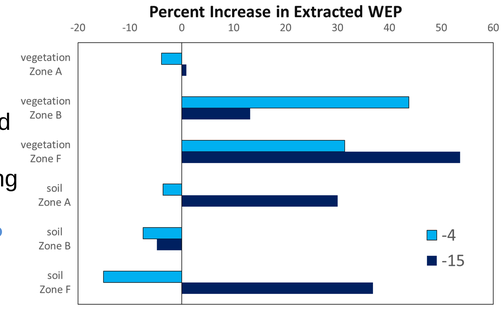
Soil bulk density assumed to be 0.3 g/cm³ for A and 1.05 g/cm³ for B and F (based on previous data). WEP put in terms of kg [P] / ha , to account for the actual pools present.

Dramatic initial adsorption of P from runoff by **soil**

Vegetation is concentrated but holds less P overall

Frost Effects on P

In most sites and sample types, increased freezing conditions increased **WEP**



Sample temperatures (in °C) were held at +5 (control), -4, and -15 for 5 days.

Vegetated Swale Site and Sampling Zones

Storm events create runoff that collects excessive amounts of nutrients from the impermeable bunker silo, which collects and flow into the vegetated swale. Highlighted is the designed flowpath and sampling locations A, B, and F.

Conclusions

1. Areas subjected to high nutrient flows, such as effluent from a bunker silo, have dramatically increased soil P pools by area, and increased vegetation P pools
2. Severe frost can release more soil and vegetation bound P but effects high P vegetation to a lesser extent
3. Riparian soils can adsorb the majority of released vegetation P, but this ability is reduced in P saturated soils

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