Proposal: Assessing soil phosphorus status over time and under different land uses

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Introduction

- The most important function of P in plants is the storage and transfer of energy, and cell division (Norfleet, 1998).
- The concentration of soluble phosphate in the soil solution is very low, and phosphorus is relatively immobile in the soil.
- Because nearly all soil P is unavailable for immediate use by soil microbes and plant roots, relationships between labile and recalcitrant P are an important topic for study (Chang and Jackson 1957).
- Climate and geological history are important factors affecting soil P availability within critical zones (Wang et al. 2001).
- Land use and soil management practices influence soil P through processes such as erosion, oxidation, mineralization, and leaching (Fig. 1) (Liu et al., 2010).

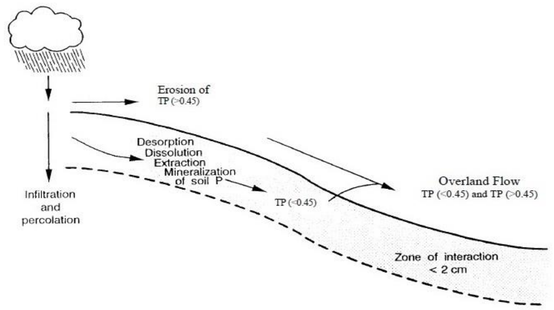

Fig 1. Mechanism and forms of P transported in overland flow (Daniel, 1994)

Objective

- The long-term goal is to understand the evolution of soil P across critical zones both through the profile and over the landscape.
- In the Calhoun CZO there is also a specific interest in historic land use on soil P.
- The following specific objectives will be implemented in CCZO:
  - ❑ **Investigate P fractions in current land covers with landscape position**
  - ❑ **Quantify the trend in P fractions and the bioavailability of P in the long-term soil plots from 1957 to 2015.**

Rational and Significance

The aim of the proposed project is to investigate the evolution of soil phosphorus fractions across critical zones with a particular interest in the Calhoun CZO on impacts of land use history, especially changes in organic and inorganic P that are associated with Fe and Al oxides.

- By monitoring phosphorus fractionations over time in the LTSE, we will evaluate how labile P fractions restructure during ecosystem development
- Phosphorus fertilization in parts of the Calhoun CZO area has had a remarkably long-term effect on soil phosphate, especially in surficial layers of soil. Therefore, there are differences between soil phosphorus under different land uses/covers, which by measuring, will enable us to monitor the mobilization or retention of phosphorus fertilization over time.
- However, there are several research and paper about soil phosphorus, this issue is so important and need more research specially in forest soil because labile P that is most accessible to plants typically represents a small but variable fraction of total P (Yang & Post, 2011),
- Whereas slowly cycling organic and 'occluded' pools constitute a much larger share and regulate ecosystem P availability over decadal scales (Richter et al., 2006).

Material and Method

Obj1: To investigate the trend of P in different land use/cover types in contemporary time

- To evaluate phosphorus under different land use/covers, we will use existing and new samples from at least three different land uses in the Calhoun CZO:
  1) Hardwoods which have remained uncultivated and unfertilized
  2) Old-field pine which were all previously cultivated soil and are moderately eroded.
  3) Cultivated soil which were probably first cleared of the primary forest and then cultivated for cotton and right now, they have changed from cotton to hayfield.
  4) Floodplains of 1st, 2nd, and 3rd order streams and rivers

Obj2: To quantify the trend of P fraction changing and the bioavailability of phosphorous from 1957 to 2015 in the LTSE.

- To consider the effects of forest growth on fractions of soil P, we will use the collection of soil sampled from areas within four of the eight plots encompassed 388 m2, the other four 606 m2, until 2015, when sampling in all eight was expanded to nearly 0.2-ha plot areas.
- Individual sample points will be located within each plot with a stratified random design and samples will take from four depths (0–0.075, 0.075– 0.15, 0.15–0.35 and 0.35–0.6 m). Then, samples will air dry, sieved through 2-mm screen.
- After sieving the soil samples, we need to extract phosphorus of each samples by Mehlich III and then fraction phosphorus by Hedley's fractionation method. After assessing phosphorus fractionation, we will compare with results from 1957 until 2005 for monitoring the change of phosphorus fractionation over time.

Expected results

Expected of obj1:

- ❑ Our hypothesis is centered on different land use/cover in Calhoun, based on the previous research (fig2).
- ❑ Soil P in Harwood forest would expected to be less, although with a higher proportion or organic P than previously cultivated land. Moreover, phosphorus density will decrease with increasing soil depth.

Expected of obj2:

- ❑ We expect P to increase in soil depth through some mobility over time. The last analysis found that total P decreased in surficial soil and increased in deeper soil during time (fig3).
- ❑ Consequently, we expect less Al and Fe adsorbed P in the surface .

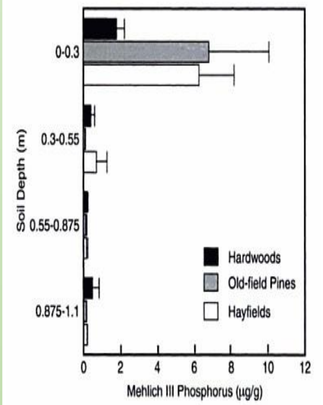

Fig2. P concentration in different land use

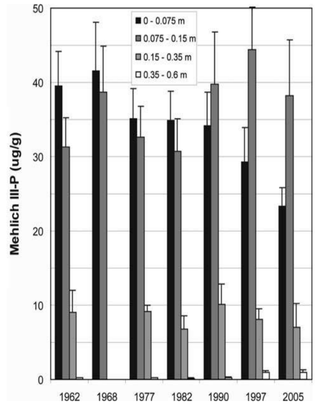

Fig3. changing in Mehlich III-extractable P

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