UniLaSalle Terre & Sciences

PhD position in Soil Science, Biogeochemistry and Agroecology

Région Hauts-de-France

"Unravelling the role of phosphorus (P) forms on the efficacy of renewable P sources to improve P availability"

Although phosphorus (P) is essential for all living organisms, it acts as a limiting nutrient for the productivity of many agrosystems due to its low availability in soil. P fertilization is therefore needed to meet the crop demand and achieve high yields. Most of the P currently used in chemical fertilizers is derived from phosphate rocks that are finite and located in only a few places on Earth. Moving towards more sustainable sources for managing P in cropping systems, renewable nutrient-rich (derived-)organic amendments (manure, sludge, compost, biochar, ashes, struvite …) are increasingly considered to replace P fertilizers produced from phosphate rocks, not only by scientists but also by politics and stakeholders. However, compared to conventional P fertilizers such as triple superphosphate, P is present in these amendments in various inorganic and organic forms which differ in their plant availability. Most of the research investigating the fate of P applied to the soil has focused on (soluble) inorganic P while the fate of other P forms has been disregarded so far. Moreover, since plant species differ in their ability to mobilize P from soil P pools, it is highly likely that the potential of recycled P fertilizers to increase plant uptake will be dependent not only on the forms of P but also on the P mobilization/acquisition strategies (e.g. soil acidification, carboxylate secretion, phosphatase release …) used by the plants. Thus, in order to optimize the use of recycled P fertilizer and to be able to predict P availability in cropping systems, there is a great challenge to elucidate the relationships between the forms of P applied to the soil, the soil properties and the plant traits involved in the P mobilization/acquisition and their consequences on P mobility and uptake by plants (Figure 1).

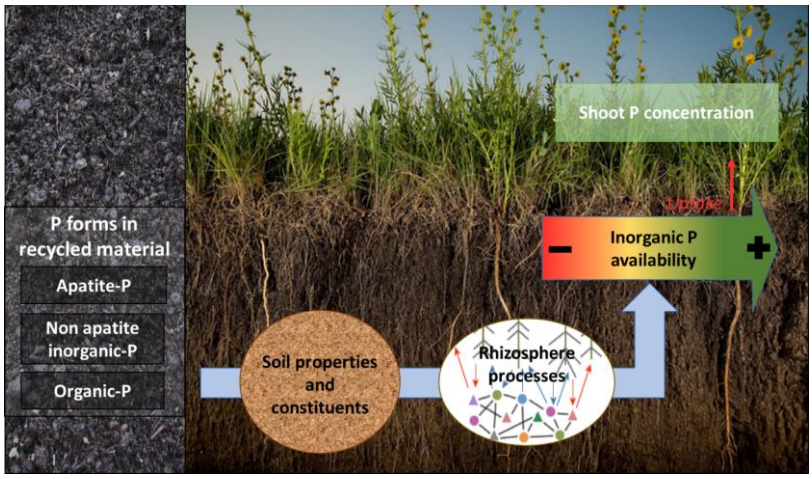

Figure 1. Phosphorus dynamics in soil amended with recycled P resources. Phosphorus availability for plants is not only dependent on P forms in recycled materials but also mediated by soil properties and rhizoshere processes.

Objectives

The main objective of this PhD project is to optimize the use of renewable P fertilizers through a better understanding of the impact of P forms on P availability in contrasted soil-plant systems (Figure 2). The first step of this PhD project will be to identify the soil constituents and properties which are involved in the sorption/desorption of P applied under different forms. The knowledge of these parameters will be of help to predict the availability of P as a function of the form which is applied and to better model the behavior of P according to the soil properties.

The second step will be to validate the results of the sorption/desorption experiments by analyzing the P uptake by plants in response to the application of various P forms. Since most of the renewable P fertilizers differ also in terms of nitrogen (N) concentration and organic carbon (C) composition (e.g. cellulose, hemicellulose, lignin) which can in turn impact physico-chemical and biological soil properties, the third step will be to evaluate the effect of these compounds on the P uptake. The final step will consist to evaluate the genericity of our data by

testing the effect of "real" amendments (struvite, sludge, biochar …) with contrasted P forms on P mobility and uptake by plants. In this step, plants with different P mobilization/acquisition traits will be tested alone (single-species treatment) or in combination (multi-species treatment).

We hypothesize that the overall uptake of P will be higher in multi-species than in single-species treatments and, more importantly, the addition of a mixture of inorganic and organic P forms will result in higher P use efficiency by multi-species treatment than the addition of only one P form.

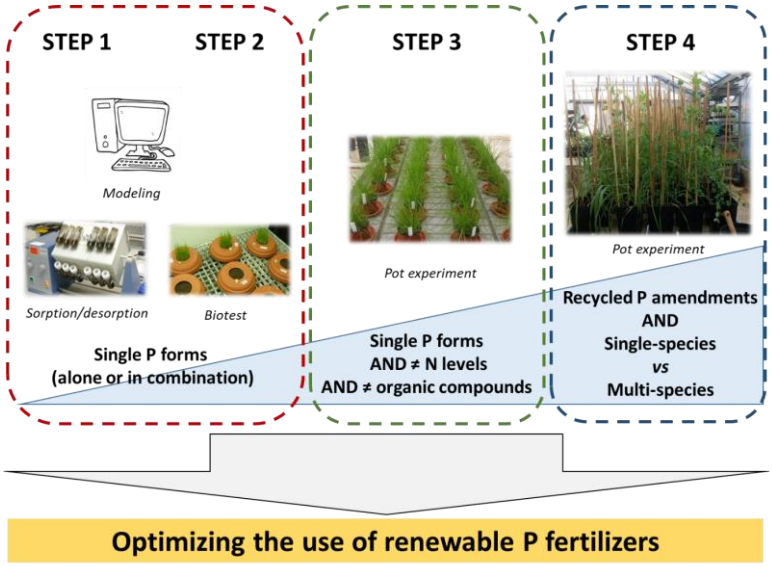

Figure 2. Schematic thesis ouline.

Framing: This PhD Thesis takes place at UniLaSalle in Beauvais (France). The intern will benefit of the multiple services available on the campus (100 student associations, fitness room, university restaurant…). https://www.unilasalle.fr/.

This PhD Thesis will be performed in the AGHYLE unit under the supervision of Dr David Houben and Dr Michel-Pierre Faucon, in co-tutelle with Prof. Gilles Colinet (ULiège, Belgium) and in collaboration with an international partner from the LaSalle network.

Academic level: Master degree ***(Graduate Students)***

General Information:

Period: 3 Years

Starting date: October 1st 2019

Ending date: September 30th 2022

PhD Thesis grant: 1768.55€ per month (**gross salary**)

To reply to this PhD Thesis offer, please send:

- ***Academic transcript (undergraduate/Master degree)***
- ***Cover letter***
- ***Curriculum Vitae***

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Deadline: May 25th