INTERNSHIP PROPOSAL

Effect of organic agriculture expansion in France on nutrients cycling. Focus on the phosphorus cycle.

Context

In Europe and in France, organic agriculture (OA) is expanding rapidly. In 2020, the French agricultural surfaces cultivated under organic farming management represented 10% of French agricultural areas, and had increased by 12% between 2020 and 2021 (l'Agence Bio). Despite the numerous advantages of OA, questions remain about its ability to feed the world. These questions are based on two main arguments: (i) yields in OA are on average 19-25% lower than in conventional agriculture[1-3] and (ii) a massive shift to OA would lead to additional nutrient limitations resulting in lower yields[4]. Many scientific studies have tackled these criticisms and have shown that it would be possible to convert up to 60% of the world's agricultural land to OA without any drop in food production and without expansion of agricultural lands[5,6]. Beyond 60% conversion rate, nitrogen would limit food production. To be compatible with the objective of global food security, this massive shift to OA is nevertheless subject to several constraints: (i) livestock loads will have to be drastically reduced, (ii) food waste will have to be reduced, and (iii) human diets will have to change.
However, a major limitation of these studies is that they have not considered the extent to which soil phosphorus (P) availability could limit crop production. This is a matter of concern, given that the use of mineral P fertilizers is prohibited in OA. In this context, it is necessary to evaluate to what extent a large expansion of OA would affect agricultural soil P fertility and thus food production.

This internship is part of the PhosphoBio project led by Arvalis Institut du Végétal. It also associates the French National Research Institute for Agriculture (INRAE) and the engineering school Bordeaux Sciences Agro.

Objectives

The internship will focus on the case of France. The objective will be to evaluate to what extent the availability of nutrients, especially phosphorus, in French agricultural soils could limit the production of OA, in the context of a large expansion. More specifically, the work of the internship will consist in the following steps:

1. Get familiar with the subject of the internship and the model used (GOANIM[5] model) (2 weeks)
2. Collect the input data of the model for the case of France. The data will be collected in the existing literature. There will be no fieldwork or surveys to carry out (2 months).
3. Convert the input data into a format (including resolution) compatible with the GOANIM model (1 month).
4. Improve the model to make it more representative of French specificities. This includes coding the possibility to simulate differentiated developments of organic farming depending on French regions specificities (taking into account current livestock loads and current conversion rates) (1 month).
5. Analyse the model outputs (1 month).
6. Write a synthesis report on the work done.

7. Depending on the results, you will participate in the writing of a scientific article based on this analysis work.

Internship conditions

The internship will unfold within the ISPA joint research unit, associating INRAE and Bordeaux Sciences Agro on the INRAE campus in Bordeaux. You will be supervised by Joséphine DEMAY and you will benefit from an extended research team, inducing several Ph.D. students and researcher of the ISPA unit. You will also benefit of the expertise PhosphoBio partners.

Expected dates range from January to June 2023, preferably, or from February to July 2023. You will receive a salary of ~ 550€ per month and you will benefit from a granted access to the INRAE canteen.

How to apply

Write an application letter describing your background and explaining your motivations and interests for the project. Send that letter together with your CV to Joséphine DEMAY (josephine.demay@inrae.fr). ***Application deadline: 21/11/2022. The pre-selected candidates will be contacted for an interview.***

Profile

We look for someone with a background in agronomy or environmental sciences, who know how to code in python or who would be highly interested in learning python programming.

References

1. De Ponti, T., Rijk, B. & Van Ittersum, M. K. The crop yield gap between organic and conventional agriculture. *Agric. Syst.* **108**, 1–9 (2012).
2. Ponisio, L. C. *et al.* Diversification practices reduce organic to conventional yield gap. *Proc. R. Soc. B Biol. Sci.* **282**, (2015).
3. Seufert, V., Ramankutty, N. & Foley, J. A. Comparing the yields of organic and conventional agriculture. *Nature* **485**, 229–232 (2012).
4. Connor, D. J. Organic agriculture and food security: A decade of unreason finally implodes. *F. Crop. Res.* **225**, 128–129 (2018).
5. Barbieri, P. *et al.* The global option space for organic agriculture under nitrogen limitations. *Nat. Food* **2**, 363–372 (2021).
6. Muller, A. *et al.* Strategies for feeding the world more sustainably with organic agriculture. *Nat. Commun.* **8**, 1–13 (2017).