

# Closing phosphorus cycles in Europe – knowledge basis for new policies

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#### Introduction

European agriculture is dependent on imported phosphorus (P) fertilisers for sustaining its productivity. However, at the same time overfertilisation has increased soil P status in some regions, mainly due to segregation of crop production and animal husbandry. Optimising the use of bio-based fertilizers (BBF), produced from nutrient-rich side-streams (NRSS), in agriculture is a requirement for closing the nutrient cycles (Fig. 1) and securing the availability of finite P resources in the future. Here we present the concept of the work package on P in a new Horizon 2020 project on "Optimising bio-based fertilisers in agriculture – Providing a knowledge basis for new policies (LEX4BIO)"

#### P use efficiency of BBFs

The most promising BBFs of three groups: i) mineral BBFs, ii) organo-mineral BBFs and iii) organic BBFs will be evaluated for their P use efficiency (PUE) in both greenhouse and field trials (Fig. 2). Growth trials will be conducted in various climatic regions across Europe (Finland, Germany, Switzerland, Austria, Hungary, France, Spain).



Figure 2. Greenhouse and field trials

# Compliance methods

The new EU fertiliser regulation sets P solubility criteria for BBFs. Methods included in the EU fertiliser regulation are evaluated against PUE determined in growth trials. Also following novel potential methods are evaluated:

- Diffusive Gradient in Thin-films (DGT)
- Electro-ultrafiltration (EUF)
- Iron oxide-filled dialysis bags



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Figure 1. LEX4BIO aims at enhancing the circular economy by improving the utilization of bio-based fertilisers (BBF)

# P status of cultivated fields in Europe

Bioavailable P content of European cultivated fields is determined by analysing soil samples derived from the LUCAS soil archive collected in 2015 and 2018. About 3000 out of 9000 soil samples from arable fields across EU-28 will be analysed with the following methods: DGT, EUF and modified Olsen. Results are extrapolated to the whole LUCAS dataset through correlation with known Olsen P data.

#### **Environmental P losses**

Fractionation of soil P (e.g Hedley fractionation) after greenhouse trials will give an indication for P leaching potential. This is validated in a rainfall simulation with typical agricultural soils across Europe: Northern (Finland), Central (Germany) and Southern (Spain).

# Potential of BBFs in the EU

Critical soil test P values and required P application rates for achieving up to 97% of the maximum yield in different regions across the EU is determined:

- Field trials in LEX4BIO
- Other past and on-going field trials for which archived soil samples and information for the optimum P application rates are available.

Phosphorus fertilisation requirement across the EU together with the PUE of BBFs gives an estimation for their potential to replace imported mineral P fertilisers.