

## SoilCare project BSc / MSc / PhD Research Information

### Research level

PhD

### Research Title

Distribution of P, C and Arbuscular Mycorrhiza in agricultural soil profiles after long-term contrasting liming and P fertilization.

### Abstract

Long-term liming and P fertilisation strategies of agricultural soils have profound effects not only on soil pH and soil phosphorus (P) content and crop yield, but also on other characteristics such as P sorption characteristics, the Arbuscular Mycorrhizal Fungi (AMF) community and the soil organic matter content. Improving our understanding of this is crucial for maintenance of soil fertility on the long term. The core of this project is linked to the long-term field experiment on liming and P fertilization at St. Jyndevad field experiment, Denmark where treatments with different levels of P fertilization and liming have been maintained since 1944. This is supported by a study from long-term field experiment on animal manure and mineral fertilizer at Askov Experimental Station initiated in 1894. In St. Jyndevad field experiment, lime has been added at four rates (0, 4, 8 and 12  $\text{ton}^{-1}\text{ha}^{-1}$ ) since 1942 while P has been added at an annual rate of 15.6  $\text{kg P ha}^{-1}$  since 1944. Reference treatments were no lime and no P additions since 1942/44. In order to study the distribution of P, AMF and soil carbon (soil C) in the soil profile, soil cores (0-100 cm) were collected in autumn 2016 after barley harvest from one of arable fields in all the lime treatments using plots treated with 156  $\text{kg P ha}^{-1}$  in 1944 and no P since 1944 and 156  $\text{kg P ha}^{-1}$  in 1944 plus annual addition of 15.6  $\text{kg P ha}^{-1}$ . Soil chemical properties (pH, total P, total inorganic (Pi) and organic P (Po), Olsen P, water extractable P (Pw), soil C, and oxalate-extractable P, Fe and Al) and AMF biomass using signature fatty acid 16:1 $\omega$ 5 as biomarker for AMF, were determined in five depths. A single point P sorption index (PSI), based on addition of 50-mmol P  $\text{kg}^{-1}$  soil was used to evaluate soil sorption capacity. Soil pH significantly increased with increased liming addition to at least 70 cm depth. The P fertilized treatments had more total P, Pi, Olsen P, Pw and oxalate P in the upper 30 cm of the soil profile while P content at deeper layers were unaffected by fertilization. Liming significantly increased soil C and AMF abundance in 0-30 cm. There were strong relations between oxalate-extractable Al and PSI, while the relations between oxalate-extractable Fe and PSI were weak. In Askov Long-term Experiment, archived soils sampled in 1988, 1992, 1996, 2000, 2004, 2008, 2012, and 2016; and plant materials (wheat grains and straws) sampled in 1989, 1993, 1997, 2001, 2005, 2009, 2013 and 2017 in B4 field were retrieved autumn 2017 from selected treatments. Grains and straw yields were also available for this study. This provides opportunity to study changes in soil and crop parameters that occur when soils with high P are subject to gradual depletion and when soils depleted in P are subject to fresh additions of this nutrient. Soil chemical properties (water extractable P, Olsen P, Total P) and P concentrations in grains and straws were determined. Data analyses are currently in progress.

### Objectives of the research

- 1 To quantify soil pH, total organic and inorganic P, available P and SOC in soil profiles under contrasting long-term liming strategies
2. To evaluate the long-term effects of yearly P fertilization on soil P pools, P sorption characteristics and AMF inoculum potential in soils with different liming status.
3. To quantify the changes in the available P pool in soil to fertilization regimes causing either accumulation or mining of soil P (positive or negative P balances) in the long-term fertilisation field experiment at Askov

### SOILCARE study site

This PhD study is being carried out at two long-term experiment associated to the Danish study in the SoilCare project:

1. Long-term lime and P fertilizer trial at St. Jynde vad Experimental Station
2. The Askov Long-term Experiments on Animal Manure and Mineral Fertilizers

### Partners in this research

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