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Evaluation of the sustainability of minor crops in Normandy region, France

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Wassila Riah-Anglet^a, Elodie Cusset^a, Mélanie Bressan^a, Babacar Thiouye^a, Elisa Marraccini^b, Alicia Ayerdi Gotor^c, Murilo Veloso^a, Pierre-Yves Bernard^a, Adeline Michel^d, Corentin Depreaux^e, Isabelle Trinsoutrot-Gattin^a

^a AGHYLE Research Unit, UP 2018.C101, UniLaSalle, Rouen, Mont-Saint-Aignan, France, ^b INTERACT Research unit, UP 2018.C102, UniLaSalle, Beauvais, France, ^c AGHYLE Research Unit, UP 2018.C101, UniLaSalle, Beauvais, France, ^d Cerfrance Normandie Maine, Bois-Guillaume France, ^e Natup, agricultural and agri-food cooperative group, Mont-Saint-Aignan, France



Introduction

Crop production in Normandy is highly specialized and based on few crops, which raises the issues of agricultural sustainability. This issue of sustainability is of great concerns when we consider protein autonomy outcome at French and European levels. Thus, the development of alternative crops could help to the diversification of crop rotations and contribute to the increase of the proportion of plant-based proteins. Because of their high protein content, grain legumes, cereals and oilseeds offer benefits for human health (Becerra-Tomás *et al.*, 2017), the environment (Springmann *et al.*, 2016), and global food security (Erb *et al.*, 2016). Increasing the proportion of grain legumes in cultivated areas could reduce the current deficit in protein and contribute to sustainable farming systems.

Objective

PROVEG project aims to evaluate the potential of protein-rich crops that are absent or poorly established in Normandy region

Materials & methods

Field experiments including pea, lentil, faba bean and lupin crops

1- Experimental sites: Eure & Seine Maritime

- Strips of 10 m x 1.5 m
- 3 repetitions of each crop



2- Farmers plots: 24 plots

- With and without tillage (no ploughing for at least 5 yrs)
- Different agropedoclimatic contexts in Normandy



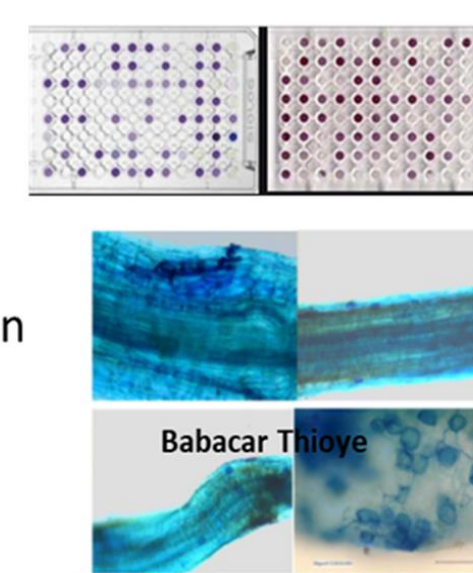
3- Studied parameters

- The soil samples were collected using an auger at a depth of 0–20 cm by pooling 10 subsamples.

Microbial abundance and diversity

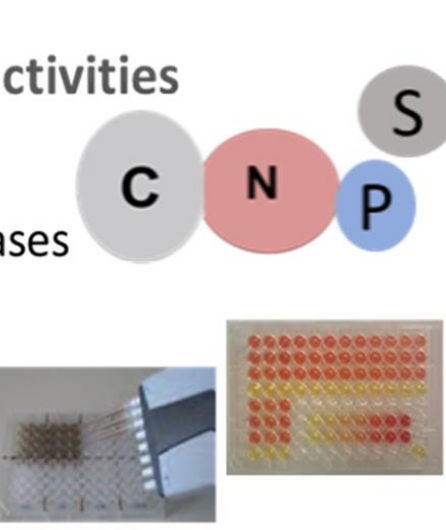
- Abundance of microorganisms
 - Total DNA
- Abundance of bacteria
 - 16S rDNA gene copy
- Abundance of fungi
 - 18S rDNA gene copy
 - Glomalin content
 - % of mycorrhizal colonization in roots

- Community level physiological profiling
 - *ex situ* (Biolog System) (Calbrix *et al.* 2005)



Microbial activities

- in situ* enzyme activities
 - β-Glucosidase
 - Acid Phosphatases
 - Arylamidase
 - Arylsulfatase



Yields and grains quality

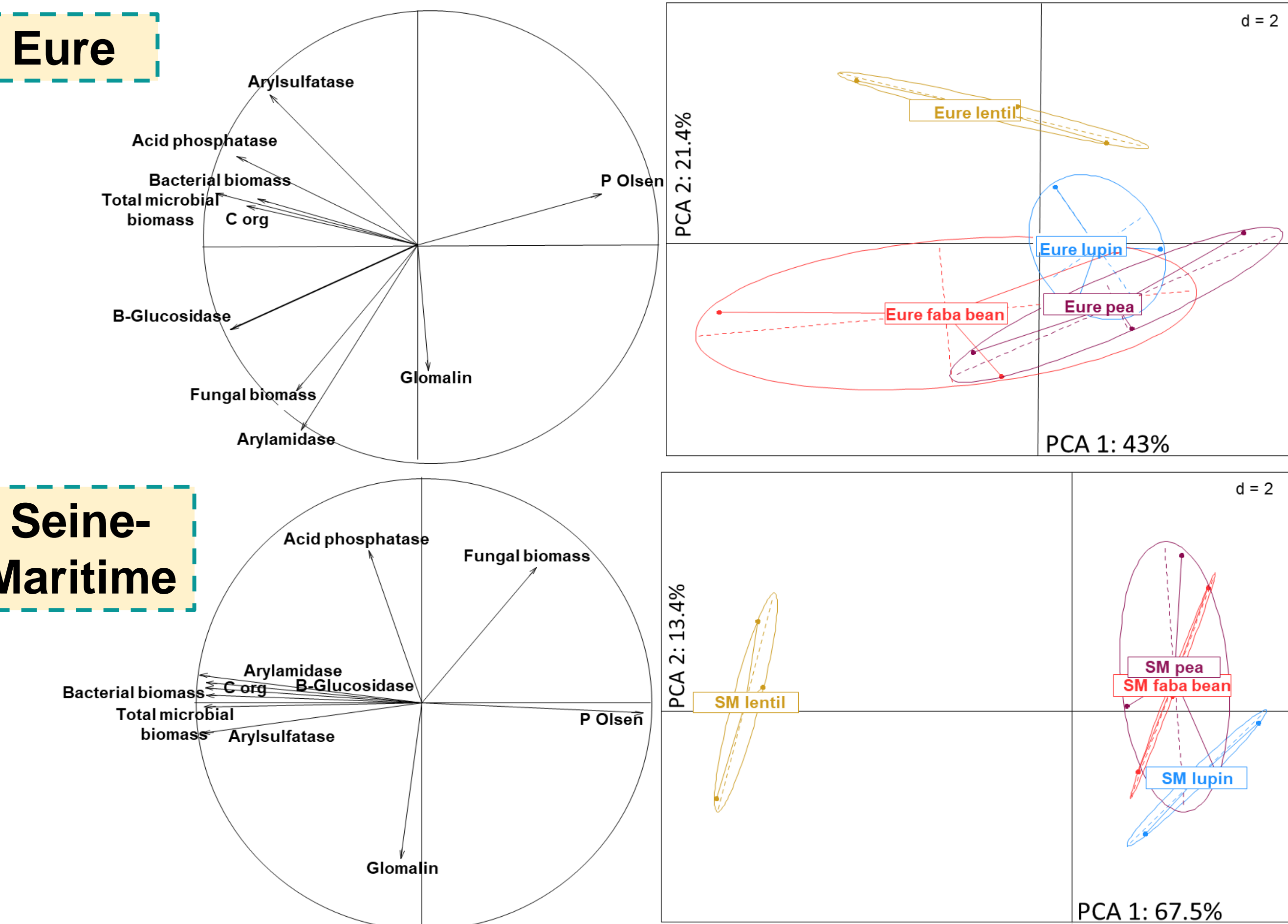
- Grain quality : protein content
- Yield evaluation

Results & Discussion

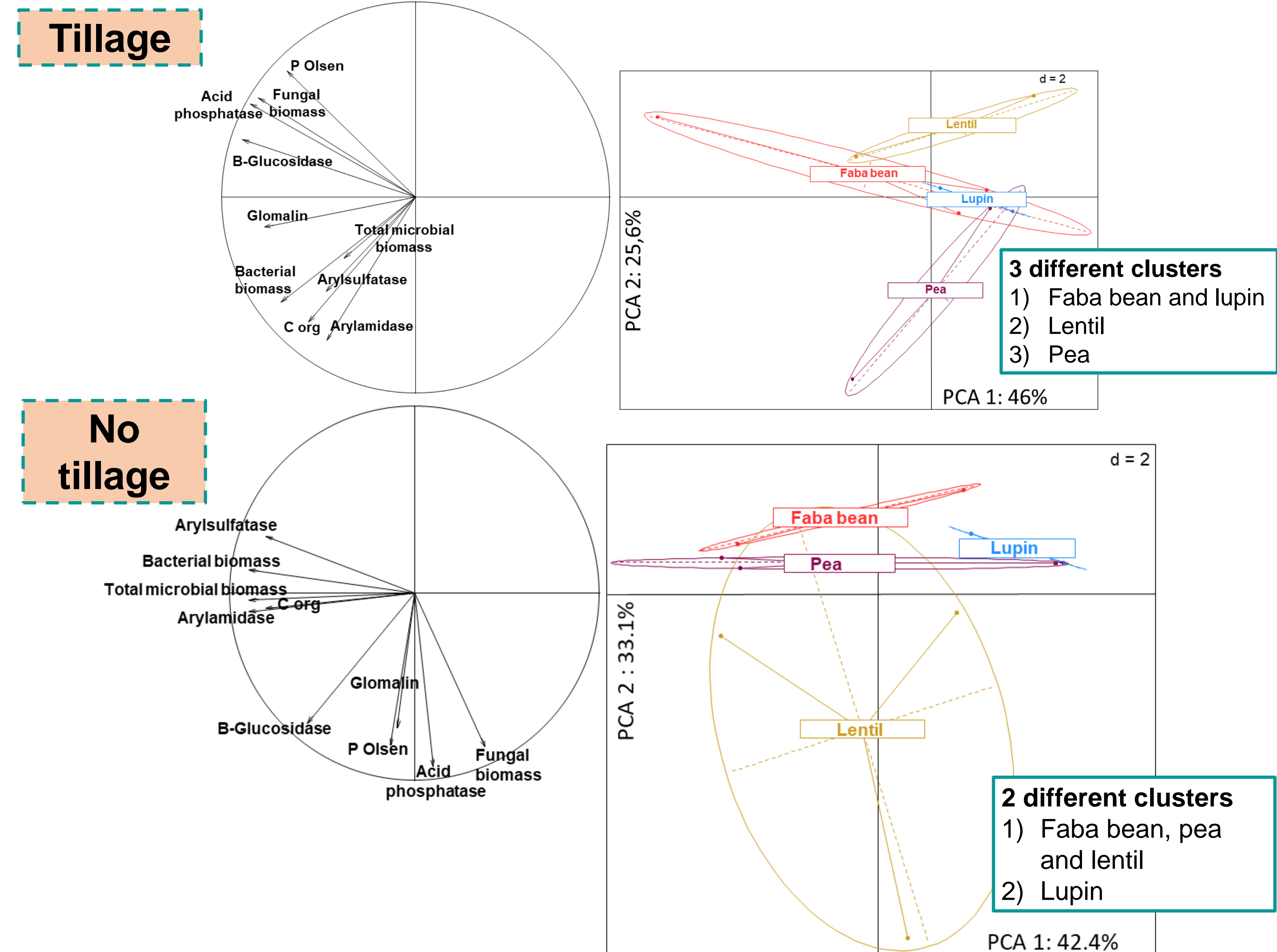
Effect of crops introduction on the soil biophysicochemical state

Principal component analysis and correlation circle of soil parameters under faba bean, pea, lentil and lupin crops

Experimental sites



Farmers plots



In two different pedoclimatic contexts, the lentil crop is differentiated from other crops. This differentiation seems to be related to an increase in microbial biomass and enzymatic activities. These results are in agreement with those of Lupwayi *et al.* (2021). Other soil parameters (mineral N, pH and microbial (% of mycorrhizal colonization in roots, CLPP) are being analyzed and will be integrated into this dataset to help in the identification of suitable crop managements to promote soil state

- Difference in soil state and crop typologies across tillage management
- Crops effect is greater than the pedoclimatic effect whatever the tillage management. Despite farmers plots, were located in different pedoclimatic conditions in Normandy region, observed heterogeneity between crops stay limited

Trade-off between the suitable state of soil and crop yields?

Conclusions

These results need to be confirmed after the addition all the measured variables, particularly yield evaluation. Another campaign is in progress, it corresponds to the post-harvest stage and will allow to follow the kinetics of the soil biophysicochemical modifications induced by the implantation of these crops in Normandy region.

Final goals of the project: The expected findings will include i) the identification of suitable crop managements to maximize yields and sustain global soil functioning, ii) the assessment of crops vulnerability under climate change by taking into account the nature, the magnitude and the rate of climate change as well as the agro-ecological and socio-economic aspects of crops.