Long term Phosphorus dynamics in a French organic cropping system network

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Introduction

• P management is a major issue for organic farming (OF) systems. Maintenance of acceptable Soil Test Phosphorus (STP) levels over the long term is considered a key criterion for sustainability evaluation.

• Fertilization strategies are chosen according to the cropping system:
-**High Input Productive systems** : supply of organic fertilizers to compensate for P output and maintain STP at acceptable level.
-**Low Input Autonomous systems**: no fertilization or low level and use of Fabaceae for N supply,

Objectives

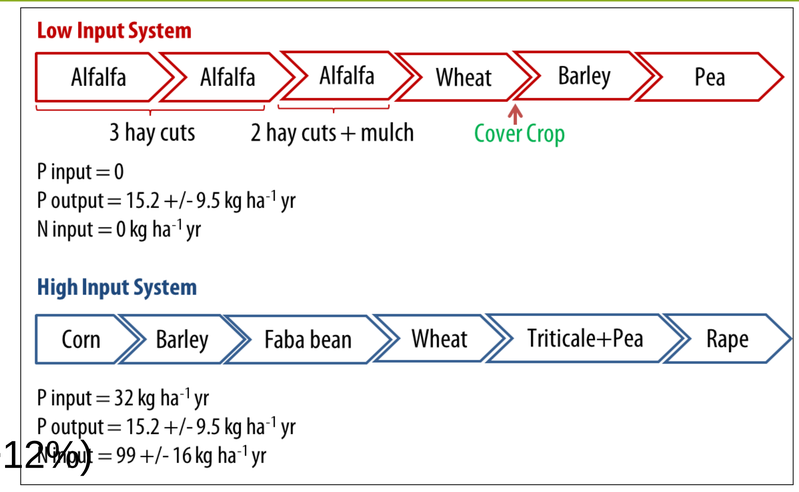
To analyze and compare the medium to long term dynamics of STP for OF cropping systems managed under contrasted fertilization regimes.

The study is part of **InnovAB** a national project which aims at testing innovative techniques for soil fertility management in OF systems at several sites in France.

Materials & Methods

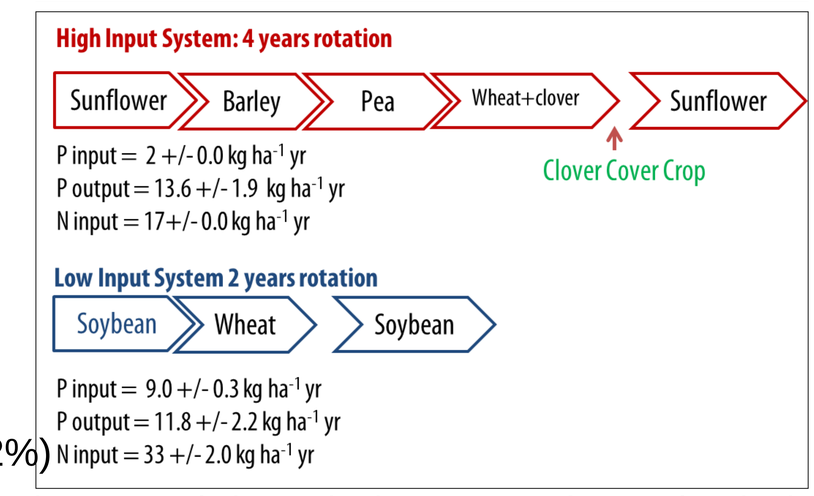
La Saussaye

2010 - 2017; 3 repetitions.
Silty clay loam;
7.3<pH<8.3; CaCO3 (0.1>12%)



La Hourre

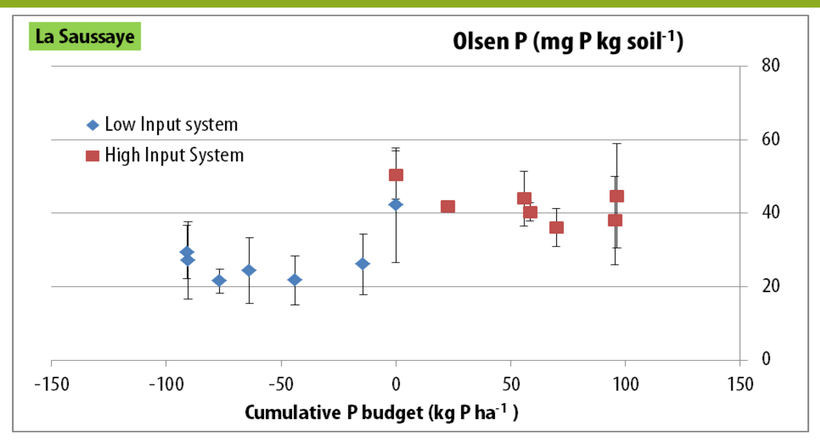
2002-2016; 2 repetitions
Silty clay loam;
pH = 8.3; CaCO3 (0.1>12%)



• Olsen P on 0-30 cm soil horizon; cumulative P budget= Sum of annual P budgets (Input-Ouput)

• Outputs are calculated from grains yield and P content.

Results & Discussion



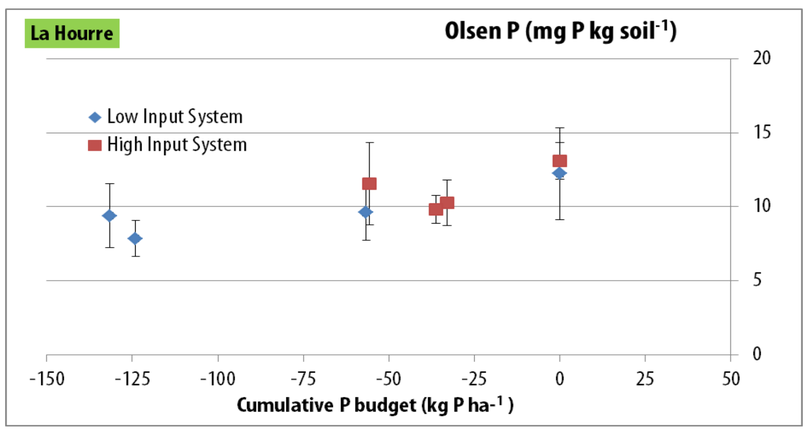


Figure 1: Relationship between Olsen P and cumulative P budget calculated between 2010 and 2017 (La Saussaye) and 2002-2017 (La Hourre), with cumulative P budget= Sum of annual P budgets (Input-Ouput)

• Annual P budgets (Input-Output, kg P ha^{-1} yr) were highly contrasted according to sites and system (Mat & Met) : negative for LI systems at both sites and for HI system at La Hourre ; they are positive at La Saussaye for HI system.

• Olsen P dynamics were variable according to sites and P budgets (Fig 1): we observed a continuous decrease with time for both systems at both sites.

• Changes in Olsen P associated with removal of 1 kg P ha^{-1} differed greatly among sites: 0.04 mg P at La Hourre 0.13 mg P at La Saussaye.

• For low input systems, at both sites, STP decreased with decreasing cumulative P budget ; similar pattern was observed for La Hourre HI where it remained negative ; at that site fertilization regime did not compensate for outputs (Fig.1).

• For La Saussaye HI, although cumulative P budgets remained positive, there was no increase in P Olsen as would be expected (Messiga et al., 2015) (Fig.1).

Conclusion

• Low fertilization regime results in a continuous decrease of STP as soil P deficit increases; P dynamics in low input OF systems is similar to that of conventional ones. The P budget model is validated at both sites.

• The absence of a direct relationship between Olsen P and cumulative P budgets at La Saussaye questions the P fertilizing value of organic manures and / or the capacity of STP to provide adequate diagnostic of Soil Plant Available P when organic manure is supplied on carbonated soils.

Reference

• Messiga et al. (2015) AMBIO. 44:252–262.