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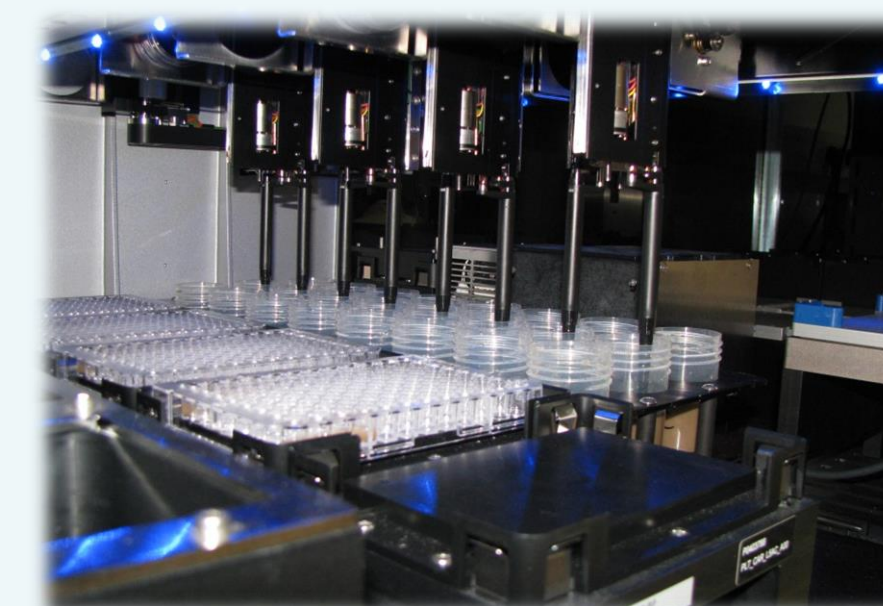
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LONG-TERM EFFECT OF ORGANIC WASTE PRODUCTS ON BIOLOGICAL FUNCTIONING OF NITROGEN AND PHOSPHORUS SOIL CYCLES



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ABSTRACT

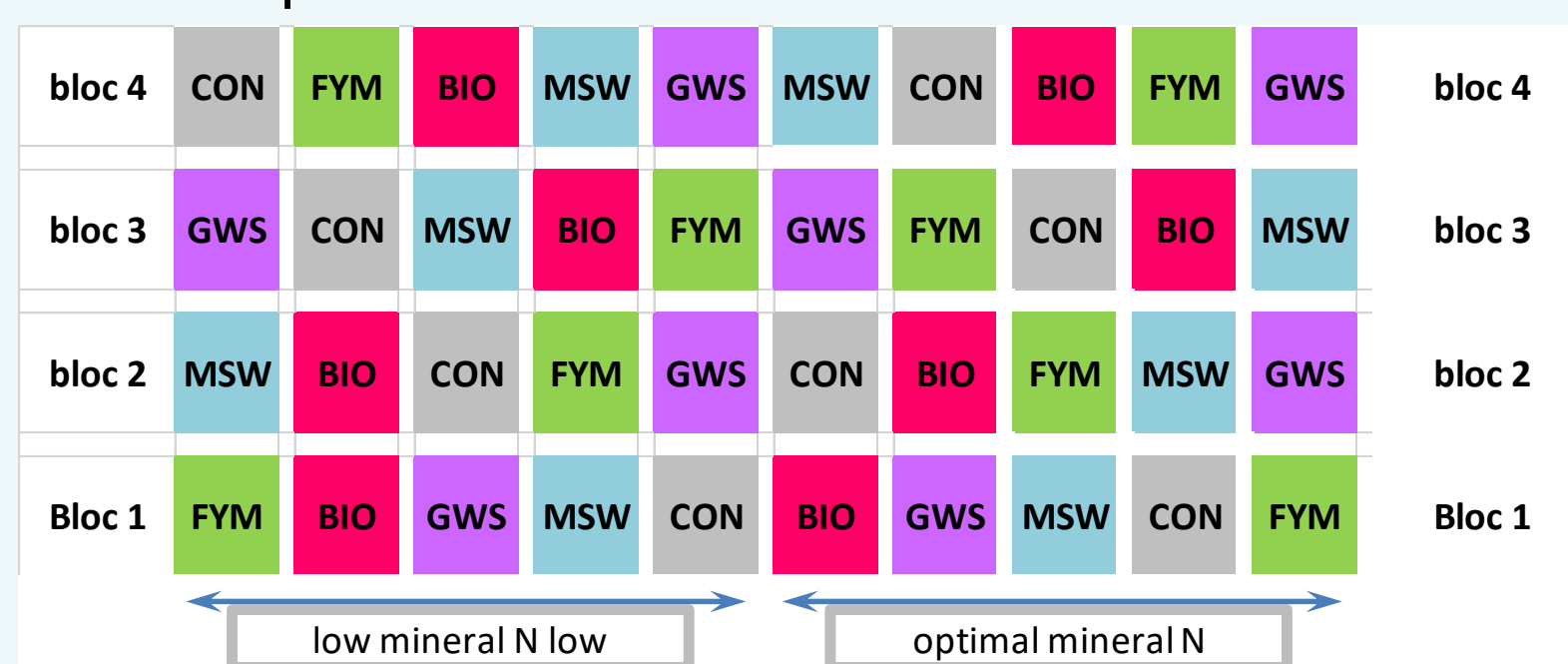
Soil is considered as a reactor for recycling human and agricultural wastes. The use of organic waste products (OWPs) as amendments seems a good alternative to reduce soil organic matter losses, to improve soil fertility, and thus to limit deleterious impacts of intensive agriculture on soil ecology. For example, organic waste recycling stimulates the activity of soil microorganisms in relation to the biogeochemical cycles.

In France, the SOERE-PRO (<http://www.inra.fr/valor-pro/SOERE-PRO>) is a network for long-term experiment to monitor and understand the effects of OWPs on cropped soils. It is very useful to investigate the environmental impacts of recycling OWPs on soil biochemical properties, as well as the possible resilience of the agrosystems, to assess cost/benefit balance, and to improve agricultural practices.

Soil microorganisms are involved in the transformation and recycling of organic matter (OM) and contaminants. They are the main contributors to biogeochemical cycles and are key actors responsible for optimal soil functioning with the production of extra or intracellular enzymes. Enzymatic activities are relevant indicators of soil functioning and soil functional biodiversity. Here we investigated the enzymatic activities involved in the nitrogen and phosphorus cycles, in relation with OM amendments and agricultural practices in the Qualiagro site.

Field experimental plots

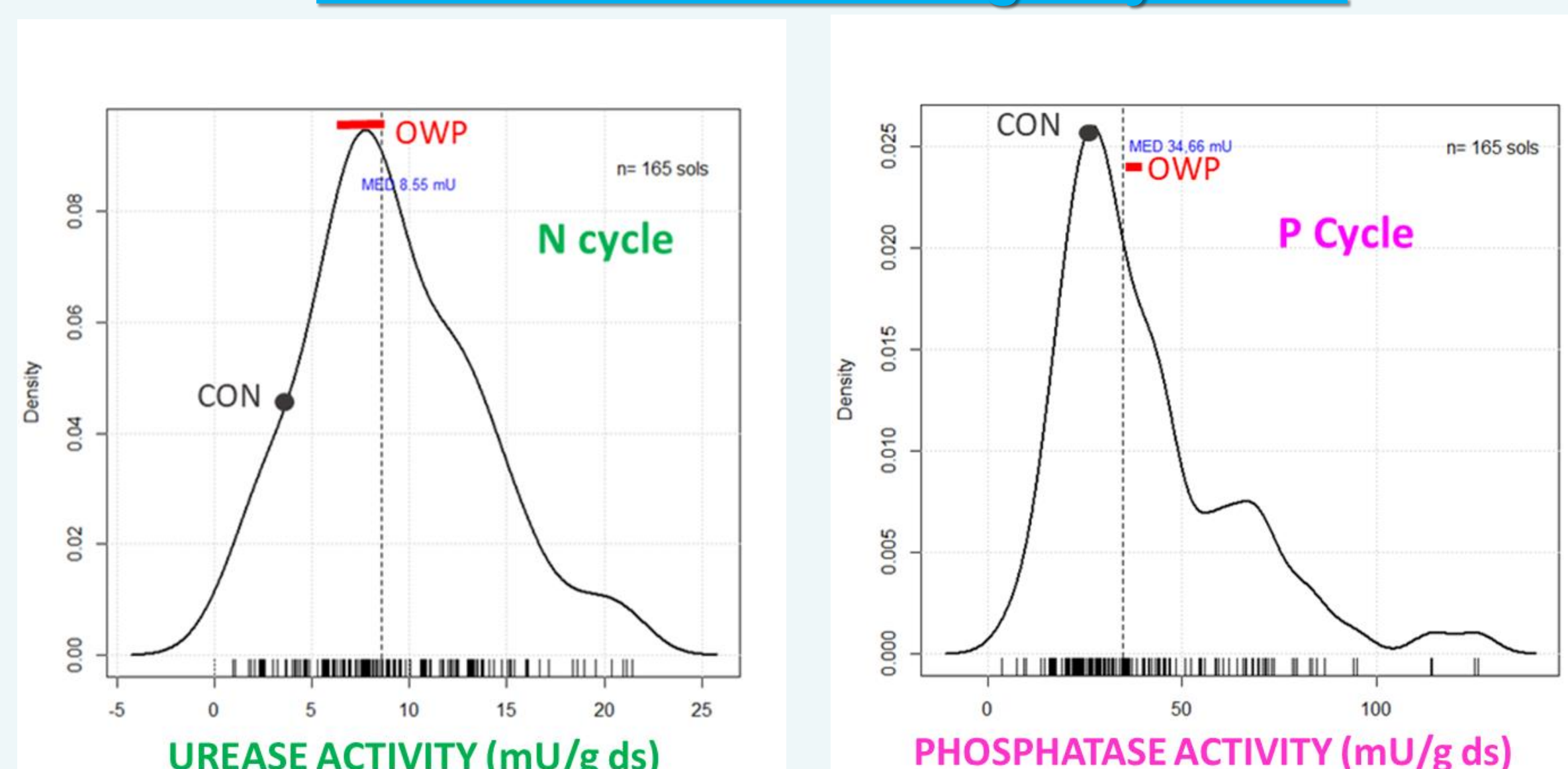
Qualiagro (Feucherolles - Yvelines; France), is a long-term experiment network to observe and understand the effects of OWP amendments on cropped soils to investigate the environmental impacts of recycling organic residues on soil biochemical properties, as well as the possible resilience of the agrosystems, to assess cost/benefit balance, and to improve agricultural practices. Since 1998, Qualiagro allows to study the effects of fertilization composts and manure in relation with level of nitrogen. Since 2014, mineral fertilization translates to organic one and since 2015, plots "low mineral" incorporates alfalfa into crop rotation.



No organic amendment (CON), farmyard manure (FYM), biowaste compost (BIO), co-compost of green wastes and sludge (GWS) and municipal solid waste compost (MSW)

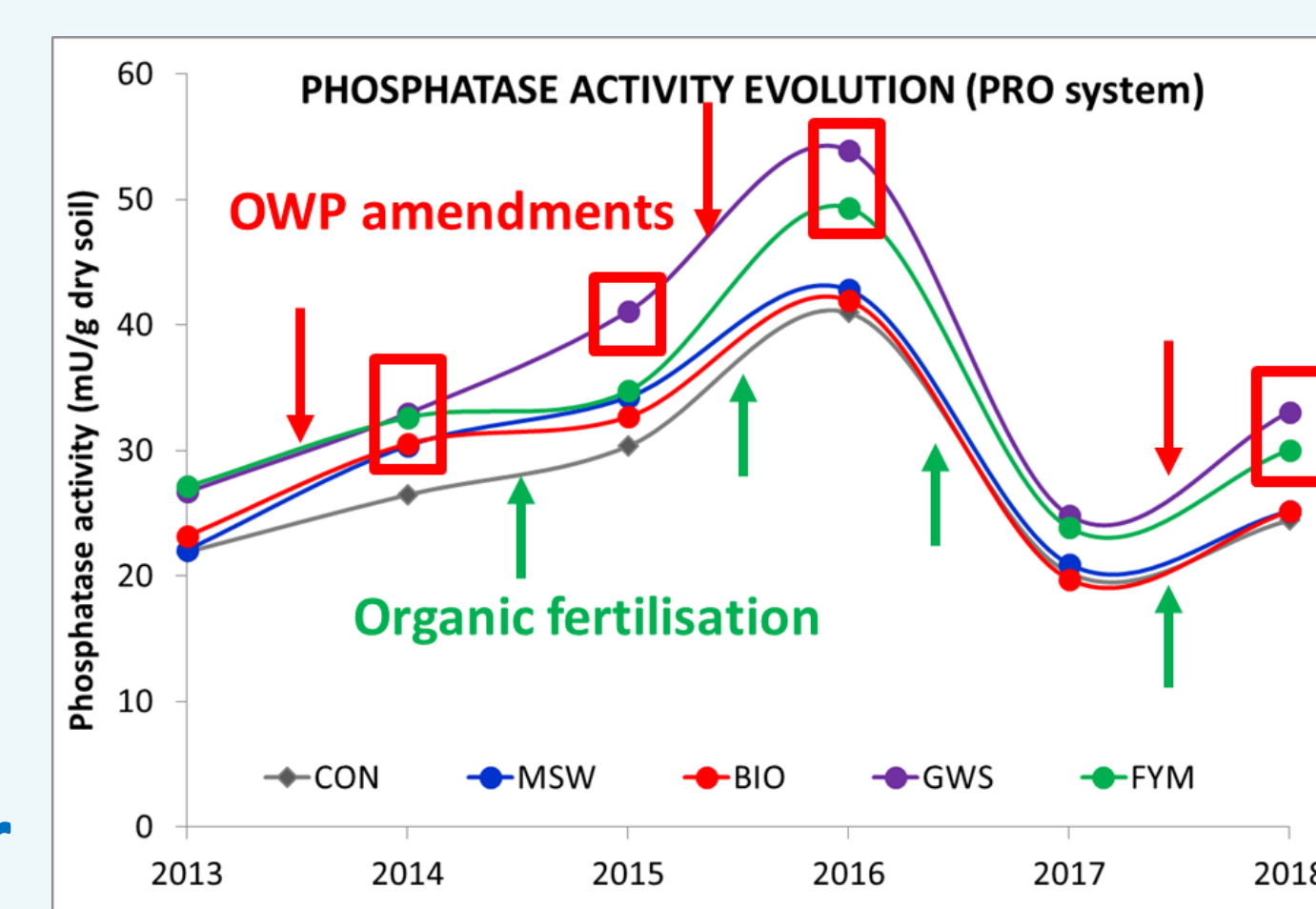
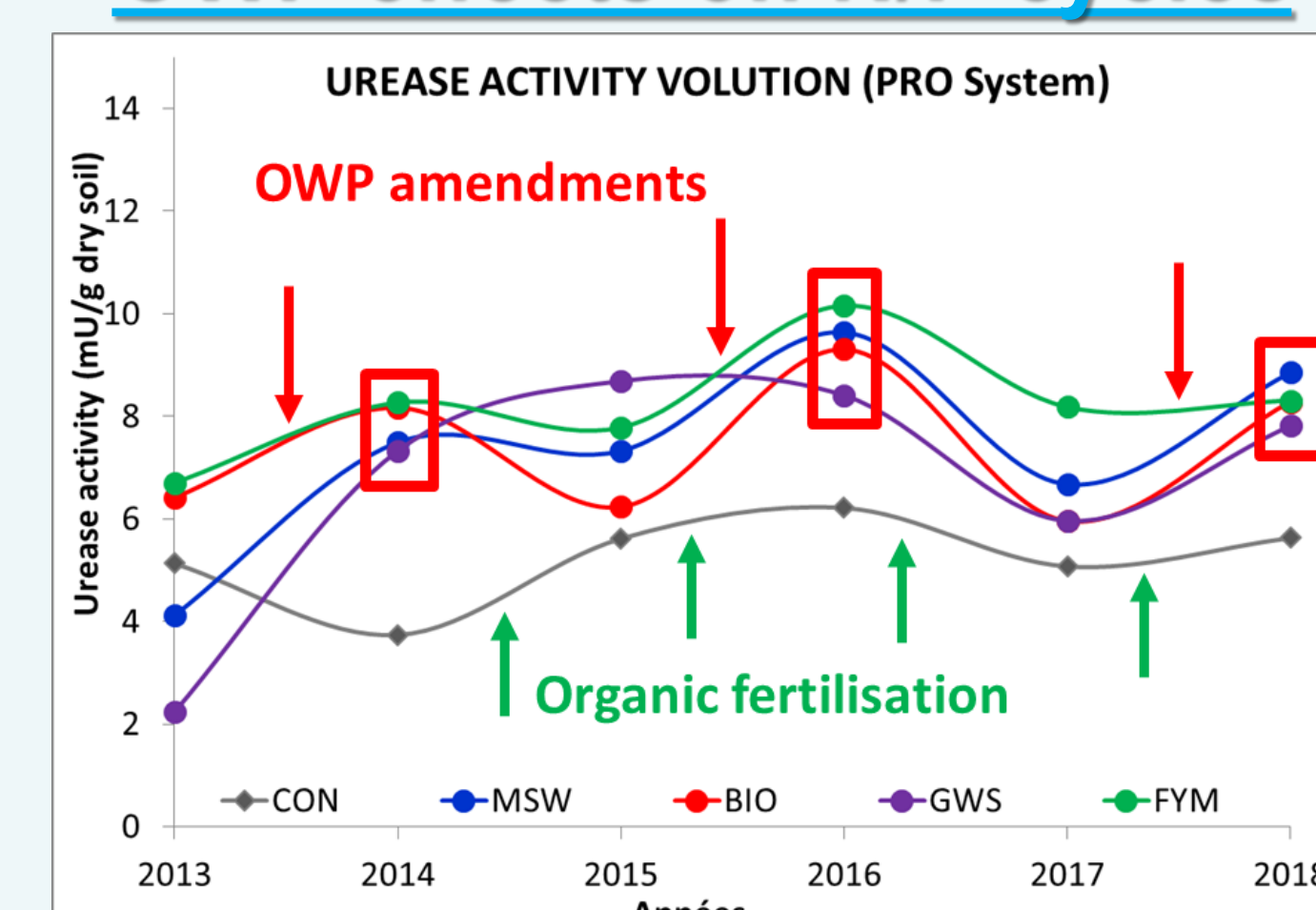


Positionnement of Qualiagro plots regarding french reference for agrosystems

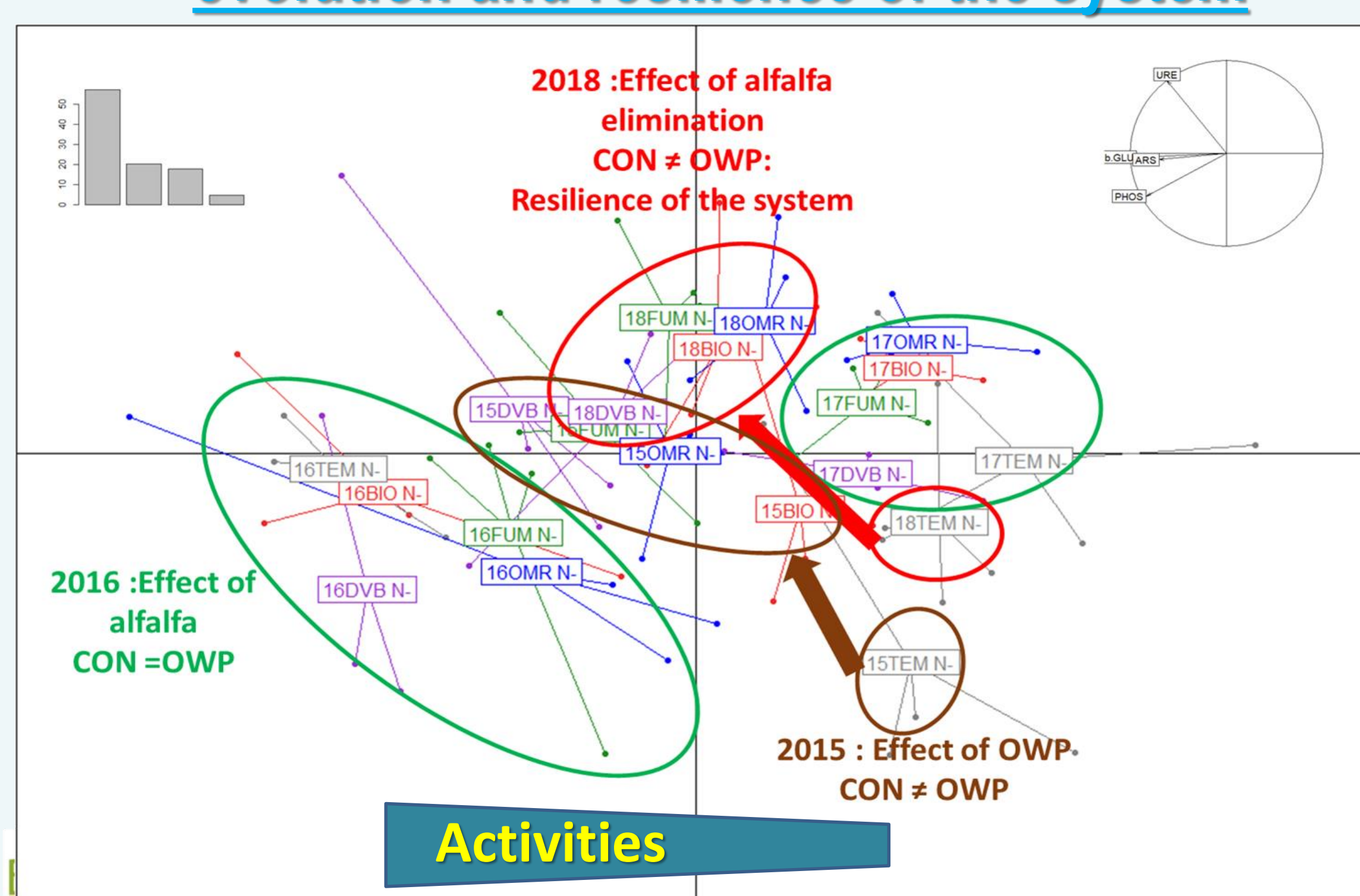


- ✓ Enzymatic activities in Qualiagro site in the range of values measured for the french soils
- ✓ OWP stimulate enzymatic activities
- ✓ OWP have more or less sustainable effects depending of their composition and biodegradability

OWP effects on N/P cycles



Enzymatic activities to visualise practices evolution and resilience of the system



Correlation between enzymatic activities and chemical data

	Nitrogen in grains	Nitrogen restitute to soil	OC in OWP	NH4 in OWP	Mineral nitrogen in OWP	Organic nitrogen in OWP
Phosphatase P Cycle	✓		✓			✓
Urease N Cycle	✓		✓	✓	✓	✓

- ✓ Enzymatic activities are not correlated to global quantity of C and N but closely linked to quality of organic matter and could reflected quality of the products

FYM exogen microorganism input, very degradable

MWS high biodegradability, very thin, rapidly incorporated and mineralised

GWS: pool of degradable (sludge), and few degradable (Green Wastes)

BIO: contains lots recalcitrant organic compounds; thin mineralisation, poor disponibility of nitrogen

Conclusions

- organic amendments have noticeable long-term-effects on nitrogen and phosphorus cycles.
- soil microbial processes are sensitive indicators for monitoring the evolution of soil biological properties due to amendments by OWPs, and evolutions of agricultural practices and for studying the resilience of the cropped system.



MATERIALS AND METHODS

For each treatment, the Qualiagro site (INRA and Veolia Environment collaboration) comprised four replicates of plots (45 m x 10 m, 450 m²). The treatments were: organic fertilisation (CON), farmyard manure (FYM), biowaste compost (BIO), co-compost of green wastes and sludge (GWS) and municipal solid waste compost (MSW)(Figure 1). In the site, the luvisol was a silt loam comprising 15% clay, 78% silt, and 7% sand. Its initial pH value was 6.9 and initial organic matter was 1.8%. During the past twenty years, the average annual precipitations amounted to 582 mm, and the average annual temperature was 11°C. The soils were collected each year in spring since 2013 at a depth of 0-20 cm. Samples were sieved through a 5 mm mesh, and stored at 12 °C before use. Soil water content was determined by drying 5 g of soil at 105 °C for 48 h. H.O Phosphatase, β-glucosidase, arylsulfatase, and urease activities were performed in microplate according to ISO20130, less than 48 hours after sample collection.

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