CA-SYS Platform

Co-designed Agroecological-SYStems Experiment

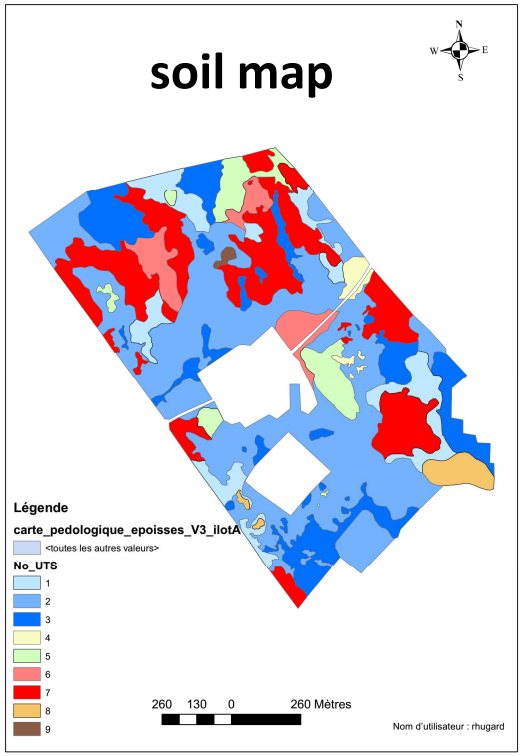
Coordinators:
Stéphane CORDEAU (UMR Agroécologie)
Violaine DEYTIEUX (UE Epoisses)

@CASYSdijon
@scordeau_inra

INRA Experimental farm « Domaine D'Epoisses »

INRA experimental farm « Domaine d'Epoisses »

- 130 ha of cultivated fields
  50 fields, 2 to 3 ha each
- Clay-loamy soil, with good yied potential
  (winter wheat 8,5 T/ha ; winter oilseed rape 4 T/ha)
- Drainage of all the cultivated area
- 2 systems of irrigation, covering the farm



- 15-20 species of crops

~ 25-30 ha dedicated to factorial trials, in a 3-years rotation
~ 14 ha dedicated to a high-throughput phenotyping platform
~ 70 ha dedicated to cropping system experiments and cash crops

INRA experimental farm « Domaine D'Epoisses »

Multiple skills and high-performance equipment

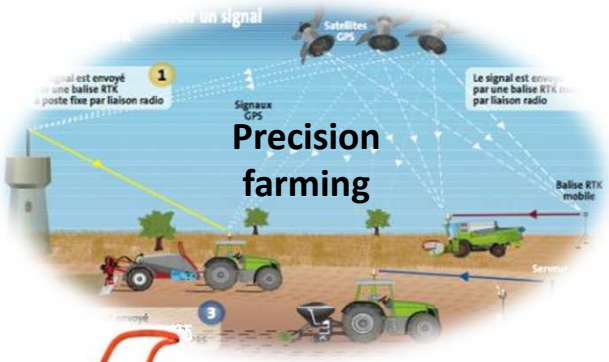
Rotary hoe

Strimmer

Hoe with local treatment on the row

Tine harrow

Direct driller (JD 750A)



Precision farming

Autumn ploughing

High-throughput imaging

radio-controlled tool holder

Precision seeding for micro-plots GPS trigger

INRA experimental farm « Domaine D'Epoisses »

Historical skills

- **Design, assess and adopt innovative cropping systems, less dependant to pesticides (e.g. herbicide)**
- **Test crops and cultivars adapted to new context of production**

New skills

- **Propose an experimental platform in agroecology, which combines systemic and factorial approaches**

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1. Shift to agroecology driven by policy and environmental change

Mobilize and harness functions delivered by cropped and wild diversity to support agricultural production

e.g. Conservation agriculture

e.g. Organic agriculture

CA-SYS Objective

Design and test the feasibility and performances of pesticide-free agriculture using (cropped and wild) biodiversity in support of production

= Biodiversity-based agriculture

Agronomy for Sustainable Development (2018) 38:48
https://doi.org/10.1007/s13593-018-0525-3

REVIEW ARTICLE

CrossMark

Biodiversity-based options for arable weed management. A review

Sandrine Petit[1] · Stéphane Cordeau[1] · Bruno Chauvel[1] · David Bohan[1] · Jean-Philippe Guillemin[1] · Christian Steinberg[1]

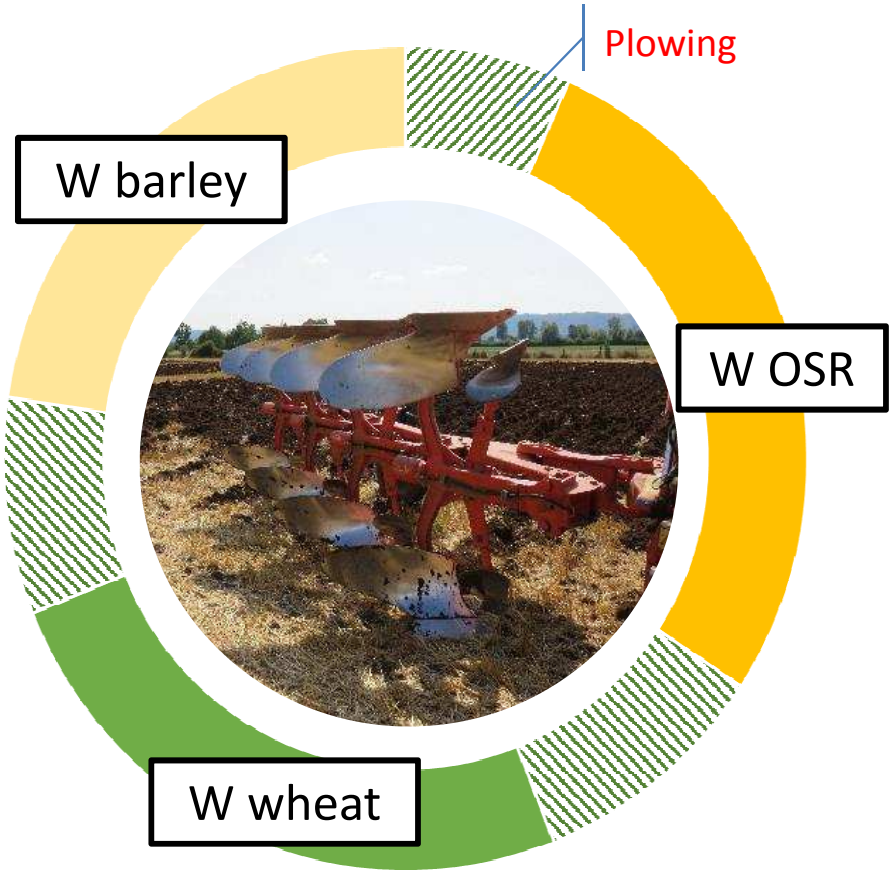
Aspects of Applied Biology **128**, 2015
Valuing long-term sites and experiments for agriculture and ecology

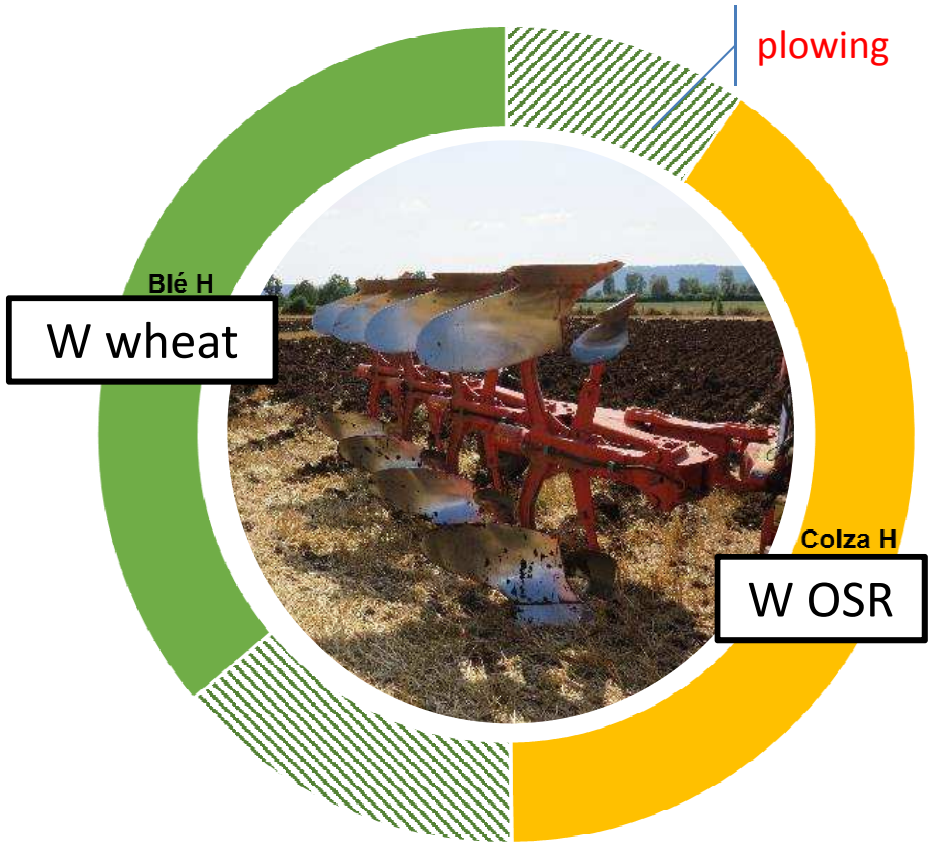
Towards the establishment of an experimental research unit on Agroecology in France

By STEPHANE CORDEAU[1], VIOLAINE DEYTIEUX[2], PHILIPPE LEMANCEAU[1] and PASCAL MARGET[1,2]

2. Transformative change & agricultural redesign

Substitution is insufficient to achieve multi-performance





Main system in Burgundy (FR)

CA-SYS: Co-development with scientists, agronomists, farmers and extension/advisors

3. Integrate biological & agronomic research and management across scales

plant-microbe → landscape

Rapport sur la faisabilité d'une expérimentation en agro-écologie du paysage au sein de l'Unité Expérimentale 0115 Domaine Expérimental d'Epoisses

à la demande de la Direction Agriculture et des chefs des départements tutelles de l'UE (BAP, SPE, et EA)

par le groupe de travail :

Marie-Hélène Bernicot, Françoise Burel, Sylvain Plantureux, Jacques Legouis, Pascal Marget, Nicolas Munier-Jolain, Jean Roger-Estrade, Jean-Pierre Sarthou.

Octobre 2013

INRA SCIENCE & IMPACT

Levers at different spatial and ecological scales

Gene

Plant

Population

Community

Interface Field-field

Field-semi-natural habitat

Landscape

Contrasting agroecological contexts

1 **Breeding and evaluation of plant ideotypes for agroecological systems**

Ideotypes that maximise beneficial plant-microbe interactions

2 **Plants/Microbes (beneficial and pathogen) interactions**

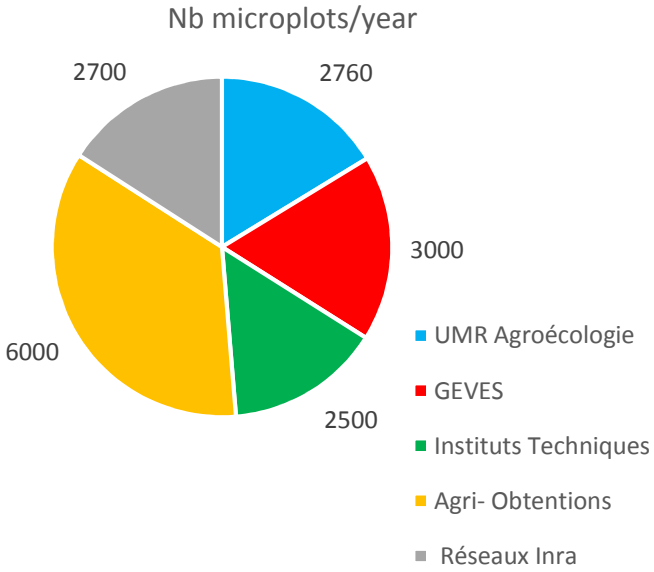
3 **Role of spatial processes for functional biodiversity and biological control**

Spatio-temporal arrangement of agroecological systems to maximise their multi-performance and the production of ecosystem services

4 **Design and evaluation of agroecological systems**

Knowledge contributing to design and development

Breed and assess performance of new crop varieties adapted to agroecological contexts



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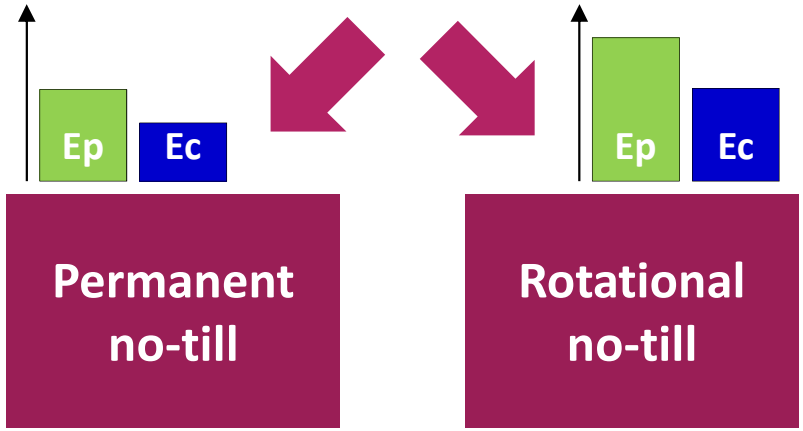
GEVES

Testing four cropping system strategies

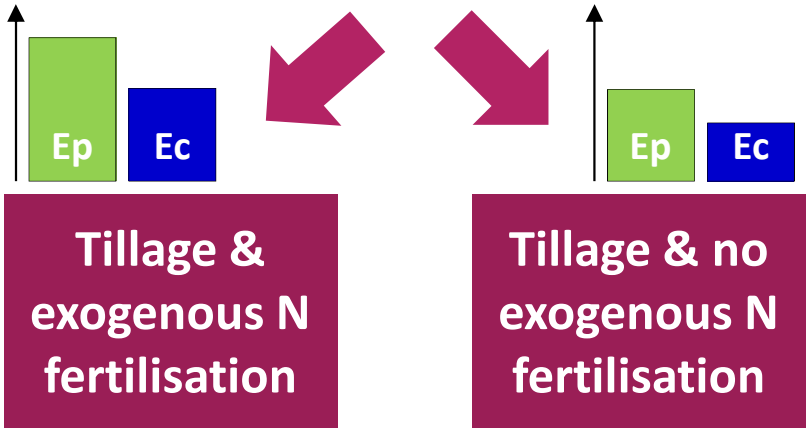
Conservation Agriculture (CA)

Two direct-drilling cropping systems



Tillage (T)

Two plowing-based cropping systems



Energetic efficiency = Ep : Energy produced (productivity) / Ec : Energy consumed

Cover crop-based Organic rotational no-till

Conservation agriculture
- No-till
- Soil cover
- Crop rotation

Rotational no-till
- include strategic tillage at particular timing of the crop sequence

Renewable Agriculture and Food Systems: 27(1); 31–40 doi:10.1017/S1742170511000457

Conservation tillage issues: Cover crop-based organic rotational no-till grain production in the mid-Atlantic region, USA

Steven B. Mirsky[1]*, Matthew R. Ryan[2], William S. Curran[2], John R. Teasdale[1], Jude Maul[1], John T. Spargo[1], Jeff Moyer[3], Alison M. Grantham[2], Donald Weber[4], Thomas R. Way[5] and Gustavo G. Camargo[6]

Weed Technology 2013 27:193–203

Overcoming Weed Management Challenges in Cover Crop–Based Organic Rotational No-Till Soybean Production in the Eastern United States

Steven B. Mirsky, Matthew R. Ryan, John R. Teasdale, William S. Curran, Chris S. Reberg-Horton, John T. Spargo, M. Scott Wells, Clair L. Keene, and Jeff W. Moyer*

The tillage and the cover crop are crucials !!!!

Common strategies of all CA-SYS cropping systems

Manage pests without pesticides

- Rotation
- Soil coverage (crop and cover crop)
- Crop and variety mixture
- Biological regulation
- Increase crop tolerance to biotic and abiotic stress

Long-term économic profitability

- Insertion of profitable crop
- Decrease of production cost (mecanisation, imput, irrigation)

Common strategies of all CA-SYS cropping systems

Good environnemental performances

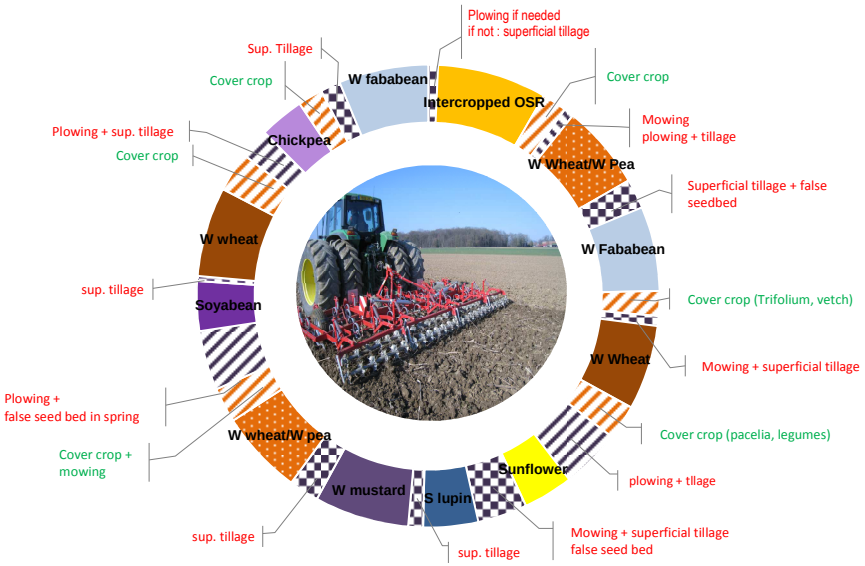
- no pesticide
- use of legumes
- increase carbon stock
- Decrease the use of irriguation

Maximise energetic efficiency

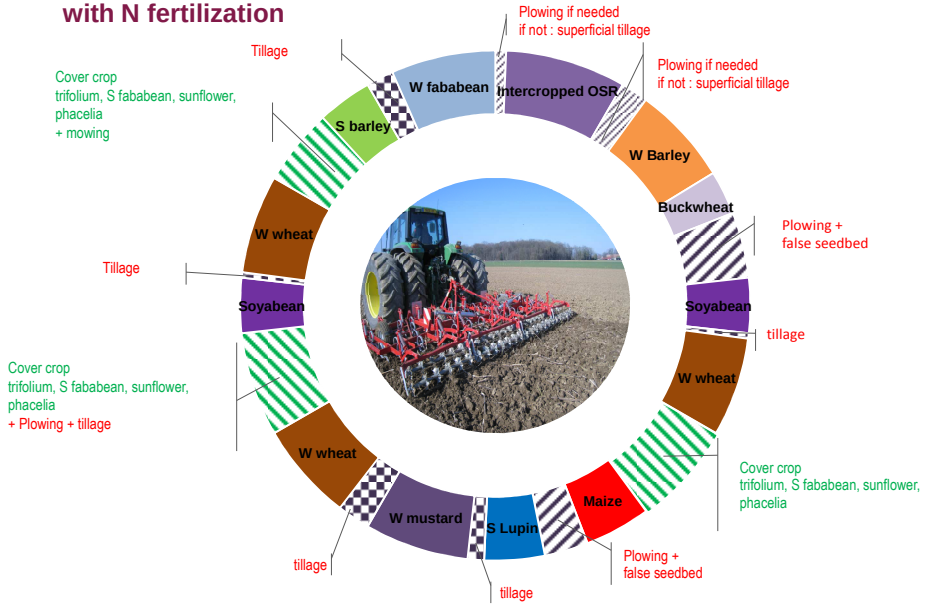
- Increase products
- Decrease costs

Co-designed cropping systems

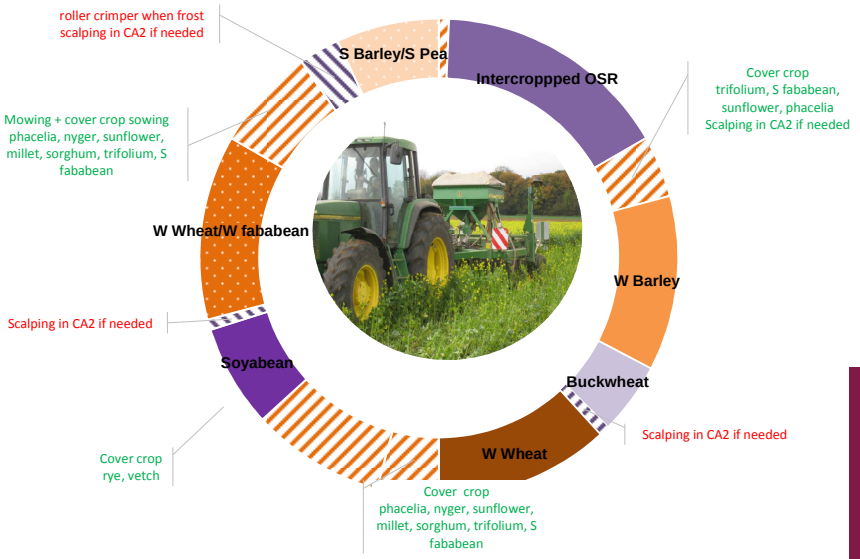
Plowing-based system P2 without N fertilization



Plowing-based system P1 with N fertilization

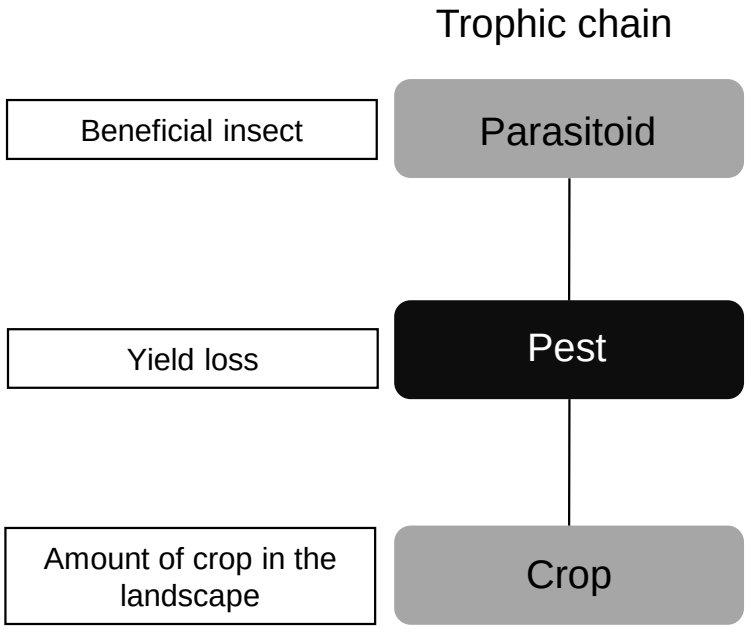


Conservation Agriculture systems CA1 and CA2



4. Field margins & landscape context

ex. Biocontrol of insect pest



Tersilochus heterocerus

Phradis morionellus

Phradis interstitialis

Meligethes aeneus

Brassica napus

CA-SYS = transformative landscape change

Landscape structure = field shape and size

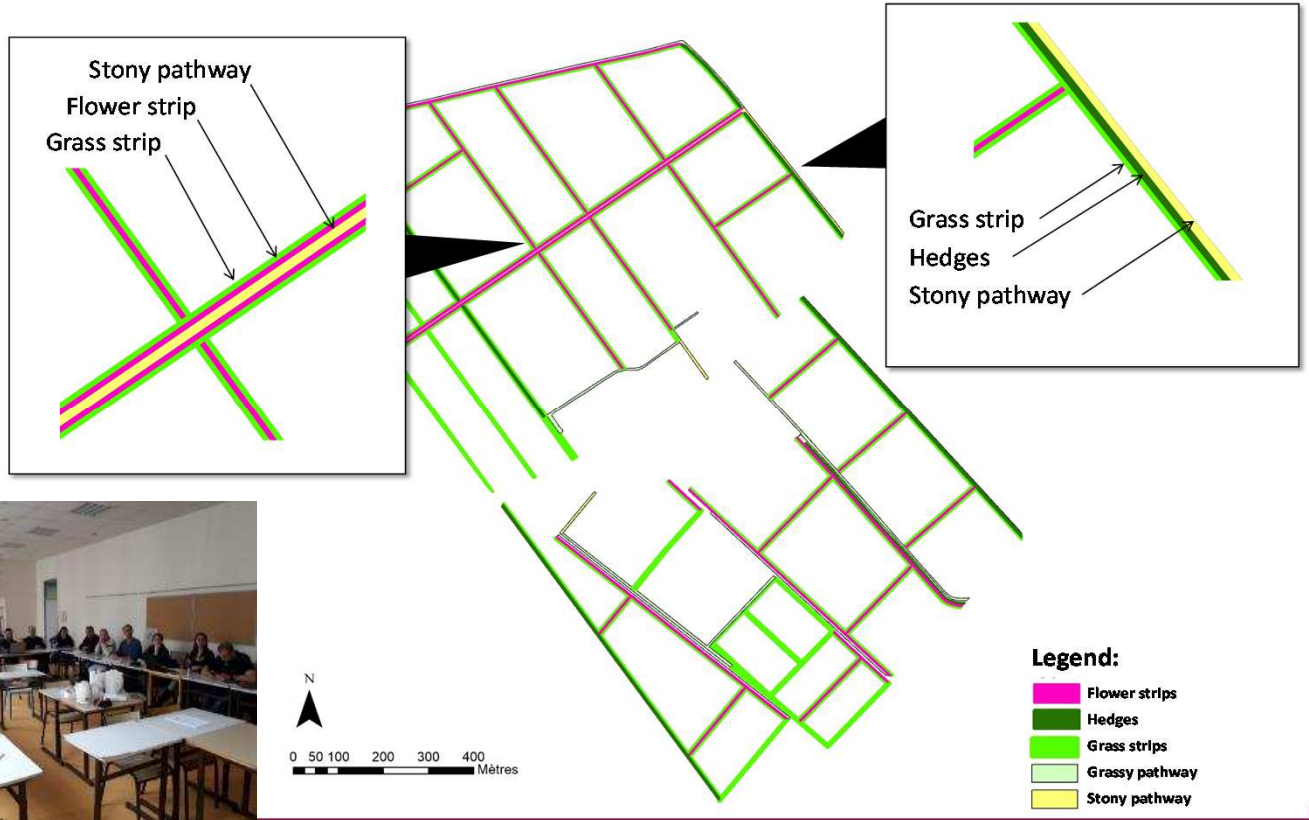
Landscape context of field = semi-natural habitat

Landscape composition = diverse farming practices

Semi-natural habitats of CA-SYS

Maintenance of habitats & resources for beneficial insects over the year

- ***Flower strips:*** *2.9ha of 36 species*
- ***Grass strips:*** *7ha of 6 species (perenial grass & legumes)*
- ***Hedges:*** *3.4km of 15 species (trees and shrubs)*



Hay cutting in grass strips of CA-SYS

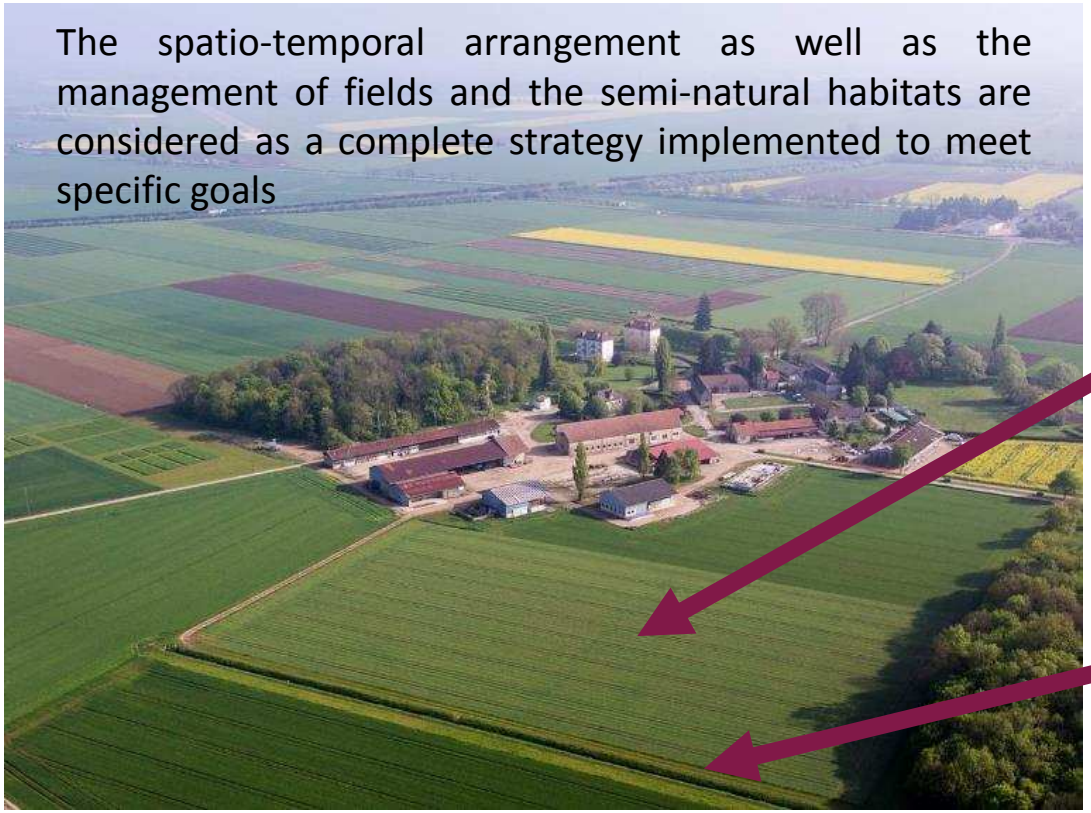
5. Coherent integration of within field and margin management

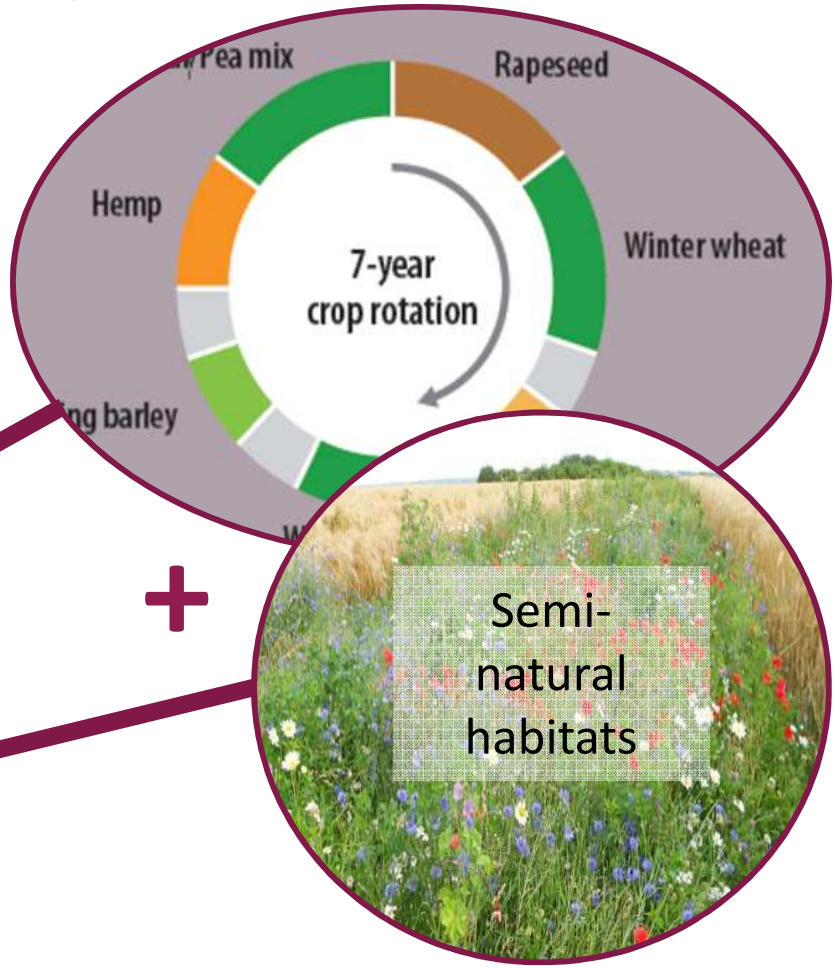
Semi-natural habitat × cropping systems ? beneficial insect ? biological regulation ? reduce insecticide ?

CA-SYS is an Agroecological Systems Experiment

- **Design** and **assess** agroecological systems

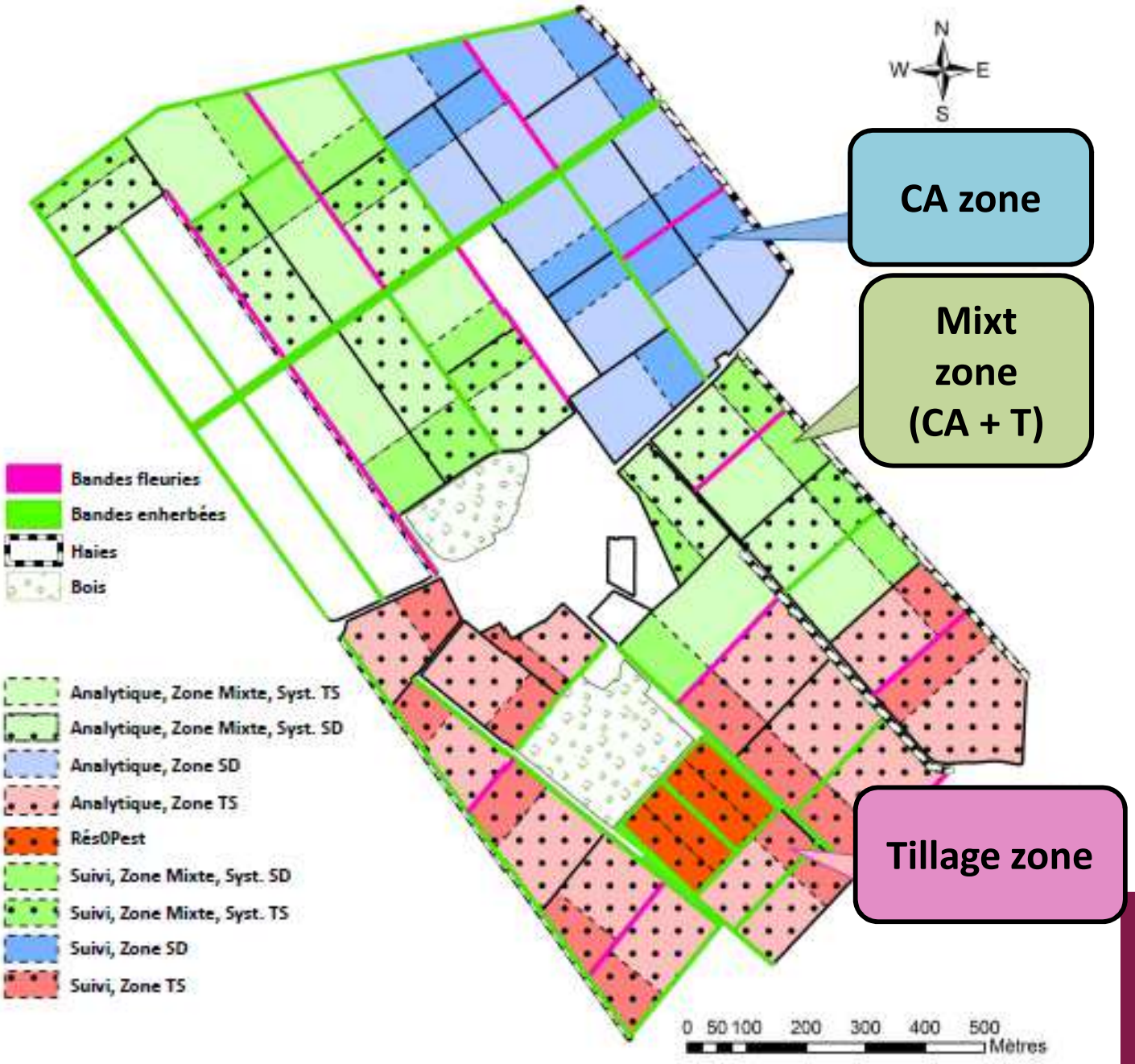
The spatio-temporal arrangement as well as the management of fields and the semi-natural habitats are considered as a complete strategy implemented to meet specific goals





Cordeau S., Deytieux V., Lemanceau P., Marget P., 2015. Towards the establishment of an experimental research unit on Agroecology in France. Aspects of Applied Biology 128: **Valuing Long-Term sites and Experiments for Agriculture and Ecology**, 271-273.

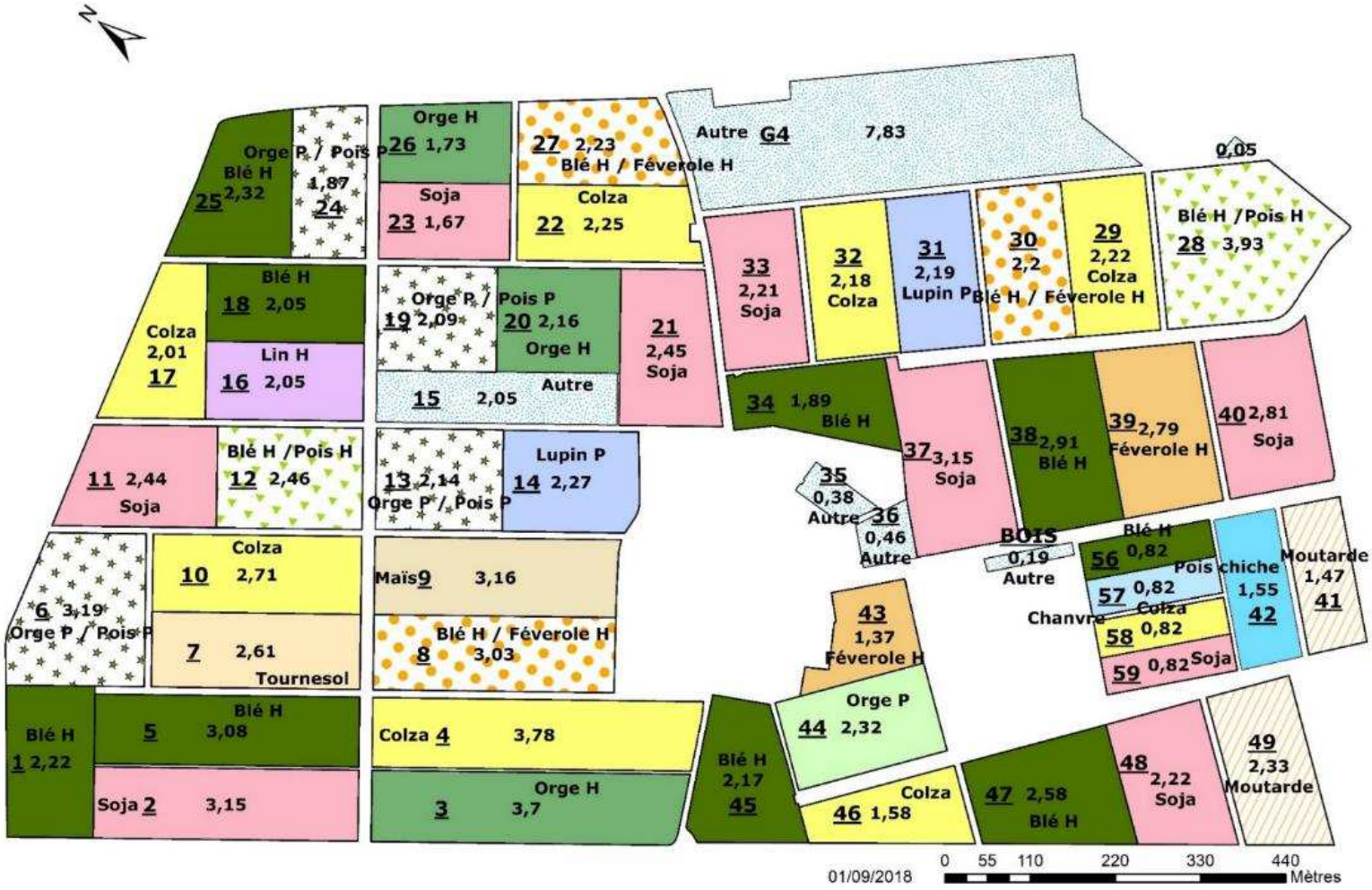
Map of the experimental site of CA-SYS (125ha) since the summer 2018



Outlets required for diverse crop and crop mixtures

ex. 200t/year of crop mixtures to be sold to the local cooperative

Rotation 2018-2019

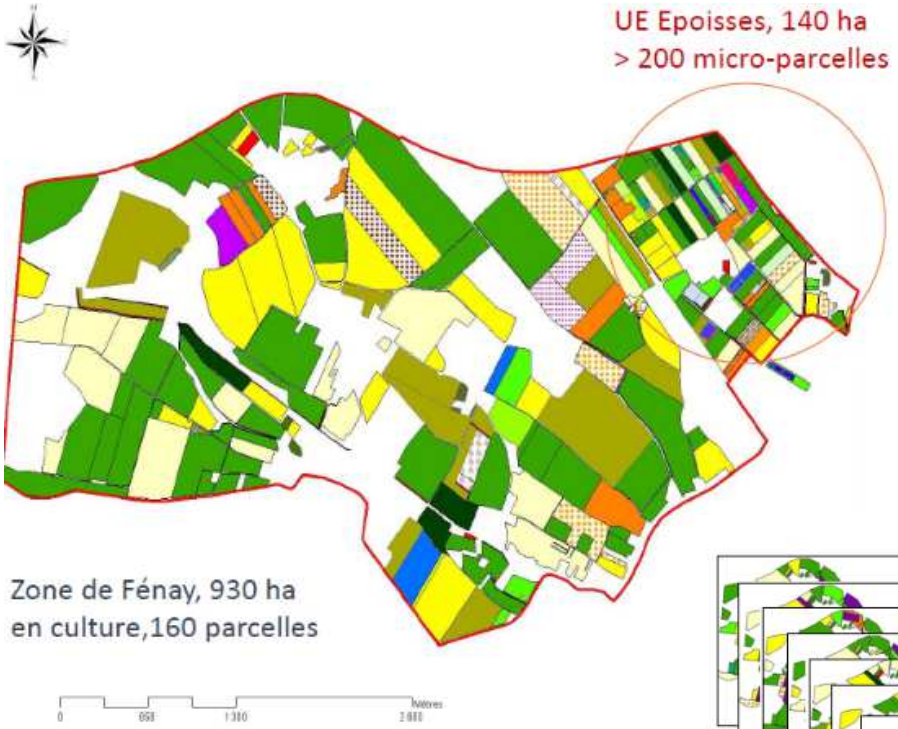


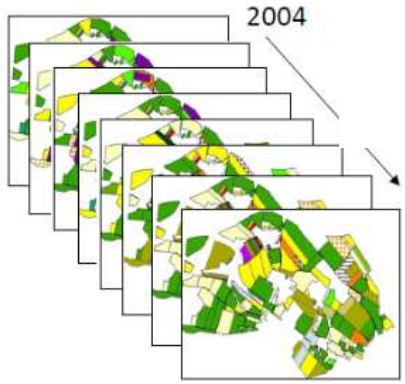
2018, Oct 19

2019, Feb 08

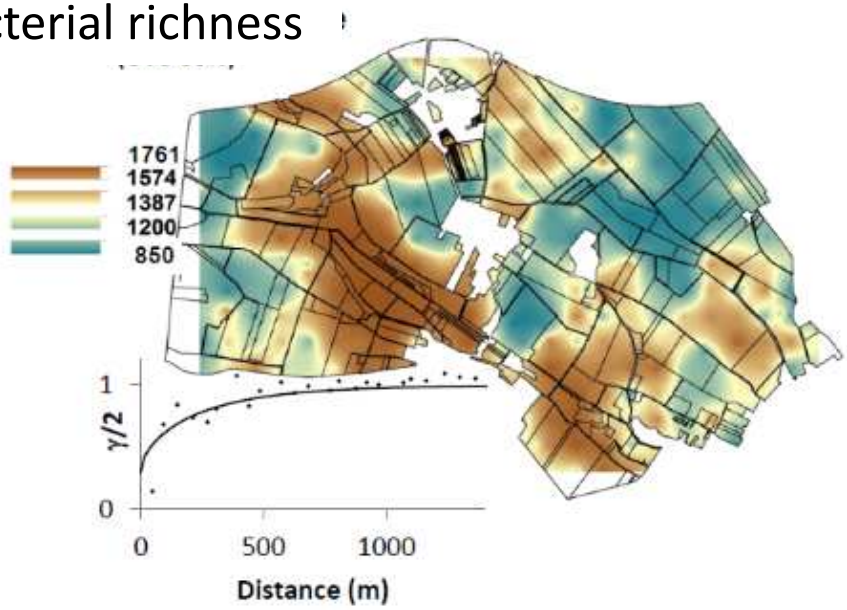
To study the transition toward agroecological systems …

- A need for a reference or baseline state?

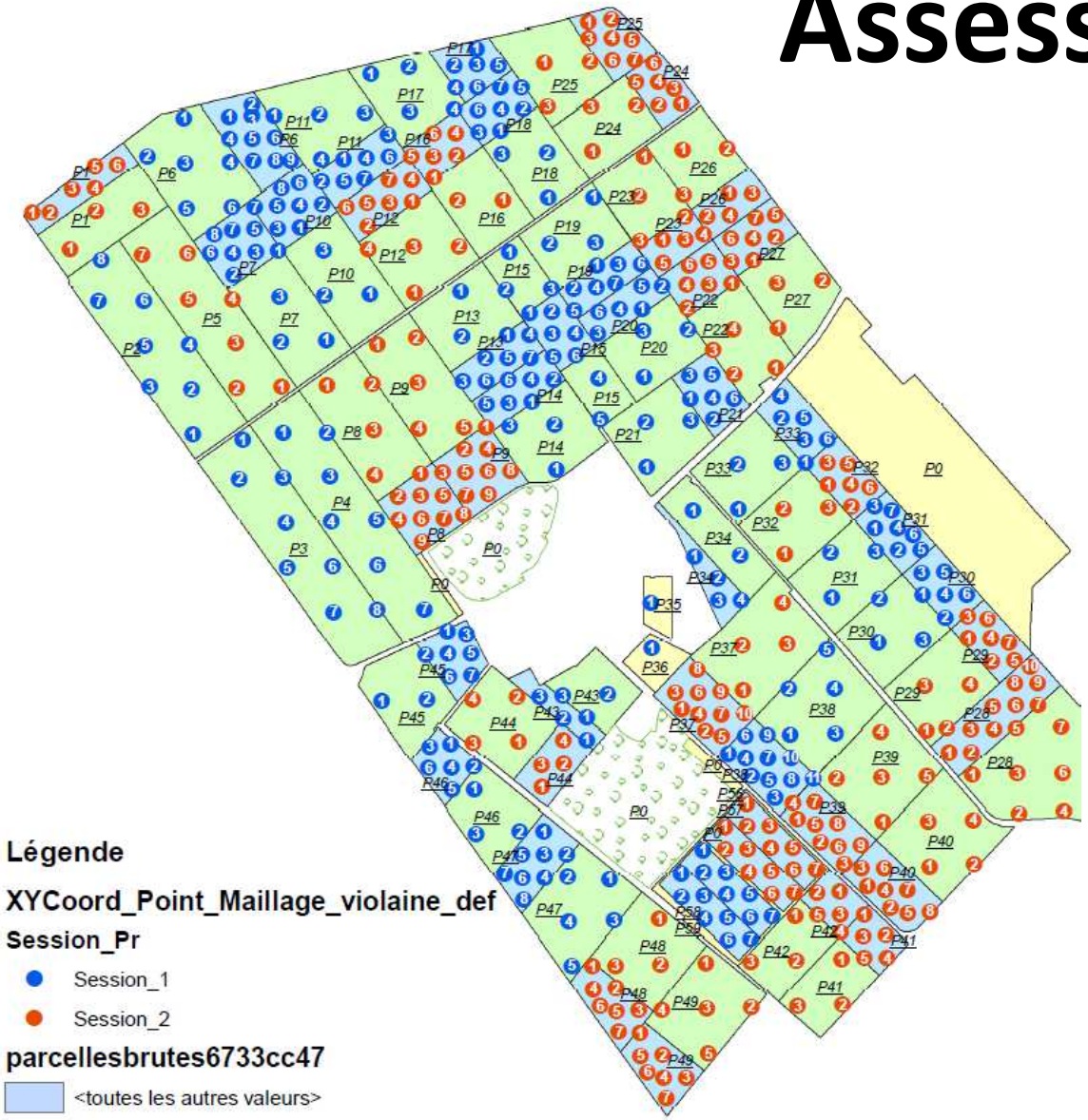




Bacterial richness



Assessment of the CA-SYS baseline 504 points



35m x 35 m grid
70m x 70m grid

Weed seedbank
Microbial diversity
Enzymatic activity
Physical and Chemical analysis

GenoSol PLATEFORME

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Biochem ENV

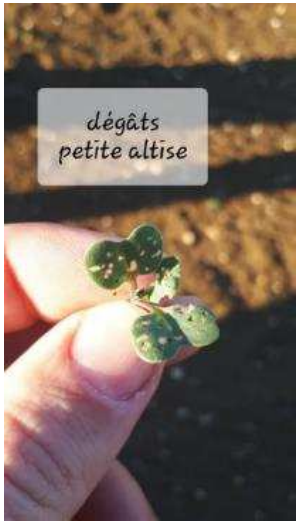
A wide variety of field measures to assess the performance

Farming practices

Yield and quality

Pests & damage

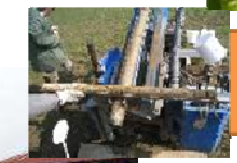
weeds and yield loss



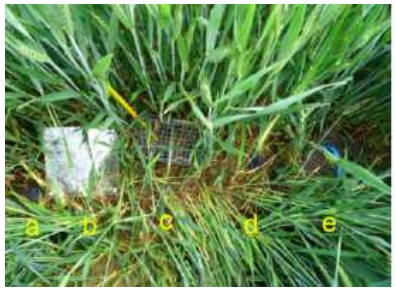
Crop growth

Natural biocontrol

Pollinators



Microbial diversity
Carbon stock
N20 emission

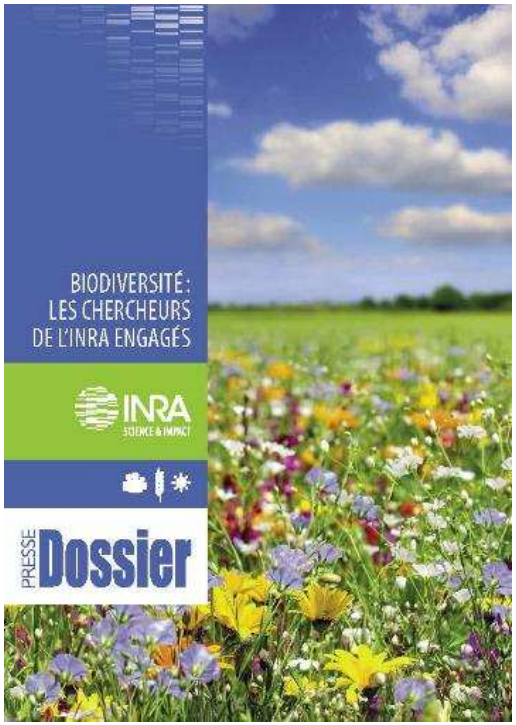


Take home message

The CA-SYS Platform is:

- **an Agroecological Systems Experiment**
  - open-field farming without livestock
  - contrasted with current practices
  - co-designed with farmers and extension workers
  - a high density of semi-natural habitats
- **with Nested Experimental Designs**
  - including analytical, systemic and landscape
  - to increase interdisciplinary research
- **and a Collaborative Open Platform**
  - to facilitate sharing, transparency, data access, …

Good tool to transfer ideas to stakeholders and politician



Good tool to discuss ideas, methods, results with farmers and extension

To follow us …

www.inra.fr/plateforme-casys

@CASYSdijon

Acknowledgements:

L'Inra prépare activement l'agriculture de demain

RÉGION

RésOpest, huit sites pour tester le zéro pesticide

Un projet I-Site pour multiplier les points de vue de l'agroécologie