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

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Valuing long-term sites and experiments for agriculture and ecology

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Abstract

Agroecology is today a source of numerous publications defining the term as a science, a movement or a set of practices (Wezel *et al*., 2009, 2014). Indeed, agroecology involves various approaches. Following political and scientific commitments the French National Institute for Agricultural Research (INRA) ranked agroecology among its top two research priorities for the 2010–2020 period. To develop ambitious and large-scale experiments on an experimental research unit, the Joint Research Unit (JRU)'Agroecologie' (Dijon, eastern France), associated with the Experimental Research Unit Dijon-Epoisses (20 km next to Dijon), has laid the foundations for a future experimental site. This will focus on work that links across various scales (from the organisms interactions to the landscape scale) and will welcome research on a range of topics (among those of the Joint Research Unit 'Agroecologie' and the experimental research Unit Dijon-Epoisses).

With its 130 ha divided into 70 fields, all drained and irrigable, the Unit Dijon-Epoisses carries out research at field scale in agronomy, ecology, genetic and agroecology. Currently, the current two major challenges of the experimental unit are to improve crop varieties of various crops to meet the future needs of farmers and to evaluate innovative cropping systems with low inputs, promoting integrated pest management. Indeed, the historic mission of the Unit was to support work on crop selection with a high number of experimental micro-field plots. For 35 years, the experimental unit has studied legumes, cereals, and forage crops. The diversity of crop species on site is still high: wheat, barley, oat, corn, faba bean, lupin, oilseed rape, sugar beet, mustard etc. The second main task of the unit is to develop, evaluate and design innovative cropping systems less reliant on pesticides. It thus responds to the major current issues related to food security and environmental protection. Since 2000, on the Unit (Fig. 1), the JRU 'Agroecologie' has carried out a long-term cropping system experiment testing five innovative weed management systems (Chikowo *et al*., 2009; Cordeau *et al*., 2014). In addition, since 2012, the Rés0pest project has tested pesticide-free cropping systems across a network of eight sites in France among Dijon-Epoisses.

The Dijon-Epoisses experimental site (Fig. 1) is surrounded by important physical elements including the highway, the Burgundy canal and a railway line. There are some landscape elements, 6 ha of woods, many grassy ditches, many sown grass margin strips (5 m wide, 2.46 ha), 5 field margin flower strips (0.15 ha), grass paths (1.47 ha) and a young hedge (260 m, 0.11 ha) established in 2012.

In Dijon, a working group composed of 40 agronomists, weed scientists, plant and microbial ecologists, pathologists, ecophysiologists, geneticists and field experimenters are currently working to select and link their research topics in the design of the site. The questions are likely

to deal with the trade-offs between ecosystem function/services (e.g. design and evaluation of cropping systems maintaining agricultural production in terms of food quality and quantity with environmental-friendly practices), the underlying processes occurring in fields in agroecological systems (plant-microbe interactions, effects of above- and belowground organisms on plant diversity and ecosystem processes, genotype / environment interactions, biological regulations of pest and disease, weed management with biological regulation and biocontrol), etc.

Fig. 1. The INRA Dijon-Epoisses experimental site. W: woods; IWM: Long-term experiment on Integrated Weed Management cropping systems (since 2000) and 0-pesticide: Long-term experiment on Pesticide-free cropping systems (since 2012); sown grass margin strips shown by dark lines at field edges

The research tool provided by the site will allow prospective and innovative approaches to be combined. It will contain, juxtaposed or nested, analytical (factorial design), cropping system (systemic design), and landscape experiments (Fig. 2). The juxtaposition of experiments may be used to study targeted processes at the intra-field scale (e.g. plant-plant, plant-microbe, plant-pest relationships) in different surrounding landscape contexts (e.g. with or without semi-natural habitats). The nested experiments can be used to study the intra-field processes occurring within various cropping systems, e.g. conventional tillage *vs* no-till systems and also be used to study the effect of the same cropping systems in various surrounding landscapes (e.g. with or without semi-natural habitats).

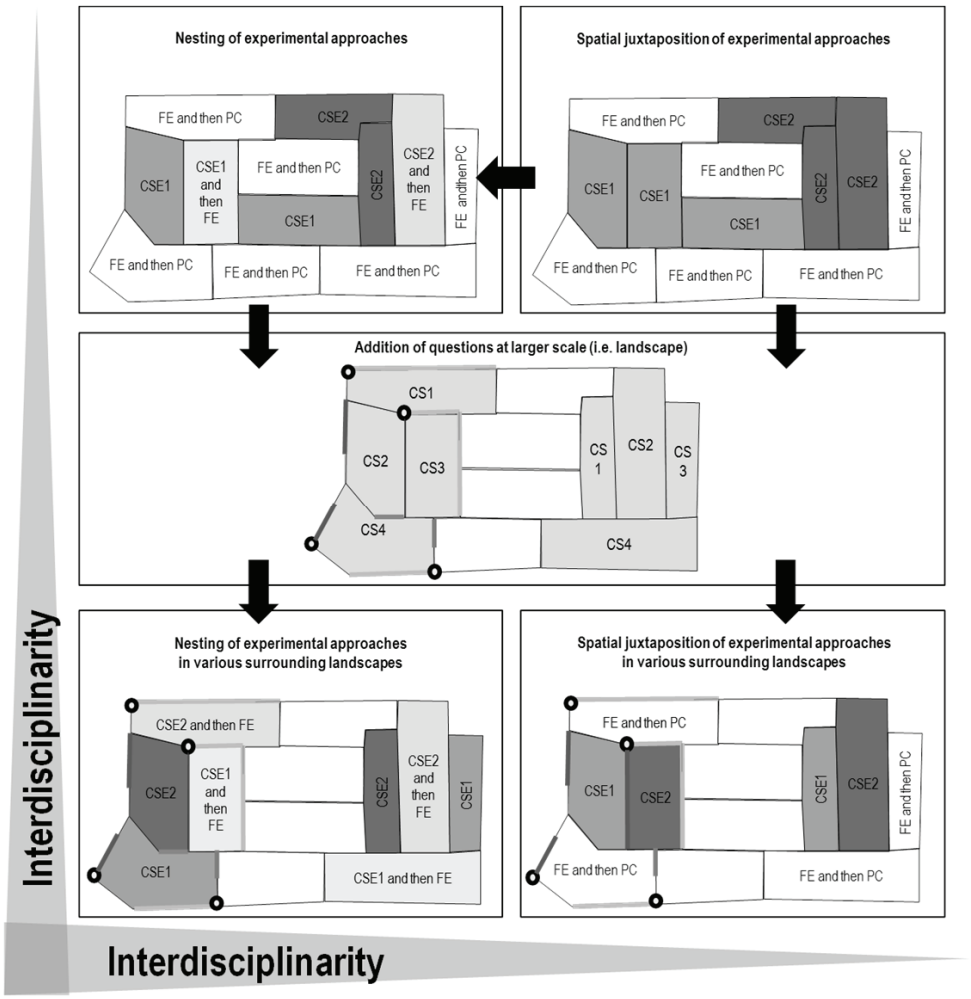

Fig. 2. Various scenarios of spatio-temporal arrangement of factorial experiments (FE), with preceding crops (PC) used to homogenize the field for the FE, cropping system (CS1, CS2, CS3, CS4) and cropping system experiment (CSE1, CSE2). Lines and dots represent semi-natural habitats.

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