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## Plant based-diversity practices in conventional and organic farming: a farmers' survey in france

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**Key words:** plant-based diversity, cropping practices, France, survey

### Abstract

*Enhancing plant-based diversity within agroecosystems might help designing more resilient and low-input agricultural systems. The objectives of this study were (i) to describe the plant-based diversity practices (ii) to identify the farmers' motivations to apply them and (iii) to compare their application in organic or conventional farming systems. The survey was carried out in five French regions with 196 farmers that apply at least one plant-based diversification practice. Five diversification practices were studied. Simultaneous intercropping and agroforestry are less applied compared to catch crops and semi-natural landscape elements because they imply a deeper change in the cropping system. Organic farmers apply more often simultaneous intercropping and agroforestry and 40% of them applied more than 4 diversification practices (compared to less than 20% of the conventional farmers). Organic farmers seem thus to be a step further on the path transition towards agroecological systems.*

### Introduction

Nowadays, agriculture has to face up different global changes such as climate change, consumers' expectations in terms of product quantity and quality, environmental impacts and inputs availability and cost. This changing environment leads farmers to make changes in their cropping and farming systems. The collective awareness on the impacts of agriculture on environment and human health requires designing more resilient and low-input agricultural systems. Several authors highlight that enhancing diversity into the agroecosystems, either by adding species and/or varieties into existing systems or by a complete redesign of the cropping system (i.e. combination of innovative practices and management of the system), may be an efficient way to achieve this objective (Altieri, 1999; Malézieux et al., 2008; Griffon, 2010; Médiène et al., 2011; Wezel et al., 2013). This diversification could occur both in time (e.g. including cover crops in rotations, lengthening crop rotations by adding new crops) and/or space (e.g. agroforestry, semi-natural landscape elements, intercropping) (Malezieux et al, 2008; Médiène et al, 2011; Wezel et al, 2013).

The challenge of designing more resilient and low-input systems is at stake for both conventional and organic farmers although organic farmers are already more aware to cropping system management with low inputs. According to IFOAM (2008) organic farming "*relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects*". Thus, it could be assumed that, compared to conventional farmers, organic farmers are more widely applying diversification practices in their farming systems.

The objective of this study was to describe plant diversification practices implemented in organic and conventional farms in France and identify motivations which drove farmers to perform such practices. The second objective was to compare the integration of such practices in organic and conventional farming systems and assess if organic farmers are more likely to apply such practices.

### Material and methods

A survey was carried out in 2012 with 196 farmers (51 farmers in organic) in five French regions, ranging from 35 to 42 farmers in each region (Aquitaine, Midi-Pyrénées, Nord-Pas de Calais, Pays de la Loire, Rhône-Alpes) (Fig. 1). These farmers have been selected because they were considered as innovative as they were applying at least one of the following diversifying practices:

(1) Diversified crop rotations: crop rotations that include more than 3 different cropped species; (2) Simultaneous intercropping: cultivation of two or more crops in the same field at the same time (same date for sowing and harvest); (3) Cover cropping: short cycle crops that are cultivated between two main crops of

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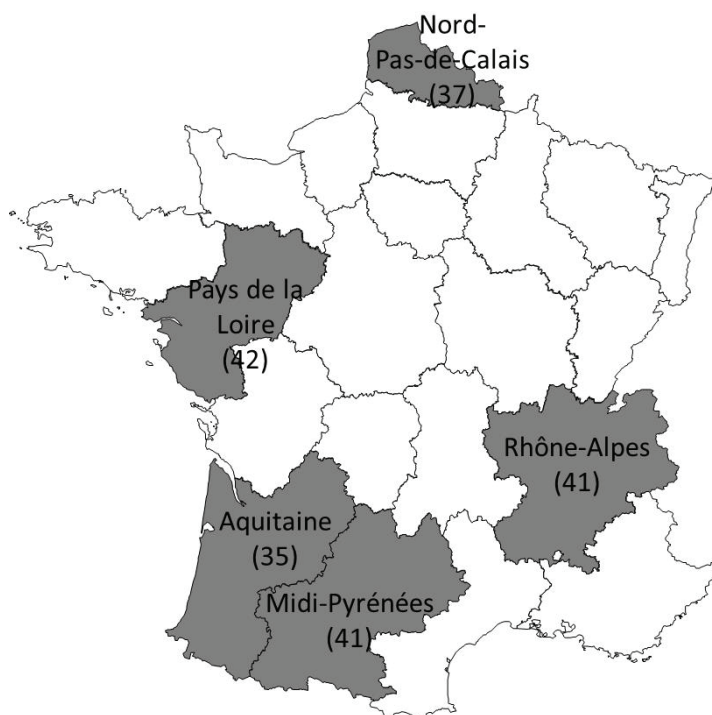
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the rotation, they could be temporarily associated with main crops; (4) Agroforestry: combination of trees with cash and/or forage crops on the same plot; (5) Semi-natural landscape elements: integration and/or management of semi-natural landscape elements such as hedges, vegetation strips, either within or around the field.



**Figure 1. The five surveyed regions (grey colour, number of interviewed farmers within brackets)**

These farmers were identified thanks to various farmers' networks. Phone interviews with farmers were performed during autumn and winter 2012 to fulfill a questionnaire with closed-ended questions. The questionnaire encompassed general information about the farm, detailed description of crop rotations (including cover cropping and simultaneous intercropping), and general information about crop management (fertilisation, tillage, irrigation and pest and disease management). It also addressed farmers' motivations for applying diversification practices and their satisfaction with regard to agronomic and socio-economic effects of the practices on the farming system. Finally, we identified their information sources for each practice (e.g. networking, advising services). We performed student tests to check the effect of organic farming on diversifying practices.

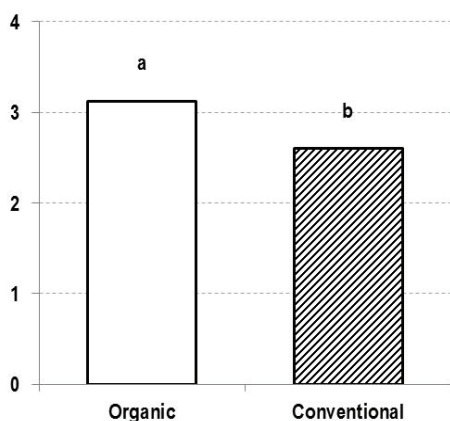
## Results and discussion

Cover cropping and semi-natural landscape elements are the most widely applied practices with 85% and 80% of organic and conventional farmers applying them, respectively (Fig. 3). The third ranking practice is the diversified crop rotations (66% of farmers). Simultaneous intercropping and agroforestry are less applied with 37% and 6% of farmers applying them, respectively. The wide application of cover cropping in France may be linked to the regulation on vulnerable water areas where bare soils are prohibited. Indeed 67% of farms applying cover cropping are located on nitrate-vulnerable zones. Nevertheless, only 39 of the 167 interviewed farmers applying cover cropping cited the regulatory constraint as their main motivation and none of them are organic farmers. The presence and maintenance of semi-natural landscape elements are also frequently found in the farmers' answers. This is linked to the French regulations (buffer strips close to rivers), and also because the management of existing hedgerows does not require a lot of change in farming systems.

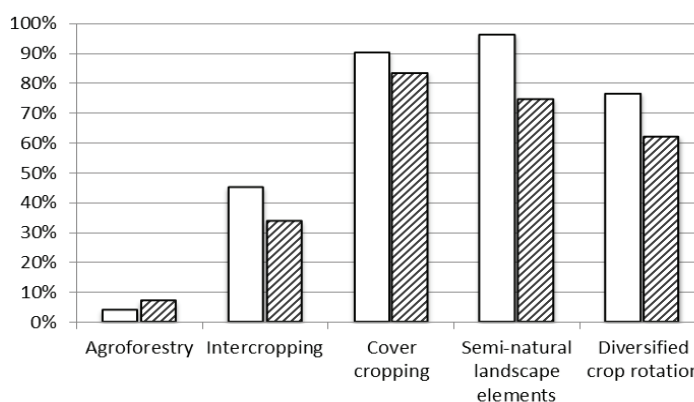
Interviewed farmers are applying simultaneously from 1 to 5 of the previously listed practices. Ten percent of farmers are applying only one practice: cover cropping (42% of them), semi-natural landscape elements (32% of them) or diversified crop rotation (26% of them). Such practices generally do not imply a large redesign of the farming systems (Wezel et al., 2013). That makes them probably easier to implement. Seventy-seven percent of interviewed farmers are applying 2 or 3 practices (respectively 27 and 40%). Most of the farmers (77%) that are applying two practices combine cover cropping with another diversification practice. When 3 practices are combined in the same farm, the main combination is cover cropping, semi-

natural elements and diversified rotation (65%). Twenty-two percent of farmers combine 4 diversification practices. In such configuration, they usually combine cover cropping, semi-natural elements and diversified rotation with simultaneous intercropping (84% of farmers that apply 4 practices), with this last practice considered as a more complex diversification practice than the others (Wezel et al., 2013). Only one farmer is applying the 5 selected diversification practices, including the four previously discussed and agroforestry. This survey seems to highlight how agroforestry and, to a lesser extent, simultaneous intercropping are the most complex plant diversification practices, since only low fraction of surveyed farmers implement them.

The comparison of organic and conventional farmers interviewed in this survey highlighted that organic farmers apply a significantly higher number of diversification practices ( $3.11 \pm 0.27$  and  $2.61 \pm 0.15$  respectively) (Fig. 2). With the exception of agroforestry practices, the rate of application of each practice was also slightly higher for organic farmers than for conventional farmers (Fig. 3). The difference between organic and conventional farms was larger for cover cropping, semi-natural elements and diversified rotation (Fig. 3). This shows that most of the organic farmers have already integrated these 'less complex' practices in their farming systems. The diversification is already well integrated by organic farmers as a tool to enhance sustainability of their farming systems. Indeed, the combination of at least 4 diversification practices is performed by 40% of the organic farmers while the ratio is lower than 20% for the conventional farmers. This seems to confirm that organic farmers implement more plant based-diversity practices into their systems, compared to conventional farmers, allowing low input cropping systems.



**Figure 2. Average number of diversification per farmer (student test, p-value <0.05)**



**Figure 3: Rate of organic (white bars) and conventional (dashed bars) farmers applying each type of plant diversification practices**

## Conclusions

This study revealed that the two most common diversification practices applied in the five surveyed regions are cover cropping and semi-natural elements. Most farmers of our sample (63% of total sample) combine at least 3 of the 5 selected diversification practices on their farm. The complexity of diversification seems to correlate with the number of combined practices: cover cropping, semi-natural elements and diversified rotations being the simplest practices to implement and agroforestry, and to a lesser extent intercropping, being more complex to apply. Finally, we showed that organic farming systems use more plant-based diversity practices than the conventional method, suggesting that they have higher cultivated plant species in their cropping systems. This may place them in a better position regarding the current context of agroecology development and biodiversity concern in France.

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