

## Diversity of conservation agriculture practices among European organic farmers "TILMAN-ORG session"

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**Key words:** conservation agriculture, European organic farmers, survey, diversity of practices

### Abstract

*The interest of organic farmers for adopting conservation agriculture practices is currently growing. But, there are few technical and scientific references available for organic farmers when they start applying conservation agriculture practices. The main objectives of this study are (1) to explore the diversity of crop management practices using conservation agriculture methods among European farmers, and (2) to identify main farmers' strategies. We carried out a survey of 159 farmers located in 10 European countries. Data were analysis to identify groups of farmers that share the same type of spring and winter crop managements. Organic farmers in Europe show very diverse crop management. The high diversity of crop management can be described by two main strategies: 'low soil cover' and 'soil conservation' strategy. Distinct geographical distribution of both strategies suggests that applicability of conservation agriculture practices is strongly context oriented.*

### Introduction

The interest of organic farmers for adopting conservation agriculture practices is currently growing. Conservation agriculture relies on 3 main concepts: (1) Minimum soil disturbance; (2) Diversified crop rotation and (3) Permanent soil cover (use of green manure). These practices aim at preserving soil fertility. Nevertheless, conservation agriculture has major constraints in organic farming, such as weed control (Peigné et al., 2007). As organic cropping systems are very different from conventional ones, there are few references available for organic farmers when they start applying conservation agriculture. The main objectives of this study are (1) to explore the diversity of crop management practices using conservation agriculture methods among European farmers, and (2) to identify main farmers' strategies. Results from this study performed as part of the CORE Organic project TILMAN-ORG will help researchers to understand what farmers do and might inspire them for further experiments.

### Material and methods

We carried out a survey with 159 organic farmers located in Estonia, Germany, United Kingdom, Ireland, Belgium, France, Switzerland, Austria, Italy and Spain. Selected farmers are applying at least two of the three conservation agriculture techniques:

- (i) No-tillage: a conservation tillage practice in which the crop is sown directly into soil not tilled since the harvest of the previous crop.
- (ii) Reduced tillage: Any tillage practice with a depth shallower than the conventional practice and/or a non-inversion method such as chisel ploughing.
- (iii) Green manures: any crop that is grown primarily or solely for the purpose of soil protection and improvement including: increasing soil N supply to the subsequent crop, increasing soil organic matter,

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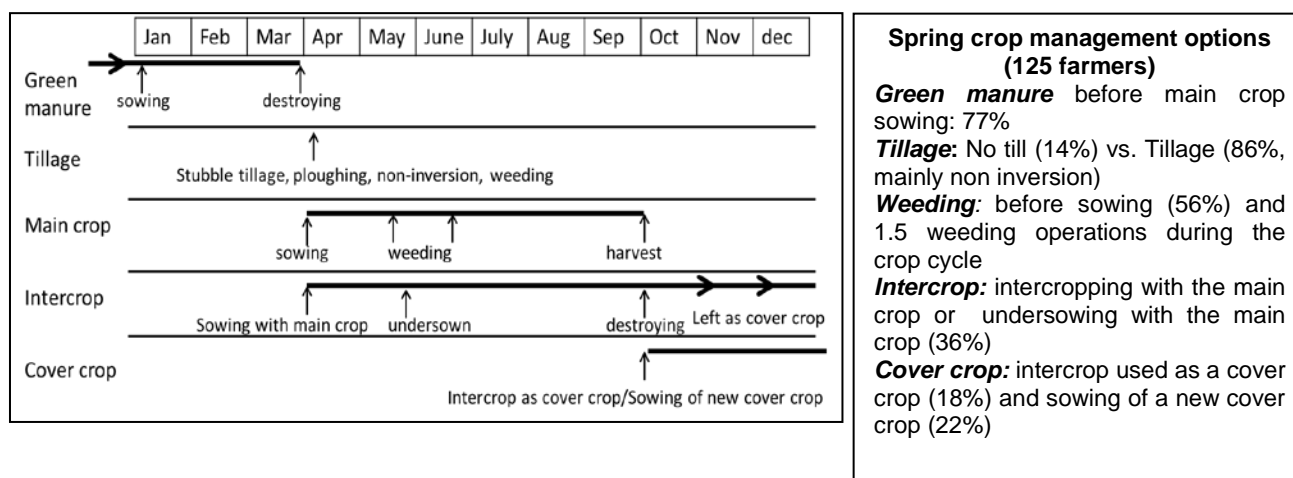
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regulating the populations of pests and diseases, reducing competition by weeds in subsequent crops, and minimizing soil erosion.

A questionnaire with closed-ended questions was filled by farmers. Crop management practices were described for one winter crop and/or one spring crop by farmers. They detailed the crop cycle by five successive steps: (1) operations before sowing (green manure, weeding, stubble cultivation, and soil tillage), (2) sowing of the main crop, (3) operations after sowing and before harvest (weeding, green manure management if present), (4) harvest and (5) operations after harvest (stubble cultivation, green manure sowing and destruction). For each operation, farmers detailed: type and date of application, used machinery, and depth of tillage. In order to get the same data photos of machinery with a lexicon were provided to the investigators. We collected all the answers of the farmers and carried out a Multi Factor Analysis (MFA) followed by clustering to identify groups of farmers that share similar crop management respectively for winter and spring crops. We analysed such crop management groups to identify common strategy within the groups.

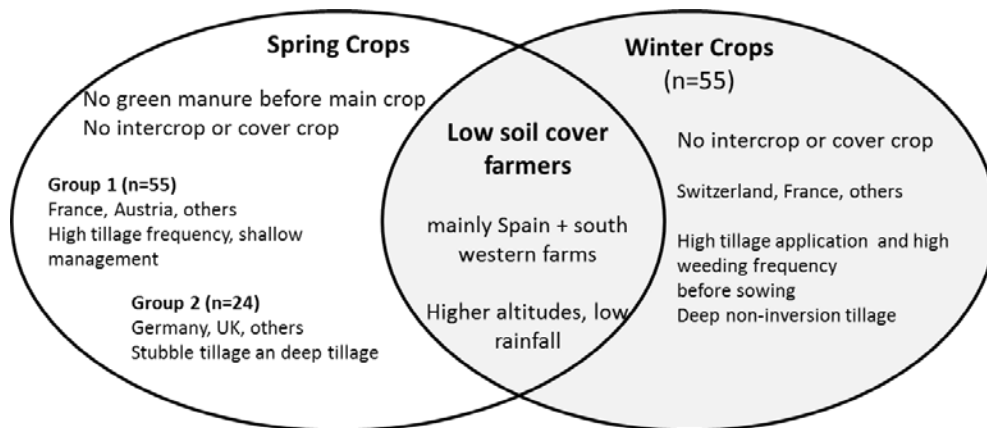
## Results

Among the 159 interviewed farmers, we collected 117 and 125 winter and spring crop management descriptions, respectively. The main winter crop type was cereal, while other crop types, such as field vegetables or legumes were not widespread. The most frequent preceding crop was cereal (36%) or legume (29%), similarly to the following crop which was also mostly cereal (38%) or legume (17%) or cereal+ legume (12%). 55% of farmers have mainly sown a leguminous green manure before main winter crop. The main spring crop types were 43% cereal, 21% legumes, 15% field vegetables, 13% oilseed crops and 8% other crops. Preceding crop was usually a cereal (54%) or a legume (28%), similar to the following crop with mostly cereals (44%) or legumes (29%). 77% of farmers have sown a green manure before the main spring crop, the green manure was often a legume crop in combination with another type of crop (*Brassica sp.*, grass) (43%), or a pure legume crop (35%), although *Brassica sp.* was also present (7%). As shown for spring crops in the figure 1, there was a large diversity of crop management options ranging from deep tillage without soil inversion to no-till. The same diversity was found for winter crops.



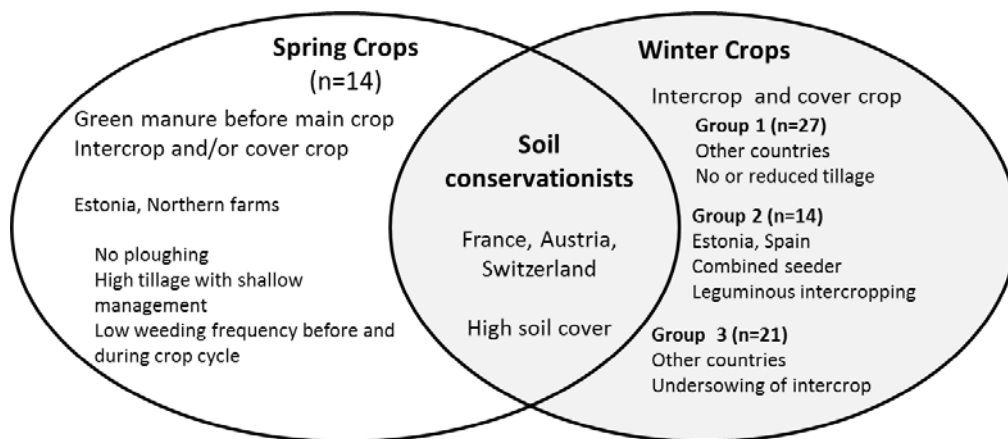
**Figure 1. Range of crop management options of spring crops from the farmers' survey** - On the left side of the figure, the graphs show the range of different recorded farmers' practices - On the right side of the figure, we indicate the percentage of farmers applying each practice among the interviewed farmers.

MFA and cluster analysis provided groups of farmers sharing similar crop management for winter and spring crops, respectively. Figure 3 shows that there were similar strategies when comparing the groups of the two types of crops (spring and winter sown). The combination shows two main strategies when farmers used conservation agriculture techniques: 'the low soil cover' strategy and 'the soil conservation' strategy.



**Figure 2. 'Low soil cover' strategy for spring and winter crops: no or very limited use of green manures in the crop management** – Each oval represents a group of farmers with similar crop management—intersection represents common characteristics

The 'low soil cover' strategy was characterized by the lack of intercropping, green manure and intensive tillage application (Fig. 2). Farmers mostly came from the mountainous areas in Spain, but also from other European countries (e.g France, Austria, Switzerland). This strategy brings together farmers who did not apply green manure or cover crops. This kind of management increased the frequency of weeding applications to cope with weed pressure. Soil cover was expected to be higher in the Southern countries to reduce erosion losses. But low precipitations and high altitude can lead to a scarcity of water resulting in competition between the main crop and possible intercrops. Soane et al. (2012) suggested, that main benefit of reduced- tillage in Southern Europe could be water conservation, however the weed pressure seems to be a strong constraint in organic farming where there is no herbicide option. The detrimental effects of low soil cover on weeds could be somewhat compensated with stubble tillage and deep non inversion tillage practices in this strategy.



**Figure 3. 'Soil conservation' strategy for spring and winter crops: a lot of green manures are included in crop management** – Each oval represents a group of farmers with similar crop management—intersection represents common characteristics

The 'soil conservation' strategy was characterized by the intensive use of green manure before sowing the main crop, intercropping and/or cover crop after harvest (Fig. 3). A common feature of this strategy was the use of reduced intensity in tillage practices. Most of the farmers sharing this strategy were from France, Austria and Switzerland. Estonian farmers and farmers from northern Europe were also part of this group. Generally, medium or low weeding frequencies were recorded. In this group, the generally high soil cover, mainly with the use of green manures probably enhances weeds suppressing due to competition or allelopathic effects (Köpke and Schulte, 2008).

## Discussion

Organic farmers in Europe, applying conservation agriculture practices, show very diverse crop management. Indeed the high diversity of crop management can be described by two main strategies: 'low soil cover' strategy and 'soil conservation' strategy. Distinct geographical distribution of both strategies suggests that applicability of conservation agriculture practices is strongly context oriented and thus related to environmental conditions (precipitations, temperature) and available technology and knowledge.

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