

## Valorising European Research for Innovation in Agriculture and Forestry



### VALERIE Stakeholder Trials:

## Sustainable innovative practices in the central region of France: a focus on soil structure assessment in the field

#### The problem

Arable farming in Berry, in the central region of France (departments of Indre and Cher), is characterised by oilseed rape, wheat and barley grown in rotation. Over the last 20 years yields have been decreasing or stagnating. An agronomic diagnosis (2005-2012) based on 500 agricultural plots linked the problem to short rotation, weeds and pests (especially insects). The quality of the seed planting phase, germination, rooting and weed infestation, as well as crop growth in the autumn, were identified as the main factors limiting potential crop yield. To tackle the short rotations identified as responsible for recurrent weed and insects problems, farmers have gradually shifted towards simplified tillage in terms of number of operations and working depth. However, this simplified tillage is not always beneficial to the structural qualities of the soil.

#### The proposed solution

Sustainable innovative practices, which involve adjusting tillage practices (no- or reduced- tillage) and sowing dates, lengthening crop rotations, and growing cover crops and new crop associations (oilseed rape in legumes cover, winter pea and barley/wheat), were identified by farmers as having the potential to address these problems. Specifically farmers requested better decision support to help them select the most appropriate practices for managing the soil (e.g. no-till, cover crops, crop association, sowing dates, etc.) under particular climatic and environmental conditions, and as part of this a field method to assess soil structure was proposed.

#### Stakeholders

A group of 15 arable farmers and 5 public and private advisors have been working together with group discussions, regular meetings and on-farm testing since 2015 and are supported by an agronomist from Terres Inovia. The farms, which vary in size from 100 to 500 hectares, are located in the departments of Indre and Cher, where the soils are typically calcareous clay (stony) soils. These farmers regard soil quality as the key factor in achieving more productive and efficient systems. This group is accustomed to interacting with research projects.



## Aims and Method

The trials aim to;

- Examine how management of soil tillage (deep tillage, no-tillage, reduced-tillage, etc.), cover crops and crop associations affect soil quality characteristics
- Examine how soil quality influences crop growth processes and yields for different soil and crop management
- Collect data to create a decision support tool to guide farmers in selecting innovative cropping practices. This tool includes simple field soil structure assessment.

### Field experiments

On-farm trials were conducted in a network of 10 farms over two years (2015 & 2016). Conventional and innovative practices are compared in the same plot with data collected on 19 oilseed rape plots, 16 wheat plots and 7 protein crop plots (pea, faba bean).

The tested innovative practices were:

- **Seeding methods:** No-till versus strip-till. Conventional seed drill or seed drill equipped with tine coulter and alternations of seeding methods. The performance of a prototype no-till seed drill was also tested.
- **Lengthening of the rotation:** Introduction of protein plants
- **Cover crops in intercropping:** As frequently as possible
- **Associations of crops:** Service plants (oilseed rape/legumes), association of two cash crops (wheat/grain legumes).



### Data Collected

#### Main visual analysis of soils:

- The colour: using organic matter content and the presence of hydromorphic features
- The type of clods: indicates level of compaction
- The porosity: biological (earthworms, roots), structural (peds) and textural indications
- The presence of organic matter

#### Main observations on crops are:

- At the beginning of winter: stand structure, roots and aerial growth, nitrogen content, Nitrogen Nutrition Index
- At flowering stage: sanitary state, growth, nitrogen content, Nitrogen Nutrition Index
- At G4 stage of oilseed rape: health state, growth, nitrogen content
- At harvest: crop yield

A group of 7-10 farmers met at four key periods over the crop growing season to assess soil and crop quality and to help select the most effective practices. The group was coordinated by the Terres Inovia agronomist and a technical assistant (who carried out soil sampling, photography, inventory of samples, database management etc.). Farmers were invited to join in the sampling and in-field soil structure evaluation (on some 25-30 field plots). At each occasion, discussion amongst farmers helped to improve and adapt a quick, visual, demonstrative soil quality assessment method on successions of oilseed rape in cover plants and wheat in association with grain legumes.



## Field evaluation farmers, advisers and soil scientists

Field trial on soil structure characteristics	Field tests with the 15 farmers of the Berry group. 5 regional advisers and a soil scientist tested a tool based on quick visual assessment of structure and porosity using a spade test.
Measurements of plant structure, density and growth	Measurements were made during autumn in 2015 & 2016
Evaluation of the quality of roots (length, biomass)	The tap root lengths were measured at the beginning of winter (2015-16) with comparisons between different soil tillage
Evaluation of soil structure and quality of the crop	The state of the soil structure and its porosity were evaluated during the autumn 2015. Measurements of plant growth were conducted during the flowering and G4 stage of oilseed rape.

## Results

Results are summarised from the on-farm trials carried out over two years (2015-2016) on 25-30 field plots over 10 farms. Full results are available in the Annexes.

**At the beginning of winter**, there was no difference in tap root length of oilseed rape between conventional or innovative plots.

**During the autumn**, there was a high % of healthy plants (in relation to flea beetles or rape winter stem weevils) in innovative\* oilseed rape compared to conventional. A strong correlation was observed between the % of healthy plants and crop biomass at this stage.

**During spring**, innovative oilseed rape presented better biomass growth and nitrogen dilution curves showed that nitrogen concentrations in soils were not limiting. For all plots, yields were also higher for innovative compared to conventional oilseed rape, 34 vs. 27 quintaux\*\*/ha

**After innovative oilseed rape**, wheat crops, associated with or without legumes presented similar yields limited by water excess and low solar radiation. Yields were lower with N fertilization (34 vs. 47 quintaux/ha) but unfertilized crops did not show diseases and presented higher grain quality compared to fertilized plots.

The field trials were used to develop and test a decision support tool based on four steps:

1. Field information (weeds, pests, risks etc.)
2. In-field assessments (soil structure, crop residue etc.)
3. Decision making (use of innovative practice?)
4. Evaluation

A simple guide for field assessment of soil structure was developed to support this process (Annex 2 & 3).

\*Oilseed rape in association with legume cover with or without N fertilization in no-tillage or simplified tillage.

\*\*quintaux = 100kg



Oilseed rape with companion plants (limiting the impact of autumn insects) and of oilseed rape alone



Farmers and advisers assessment of the on-field method to assess soil quality

Picture: Terres Inovia

## Overall stakeholder involvement and feedback

The farmer group, together with their agronomist, have been central to the identification of the trial topic, the on-farm trial design, and data collection and tool development. Holding farmer meetings on the plots, at each of the four key growth periods, to sample and discuss results provided stakeholder input throughout.

In addition annual group meetings were held, together with a wider and larger groups of farmers and advisers in the region, to view different plot comparisons and discuss the results of the growing season (of oilseed rape and wheat/protein crops).

Although the stakeholders found the results interesting and co-developed the field soil assessment method, they agreed that further trials and testing with farmers is needed to fully address the issues raised. Even for these innovative farmers observation of soil structure is unfamiliar, so further training is needed to support them in soil assessment. They found the contribution of the soil scientist was very beneficial to help them better understand their soils, but they reported that the focus on the long term assessment of soil and its intervention did not address their need for short term diagnostics for crop management. They proposed some revisions to the tool, amongst them use of non-scientific terms to describe soil peds.

## Key findings

Oilseed rape in a no-till or reduced-tillage situation in association with cover plants:

- Decreases weed and insect pressure. Good oilseed rape biomass at the beginning of winter can be linked to a decrease in weeds and insect pressure.
- Increases yields of oilseed rape and of the following wheat.
- The decision support tool could help the farmers and advisers choose the best practices in these new cropping systems.



## Further reading

Annex 1. Trial details - material, method and main results

Annex 2. Field trial on soil structure characterisation

Annex 3. Evaluation of Soil Structure (French)

Annex 4. A video demonstrating the decision support tool (in French with English subtitles)

<https://youtu.be/u4fE-4x6Ypw>

Annex 5. Detailed results (French)

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