OPTING FOR NEW STRATEGIES

Various research institutes are currently testing different cropping systems incorporating some agri-environmental principles.

Agri-environmental principles involve an approach spanning several years and adapted to each field depending on its particular conditions. The search for a compromise between production and reduction in the environmental impact should therefore be focusing on the cropping system.

Acting at the level of the cropping system opens up the possibility of using a coherent combination of levers each contributing to the overall effect, as well as of capitalizing on processes with benefits reaching beyond a particular field and a particular year. The aim of the chosen strategies must therefore be to reduce the pressure exerted by bio-aggressors, while promoting soil fertility, which is a prerequisite for reducing synthetic inputs and maintaining production levels.

Trial results confirm that "natural" processes have the potential to impact positively on the performance of the cropping systems. There are still some incompatibilities between some of the levers. This underlines the need for prioritising challenges according to the local context. It also highlights the importance of gaining a deeper understanding of the subject (see insert).

Maximising some of the effects

The system implemented for organic crops at the Boigneville Research Station (1), with no added organic products and replacement of inputs with organic mechanisms as much as possible shows the possibilities that those levers can offer.

Emphasis is placed first of all on "controlling bio-aggressors through organic means", including by growing a variety of different species, using genetic profiles suited to the biotic pressure, and using ploughing to control annual weeds.

This sees septoria attacks on soft wheat significantly lessened and ear fusarium virtually non-existent, but it hardly controls rusts and insects. The "soil fertility" function then plays its part by supporting plant nutrition through use of legumes, incorporation of crop residue and returning cut lucerne to the ground. However, the symbiotic nitrogen provided by legumes and the return of biomass to the soil are not quite sufficient to meet the needs of cereal plants. The difference in production, expressed in units of energy, shows the effect of the "agri-environmental levers", with around 60% of the potential production realised, and only 40% in the case of winter cereals. The cost-effectiveness, which is equivalent to that of the reference system, relies on recognition of organic

SYPPRE : platforms for agri-environmental systems

ARVALIS - Institut du vegetal, Terres Inovia, ITB and UNIP have joined forces under the SYPPRE (efficient and environmentally-friendly production systems) project. The "long-term platforms" component aims to develop cropping systems that find a balance between productivity, cost-effectiveness and environmental excellence. The originality of this initiative comes partly from the pooling of each institute's expertise, collaboration with local stakeholders, the establishment of 5 experimental platforms, each covering between 10 and 15 ha, that all take account of contrasting issues and conditions, and the organisation of farmers' networks to promote communication and knowledge transfer. The trials will start in 2015 and will run for at least 15 years, in order to study the transition period of the systems, followed by their stable phase.

farming specifications by the market, as well as on specific public support.

Achieving references

The "integrated production" (2) system is based on lessening the risk of disease and lodging (limitative fertilisation) and on reducing external inputs (treatment frequency index reduced by 71% compared to the regional reference point). Compared with the previous organic system, there is an increase in production (3), costs are under control, but the environmental impact is slightly adversely affected (table 1). This system also highlights the crucial importance of better understanding weed control processes.

Two other key agri-environmental levers have been tested on the Boigneville site, as part of a third system based on minimum tillage techniques: direct drilling and establishing cover crops, both during the Intercropping season and in oilseed rape. This system was launched in 2010 and is still in a transitional phase. It is showing mixed results, including as regards to herbicides. The effect of mulch as a herbicide, and the activation of organic materials mineralisation still depend on the ability to enrich the surface of the soil with crop residue, or even to keep cover plants in place.

The results of ongoing trials are encouraging for the future.

A **40%** reduction in nitrogen inputs was achieved in a trial carried out in central France, with equal performance.

Focusing on the local context

Since 2009, the Technical Centre for Oilseed Crops (Terres Inovia) has established three "system trials" aiming to reduce reliance on plant protection products (treatment frequency index), and decrease greenhouse gas emissions by 50% and nitrogen fertilisation by 30%, while maintaining revenue and yield. Alongside a reference system representative of each region, a new system adapted to each context (figure 1) has been defined, partly based on the following agri-environmental principles:

- improving soil fertility (introduction of legumes as the main crop, during the intercropping season and combined with oilseed rape, with direct drilling, shallow cultivation or strip-till, depending on conditions),
- limiting the development and the impact of bio-aggressors (through crop diversification and sowing dates, associated crops, mixing varieties etc.).

In the trial carried out in central France in shallow soil, the innovative system resulted in steady yields and gross margins between 2009 and 2013, while reducing the amounts of nitrogen (from 160 to 97kg N/ha), plant protection products (the treatment frequency index went from 5.1 to 4) and labour (from 1h57 to 1h20 per ha) used. In addition to the reduction in nitrogen input through the introduction of sunflowers, and to the non-fertilisation and after-effect of peas, the strategic build-up of symbiotic nitrogen in the soil led, after three years, to a reduction in nitrogen fertilisation of around 20 kg per ha, compared with the rate used for the other crops and calculated according to the nitrogen balance method.

At the end of its initial four years, the trial established in deep soil in northern France showed that the amounts of nitrogen and plant protection products used have been reduced (from 134 down to 110kg N/ha, and the treatment frequency index (TFI) went down from 4.3 to 3.5), as well as the estimated greenhouse gas emissions (-11%). Gross margin and yields are lower than the reference figures, but labour, which was significantly reduced from 5h13 to 3h45 per ha, increases the margin per man hour.

Despite significant progress, those innovative systems do not entirely meet the ambitious targets of the experiment and lead to an increased reliance on total herbicides.

Transitional phase

The results of the ongoing experiments carried out by ARVALIS - Institut du vegetal and the Technical Centre for Oilseed Crops (Terres Inovia) are encouraging. They highlight the technical nature of certain innovations and the need for a transition period in order for the agri-environmental processes to produce an effect. Research must continue to further improve our understanding of those processes and enhance them, in order to better reconcile productivity, cost-effectiveness and low environmental impact.

(1) See Perspectives Agricoles No. 414, September 2014, p. 26.
(2) See Perspectives Agricoles No. 405, November 2013, p. 37.
(3) 68% of the reference figure with a conventional system.

Clotilde Toqué
c.toque@arvalisinstitutduvegetal.fr
ARVALIS - Institut du végétal
Stéphane Cadoux – s.cadoux@terresinovia.fr
Terres Inovia

October 2014

Find out more

You will find all the ARVALIS - Institut du vegetal and Terres Inovia trial results at www.perspectives-agricoles.com.

AGRI-ENVIRONMENTAL LEVERS: finding the right combinations

	Organic with no soil enrichment	"Integrated" system
Spread nitrogen (% ref.)	0	69%
TFI / including herbicides	0	1.6 / 1.2
Greenhouse gas emissions (% ref.)	14%	77%
Soft wheat yield (% ref.)	45%	80%
Total gross energy produced (% ref.)	73%	82%
Semi-gross margin not including subsidies (% ref.)	126%	84%
Tractor time (h/ha)	3.6	3.9

Table 1: Performance indicators for 2 cropping systems. Moderately deep soil (2009-2013) - Micro farms at Boigneville (near Paris). Value expressed as a % of the reference system.

REGIONALISED TRIALS: diversified rotations adapted to the local context.

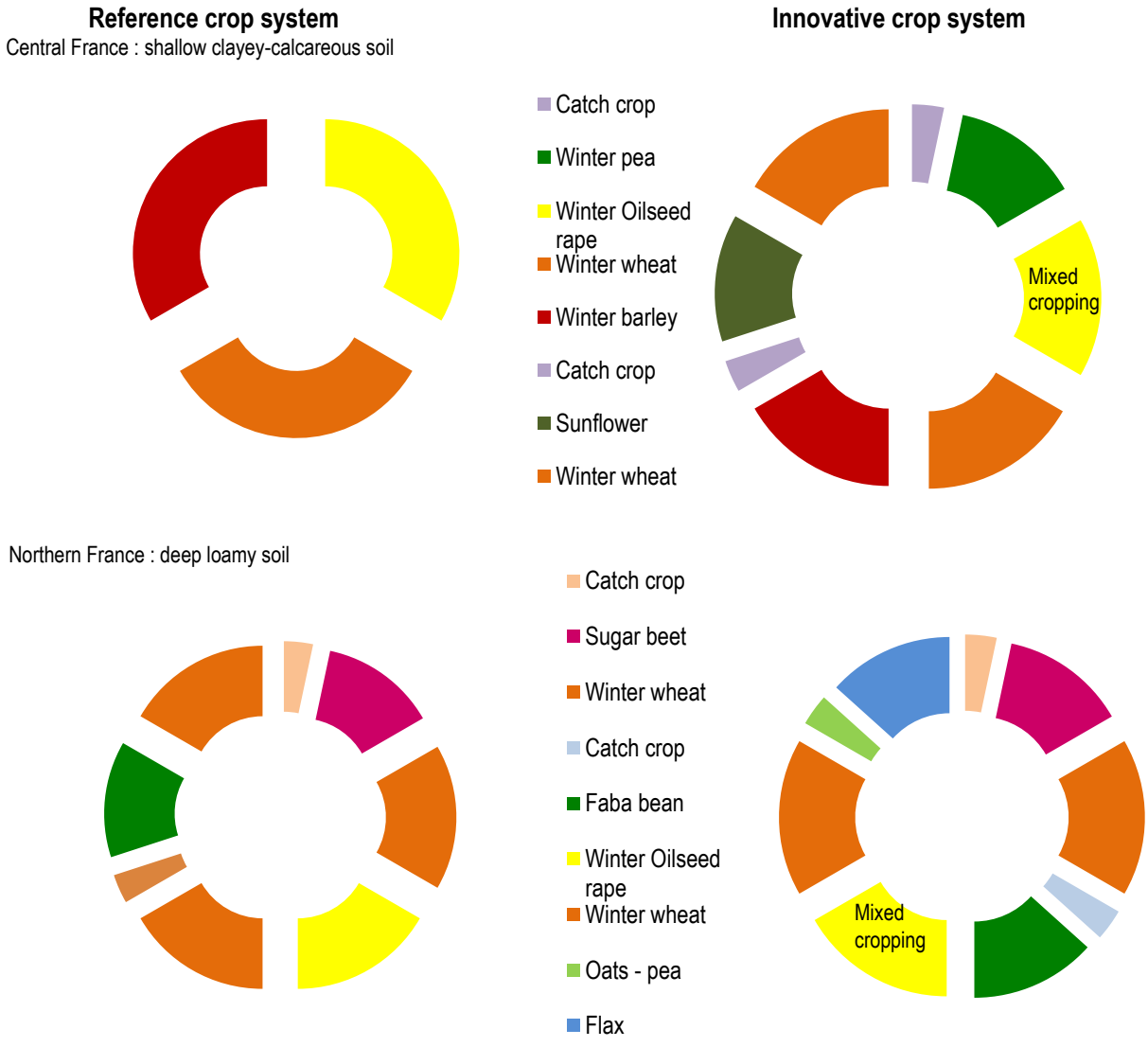

Figure 1: Rotations used in Terres Inovia's cropping system experiments in central and northern France.