WORKING ON DIRECT AND INDIRECT IMPACTS

Agronomic research has developed numerous measures for reducing greenhouse gas emissions. It focussed some of its efforts on the highest contributing factor, nitrogen.

The COP 21 agreement reached in Paris last December confirms the participating countries' commitment to reducing greenhouse gas emissions (GHG). In arable crops, emissions come from input manufacturing and delivery, as well as from direct sources in the field.

It is estimated that agriculture contributes 19% of Metropolitan France's overall greenhouse gas emissions. They are linked to methane (CH_4) emissions, due primarily to livestock systems (enteric fermentation), and to nitrous oxide (N_20) emitted by cultivated soils. Measured in terms of global warming potential, the arable and livestock sectors' contributions are fairly similar (respectively 40% and 46% of overall agricultural emissions in 2013). Carbon dioxide (CO_2) produced by fuel (tractors, etc.) accounts for a minor part of all agricultural emissions, at 10%. According to the 2015 "SECTEN" sectorial report produced by CITEPA *(1)*, agriculture is the main contributor to CH_4 (67%) and N_2O (90%) emissions in France.

Focussing on optimising nitrogen fertilisation

Studies clearly show that in cereal crops, there is a link between nitrogen application and N_2O emissions, albeit not in the same proportions from one cropping scenario to another. One of the sources of N_2O is the activity of microorganisms in the soil when there is no oxygen (denitrification). Emission peaks have been noted when rain events leave the soil waterlogged. More generally, this phenomenon occurs under the combined effect of several factors (humidity, soil density, mineral nitrogen levels, temperature, microbial populations' potential for denitrification to reach the stage when N_2O is emitted).

Drainage, as well as practices that help plants absorb applied nitrogen rapidly (N split application, application conditions) or that reduce compaction, all help to minimise N_2O emissions. Other possibilities involve the use of additives to reduce emissions from fertilisers.

Additional action levers might be available in relation to the rotation and cropping system, although they need to be further investigated in order to assess their effect more precisely. They include taking account of mineralisation dynamics in crop residue management to provide more or less nitrogen to bacteria, and introducing legumes to make a cropping system less dependant on nitrogen fertilisers. Nitrogen capturing cover crops may play a part too. Trials have also shown that soil cultivation (modification of the nitrogen cycle, fuel used) has actually a low impact on N_2O emissions and on the GHG balance of cropping systems *(2)*.

It is therefore crucial to adapt application rates to the plants' actual needs and to split applications appropriately during the season, taking into account soil and weather conditions.

Biodiesel: a global approach

The maximum proportion of biodiesel obtained by processing oilseed rape allowed in fossil fuel diesel went up to 8% on 1st January 2015. Up until now, farmers were asked to produce oilseed rape to reduce GHG emissions by 35% compared with the fossil fuel diesel it replaces. This target will go up to 50% from 2018. But 90% of emissions from an oilseed rape parcel come from applied nitrogen: 33% is attributable to the production of mineral nitrogen fertiliser and 57% to N_2O emissions from the soil *(3)*.

An "improvement approach" involving cooperatives, traders, Agrosolutions, FNA and Terres Inovia is supporting farmers in improving cropping practices and energy efficiency, and reducing GHG emissions. The aim is to optimise nitrogen nutrition management and to control limiting factors affecting grain yield. This is done through various means, including using decision support tools, introducing legumes as cover crops or previous crop, improving crop establishment and making more appropriate varietal choices. In order to assess those practices' impact, Terres Inovia is coordinating an investigative network and calculating energy balance and GHG emissions. This in turn helps to introduce improvement measures (www.progrescolzadiester.fr).

(1) Centre Interprofessionnel Technique d'Etudes de la Pollution Atmosphérique (Interprofessional technical centre for the Study of air pollution).
(2) See the "Faut-il travailler le sol?" publication (QUAE/ARVALIS 2014) available from www.editions-arvalis.fr.
(3) Estimate obtained using the GIEC's calculation method based on worldwide measurement data.

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February 2016

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Assessing GHGs at farm level

The EGES® (GHG emission) calculator, which is available from www.arvalis-infos.fr (in the "Mes outils" section), estimates the greenhouse gas emissions linked to the rotation, and suggests appropriate ways of improving them. It takes into account the direct impact of crop management as well as the impact of producing the inputs and fertilisers used. This calculator was developed by the Technical Institute on Beet (ITB), Terres Inovia and ARVALIS