Design of a decision support system to reduce nitrogen losses in cropping systems

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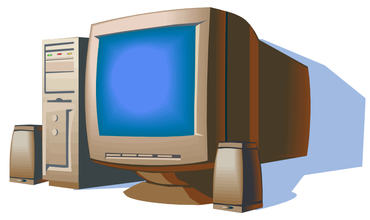


Initial analysis

• Development of sustainable agriculture, reducing N losses (under gaseous or nitrate forms) and avoiding pollution swapping, relies on production system diagnosis and design of innovative systems.

• Nitrogen management requires improvement, on the basis of a **diagnosis of crop nitrogen use, losses and impacts, in diverse agricultural systems**

But:

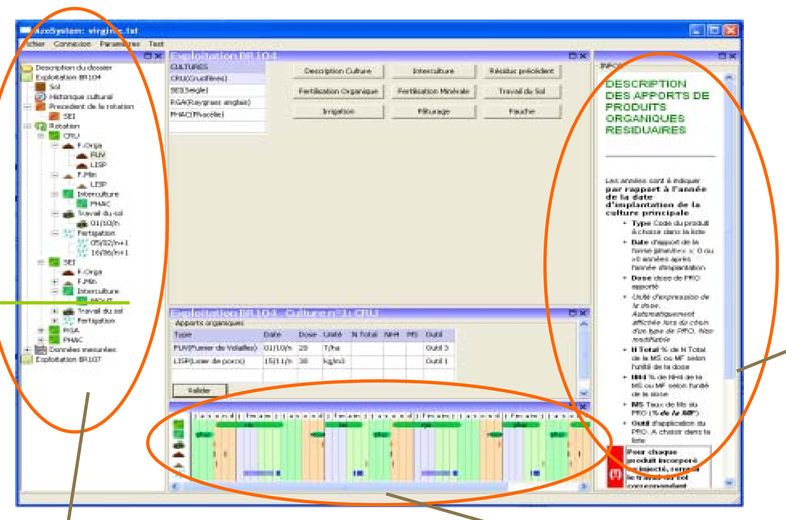
• scientists did not always provide relevant tools to perform diagnosis and assessment, because they often neglected the constraints and requirements of stakeholders and advisers, the users of these tools

• few assessment and diagnosis tools are available for users at cropping system scale (Cannavo et al, 2008)

➔a Decision Support System (DSS), called *Syst'N,* is currently being developed by French agricultural research and technical institutes in the "Azosystem" project, in order to assist N management in cropping systems, and **dedicated to environment stakeholders and agricultural extension services**

➔**DSS = N model to simulate N losses** (topic of this poster) **+ database including N loss references in various cropping systems**

Description of the cropping systems in their context, with user data and default regional database



Notes helping the users to describe the cropping systems, soil and climate

Summarised description of the cropping system, enabling to copy, paste and modify them to analyse different situations

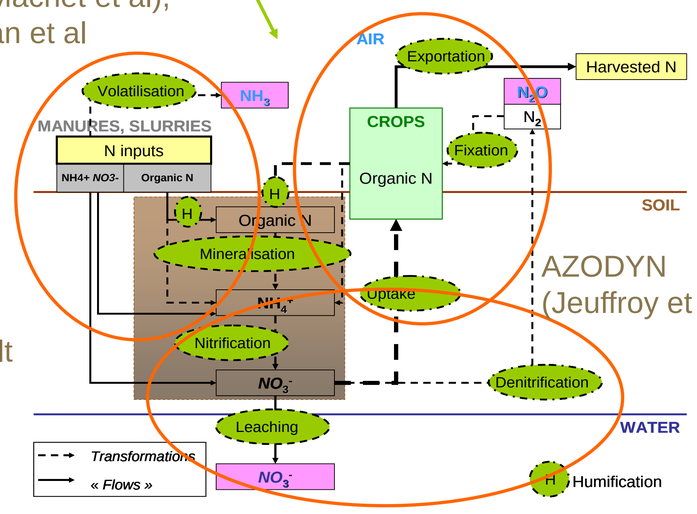
Scheme representing the cropping system being described, with every cropping operations

Input calculation for the simulator

e.g. Pedotransfer functions

Simulation of N fluxes at the rotation scale

Volt'air (Genermont et al) AZOFERT(Machet et al), Morvan et al



STICS (Brisson, Mary et al), NOE (Henault et al)

AZODYN (Jeuffroy et al)

Design process

1. Survey by the possible users → specifications ➔ **various prototypes** of DSS interfaces proposed and discussed **between the designers**, and **proposed to a panel of potential users** - *collaboration with an ergonomist to organize the experimental device*

2. Design of the dynamic N model from exhaustive **bibliographical analysis** (Cannavo et al, 2008) and negociation among modellers

➔decision to **build a new model, based on existing sub models adapted to the specific requirements of the users and functioning with their available data**

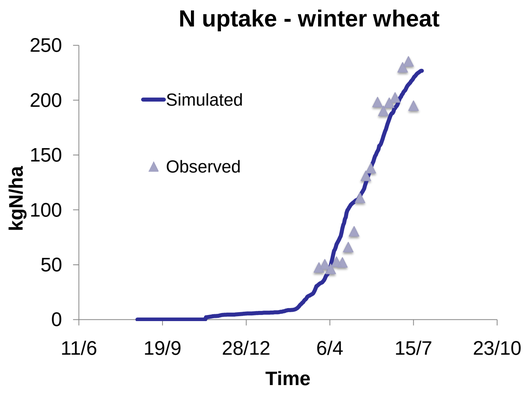
3. Parametrization and assessment of the model (ongoing step)

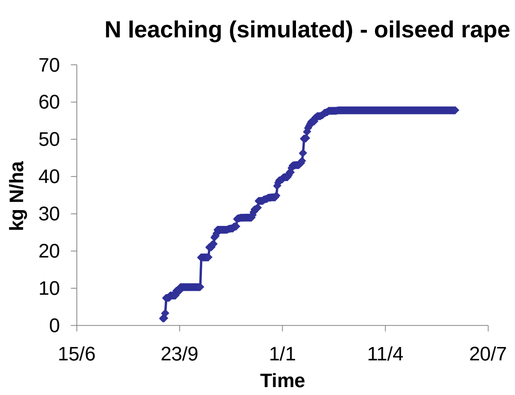
Scientific and technical challenges and results

- **An interdisciplinary approach involving future DSS users**
- **A reliable model functioning with available data of users**
- **Towards a realistic diagnostic tool**

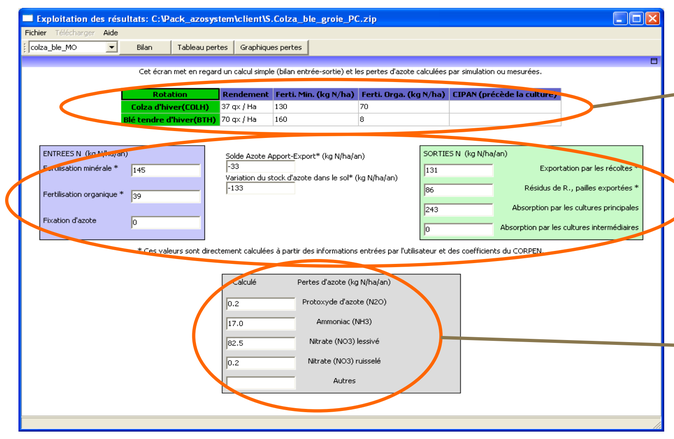
Necessary **to include the crop yield as an input** to better predict crop growth and N uptake, in order to precise soil mineral N at autumn and consequently N leaching (Makowski *et al.*). This requirement is being studied from the point of view of the computer scientists to **assess the scientific and technical feasibility of this formalism.**

Model parametrization and assessment steps - examples





DSS graphical interface for outputs, helping users for the N diagnosis in the cropping systems



Brief description of the cropping system (crops, fertilisation, cover crops)

Annual N balance usually calculated vs Simulated (or measured) N losses

N losses placed under different crops and stages of the cropping systems

Until now, the graphical interface for inputs and outputs and the simulator have been implemented. The ongoing step is the **test and assessment of the whole model with external datasets**. Another step is the adaptation of the N model to cropping systems including grasslands or vegetable crops. In parallel, the database to collect and store N losses references in cropping systems is being developed.

The design process will continue, by **associating stakeholders in the improvement of the DSS through a learning loop**, and we will **develop a learning activity** with advisers in order to improve assessment of N losses and to enable the use of simulation and virtual experimentation.

References: Cannavo P. et al. (2008) Modeling N dynamics to assess environmental impacts of cropped soils. Advances in Agronomy, vol. 97:131-174 ; **Makowski et al.** Measuring the accuracy of agro-environmental indicators. Journal of Environmental Management*, in press*. ; **Parnaudeau V., et al.** (2007). A Sociological Approach to Determine the Advisers and Stakeholders Requirements for Nitrogen Management and Diagnosis Tools. 15th European N workshop, Lleida (Espagne) Mai 2007.

Acknowledgements: This work has been funded by the institutes members of the Azosystem project and CasDar.