

Greater diversification and the use of a decision tool to reduce mineral nitrogen application in durum wheat without compromising yield and quality

Results from the Syppre Lauragais platform

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Context

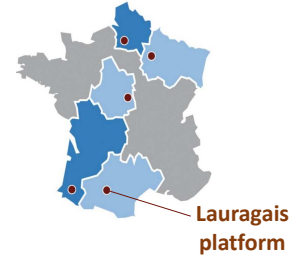
- The reduction of nitrogen (N) synthetic fertilizers is key to lower French agricultural sector emissions;
- In south-western France, durum wheat (DW, *Triticum durum*) is an important crop both in terms of area and contribution to the economic performance of local arable farms. DW N fertilization is relatively high to maximize yield and guarantee quality, mainly linked to grain protein content;
- Cultivar diversity, longer rotations** including legumes crops and **multi-services cover crop (MSCC)** are tested in the Syppre network to lower mineral nitrogen rates of 20 % compared to the reference.

Hypothesis

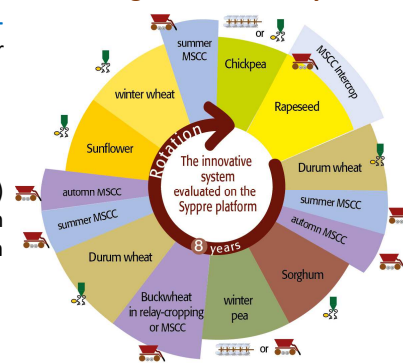
- Diversification levers combined with the use of a decision-tool (CHN) capable of considering the benefits of diversification for the fertilization recommendations, would significantly reduce mineral nitrogen application in durum wheat without compromising yield and quality.

Syppre Network

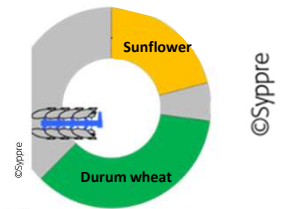
- 5 sites across France.
- On each site:**
 - A reference and an innovative system;
 - All crops present every year;
 - 5 – 10 ha experimental fields;



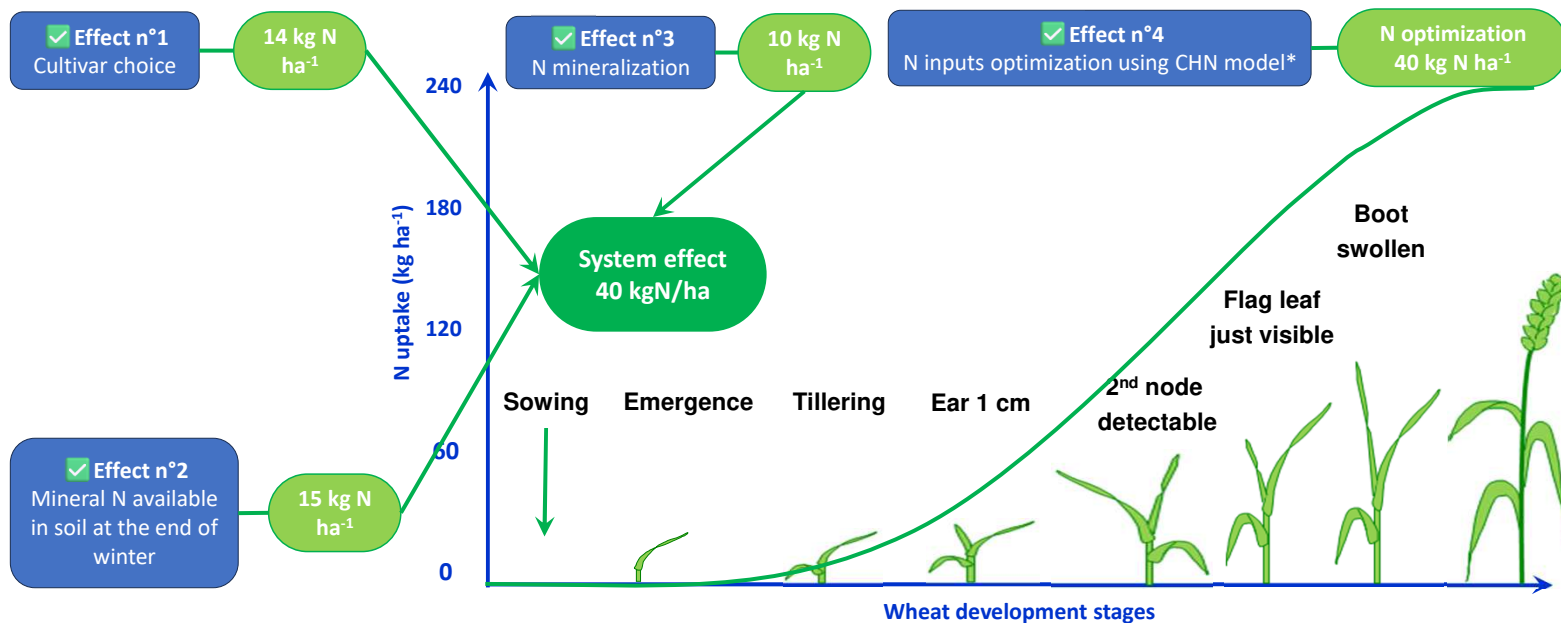
Lauragais innovative system



Lauragais reference system



Ploughing
deep non-inversion till
Direct seeding
Reduced tillage
MSCC: Multi-Services Cover Crop
ECC: Energy Cover Crop



Main results obtained on average after of 7 years of trial (innovative vs. reference system):

- Effect n°1:** lower needs per quintal cultivar (3.7 to 3.5 kg N q⁻¹) for a 7 t of grain yield potential on the platform led to about 14 kg N ha⁻¹ savings;
- Effect n°2:** higher mineral N available at the end of winter (15 kg N ha⁻¹, $P < 0.15$) due to lower C/N residues of previous crops and MSCC, including legumes;
- Effect n°3:** higher organic N mineralization during the durum wheat cycle due to higher soil organic matter content after 9 years → 4.6 t ha⁻¹ vs. 3.8 t ha⁻¹. The reference point was similar between modalities;
- Effect n°4:** lower N inputs thanks to the use of the CHN decision tool, which takes best account of soil, weather and physiological conditions during the growth stages;
- In total, mineral N inputs were reduced by 80 kg N ha⁻¹ on average ($P < 0.001$);
- Grain yields were non significantly different with 6.5 vs. 6.7 t ha⁻¹ ($P = 0.82$). Grain protein content was lower in innovative system ($P = 0.058$ ns) although remained always equal or above the quality threshold;
- Lower mineral fertilizer costs did not offset the costs of MSCC-certified seed and higher herbicide costs (chemical destruction of MSCC). However, the innovative system is less sensitive to fluctuations in fertilizer prices.

*The **Crop Hydro-Nitrogen (CHN)** model developed by ARVALIS is a mechanistic crop model designed for real-time decision support during the agricultural season. It uses modules to calculate carbon (C), water (H), and nitrogen (N) fluxes daily across each 1cm layer of soil.