

GREENSCALE

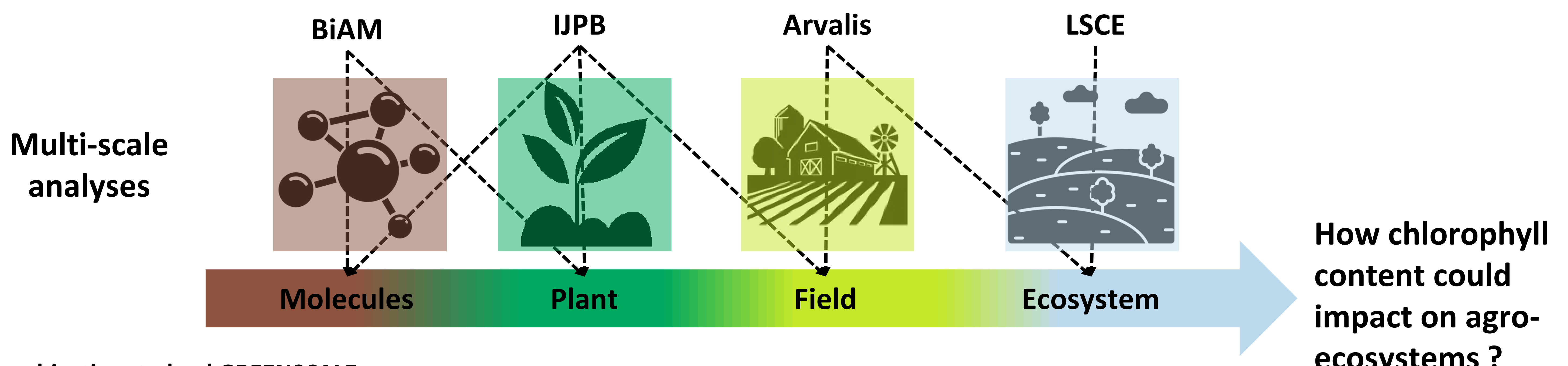
Growing Resilient Ecosystems: Enhancing Nitrogen Savings and Carbon in Agriculture - a Leverage of Efficiency
CO-PI: Jean Alric and Fabien Chardon

The interplay between [Chl], LUE, and NUE presents a unique opportunity to uncover how plants adjust their photosynthetic machinery to varying light conditions and nutrient availability, ultimately contributing to the development of more efficient and resilient crop systems. To explore the complete spectrum of variation in [Chl], we will use a "Green Scale" germplasm collection of non-GMO grass spring barley (*Hordeum vulgare*) accessions, ranging from normal to less than 20 % [Chl].



The "Green Scale" germplasm collection at tillering stage in the greenhouse.

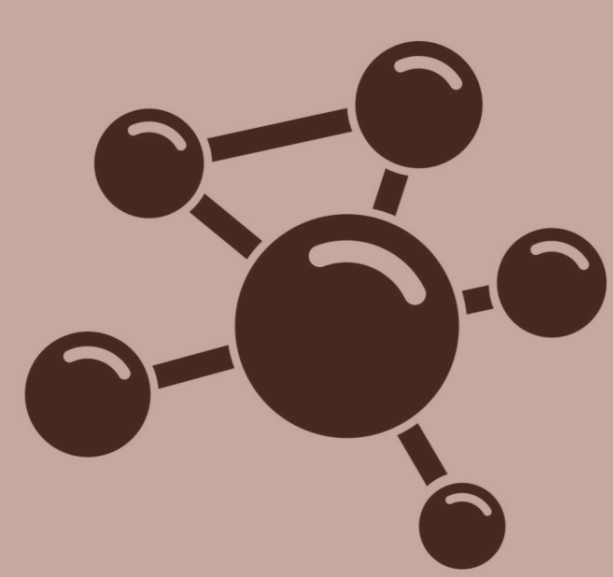
GREENSCALE's outline is to draw inspiration from the natural adaptive response of straw cereals to drought and N limitation



Four objectives to lead GREENSCALE program:

- **"Break down barriers"** Our research endeavours will span different terrestrial ecosystems ranging from agro-ecosystems to grasslands.
- **"Share, spread, and implement"** The incorporation of controlled conditions and field experiments serves as a crucial calibration test for our multi-scale approach.
- **"Interdisciplinarity and complementarity"** Our project involves collaboration across multiple disciplines, bringing together expertise in biochemistry, plant physiology, genetics, agronomy, and environmental science.
- **"Research-Society Continuum"**. Going beyond the realms of fundamental research, our project delves into the practical implications within the context of sustainable agriculture and climate change mitigation.

Work Packages



Objective 1. Leaf Chlorophyll Control. Investigate how leaf chlorophyll content regulates various aspects of photosynthetic electron transport, CO₂ assimilation, Light Use Efficiency, Nitrogen Use Efficiency, and resource management.

- **Task 1.1:** In depth characterization of photosynthesis in the "Green Scale" panel grown under various controlled climatic and light conditions.
- **Task 1.2:** Assessment of carbon and nitrogen management across the same "Green Scale" panel grown under normal and low-N conditions.



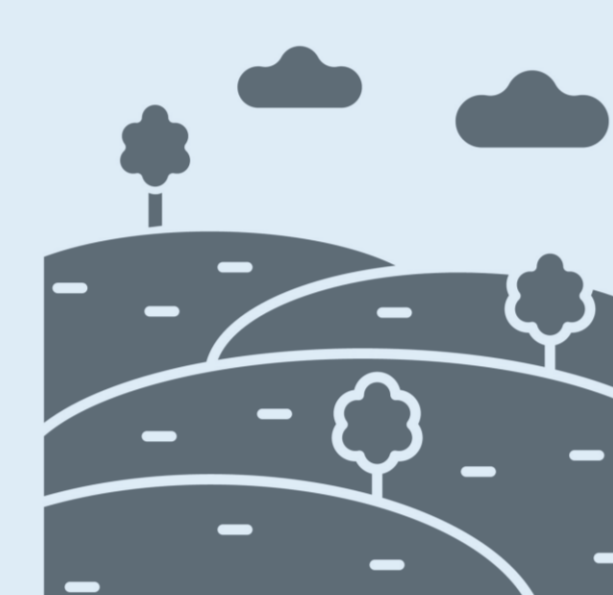
Objective 2. Nexus of N Availability and Chlorophyll Dynamics: Explore the impact of soil nitrogen availability on leaf chlorophyll content and the reciprocal influence of chlorophyll levels on nitrogen remobilization during grain filling.

- **Task 2.1:** Measurement of N absorption and N remobilization using ¹⁵N labeling.
- **Task 2.2:** Measurement of C and N allocation using double isotopic labeling
- **Task 2.3:** Measurements of the spatial heterogeneity of photosynthetic activity during crop development.



Objective 3. Pale Green Cultivar Evaluation. Assess the productivity of pale green cultivars in both laboratory and field settings.

- **Task 3.1:** Seed propagation and sharing.
- **Task 3.2:** Field trials and phenotyping.
- **Task 3.3:** Deployment of the new Fluorescence Imager for Spatialized Data Collection.
- **Task 3.4:** Investigate the Impact of Low-Chlorophyll Biomass Recycling on the Leaf and Straw Litter.



Objective 4. Multiparametric Function Integration. Utilize data from Work Packages 1 and 2, followed by WP3, to develop a multiparametric function for carbon and nitrogen fluxes based on leaf chlorophyll content.

- **Task 4.1:** Refine the photosynthesis module in ORCHIDEE.
- **Task 4.2:** Plugins to the ORCHIDEE land surface model to facilitate comparisons with measurements obtained from experiments involving ¹⁵N enrichment.



Objective 5. Collaboration and Outreach. Promote collaboration among different Work Packages and enhance project outreach.

- **Task 4.1:** Standardization of methods.
- **Task 4.2:** Data management plan.
- **Task 4.3:** Environmental awareness, education and discussion of the possible extension of our work.

Members of the consortium comprise: Antoine Fournier, Mathieu Marguerie, and Katia Beauchêne (ARVALIS), Xenie Johnson, Stephania Viola, Bernard Genty, and Jean Alric (CEA-BIAM), Fabienne Maignan, Nicolas Viovy, and Nicolas Vuichard (CEA-LCSE), Anne Marmagne, Céline Masclaux-Daubresse, Maxime Marques, Clara Gilloteau, and Fabien Chardon (INRAE - IJPB)