# MSc Internship proposal 2024

# Study of the genetic variability of parameters of an ecophysiological model in tomato

## Work environment, missions and activities

- You will be working in the Genetics and Improvement of Fruits and Vegetables unit (**Génétique et Amélioration des Fruits et Légumes,** GAFL), which focuses mainly on Mediterranean vegetable and fruit species, with particular emphasis on pathogen resistance and fruit quality to maintain production under abiotic stress conditions.
- You will join the DADI tomato team (Diversity, Adaptation, Determinants and Integration), whose main missions are to analyze and integrate traits linked to fruit quality, pest resistance and production regularity for low-input production.
- The internship will be supervised by Emilie Millet (CR GAFL) and Mathilde Causse (DR GAFL), in close collaboration with scientists from the PSH unit in Avignon (INRAE).
- The internship could take place from **March to July/August** so that the student can take part in the whole greenhouse experiment.

### Context

Climate change already impacts crops, with reductions in yield and quality. The effects of this change are little studied and modelled in vegetable species, making it more difficult to implement appropriate strategies. In particular, it is crucial to understand the interaction between genotypes and the environment, and to attempt to model it. In other species, approaches combining genetic and ecophysiological models have shown promising results.

Tomato is a crop of worldwide importance. It is the world's leading vegetable, 190 million tonnes (including 38 million tonnes for processing) produced in 2020, and is widely consumed (over 20 kg per capita per year in France). European production is mainly in the Mediterranean region. As a mainly irrigated vegetable crop, tomatoes are facing a decline in water resources, leading to lower yields and impacting fruit quality (Albert et al. 2016), or even halting production (case of Morocco).

Various models of tomato plant and fruit development exist. For example, a dynamic 3D model of plant architecture was used to estimate light interception (Najla et al. 2009). More recently, an integrated tomato model, which explicitly takes into account early developmental changes (from cell division to harvest), has been used to study the impact of drought and carbon limitation on nutrient fluxes and fruit growth (Baldazzi et al. 2013). These models have not yet been validated with a genetic diversity.

### Internship objectives

The aim of the internship is to advance the **combination of ecophysiological and genetic models in tomato**. It is based on the **phenotyping** in the greenhouse of around 50 accessions from a diversity panel and the use of data already acquired on the same material under various stress conditions. This selection of accessions will be phenotyped in a greenhouse equipped with an automated irrigation system (in conjunction with the A2M experimental unit), fitted with environmental sensors and scales that continuously monitor plant weight, under two irrigation conditions, controlled (20% drainage) and water deficit (50% less water input). The student will attempt to answer the following research questions:

- Can a **phenotyping protocol** be developed to measure the **values of the parameters** of the ecophysiological model on a large number of plants and adapted to a wide genetic diversity?
- Which **parameters** of the plant and fruit development model show **genetic variability**?
- What is the impact of **water deficit** on parameter value estimation?

### Work program

1. **Greenhouse phenotyping**: non-destructive measurements (flowering dates, number of leaves, plant height, diameter, etc.) and destructive measurements (leaf biomass, individual leaf area from photo, etc.) will be carried out daily and once a week respectively.

2. **Monitoring of climatic data** during experimentation: weather sensors and soil moisture will be read once or twice a week by the A2M experimental unit, and the student will check them (visualization) to anticipate missing data.

3. **Data analysis**: statistical analysis of collected data to correct for outliers and experimental effects, descriptive analysis and correlations. Estimation of model parameters from measured data. For example, the total leaf area will be deduced from the number of leaves and the estimated individual areas.

4. **Correlations** with phenotypic data previously collected in different trials.

## Training and skills required

**Master/Engineer (Bac +4)**

- Recommended training : Genetics and plant improvement
- Knowledge required : Ecophysiological modeling, statistical modeling (linear models), R software
- Desired skils : Curiosity, rigor, interest in genetics and ecophysiology, interdisciplinary work, greenhouse work