Vulnerability of fruit trees to late frost: genotype x environment interaction

Context

The spring frost of 2021 - the worst in Western Europe since 1947 - was the most recent reminder of the growing risk of extreme weather events with devastating consequences for agricultural production. Changes in temperature patterns that are expected to accompany ongoing climate change will increase the vulnerability of plants to frost, while the likelihood of frosts will remain high. As a result, the incidence of frost damage is set to increase over the coming decades, particularly in fruit growing.

The PIAF lab works on the physical and physiological determinants of tree functioning and development in a context of climate change. More specifically, our research focuses on the responses of trees to fluctuating abiotic factors through their acclimation or survival. In recent years, late frosts have had a major impact on fruit crops due to the concomitance of a hazard (drop in temperature), exposure (low organ temperature and ice nucleation) and high vulnerability (frost hardiness). In order to survive the winter without damage, plants must simultaneously suspend their growth and increase their tolerance to frost. Vulnerability to frost can be simulated to predict the risk of frost.

Using a unique phenology observatory orchard (DIVAE), this thesis will characterize phenotypic traits and their plasticity in four major fruit species (apricot, cherry, peach and apple). The DIVAE system has been set up across France at 5 sites with contrasting climates (Angers, Toulenne, Bellegarde, Clermont-Ferrand and Gotheron) and groups together 4 fruit species including varieties with contrasting phenologies. Characterisation of the responses of these different varieties in a variety of environments will make it possible to define the relevant traits as well as their plasticity in order to define ideotypes adapted to current and future environments in different current and potential production basins. The main objective of the thesis will be to develop a model for predicting frost risk by integrating data relating to the phenological cycle, frost tolerance and ice propagation in buds.

The candidate will seek to measure the genetic (inter- and intra-specific) and environmental components and their interaction in vulnerability to late frost. The main aim of the thesis will be to develop a model for predicting the risk of frost by integrating data relating to the phenological cycle, tolerance to frost stress and the location and spread of ice during frosts.

Required skills

Engineering degree/Master's 2 in agronomic sciences, ecology or plant biology with a strong motivation for research. Knowledge of tree physiology and a taste for physical measurements, setting up experiments and/or modelling will be an asset.

Hosting arrangements

Assignement : UMR PIAF - Centre INRAE Auvergne-Rhône-Alpes Site de Crouël
36-month doctoral contract
Desired start date: 01/10/2024
Remuneration: ca. 30k€ gross

To apply

Send a CV, including Master's grades, name of two references and a 1 page cover letter to Guillaume Charrier (guillaume.charrier@inrae.fr).
Interviews will take place from late August 2024 until position is filled.