# Proposition of Master 2 internship

***« Statistical analysis of a database on bacterial canker of apricots caused by Pseudomonas syringae*** ***»***

## Context

Diseases caused by *Pseudomonas syringae* are recognized as the most damaging factors in fruit trees with a significant economic and sanitary impact on crops. Over the last 10 years, *P. syringae* has become a major pathogen of fruit trees, affecting nut trees, hazelnut and kiwi, in addition to pome fruits and Prunus spp. (cherry, peach, plum and apricot) that have been known as hosts of the pathogen for a long time. A recent study has also found that at least four different phylogroups of *P. syringae,* not necessarily closely related phylogenetically, can infect apricots (Parisi et al. 2019). In Europe, bacterial canker is one of the most important diseases of apricot in the regions with spring frost conducive for the disease. In France, bacterial canker of apricots is an important disease in regions of production with cold winter and conducive soils that are generally light, sandy soils with fluctuating drought conditions. Mid-mountain regions with alternating night frost and diurnal melting are highly impacted by the disease, due to the ice nucleation activity (INA) of several lines of the *P. syringae* group. This is the case in Rhône-Alpes historical region, which represents a great part of the apricot production in France (58% of French production in 2017). Furthermore, the disease is exceedingly difficult to control due to a lack of efficient prophylactic measures.

## Description of the internship

This multidisciplinary project is devoted to the statistical analysis of a raw database on bacterial canker that has been collected by phytosanitary services in Southern France and made available by microbiologists of two INRAE units in Avignon. The dataset contains observations on the prevalence of symptoms in orchards while other variables have also been recorded, such as geographical location, date, plant variety and the phenotype of the pathogen. The first objective of the internship is to combine these observations (intended as site/date) to a cohort of other covariates describing meteorological, landscape and other epidemiologically relevant factors. A review of the literature on bacterial canker and its causal agent will drive the choice of which variables to include into the dataset. The second objective is to analyze the obtained dataset with machine and statistical learning techniques in order to identify relevant factors associated to the disease and to compare the results with the known literature on the subject. Such large-scale studies offer the possibility to identify broad-effect factors that may elude from in-situ and laboratory analysis. The student is invited to submit a manuscript in the form of a research paper at the end of the internship.

Required competences

* Experience in data collection and manipulation
* Hypothesis formulation and testing
* Coding experience in R
* Good knowledge of microbiology and epidemiology
* Taste for interdisciplinary work
* Ability to communicate with experts from different fields (both in English and French)

New skills and competences to be acquired

* Handling of temporal data (GIS) and climatic data
* Statistical learning

Hosting unit

The internship will be based at the INRAE institute in Avignon, France, and split between the two Avignon centers of Saint Paul and Saint Maurice. The main hosting unit is BioSP (UR 0546), while frequent visits to the Patholagie Végétale unit (UR 407) are expected during the internship.

Supervisors

* Davide Martinetti – UR BioSP – CRCN
* Christelle Lacroix – UR PV - CRCN
* Daniele Bevacqua – UR PSH – CRCN (HDR)

Références

Parisi et al. 2019. *Bacteria from four phylogroups of the Pseudomonas syringae complex can cause bacterial canker of apricot*. Plant Pathology, 68(7),1249–1258.