Biophysical modeling of plant-microbiome interactions: application to grape vine infected by GFLV

One year postdoctoral position
(with possibilities of extension – start no later than Oct. 1st)

Scientific topic. The soil is an ecosystem composed of microorganisms – bacteria, mychorrhizal fungi and viruses– that contributes to the growth, health and quality of plants. It has become necessary to dissect the mechanisms regulating these interactions to develop sustainable agriculture in order to face the challenges of world population growth , soil erosion and the collapse of biodiversity. We will focus on the response of grape vines to an infection due to the grapevine fanleaf virus (GFLV). It is known that the microbiome of the plant is influenced by the one of the soil and can be modified by an infection, but can influence the response to this infection by a bio-protection. The GFLV affects the longevity, the production and the quality of grapes. It is transmitted by the nematode *Xiphinema index* that bites the vine roots to eat. This project will benefit from a collaboration with Daniel WIPF and Pierre-Emmanuel COURTY, both experimentalists at INRAE (Dijon).

Objectives. The postdoctoral researcher will model the multi-scale modifications of the grape vine infected by the GFLV. Our model predictions will be compared to the experiments performed at all scales by our collaborators at INRAE (Dijon). We will consider : **1.** the scale of the vineyard : the diffusion of the virus from vine to vine through the motion of nematodes with Lotka-Volterra and SIR models with diffusion, **2.** the scale of an individual vine : the equilibrium of bacterial populations and fungus with a multi-species Lotka-Volterra model. This model will be built from taxonomic data (biological estimation of bacterial, fungus and virus species) and **3.** the cellular scale : the change of the gene regulatory network of a vine following the exposure to the GFLV with graph-like models. This model will be built from transcriptomic and metabolite data.

Candidate background. The applicant will display a strong background in biophysical modeling of population dynamics. This experience may include Lotka-Volterra-like models or infection models (SIR-like) (steps **1.** and **2.** above). We will also consider applicants with experience on graphs to model gene regulation networks of plants exposed to viruses (step **3.**). The methods will be a combination of analytical calculations and numerical simulations. An experience or a strong interest in applications to microbiote or plant behavior will be strongly appreciated.

Academic context. This project will benefit from a local scientific community with strong expertise in ecology and plant physiology attached to National Institutes like CIRAD, INRAE, CNRS and Laboratories like AMAP, CEFE and ISEM. National funding has enabled the development of *The Montpellier Université d'Excellence* (MUSE) federating the academic community in the areas of biodiversity, agriculture and health under the theme « feed-protect-heal ». Due to this exceptional academic context, it will be possible to apply for funding to extend this grant.

The city & region. The city of Montpellier displays a vibrant atmosphere, with plenty of cultural and sporting activities. The city has a long history with a beautiful old city center and is surrounded by mountains to the North, the Mediterranean sea to the South, while Pyrenees and Alps are nearby. The weather is mild and sunny most of the year.

Contact and Application. Please send CV and motivation letter to Jean-Charles Walter (jean-charles.walter@umontpellier.fr), researcher at Laboratory Charles Coulomb (CNRS & Montpellier Univ.).