PhD position
in Toulouse, France

The *Medicago truncatula* receptor protein NFP and redox control at the interface of symbiosis & immunity

Plants benefit from two major symbiotic interactions with soil microbes, the Arbuscular Mycorrhizal (AM) and the Rhizobium-Legume (RL) symbioses, to improve their mineral nutrition. These associations often involve recognition of microbial symbiotic chitooligosaccharide (CO)-derived molecules called Myc-LCOs (AM fungi) and Nod factors (NFs, rhizobia) by plant LysM-domain Receptor-Like Kinases (LysM-RLKs), which can also perceive pathogenic CO molecules leading to immunity.

In the model legume *Medicago truncatula*, four LysM-RLKs, MtNFP, MtLYK3, MtLYR3 and MtLYK9, are particularly important to perceive microbial CO-derived signals and trigger appropriate responses to symbionts and pathogens. **How these LysM-RLKs control and trigger these adapted responses is not well understood**, although the formation of specific receptor complexes, as well as the production/regulation of Reactive Oxygen Species (ROS) and Reactive Nitrogen Species (RNS), upon perception of symbiotic signals or pathogenic elicitors are likely two of the earliest signalling mechanisms that determine the fate of the interactions.

The PhD is part of a recently accepted ANR project "DUALITY", which aims to decipher the roles of LysM-RLKs in the fine-tuned spatio-temporal dynamics of ROS and RNS production that enable *M. truncatula* to distinguish between symbiotic and pathogenic signals, with a particular emphasis on MtNFP that is essential for the RL symbiosis and controls immunity to pathogens. Such knowledge may provide leads to simultaneously maintain efficient symbiosis and increase disease resistance in order to promote sustainable agriculture.

The PhD will be co-supervised by Clare Gough (Laboratoire des Interactions Plantes Microbes Environnement (LIPME), UMR INRA-CNRS, Toulouse), an expert of the molecular genetics of symbiotic signalling in *M. truncatula*, and Christophe Jacquet (Laboratoire de Recherche en Sciences Végétales (LRSV), UMR CNRS-UPS, Toulouse), an expert of dissecting molecular mechanisms underlying plant resistance in the *M. truncatula* - *Aphanomyces euteiches* pathosystem.

The main objectives of the PhD will be to better understand how MtNFP has a dual role in controlling symbiosis and immunity by understanding the mechanisms involved in the early MtNFP-dependent signalling steps of both types of interactions. This will include studying the involvement of MtNFP-interacting proteins, the capacity of MtNFP to tightly regulate redox signalling, as well as the identification of MtNFP-dependent differentially expressed genes in symbiotic and pathogenic contexts. The project will involve tests on different plant genotypes both in a symbiotic context and in response to the oomycete pathogen *A. euteiches*. It will exploit innovative new tools such as biosensors for *in vivo* spatio-temporal analysis of redox states and new *M. truncatula* mutants, and will include confocal microscopy and RNAseq analysis.

The PhD student should have a good background in plant-microbe interactions, plant molecular genetics and plant physiology. An experience of plant phenotyping and/or microscopy would be an advantage. A good knowledge of statistics is necessary, as well as a good level of English.

To apply, please email Clare Gough (clare.gough@inrae.fr) and Christophe Jacquet (jacquet@lrsv.ups-tlse.fr) before the 1st May 2021. The latest starting date will be September 2021.