Proposal for a PhD thesis

Identification of fungal effector targets involved in susceptibility of bread wheat to Fusarium head blight

Contacts and supervision :

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Deadlines :

Closing date for applications: 30/09/2021
Start of PhD: November 2021
Duration: 3 years

Application :

Please send your application including a cover letter, Master's grades and CV to L. Bonhomme and C. Tatout.

Lab :

UMR UCA/INRAE 1095 GDEC
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Funding :

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Scientific rationale and issues of the PhD thesis project:

Pathogen development in plant tissues is controlled by an intricate "molecular dialogue" that shapes the expression of specific genetic programs in both partners. This dialogue is established in the pathogen by the expression of a complex arsenal of molecular actors, the so-called effectors, released into the inter-cellular space or directly injected into the cytoplasm of the host cells, whose function is to promote the establishment of an environment favorable to its development. As primary actors of a full-fledged parasitic manipulation, they control the expression of specific responses in the plant, able to promote the infection process. All of these "manipulated" plant functions become *de facto* the so-called susceptibility factors, and the genes that control them, are referred to as susceptibility (S) genes.

In bread wheat, recent works on Fusarium head blight conducted within the 'Cereal Diseases' team (UMR GDEC, Clermont-Fd) have clearly demonstrated the outstanding intricacy of this molecular dialogue with the fungus *Fusarium graminearum* (Chetouhi et al., 2015; Chetouhi et al., 2016; Fabre et al. 2020). More specifically, innovative dual-omics approaches have identified a set of putative effectors that are highly conserved between pathogen strains (core-effectome), produced in waves at key stages of the interaction and co-regulated with the wheat's molecular responses (Fabre et al., 2019a; Fabre et al., 2019b; Fabre et al. 2020; Fabre et al. 2021; Alouane et al., 2021). This work also indicated that the accumulation of some of the fungal effectors discriminates *F. graminearum* strains of contrasting aggressiveness and that they harbor targeting sequences to different sub-cellular compartments of the plant, in particular to the plant nucleus where they could directly or indirectly control the transcription of host genes. Together, these data provide a list of candidate effectors that could explain the expression of susceptibility factors to Fusarium head blight. The identification of their targets in bread wheat therefore represents a valuable opportunity to identify original susceptibility genes and

to better understand the specificity of the underlying physiological and molecular mechanisms.

PhD Thesis project:

The PhD thesis work is part of the FHB-SECURE project (Fusarium Head Blight susceptibility: fungal effectors at the plant nuclear gate), funded by the Auvergne-Rhône-Alpes Region, and whose objective is to characterize the role of nuclear transport in the susceptibility of bread wheat to Fusarium head blight. In this context, the purpose of the PhD thesis are to decipher the links between fungal effectors addressed to the nucleus of host cells and the molecular responses of the plant, in order to identify susceptibility factors potentially manipulated by the pathogen to favor the establishment of its infectious process. The first step will be to screen candidate effectors with a plant nuclear localization signal, by transient expression in the plant. From this screen, a selection of effectors will be established in order to characterize their interactions with protein players or DNA/RNA, to identify their targets in the plant cell. The identification of the targets of these effectors in wheat will make it possible, with the help of the Limagrain group, one partner of the FHB-SECURE project, to screen available genetic resources using a gene-capture methodology to identify the polymorphisms in the candidate genes on a panel of wheat lines including elite cultivars.

Required profile to apply:

Master's degree in Plant Biology or equivalent
Desirable experience in plant experimentation and plant pathology
Good skills in Molecular Physiology and Molecular Biology

Recent publications of the team:

F. Fabre, S. Urbach, S. Roche, T. Langin, L. Bonhomme. 2021. Proteomics-Based Data Integration of Wheat Cultivars Facing Fusarium graminearum Strains Revealed a Core-Responsive Pattern Controlling Fusarium Head Blight. *Frontiers in Plant Science* 12:644810.

F. Fabre, F. Rocher, T. Alouane, T. Langin, L. Bonhomme. 2020. Searching for FHB Resistances in Bread Wheat: Susceptibility at the Crossroad. *Frontiers in Plant Science* 11:731.

F. Fabre, J. Bormann, S. Urbach, S. Roche, T. Langin, L. Bonhomme. 2019. Unbalanced roles of fungal aggressiveness and host cultivars in the establishment of the Fusarium head blight in bread wheat. *Frontiers in Microbiology* 10:2857.

F. Fabre, M. Vignassa, S. Urbach, T. Langin, L. Bonhomme. 2019. Time-resolved dissection of the molecular crosstalk driving Fusarium head blight in wheat provides new insights into host susceptibility determinism. *Plant Cell & Environment* 42:2291–2308.

T. Alouane, H. Rimbert, F. Fabre, F. Cambon, T. Langin, L. Bonhomme. 2018. Genome sequence of Fusarium graminearum Strain MDC_Fg1, isolated from bread wheat grown in France. *Microbiology Resource Announcements* 7, e01260-18.

C. Chetouhi, L. Bonhomme, P. Lasserre-Zuber, S. Pelletier, J.-P. Renou, T. Langin. 2016. Transcriptome dynamics of a susceptible wheat upon Fusarium head blight reveals that molecular responses to Fusarium graminearum infection fit over the grain development processes. *Functional & Integrated Genomics* 16:183–201.

C. Chetouhi, J. Panek, L. Bonhomme, H. El Alaoui, C. Texier, T. Langin, C. de Bekker, S. Urbach, E. Demettre, D. Misse, P. Holzmuller, D.P. Hughes, A. Zanzoni, C. Brun, D.G. Biron. 2015. Cross-talk in host-parasite associations: what past and recent proteomics tools tell us? *Infection, Genetics & Evolution* 33, 84-94.