PhD thesis offer:

Getting new insights into the control of plant mineral nutrition: The transcriptional regulation of iron homeostasis

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Summary

Iron (Fe) is the most commonly deficient micronutrient in human diet. About one billion people worldwide suffer from anaemia and for half of them providing diet enriched with Fe would be sufficient to revert the symptoms associated with this pathology. Fe is also an essential micronutrient for plant productivity as well as for the quality of their derived products (Briat et al., 2015). This is because Fe is a cofactor for numerous reactions involving electron transfer/oxidation-reduction such as photosynthesis or respiration. Fe homeostasis is tightly regulated in order to avoid deficiency or excess that could be detrimental to the plant. The regulation of the plant response to fluctuations in Fe availability has been extensively studied in many species, in particular in the model plant *Arabidopsis thaliana*, highlighting the importance of the transcriptional regulation in this process (Li et al, 2023).

We have recently identified ILR3 (a bHLH transcription factor) as a key integrator of the plant responses to iron deficiency and excess in Arabidopsis (Tissot et al., 2019). More recently, we have identified bHLH121 as the main regulator of iron homeostasis in Arabidopsis (Gao et al., 2020a and 2020b). These studies highlighted that the transcriptional regulation of iron homeostasis in plants involves several transcription factors that act in a complex regulatory network where the bHLH transcription factors play a preponderant role (Gao and Dubos, 2020; Li et al., 2023).

Research aims

The characterisation of ILR3 and bHLH121 function is a major advance in our understanding of the molecular mechanisms that control Fe homeostasis in plants. This PhD thesis project aims at further characterizing the molecular mechanisms that control Fe homeostasis in plants, focusing on *Arabidopsis thaliana* (non-grass species) and *Brachypodium distachyon* (grass species) as a model, since both type of plants use similar but different strategies to maintain the homeostasis of this micronutrient (Li et al, 2023). Four main axes will be developed as follow:

1. Improve our understanding of how plant growth and development is coordinated with iron availability and draw a more accurate iron homeostasis regulatory network using large-scale expression and protein/DNA interaction studies (i.e. ATAC-seq, ChIP-seq, RNA-seq).
2. Decrypt the spatio-temporal organization of the regulatory network that controls iron homeostasis in roots using confocal microscopy and/or FRET-FLIM.
3. Explore the degree of conservation of the iron homeostasis regulatory network between Arabidopsis and the non- domesticated grass Brachypodium.
4. To go further on the genetic mechanisms and functioning of bHLH in the regulation of iron homeostasis in plants, a phylogenetic/comparative genomics contextualization will be conducted.

General information

This 3 years PhD thesis is supported by the BIOPOLIS project of the European H2020 Teaming program, a partnership between the University of Montpellier (Montpellier, France) and the CIBIO (Research Centre in Biodiversity and Genetic Resources, Porto, Portugal). It implies that

the applicant will conduct his research between the IPSiM (Institut for Plant Sciences of Montpellier), where most of the research will be conducted, and the CIBIO.
IPSiM is a renowned institute in plant nutrition research supported by several in-house technical platforms, including elemental quantification, imaging infrastructures, phenotypic platforms and genomic/molecular analysis as well as a large set of plant growth facilities. At CIBIO, complementary analysis will be performed by PhD anchoring on the strong expertise for bioinformatics, transcriptomics and evolutionary/comparative genomics.
The PhD candidate will be supervised by Christian Dubos who leads the Mineral Nutrition and Oxidative Stress (FeROS) group at IPSiM and co-supervised by Pedro Humberto Castro and Herlander Azevedo of the Plant Biology group (PlantBIO) at CIBIO.
In addition to the salary, all the expenses for the stay at CIBIO will be covered by the BIOPOLIS project.

Application:

Send a CV and a short motivation letter to christian.dubos@inrae
Deadline: 17th of September 2023
Starting date: Early October or early November 2023.

References

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- Gao F, Robe K, Dubos C (2020b) Further insights into the role of bHLH121 in the regulation of iron homeostasis in Arabidopsis thaliana. Plant Signal Behav 15(10):1795582.
- Gao F, Dubos C (2021) Transcriptional integration of plant responses to iron availability. J Exp Bot. 72(6):2056-2070.
- Li M, Watanabe S, Gao F, Dubos C (2023) Iron Nutrition in Plants: Towards a New Paradigm? Plants (Basel). 12(2):384.
- Tissot N, Robe K, Gao F, Grant-Grant S, Boucherez J, Bellegarde F, Maghiaoui A, Marcelin R, Izquierdo E, Benhamed M, Martin A, Vignols F, Roschzttardtz H, Gaymard F, Briat JF, Dubos C (2019) Transcriptional integration of the responses to iron availability in Arabidopsis by the bHLH factor ILR3. New Phytol 223:1433-1446.