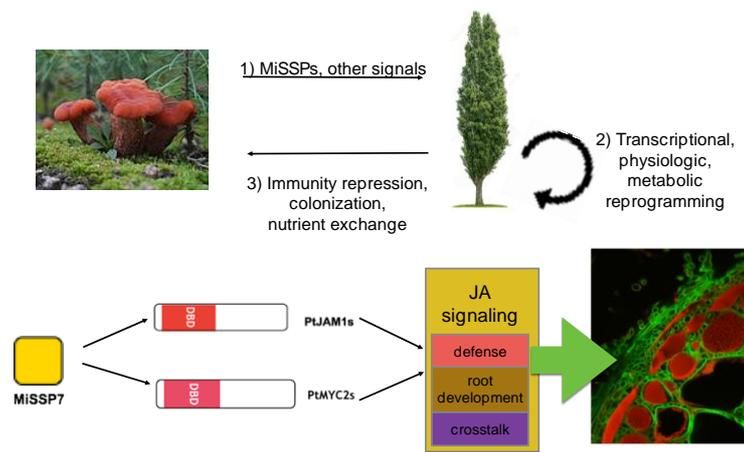


COHABIT



Controlling Hormonal Balance in mutualistic Interaction between trees and fungi

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Context — Ectomycorrhizal mutualistic symbiosis between tree roots and fungal hyphae, are essential for tree health and thus forest sustainability. These interactions can benefit tree productivity and performance by, for example, affecting nutrient uptake, growth allocation and influencing plant immunity. As development, growth and defence have in common hormonal control, it is tempting to test whether mutualistic fungi are able to control hormonal balance to establish ectomycorrhiza. In previous work, we showed that the ectomycorrhizal fungus *Laccaria bicolor* secretes one symbiotic effector MiSSP7, able to bind the co-receptor of jasmonic acid (JA) PtJAZ6. This binding blocks part of the JA-mediated signalling pathway, pointing out a putative role of JA in ectomycorrhiza development. Genomic and transcriptomic analyses have revealed hundreds of putative effectors as Mycorrhiza induced Small Secreted Proteins (MiSSPs), leading to the hypothesis that some of them could control plant immunity, physiology and development.

Objectives — Understanding how ECM fungi control hormone-mediated signalling pathways to restructure the plant host cells and promote mutualism is the fundamental aim of this project. The following specific question will be addressed: (i) How jasmonate-signalling pathway is controlled by the ECM fungus *Laccaria bicolor*? What is the exact role of the effector MiSSP7 in this control? (ii) Does *Laccaria bicolor* control other hormonal-signalling pathway to promote mutualism?

Approach — We first propose to decipher how the mutualistic fungus *L. bicolor*, using its effector MiSSP7, is able to suppress jasmonic-acid-mediated signalling through protein-protein interactions and phenotyping of transgenic poplars. Secondly, we will establish the hormone landscape of ECM root tips, identify hormonal-responsive gene in poplar roots for the plant hormones involved in immunity and development (jasmonic acid JA, salicylic acid SA, gibberellic acid GA, ethylene ET).

Main conclusions including key points of discussion —

- Transgenic poplars constitutively-expressing or silencing for two transcription factors (PtMYC2 or PtJAM1) were obtained.
- SA, JA and GA concentrations are modified in ECM root tips in comparison with lateral roots: JA concentration is reduced, whereas SA one is enhanced and the ratio between the two bioactive form of GAs (GA_6/GA_4) is increased. .
- Exogenous treatment with defense hormones impact both transcriptome and phenotype of poplar roots and ectomycorrhiza but not fungi.

Future perspectives — During this second year of the project, the hired PhD student (Veronica Basso) analyzed the results obtained on the hormonal profiling of ECM root tips together with the expression data (RNAseq) of roots colonized or not under different hormonal treatments. A manuscript is in preparation. She

also worked on the production of transgenic poplar lines and their phenotyping is ongoing. Ms. Basso also wrote a review on the role of jasmonic acid in mutualist interactions.

Valorization —

Publications

Basso V, Veneault-Fourrey C. Review : Jasmonic acid in plant-mutualistic microorganisms interactions. Special issue of the Methods in Molecular Biology series (published by Springer Nature) on *Jasmonate in Plant Biology* (éditeurs: Dr Laurent Laplace et Dr Antony Champion (IRD, Montpellier)

In preparation

Basso V, Daguerre Y, Wittulski S, Schellenberger R, Meyer L, Bailly J, Kohler A, Plett JM, Martin F, Veneault-Fourrey C. Deciphering the protein complex containing the poplar PtJAZ6, target of the symbiotic effector MiSSP7 of *Laccaria bicolor*. Soumission prévue décembre 2018.

Veronica Basso, Annegret Kohler, Shingo Miyauchi, Vasanth Singan, Kerrie W Barry, Igor Grigoriev, Ondrej Novack, Frédéric Guinet, Yohann Daguerre, Francis Martin, Claire Veneault-Fourrey. The crosstalk between defense and development phytohormones regulates the ectomycorrhizal symbiosis between *Laccaria bicolor* and *Populus trichocarpa*. Soumission prévue janvier 2019.

Presentations at conference

Congrès National Société Française de Microbiologie. Paris, France. New insights on the biology of ectomycorrhiza by studying fungal symbiotic effectors. C. Veneault-Fourrey.

INUPRAG 2018 Symposium. Barcelone, Espagne. Controlling phytohormone-signalling in mutualistic interaction between *Populus* tree and the fungus *Laccaria bicolor*. C. Veneault-Fourrey

Oral communication

V Basso, Y Daguerre, R Schellenberger, S Wittulsky, A Kohler, F Martin, C Veneault-Fourrey. Fungal manipulation of JA signaling in ECM symbiosis. 41st New Phytologist Symposium « Plant sciences for the future » 11-13th April 2018. Nancy, France.

V Basso, Y Daguerre, R Schellenberger, S Wittulsky, A Kohler, F Martin, C Veneault-Fourrey. Fungal manipulation of jasmonate signaling in *Laccaria*-*Populus* ectomycorrhizal symbiosis. XIIe rencontres de phytopathologie/mycologie 2018-15-19th January 2018, Aussois, France.

Posters

V Basso, A Kohler, V Singan, KW Barry, I Grigoriev, O Novack, F Guinet, F Martin and C Veneault-Fourrey. Transcriptomic effect of phytohormone treatment on *Populus*-*Laccaria* ectomycorrhiza. INUPRAG 2018 Symposium (Barcelona, Spain ,4-6th June 2018).

V Basso, Y Daguerre, R Schellenberger, S Wittulsky, A Kohler, F Martin and C Veneault-Fourrey. Fungal manipulation of plant jasmonate signaling in *Populus*-*Laccaria bicolor* ectomycorrhizal symbiosis. 41st New Phytologist Symposium « Plant sciences for the future » (Nancy, France, 11-13th April 2018).

V Basso, A Kohler, V Singan, KW Barry, I Grigoriev, O Novack, F Guinet, F Martin and C Veneault-Fourrey. Transcriptomic effect of phytohormone treatment on *Populus*-*Laccaria* ectomycorrhiza. 41st New Phytologist Symposium « Plant sciences for the future » (Nancy, France, 11-13th April 2018).