

PHD PROPOSAL FOR THE DOCTORAL SCHOOL « Ecologie, Géosciences, Agronomie, Alimentation »

GENERAL INFORMATION

Thesis title: The microbiota at the heart of Brassica napus x Delia radicum interactions
Acronym: MicroDef2
Disciplinary field 1: Ecology Disciplinary field 2: Agronomy
Three keywords: microbiota, holobionts, synthetic communities
Research unit : UMR 1349 Institut de Génétique, Environnement et Protection des Plantes
Name of the thesis director: Mougél Christophe Email address of the thesis director : christophe.mougel@inrae.fr Name of the thesis co-supervisor 1 (if applicable): Derocles Stéphane Email address of the thesis co-supervisor 1 (if applicable): stephane.derocles@univ-rennes1.fr Name of the thesis co-supervisor 2 (if applicable): Mariadassou Mahendra Email address of the thesis co-supervisor 2 (if applicable): mahendra.mariadassou@inrae.fr
Thesis grant (funding origin and amount): PIA CPA Deep Impact & INRAE (50/50). Amount : 105228 €
Contact(s) (mailing address and E-mail): Christophe Mougél ; UMR IGEPP, INRAE, Domaine de la Motte, BP35327, F-35653 Le Rheu Cedex - christophe.mougel@inrae.fr
Recruitment process: Recruitment process depends on thesis funding. To select the corresponding recruitment process, please visit the EGAAL website here . This information is needed for proposal publication. <input type="checkbox"/> Doctoral school contest <input checked="" type="checkbox"/> Interview <input type="checkbox"/> Other (indicate) :

All sections must be filled. Once filled, please save the proposal form in pdf format using the following naming: Supervisor Name_Unit_Subject Acronym_EN.pdf

ED EGAAL

Direction : 65 rue de Saint-Brieuc – CS 84215 – 35042 Rennes Cedex – France

Tél : 02 23 48 52 75

Mail : ed-EGAAL@doctorat-bretagne Loire.fr

Site Web : <https://ed-egaal.doctorat-bretagne Loire.fr>

SCIENTIFIC DESCRIPTION OF THE PhD PROJECT

Socio-economic and scientific context : (10 lines)

Plant-associated microbiomes have enormous and so far untapped potential to improve plant resilience to abiotic and biotic stresses and ultimately crop yield. This thesis project aims to analyze a triptych of interactions between rapeseed (*Brassica napus*), a specialist insect pest (*Delia radicum*) and their respective microbiota. These interactions take as theoretical framework that of the holobiont/hologenome. Descriptions of the microbial assemblies of the rapeseed and the insect in natura and under experimental conditions will be carried out. They will be supplemented by functional approaches mobilizing reductionist approaches of the microbial consortia type (SynCom) making it possible to experimentally manipulate the microbial components of rapeseed and insects.

Assumptions and questions (8 lines)

Q1 - What is the diversity, composition and structure of the interaction networks of the microbiota of the different compartments of *B. napus* (rhizosphere, root, leaf) according to the phenology of the plant or its health status?

Q2 - What is the relative contribution of microbiota communities to variation in health and performance of rapeseed (grown without chemical protection)?

Q3 – What is the proportion of *D. radicum* microbiota transmitted vertically or acquired horizontally from *B. napus*?
What is the weight of bacterial detoxification genes compared to the endogenous detoxification genes of *D. radicum*?

The main steps of the thesis and scientific procedure (10-12 lines)

1) Analysis of the diversity of *B. napus* microbiota and contribution of microbiota communities to rapeseed health and performance. Bacterial and fungal combinations explaining the reduction of disease and the abundance of the pathobiota, will be identified with the aim of reconstructing synthetic microbial consortia (SynComs) for step 2

2) Test of SynCom and their protective efficacy on different genotypes of *B. napus* presenting different concentrations of glucosinolates (toxic for insects). In addition to the phenotype, transcriptomic and metabolomic measurements will provide a better understanding of the interaction triptych.

3) Functional analysis of cross-processes between chemical defense of *B. napus* to *D. radicum* and detoxification mechanisms in *D. radicum*. For this, microbial consortia bearing or not detoxification traits will be built and will be used to test the role of the microbial component on the performance of the insect.

Methodological and technical approaches considered (4-6 lines)

The PhD student will analyze plant, microbiota and phytophagous insect interactions using community ecology and functional ecology approaches. He/she will combine approaches mobilizing natural and synthetic communities. He/she will mobilize skills in bioinformatics and statistics of microbiota diversity, bacterial genomics and transcriptome data. He/she will acquire skills in molecular biology, metabolomics, microbiology and entomology.

Scientific and technical skills required by the candidate

The PhD student will have skills in ecology (particularly in community ecology) and in evolutionary biology. Skills in molecular biology and statistics are also necessary. An experience in metabarcoding, if possible on themes related to the microbiota, is very strongly desired.

THESIS SUPERVISION¹

Unit name: UMR 1349 Institut de Génétique, Environnement et Protection des Plantes	Team name: Plant-Microbiota-Bioagressors
Unit director name: Nathalie NESI	Team director name: Eric GRENIER
Mailing address of the unit director: nathalie.nesi@inrae.fr	Mailing address of the team director: eric.grenier@inrae.fr
Thesis director Surname, first name: Mougel, Christophe Position: Director of research Obtained date of the HDR (Habilitation thesis to supervise research): 2010, december 6th Employer: INRAE Doctoral school affiliation: EGAAL Rate of thesis supervision in the present project (%): 40% Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): 90% Number of current thesis supervisions/co-supervisions: 1	
Thesis co-supervisor 1 (if applicable) Surname, first name: DEROCLES Stéphane Position: Lecturers Habilitation thesis to supervise research <input type="checkbox"/> yes <input checked="" type="checkbox"/> no If yes, date diploma received: Employer: Rennes1 University Doctoral school affiliation: EGAAL Rate of thesis supervision in the present project (%): 30 Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): 0 Number of current thesis supervisions/co-supervisions: 0	
Thesis co-supervisor 2 (if applicable) Surname, first name: MARIADASSOU Mahendra Position: Researcher Habilitation thesis to supervise research <input type="checkbox"/> yes <input checked="" type="checkbox"/> no If yes, date diploma received:	

¹ In EGAAL Doctoral School, if only one scientist in thesis supervision = 100% of supervision rate; if 2 people involved in thesis supervision = from 50% to 70% of supervision rate for the director; if 3 people involved in thesis supervision = 40% / 30% / 30% of supervision rate distribution among supervisors.

Employer: INRAE

Doctoral school affiliation: EDMH

Rate of thesis supervision in the present project (%): 30

Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): 50

Number of current thesis supervisions/co-supervisions: 1

Surname, first name: Ourry Morgane

Date of PhD beginning and PhD defence: 2016, november 1st to 2019, december 20th

Thesis supervision: Pr Anne-Marie Cortesero (50%) & Christophe Mougel (50%)

Professional status and location: Post-Doc, Department of Plant and Environmental Sciences, University of Copenhagen, Denmark

Contract profile (post-doc, fixed-term, permanent): Post-Doc

List of publications from the thesis work:

1. Morgane Ourry, Agathe Crosland, Valérie Lopez, Stephane A. P. Derocles, Christophe Mougel, Anne Marie Cortesero, Denis Poinot. Influential Insider: Wolbachia, an Intracellular Symbiont, Manipulates Bacterial Diversity in Its Insect Host. *Microorganisms*, 2021, 9 (6), <doi.org/10.3390/microorganisms9061313>
2. Morgane Ourry, Valérie Lopez, Maxime Hervé, Lionel Lebreton, Christophe Mougel, Yannick Outreman, Denis Poinot, Anne Marie Cortesero. Long-lasting effects of antibiotics on bacterial communities of adult flies. *FEMS Microbiology Ecology*, 2020, 96 (4), <doi.org/10.1093/femsec/fiaa028>
3. Lionel Lebreton, Anne-Yvonne Guillerm-Erckelboudt, Kévin Gazengel, Juliette Linglin, Morgane Ourry, Pascal Glory, Alain Sarniguet, Stéphanie Daval, Maria J. Manzanera-Dauleux, Christophe Mougel. Temporal dynamics of bacterial and fungal communities during the infection of Brassica rapa roots by the protist Plasmodiophora brassicae. *PLoS ONE*, Public Library of Science, 2019, 14 (2), pp.e0204195. <doi.org/10.1371/journal.pone.0204195>
4. Morgane Ourry, Lionel Lebreton, Valérie Chaminade, Anne-Yvonne Guillerm-Erckelboudt, Maxime Hervé, Juliette Linglin, Nathalie Marnet, Alain Ourry, Chrystelle Paty, Denis Poinot, Anne-Marie Cortesero, Christophe Mougel. Influence of Belowground Herbivory on the Dynamics of Root and Rhizosphere Microbial Communities *Frontiers in Ecology and Evolution*, Frontiers Media S.A, 2018, 6, pp.1-21. <doi.org/10.3389/fevo.2018.00091>
5. Tom Lachaise, Morgane Ourry, Lionel Lebreton, Anne-Yvonne Guillerm-Erckelboudt, Juliette Linglin, Chrystelle Paty, Valérie Chaminade, Nathalie Marnet, Julie Aubert, Denis Poinot, Anne-Marie Cortesero, Christophe Mougel. Can soil microbial diversity influence plant metabolites and life history traits of a rhizophagous insect? *Insect Science*, Wiley, 2017, 24 (6), pp.1045-1056. <doi.org/10.1111/1744-7917.12478>

Surname, first name: Guyomar Cervin

Date of PhD beginning and PhD defence: 2015, november 1st to 2018, december 7th

Thesis supervision: Jean-Christophe Simon (50%), Claire Lemaitre (25%), Christophe Mougel (25%)

Professional status and location: Research engineer, INRAE, Rennes

Contract profile (post-doc, fixed-term, permanent): Fixed-term

List of publications from the thesis work:

1. Cervin Guyomar, Fabrice Legeai, Emmanuelle Jouselin, Christophe Mougel, Claire Lemaitre, et al.. Multi-scale characterization of symbiont diversity in the pea aphid complex through metagenomic approaches. *Microbiome*, BioMed Central, 2018, 6 (1), pp.1-21. <[10.1186/s40168-018-0562-9](https://doi.org/10.1186/s40168-018-0562-9)>.

Cervin Guyomar, Wesley Delage, Fabrice Legeai, Christophe Mougel, Jean-Christophe Simon, et al.. MinYS: mine your symbiont by targeted genome assembly in symbiotic communities. *NAR Genomics and Bioinformatics*, Oxford University Press, 2020, 2 (3), pp.1-11. ([10.1093/nargab/lqaa047](https://doi.org/10.1093/nargab/lqaa047)).

Five main recent publications of the supervisors on thesis subject:

THESIS FUNDING

Origin(s) of the thesis funding: PIA CPA Deep Impact & INRAE (50/50)

Gross monthly salary: 1975 €

Thesis funding state : Acquired

Funding beginning date/Funding ending date: 12/01/2022 36 months

Date: 3 octobre 2022

Name, signature of unit director: Nathalie NESI

Nathalie NESI
Directrice UMR IGEPP



Name, signature of team director: Eric GRENIER



Name, signature of thesis project director: Christophe MOUGEL



C. MOUGEL