

PhD PROPOSAL FOR THE DOCTORAL SCHOOL « Ecologie, Géosciences, Agronomie, ALimentation »

GENERAL INFORMATION

Thesis title: Anthropogenic disturbance of trophic interactions: case of low doses of pesticides in grass strips of agrosystems
Acronym: PESTITROPHIC
Disciplinary field 1: Ecology Disciplinary field 2: Agronomy
Three keywords: Pesticide residual exposure, non target organisms, plant-aphid-parasitoid trophic web
Research unit : UMR-CNRS 6553 ECOBIO
Name of the thesis director: Sulmon Cécile Email address of the thesis director : cecile.sulmon-maisonneuve@univ-rennes1.fr Name of the thesis co-supervisor 1 (if applicable): Le Lann Cécile Email address of the thesis co-supervisor 1 (if applicable): cecile.lelann@univ-rennes1.fr
Thesis grant (funding origin and amount): Contrat Doctoral Ordinaire, 1769 euros brut per month
Contact(s) (mailing address and E-mail): Cécile Sulmon UMR 6553 ECOBIO, Université de Rennes 1 Campus de Beaulieu Bât. 14A, Avenue du Général Leclerc 35042 Rennes cedex France Cécile Le Lann UMR 6553 ECOBIO, Université de Rennes 1 Campus de Beaulieu Bât. 14A, Avenue du Général Leclerc 35042 Rennes cedex France
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 checked="" type="checkbox"/> Doctoral school contest <input 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)

Agriculture uses large amounts of pesticides to control crop pests and weeds. This has generated widespread pollution of terrestrial and aquatic ecosystems. Watercourse protection is ensured by the establishment downstream of agricultural plots of grass strips which intercept pesticide flows. These vegetated devices also have a role of refuge for plants and entomofauna, in particular for crop auxiliaries which regulate pests. These grass strips therefore constitute a site of chronic exposure of organisms to residual doses of pesticides. However, pesticide effects on such non-target organisms, and in particular on their trophic interactions, remain poorly documented in this context of edaphic exposure. The objective of the project is to understand the consequences of chronic exposure of grass strip food webs to pesticide residual contamination, by using the plant-phytophagous aphid-auxiliary parasitoid network as model.

Assumptions and questions (8 lines)

This project will characterize the modes of exposure of organisms to pesticides and their responses within the network of interactions. It will test the hypothesis of plant uptake and transfer of pesticides along the food web, and characterize the physiological and performance consequences of these exposures. Since pesticides induce chemical stress and metabolic and molecular perturbations in organisms, the project will test two hypotheses: the hypothesis of a direct effect of pesticides, as a stress, on each compartment of the network, and the hypothesis of indirect effects of pesticides through modifications of nutritional flows, chemical communication between organisms, and defense processes. As organisms are recurrently exposed to pesticides in grass strips, the questions will integrate the *in situ* adaptation potential of the organisms and the associated trade-offs.

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

The work will be conducted both in the laboratory (experiments under controlled conditions) and in the field (Zone Atelier Armorique: CNRS ecological observatory) within organic and conventional farming systems in order to work on the issue of adaptation to pesticides. The responses of organisms to pesticides will be characterized within the food web by measuring physiological and growth traits. At the same time, the modes of exposure of the different organisms to pesticides and, in particular, the transfer of pesticides (and related degradation products) along the network will be analyzed by monitoring and quantifying pesticides in biological matrices. Organism responses within the food web will be related to the quality of nutritional flows, their defense potential, and the establishment of chemical communications at the origin of specific behaviors (attractiveness) of phytophages and parasitoids.

Methodological and technical approaches considered (4-6 lines)

This project will use techniques of liquid chromatography (LC-QToF) for the quantification of pesticides and related degradation products, and of metabolomics by gas chromatography for the characterization of nutritional flows. Defense potential and communication traits (Volatile Organic Compounds emitted by plants) will be analyzed by transcriptomics and PTR-MS strategies.

Scientific and technical skills required by the candidate

Ecophysiology of plants and invertebrates, ecology of trophic interactions, physiology of stress, evolutionary ecology, molecular biology, omics-type data analyzes, statistics, English

THESIS SUPERVISION¹

Unit name:

UMR-CNRS 6553 ECOBIO

Team name:

NA (unit organized into themes)

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.

Unit director name: Joan van BAAREN	Team director name: NA (unit organized into themes)
Mailing address of the unit director: Joan.van-baaren@univ-rennes1.fr	Mailing address of the team director: NA (unit organized into themes)
Thesis director Surname, first name: SULMON, Cécile Position: Associate professor Obtained date of the HDR (Habilitation thesis to supervise research): 2020 Employer: University of Rennes 1 Doctoral school affiliation: EGAAL Rate of thesis supervision in the present project (%): 50% Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): 0 Number of current thesis supervisions/co-supervisions: 0	
Thesis co-supervisor 1 (if applicable) Surname, first name: LE LANN, Cécile Position: Associate professor Habilitation thesis to supervise research <input type="checkbox"/> yes <input checked="" type="checkbox"/> no If yes, date diploma received: Employer: University of Rennes 1 Doctoral school affiliation: EGAAL Rate of thesis supervision in the present project (%): 50% Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): PhD Armando Alfaro-Tapia (30%), end July 2021 ; PhD Jeniffer Alvarez-Baca (30%), end September 2021, Sacha Roudine (40%), end December 2022. Number of current thesis supervisions/co-supervisions: 3 (2 ended in 2021)	
Thesis co-supervisor 2 (if applicable) Surname, first name: Position: Habilitation thesis to supervise research <input type="checkbox"/> yes <input type="checkbox"/> no If yes, date diploma received: Employer: Doctoral school affiliation: Rate of thesis supervision in the present project (%): Total rate of thesis supervision in ongoing theses (supervisions and co-supervisions) (%): Number of current thesis supervisions/co-supervisions:	

Private partner (if CIFRE funding, private funding,...)

Surname, first name:

Position:

Employer:

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

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

Number of current thesis supervisions/co-supervisions:

International partner (if Cotutelle thesis)

Surname, first name:

Position:

Employer:

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

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

Number of current thesis supervisions/co-supervisions:

Professional status of previous PhD students supervised by the director (from 5 years)

Please provide the following information for each PhD students supervised

Surname, first name: ALBERTO Diana

Date of PhD beginning and PhD defence: 01/10/2014 – 20/12/2017

Thesis supervision: GOUESBET Gwenola, **SULMON Cécile**, COUEE Ivan

Professional status and location: Chargée d'affaires bio-contrôle chez CBC BIOGARD

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

List of publications from the thesis work:

1. **Alberto D**, Serra AA, **Sulmon C**, Gouesbet G, Couée I. 2016. Herbicide-related signaling in plants reveals novel insights for herbicide use strategies, environmental risk assessment and global change assessment challenges. *Science of the Total Environment*, 569-570: 1618-28. doi: 10.1016/j.scitotenv.2016.06.064. IF 5.589
2. **Alberto D**, Couée I, **Sulmon C***, Gouesbet G*. 2017. Root-level exposure reveals multiple physiological toxicity of triazine xenobiotics in *Arabidopsis thaliana*. *Journal of Plant Physiology*, 212: 105-114. doi: 10.1016/j.jplph.2017.01.013. IF 2.825
3. **Alberto D**, Couée I, Pateyron S, **Sulmon C**, Gouesbet G. 2018. Low doses of triazine xenobiotics mobilize ABA and cytokinin regulations in a stress- and low-energy-dependent manner. *Plant Science* 274: 8-22. IF 3.785
4. Serra AA, **Alberto D**, **Sulmon C**, Gouesbet G, Couée I. 2016. Implications des communautés végétales péri-agricoles dans la dynamique environnementale des pollutions par les pesticides. *Revue d'écologie*, 71 n°3 : 203-221
5. Serra AA, **Alberto D**, Ramel F, Gouesbet G, **Sulmon C**, Couée I. 2017. Perturbation and disruption of plant hormone signaling by organic xenobiotic pollutions. Book Chapter Mechanism of Plant Hormone Signaling under Stress (ed G. K. Pandey), John Wiley & Sons, Inc., Hoboken, NJ, USA.

Professional status of previous PhD students supervised by both director and co-supervisors (from 5 years)

Please provide the following information for each PhD students supervised

Surname, first name: TOUGERON Kevin

Date of PhD beginning and PhD defence: 2014-2017

Thesis supervision: Joan van Baaren, Jacques Brodeur (Univ Montréal), Cécile Le Lann

Professional status and location: post-doc Univ Louvain La Neuve (3 years)

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

List of publications from the thesis work:

Tougeron K, van Baaren J, Burel F, Alford L. (2016) Comparing thermal tolerance across contrasting landscapes; first steps towards understanding how landscape management could modify ectotherm thermal tolerance. **Insect Conservation and Diversity** 9 (3): 171-180. doi: 10.1111/icad.12153.

Tougeron K., Le Lann C., Brodeur J. & van Baaren J. 2017. Are aphid parasitoids from mild winter climates losing their winter diapause? **Oecologia** **183**:(3), 619-629.

Tougeron K, Hraoui G, Le Lann C, van Baaren J & Brodeur J. 2017. Competition for hosts induces offspring summer diapause in aphid parasitoids. **Insect Science**, 00, 1–9, DOI 10.1111/1744-7917.12491

Alford L, Tougeron K, Pierre JS, Burel F, van Baaren J. 2018. The effect of landscape complexity and microclimate on the thermal tolerance of a pest insect. **Insect Science** **25** (5): 905-915. DOI

10.1111/1744-7917.12460

Tougeron K, van Baaren J, Brodeur J, Llopis S, Ridet A, & Le Lann C. 2018. Disentangling plasticity from local adaptations in diapause expression of parasitoids from and within contrasted thermal environments. **Biological Journal of the Linnean Society** 124(4): 756-764. DOI:

10.1093/biolinnean/bly079

Tougeron K, Damien M, Le Lann C, Brodeur J & van Baaren J. 2018. Changes in host-parasitoid communities over the years in cereal crops of Western France: Does climate warming matters? **Frontiers in Ecology and Evolution-Population and Evolutionary Dynamics**”. 6:173. doi: 10.3389/fevo.2018.00173

Tougeron K, Le Lann C, & van Baaren J., Brodeur J. 2019. Diapause expression in a Quebec population of the parasitoid *Aphidius ervi* (Hymenoptera: Braconidae). **The Canadian Entomologist** 151: 345–349.

Tougeron K., Brodeur J., van Baaren J., Renault D. and Le Lann C. 2019. Sex makes them sleepy: host reproductive status induces diapause in a parasitoid population experiencing harsh winters. bioRxiv 371385, ver. 6 peer-reviewed and recommended by **PCI Ecology**. doi: **10.1101/371385**

Tougeron K, Brodeur J, Le Lann C, van Baaren J. 2019. How climate changes affect parasitoids' seasonal ecology? **Ecological Entomology** **45**, 167-181. DOI: 10.1111/een.12792

van Baaren J., Wist T, Soroka J, Tougeron K. 2020. Host-parasitoids network in extreme conditions: the case of cereal aphids in wheat crops in Saskatchewan, Canada. **Entomologia generalis** 40 (1): 63-77. <10.1127/entomologia/2019/0807>. [hal-02530838](https://doi.org/10.1127/entomologia/2019/0807)

[hal-02530838](https://doi.org/10.1127/entomologia/2019/0807)

Tougeron K, Devogel M, van Baaren J, Le Lann C, Hance T. 2020. Trans-generational effects on diapause and life-history-traits of an aphid parasitoid. **Journal of Insect Physiology**. **121**. 104001.

<https://doi.org/10.1016/j.jinsphys.2019.104001>

Tougeron K., van Baaren J., Town J., Nordin, D., Dumonceaux T. & Wist T. 2021. Body-color plasticity of the English grain aphid in response to light in both laboratory and field conditions. **Evolutionary Ecology** 35 (1): 163-163 (Oct, 10.1007/s10682-020-10088-4, 2020).

Surname, first name: DAMIEN Maxime

Date of PhD beginning and PhD defence: 2015-2018

Thesis supervision: Joan van Baaren, Nicolas Desneux (INRAE Sophia Antipolis), Cécile Le Lann

Professional status and location: post-doc Canada (3 years)

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

List of publications from the thesis work:

Damien M, Le Lann C, Desneux N, Alford L, Al-Hassan D, Georges R, Van Baaren J. 2017. Change in plant phenology during winter increases pest control but not trophic link diversity. **Agriculture Ecosystems and Environment** 247: 418-425

Tougeron K, Damien M, Le Lann C, Brodeur J & van Baaren J. 2018. Changes in host-parasitoid communities over the years in cereal crops of Western France: Does climate warming matters? **Frontiers in Ecology and Evolution-Population and Evolutionary Dynamics**. 6:173.
doi: 10.3389/fevo.2018.00173

Damien M, Barascou L, Ridet A, Van Baaren J, Le Lann C 2019. Food or host: do physiological state and flower type affect foraging decisions of parasitoids? **Behavioral Ecology and Sociobiology** 73:156.
<https://doi.org/10.1007/s00265-019-2758-9>

Damien M, Llopis S, Desneux N, Van Baaren J and Le Lann C. 2020. How does floral nectar quality affect life history strategies in parasitic wasps. **Entomologia generalis** 40(2): 147 – 156. ArtNo. ESP146004002003 DOI: 10.1127/entomologia/2020/0906

Surname, first name: JEAUVONS Emma

Date of PhD beginning and PhD defence: 2017-2020

Thesis supervision: Joan van Baaren, Cécile Le Lann, Anne Le Ralec

Professional status and location: research of post-doc

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

List of publications from the thesis work:

Jeavons E, van Baaren J, Le Lann C. 2020. Resource partitioning among a pollinator guild: 1 a case study of flower monocultures under high honeybee pressure. **Acta Oecologia** 104. 103527.
<https://doi.org/10.1016/j.actao.2020.103527>.

Jeavons E, van Baaren J, Le Ralec A, Bucharid C, Duval F, Llopis S, Postic E, Le Lann C. When resource diversification fails to enhance cereal aphid control: intraguild competition and predation matters. Resoumis apres correction J Applied Ecology.

+ 3 publications en préparation (à soumettre avant fin avril 2021)

Five main recent publications of the supervisors on thesis subject:

Baillard V, Delignette-Müller ML, **Sulmon C**, Bittebiere AK, Mony C, Couée I, Gouesbet, Devin S, Billoir E. 2021. How does interspecific competition modify the response of herbaceous plants against chemical stress? A hierarchical concentration-response approach. **Science of The Total Environment** 778, 146108.

Serra AA, Bittebière AK, Mony C, Slimani K, Pallois, Renault D, Couée I, Gouesbet G, **Sulmon C**. 2020. Local-scale dynamics of plant-pesticide interactions in a northern Brittany agricultural landscape. **Science of the Total Environment** 744: 140772.

Serra AA, Miqueau A, Ramel F, Couée I, **Sulmon C**, Gouesbet G. 2019. Species- and organ-specific responses of agri-environmental plants to residual agricultural pollutants. **Science of the Total Environment**, 694: 133661

Tougeron K, Van Baaren J, Llopis S, Ridet A, Doyon J, Brodeur J, **Le Lann C**. 2018. Disentangling plasticity from local adaptation in diapause expression of parasitoid wasps from contrasting thermal environments: a reciprocal translocation experiment. **Biological Journal of the Linnean Society**, 124: 756-764.

Kampfraath D, Giesen D, van Gestel CAM, Le Lann C. 2017. Pesticide stress on plants negatively affects parasitoid fitness through a bypass of their hosts. *Ecotoxicology*, 26: 383-395.

THESIS FUNDING

Origin(s) of the thesis funding: Contrat doctoral Ordinaire

Gross monthly salary: 1769 euros brut per mois

Thesis funding state: Non acquired

Funding beginning date/Funding ending date: 01/10/2021, durée 3 ans

Date: 26/03/2021

Name, signature of unit director: Pr Joan van Baaren

Joan VAN BAAREN
Directrice de l'UMR Ecoblo



Name, signature of team director: NA (unit organized into themes)

Name, signature of thesis project director: Dr Cécile Sulmon

