PhD Scholarship in beekeeping ecotoxicology

Titre / Title / Título : Utilisation des abeilles (*Apis mellifera* et Mélipones) comme outils de mesures de la répartition spatiale et temporelle des polluants dans le paysage et détermination de valeurs seuils internationales pour l'interprétation du risque de toxicité des polluants / *Use of bees (Apis mellifera and Melipona sp.) as tools for measuring the spatial and temporal distribution of pollutants in landscape and determination of international threshold values for the interpretation of pollutants risk of toxicity* / Uso de abejas (Apis mellifera y Melipona) como herramientas para medir la distribución espacial y temporal de contaminantes en el paisaje y la determinación de valores umbral internacionales para la interpretación del riesgo de toxicidad de contaminantes

Problematic and context:

Populations of honey bees and other pollinators have declined worldwide in recent years. A variety of stressors have been implicated as potential causes, including pollutants. Current knowledge does not allow us to link the exposure of pollinators to their habitat (Review of Uhl and Brühl, 2019). In addition, the fate and effects of pollutants can be very different in tropical regions compared to their temperate counterparts (Daam et al., 2019). There is therefore a need to intensify research on terrestrial ecotoxicology in the tropics, particularly in tropical regions and countries where research efforts are limited. Field studies in tropical agroecosystems are necessary to develop and calibrate scenarios of environmental fate models simulating tropical conditions. These studies would better guide what can be considered as comparable agro-ecological zones in order to obtain an evaluation method which interprets a risk assessment carried out in a country (the "reference country") and applies it to another situation. (FAO, 2018: Working Group on Evaluation of Pesticide Risks to Soil Organisms, Biodiversity and Ecological Functions - Meeting Summary Food and Agriculture Organization, Rome, Italy). A promising approach is landscape-scale modeling, which makes it possible to assess the exposure to pollutants of pollinator populations and its subsequent effects, in space and over time (Rortais et al. 2017; Topping et al. 2003). This method would also make it possible to determine if the different pollutants are detected according to the same order of magnitude in the same types of landscapes regardless of the country (Lambert, 2012).

Main research question:

Are Melipona and honeybees affected in the same way by pollutants in tropical or temperate environments, depending on the type of landscape ?

How to determine exposure to pollutants of tropical bee populations (Melipona) and its subsequent effects, in space and over time in comparison with honeybees (*Apis mellifera*) ?

Proposed work:

The research will focus on environmental biomonitoring in tropical environments (Dominican Republic and French Guiana) looking for the effects of pollutants (PAHs, Heavy metals, Pesticides) on bee species in different landscapes and over time.

In the case of active biomonitoring of the environment in which the honey bee is used as a bioaccumulator of environmental contaminants, the methodology used will refer to standard

AFNOR X43-909, developed by APILAB describing the method of exposure, sampling and preparation of honey bee samples.
In a first step, a characterization of the landscapes around each studied apiary will be carried out (by GIS to determine typology of site). Every two months, relevant biological matrices (bee bread for pesticides, etc.) will be collected in each studied apiary to measure targeted pollutants concentration. The health status of each hive will be monitored to determine any change in bee behavior, or beehive activity (the death of the colony, if applicable). Then, modeling and multivariate analysis will help to determine which pollutant (or mixture of pollutants) has the most negative impact on bee health and /or mortality (taking into account bee species, countries, type of landscape, concentration of pollutants and distance to pollution source, physicochemical properties of pollutants, means of application, etc.). Model predictions and laboratory bioassays will help to define threshold values internationally useable to diagnose a potential risk of toxicity and mortality of bee colonies linked to pollutants and landscapes over time of the year.

Host teams:

- NBC, Cayenne French Guiana : French Guiana and Dominican Republic Field bioassays, beekeeping. http://www.nbcsarl.com
- INRA - UR406 - Abeilles et Environnement, Avignon France : Environmental toxicology, redaction http://www.inra.fr
- APILAB, La Rochelle France : Beekeeping, French Bioassays ; if necessary, provision of an office and laboratory, accommodation and database. http://www.apilab.fr

Profile:

We are looking for a highly motivated student with outstanding or excellent Master's degree or equivalent qualification who is interested to work in an interdisciplinary project. The main scientific cores are: experimental ecotoxicology, modelling, analysis and processing of big data. Skills with the R software will be a clear plus. Knowledge in beekeeping, interpersonal skills, dynamism, rigor and teamwork abilities will be appreciated. Fluent Spanish and/or English will be appreciated, together with high-level editorial skills. Finally, several places have been described in order to carry out this work (French Guiana, Dominican Republic and France). The candidate should consider this in their application.

Contacts:

Students wishing to apply are invited to send by email (nicolas.brehm@nbcsarl.com, luc.belzunces@inra.fr and benjamin.poirot@apilab.fr) :

- A resume,
- A cover letter,
- A letter of recommendation,
- A copy of the results obtained in Master and / or Engineering School,
- A copy of the last internship report made (if available).

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Duration: 36-month CIFRE contract (mid-2020 to mid-2023)

Doctoral school: ED 536 "Agrosciences & Sciences" frome Université d'Avignon (FRANCE)

Main references:

Daam, M.A., Chelinho, S., Niemeyer, J.C., Owojori, O.J., De Silva, P.M.C.S., Sousa, J.P., van Gestel, C.A.M., Römbke, J. (2019). Environmental risk assessment of pesticides in tropical terrestrial ecosystems: test procedures, current status and future perspectives. *Ecotoxicology and Environmental Safety* 181, 534-547.

Lambert Olivier (2012). Contamination chimique de matrices apicoles au sein de ruchers appartenant à des structures paysagères différentes. Sciences agricoles. Université Blaise Pascal - Clermont-Ferrand II, 2012. Français. ffNNT : 2012CLF22302ff. fftel-00833765

Rortais, A., et al. 2017. Risk assessment of pesticides and other stressors in bees: Principles, data gaps and perspectives from the European Food Safety Authority. *Science of The Total Environment*, 587-588, 524–537, doi:10.1016/j.scitotenv.2016.09.127.

Topping, C. J., Hansen, T. S., Jensen, T. S., Jepsen, J. U., Nikolajsen, F., & Odderskær, P. 2003. ALMaSS, an agent-based model for animals in temperate European landscapes. *Ecological Modelling*, 167(1-2), 65–82, doi:10.1016/S0304-3800(03)00173-X.

Uhl, P. and Brühl, C. A. (2019), The Impact of Pesticides on Flower-visiting Insects: A Review with Regard to European Risk Assessment. *Environ Toxicol Chem*. Accepted Author Manuscript. doi:10.1002/etc.4572