Research Topic for the ParisTech/CSC PhD Program
(one page maximum)

Subfield: Life science and engineering for agriculture, environment science, food and the environment, sustainable development,

ParisTech School:AgroParisTech / ABIES Doctoral School

Title:Development of new insect-pest control strategies aimed at enhancing the impact of biological control agents by reducing the immunocompetence of the host.

Advisor(s): Dr. Vincent Sanchis-Borja, e-mail: vincent.sanchis-borja@inra.fr , Web site: http://www.micalis.fr/micalis_eng/Poles-and-teams/Pole-Risk/GME-Lereclus/Team-members/Vincent-Sanchis-Borja

Short description of possible research topics for a PhD: (10-15 lines in English + optional figure)

The insect gut microbiota is the first organ and barrier in contact with ingested toxins and microbes. Therefore, the integrity of the intestinal microbiota is likely to be of high importancein modulating the interactions between the host and intestinal pathogens, and for the capacity of an insect to tolerate the presence of a pathogen. Indeed, in the model insect *Galleria mellonella,*it has been recently shown thata colony resistant to *Bacillus thuringiensis*(Bt)showed a modified bacterial community (Dubovskiy et al. 2016, *Virulence*). Moreover it is well known and thatin *Spodopteralittoralis,*the gut bacterium *Enterococcus. mundtii* produces an antimicrobial peptide that strongly inhibits some potentially pathogenic organisms (Shao, et al., 2017, *Cell Chemical Biology*).However, another report claimsthat the insect gut microbiota of *S.littoralis*could enhance the impact ofBt (Caccia et al, 2016, *Proc Natl Acad USA*) Therefore, the role of the gut microbiota in infection processes in insects, either naturally occurring or following spreading of biological control agents (BCAs), remains contradictory and fragmented and is far from clear.Here, we propose to use the larvae of*G.mellonella*, to assess the virulence and infection process ofBtand of its Cry toxins that are widely used in organic farming in mosquito control. The aim in this project is to focus on the role of insect microbiome in host resistance against colonization and infection to make insect-pests more susceptible to pathogen infection.We have already information on the microbiota of *G.mellonella* and we can rear axenic insects and modify the microbiota with antibiotics. In this project we will: 1) use *Gm* to analyse how the gut microbiota interfere with pathogens entering by the oral route, such as *Bacillus thuringiensis* (Bt) 2) Determine the correlation between artificial perturbations of gut microbiota and changes in the physiological and immunological state of the insect 3) Manipulate the gut microbiota to establish which components of the insect microbiome are parasitic or mutualistic 4) Use metagenomic and RT-qPCR approaches to identify the mechanistic impact of the pathogen on antagonistic or synergistic cross-interactions of the microbiota on insect immunity. This model system is anticipated to provide insights into the importance of septicemia in the killing mechanism mediated byBtbiopesticides and could provide a sound foundation for developing new insect control strategies aimed at enhancing the killing-efficacy of biocontrol agents by reducing the immunocompetence of the host.

Required background of the student: A general background in genomic sciences including classes in genetics, molecular biology, biochemistry and preferably in bioinformatics/statistics for analysis of sequencing data.

A list of 5(max.) representative publications of the group:

- Attieh Z., Kallassy M., Rejasse A., Courtin P., Gomperts-Boneca I., Chapot-Chartier M-P., Sanchis V. and El Chamy L. (2018).Of Bacilli and Flies: D-alanine esterification of teichoic acids impedes the sensing of peptidoglycan by the host innate immune system. Submitted to Cell Host & Microbes.

- Kamar R**,** Réjasse A**,** Jéhanno I**,** Attieh Z, Courtin P., Chapot-Chartier M-P, Nielsen-Leroux C**,** Lereclus D**,** El Chamy L, KallassyAwad M**,** Sanchis-Borja V. (2017). DltX of *Bacillus thuringiensis* is essential for D-alanylation of teichoic acids and resistance to antimicrobial response in insects. Frontiers in Microbiology. 8:1437. doi: 10.3389/fmicb.2017.01437.

- Patino-Navarrete Rand Sanchis V. (2017) Evolutionary processes and environmental factors underlying the genetic diversity and lifestyles of *Bacillus cereus* group bacteria.Research in Microbiology. 2017 May;168(4):309-318. doi: 10.1016/j.resmic.2016.07.002. Epub 2016 Jul 16.

-Kamar R**,** Gohar M**,** Jéhanno I**,** Rejasse A**,**KallassyAwad M, Lereclus D,Sanchis V,Ramarao R**.** (2013). Pathogenic potential of *Bacillus cereus* strains as revealed by phenotypic analysis. J. Clin. Microbiol. 51(1): 320-323.

- Song F, Peng Q, Brillard J, Buisson C**,** de Been M, Abee T, Broussolle V, Huang D, Zhang J, Lereclus D**,** Nielsen-Leroux C**.** (2012). A multicomponent sugar phosphate sensor system specifically induced in *Bacillus cereus* during infection of the insect gut. FASEB J. 26(8): 3336-3350.