BRAIN-be
Belgian Research Action through Interdisciplinary Networks

EXOTIC-BE

EXperimentally Orientated genomics to Tackle Insects adaptive Challenges during bioinvasions: the ladybird Harmonia axyridis as a model species

DURATION
15/12/2013 – 14/12/2016

BUDGET
99 122 €

PROJECT DESCRIPTION

General context

Biological invasions or bioinvasions include all kind of organisms and ecosystems. They are now widely considered as major component of global change. Though it cannot be presupposed that all species invasions are damaging, the ecological consequences of bioinvasions include loss of native biological diversity, changes in community structure and ecosystem functioning. In addition to their potential ecological effects, bioinvasions may deeply impact human health and have economic impacts through the damages caused to agriculture, forests and fisheries.

While case studies of rapid evolutionary changes linked to bioinvasions are accumulating, only a few research programs have pointed specific genetic mechanisms underlying adaptive evolution during invasions, and only in simplified systems. The evolutionary forces that lead to populations with a greater propensity to invade largely remain a mystery, precluding a clear understanding of the nature of invasiveness. The development of new molecular tools, allowing for genome-wide studies, in the close integration with targeted experimental studies now makes this goal reachable.

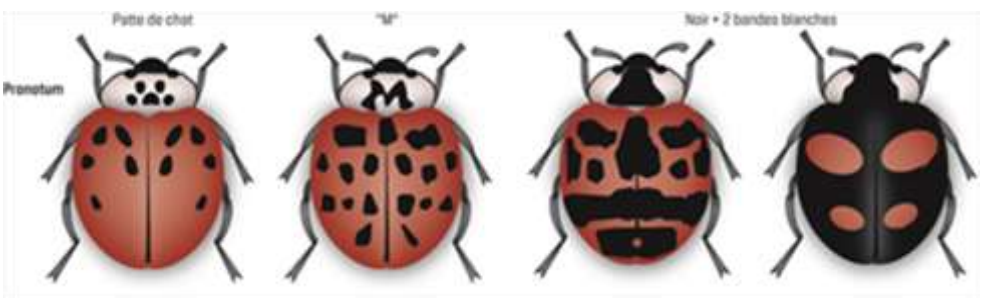
Objectives of the European collaboration project

This project aims at deciphering the adaptive pathways that have led the Asiatic harlequin ladybird (HA) to become invasive worldwide. We propose to proceed through genome-wide comparisons of adequately chosen populations of ladybirds (native, invasive and biocontrol). The project proposes a strategy based on an interdisciplinary approach combining genomics, population genetics modeling, statistics, and experimental evolutionary biology.

More specifically, we will improve the traditional blind population comparison approach

1) using improved statistical methods and simulations studies aimed at guiding interpretation of results,

2) by complementing it with a candidate-trait approach specifically investigating the adaptive response of three traits already known to have evolved during invasion as well as of two traits that, based on interspecific comparisons and biochemical analyses, may have play an important role in the invasion success of HA.



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Genome-wide comparison of laboratory-evolved populations will allow understanding adaptive pathways in a simplified context and identifying genomic regions of interest. For the two other candidat traits that may have been crucial in the invasion success of HA, i.e. a strong immune response and a spectacular aggregation behavior, information about the molecular factors involved is partially available but we do not yet know whether both traits differ between the three types of HA populations (native, invasive and biocontrol). We will thus conduct quantitative genetics experiments to test for their adaptive shifts during invasion by measuring if consistent phenotypic differences exist between native, invasive and biocontrol populations.

Objective of the Belgian team

We aim to assess whether aggregation behavior has evolved during the invasion process of HA. The aggregation behavior observed in autumn and winter in most invaded areas is conducted by volatile and non volatile molecules produced by HA specifically at this period of the year. These molecules guide the individuals toward the aggregation site both at large and short distance. Using semiochemical collection systems we will collect the semiochemicals released for guiding the aggregation behavior. They will be separated and quantified using gas chromatography and all constituents will be identified by mass spectrometry. We therefore aim at showing potential differences in composition and quantity of pheromone emissions by the three strain of HA. Behavioral assays will be conducted using mixtures of overwintering individuals and individuals belonging to the three strains. Finally, electrophysiological assay will also be carried out to study the differences in the organization of the olfactory system present on the antennae, and allowing the beetles to perceive their semiochemicals.

CONTACT INFORMATION

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Link(s)

http://www.rtbf.be/tv/article/detail_halloween-lady-beetle-coccinelle-asiatique?id=8221697

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