MODEVECO

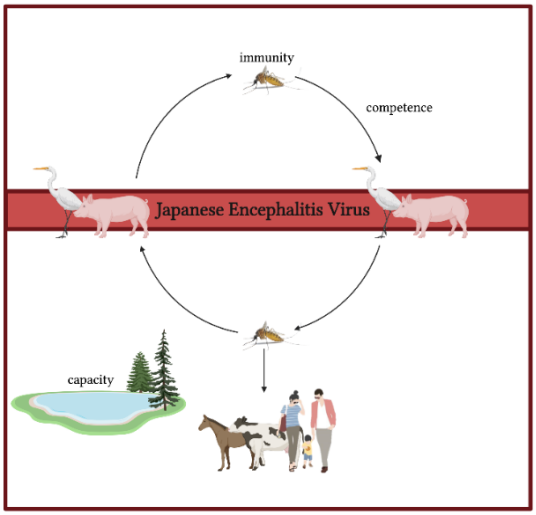
Study of vector competence and other aspects of vector capacity of Belgian mosquitoes for zoonotic flaviviruses, with focus on West Nile virus and Japanese encephalitis virus

DURATION
1/09/2022 – 1/12/2026

BUDGET
492 438 €

PROJECT DESCRIPTION

Vector-borne diseases (VBDs) are caused by pathogens that are spread by arthropod vectors (e.g. mosquitoes, ticks, Culiciodes). Globalization, changes in land use and climate change make that certain of these diseases are currently more frequently introduced in Europe and have a higher chance to be locally transmitted. The current increased prevalence and spread of several arboviruses like West Nile virus and tick-borne encephalitis virus in neighboring countries like France and Germany, indicates that also Belgium is increasingly at risk and that investing in preparedness is of key importance.



The Belgian competent authorities are aware of the growing threat of VBDs but competencies related to this topic are scattered, involving federal and regional authorities, and within the regions, different competent bodies for human health and environment exist. Sciensano, the Belgian OneHealth institute, has the intrinsic capacity to become a center of expertise that could play a central role in coordinating the topic between different partners in Belgium.

This proposal focuses on the interaction between mosquitoes and two flaviviruses, being West Nile virus (WNV) which is currently spreading in Europe and Japanese encephalitis virus (JEV) which is not present in Europe yet but represents an increasing threat.

First, this project will study whether different Belgian mosquito species have the intrinsic capacity to acquire, maintain and transmit WNV and JEV. In other words, whether they are competent vectors for these viruses and would potentially be able to transmit these viruses upon an accidental introduction.

Secondly, the project aims to identify factors responsible for differences in vector competence between different mosquito species. Previous studies using different mosquito - pathogen models have already identified several barriers that viruses have to overcome before they can be transmitted to a new host, and some molecular determinants that could mechanistically explain differences in vector competence like small RNA regulatory pathways, immune signaling cascades, autophagy and apoptosis. Much however remains to be studied to fully understand differences in vector competence between species and differences between different virus-vector pairs most probably exist. We will perform in vivo, ex vivo and in vitro assays using field collected and recently (low passage) colonized indigenous and exotic Culex, Aedes and Anopheles mosquitoes from Belgium, which encompass both competent and non-competent species based on literature data.

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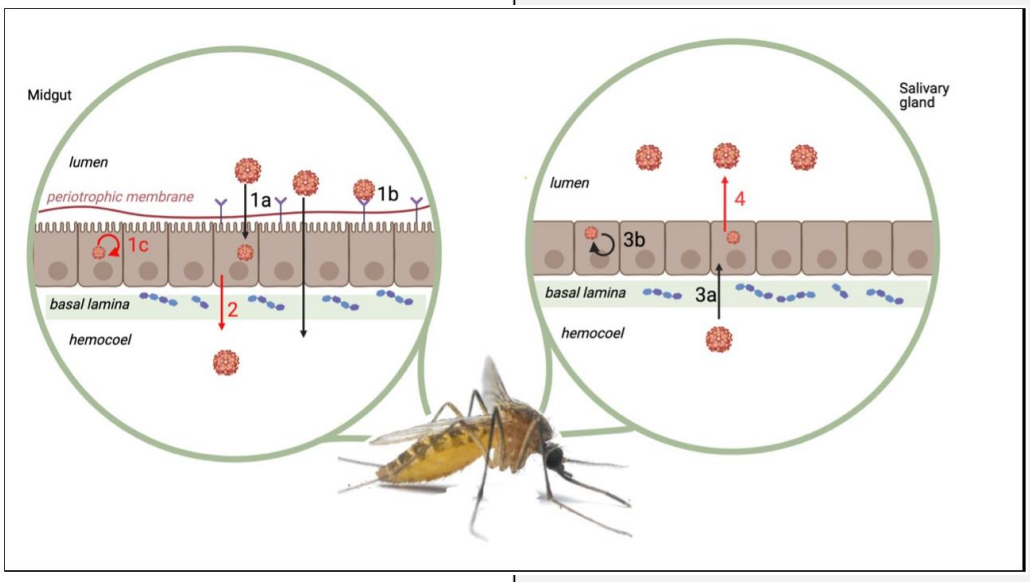
Finally, a longitudinal mosquito monitoring will be performed at Belgian pig farms. Monitoring will occur at 16 pig farms lying in different environmental habitats which will be selected to take the influence of environmental factors on mosquito diversity and abundance into account. Morphological mosquito identification will be done using the online MosKeyTool key and a blood meal analysis will be done on blood fed mosquitoes to obtain insights in their preferred blood meal hosts.

The main impact for policy will come from the combined results of the vector competence studies and the mosquito monitoring at pig farms. These will indicate if and to which extent Belgian mosquito populations could be involved in the spread of WNV and JEV upon an accidental introduction. This important information needs to be taken into consideration in preparedness plans for these upcoming threats and could urge public services to start preparing preventive and intervention actions like:

- implementing tools for vector control (identifying partners with necessary expertise, obtain access to and approval for the use of biocides)
- identifying biosecurity and vector control measures to protect animal health
- preparing public information campaigns on how to avoid mosquito bites and eliminate breeding places
- acquire expertise to perform vector monitoring and disease monitoring in vectors
- install monitoring and surveillance programs for vector-borne diseases.

The project will also increase the expertise of the partners on the topic of vector-borne diseases, making that they can provide policy makers with important scientific knowledge and advice in case of unexpected outbreaks.

Scientifically, the project will allow to implement state of the art methodology to perform vector competence studies and cell based and molecular analyses to study virus-vector interactions. This fills a research gap at the Belgian level and will allow policy supporting studies in preparedness for upcoming threats. Furthermore, several research tools (midgut cell lines) and research results (e.g. RNAi response in midgut induced by virus infection) will be obtained that will increase the current understanding of arbovirus-vector interactions and can be the starting point for follow-up projects and new collaborations.



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