

Honeybee viruses in novel hosts

Studying agrochemical-pathogen stress combination in wild bees.

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Introduction

Bees face a **combination of stressors** today such as habitat loss, agrochemicals and emerging pathogens¹. Certain agrochemicals, such as neonicotinoids, affect immunity pathways and promote virus replication in honeybees and can potentially synergistically increasing mortality². Honeybee-associated viruses has increased in prevalence across the globe³, and there is evidence of viral spillover from honeybees to wild bees⁴. The effects these viruses can have on wild bee populations, alone and together with agrochemical exposure, is still largely unknown.

Objectives

- To test the biological activity of the three most common honeybee-associated viruses in Europe³ in **new solitary bee hosts** *Osmia bicornis* (Megachilidae) and *Anthophora plumipes* (Apidae), by measuring viral replication over a set timeframe.
- Provide a **virus model** in which to test **pesticide-pathogen interactive effects** in novel wild bee species.

DWV-A Deformed Wing Virus A

Inoculum:
10⁷ viral particles
in 1 µL

Housing for
3, 6 or 10 days



Osmia bicornis



Apis mellifera



Anthophora plumipes

Results DWV-A

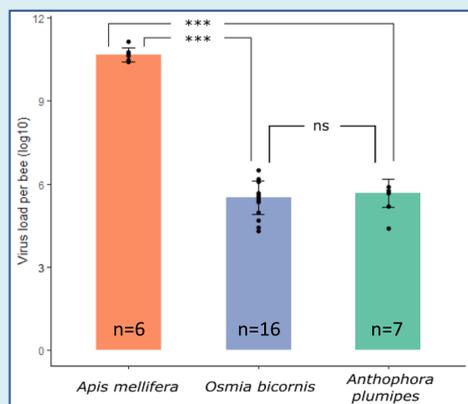


Figure 1. DWV-A virus titre per bee (log₁₀) with median and s.e. Sample day and gender pooled per sp.

Decrease in titre from start inoculum in *O. bicornis* and *A. plumipes*. Virus replication in *Apis mellifera* after 3 days.

No difference in titre between day 6 and 10 for *O. bicornis* and *A. plumipes* and no difference in titre between genders.

DWV-B Deformed Wing Virus B

Inoculum:
10⁷ viral particles
in 1 µL

Housing for
3, 6 or 10 days



Osmia bicornis



Apis mellifera



Anthophora plumipes

Results DWV-B

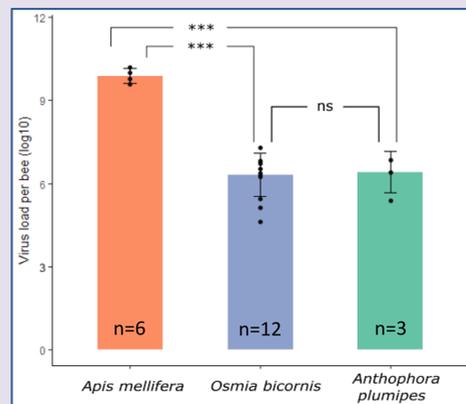


Figure 1. DWV-B virus titre per bee (log₁₀) with median and s.e. Sample day and gender pooled per sp.

Decrease in titre from start inoculum in *O. bicornis* and *A. plumipes*. Virus replication in *Apis mellifera* after 3 days.

No difference in titre between day 6 and 10 for *O. bicornis* and *A. plumipes* and no difference in titre between genders.

BQCV Black Queen Cell Virus

Inoculum:
10⁷ viral particles
in 1 µL

Housing for
3, 6 or 10 days



Osmia bicornis f + m



Apis mellifera

Results BQCV

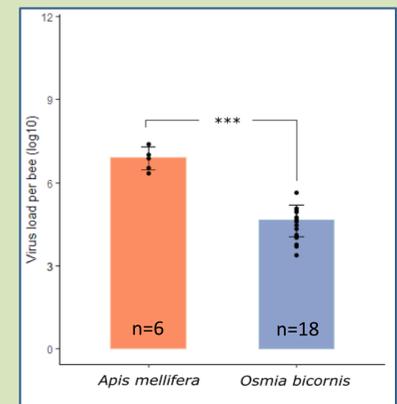


Figure 1. BQCV virus titre per bee (log₁₀) with median and s.e. Sample day and gender pooled per sp.

Decrease from start inoculum in *O. bicornis*. Weak virus replication in *Apis mellifera* after 3 days – potentially lower virus volume in start inoculum.

No difference in titre between day 6 and 10 for *O. bicornis* and no difference in titre between genders.

Methods

Virus inoculum purified from local *Apis* colonies, diluted to 10⁷ viral particles/µL with potassium sulphate buffer. Control treatment buffer only. 1 µL injected in abdomen using Hamilton syringe. Housing at 22°C (25°C for *A. mellifera*) with ad libitum 50% sugar feed. Entire bees were crushed and viral titren per individual assessed via quantitative real-time PCR (QuantStudio 3). Control bees screened for all three viruses and found to be clean. Virus titres compared using paired Wilcoxon rank-sum test.

Discussion & Way Forward

- No indication of viral replication in *O. bicornis* or in *A. plumipes*, in contrast to *Bombus terrestris* experiments, where injection caused high viral replication levels. Natural exposure route likely oral, where infectivity is likely to be even lower – viruses not infective?
- DWV-B has been confirmed to be replicating in *Osmia cornuta* through (-)strand detection⁵, but there is no evidence for replication through increase in titre in this trial.
- High mortality in all test groups – injection or housing effect?
- **Step 2 – measure virus effect on novel host's lifespan, and combine with agrochemical exposure.**



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Pan-european assessment, monitoring and mitigation of Stressors on the Health of Bees - PoshBee aims to support healthy bee populations, sustainable beekeeping and pollination across Europe.



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