

# Impacts of *Lotmaria passim* and *Nosema ceranae* on honey bee physiology and behaviour

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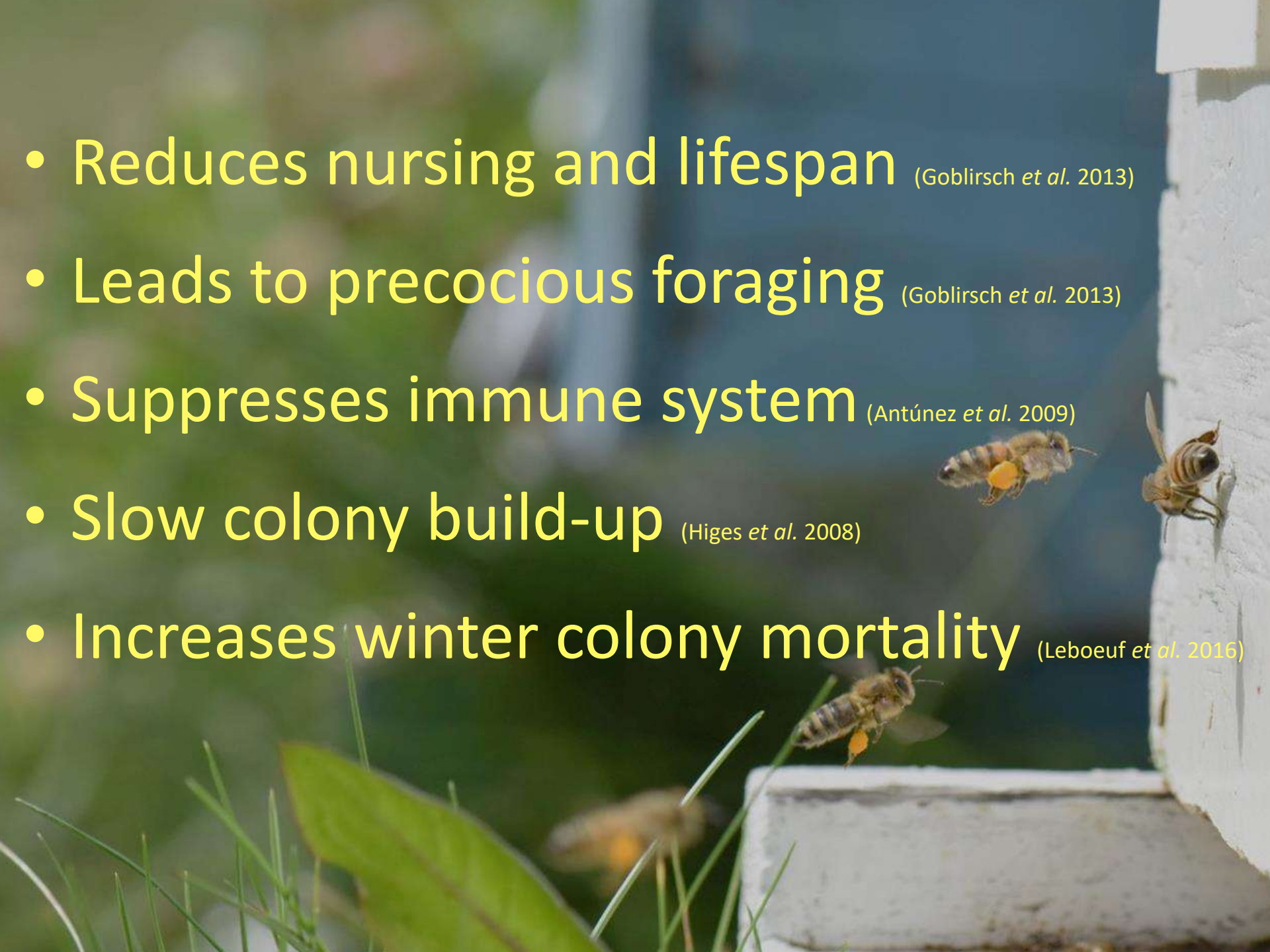
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# *Nosema ceranae*

- Unicellular
- Midgut-infecting
- Microsporidian

- Reduces nursing and lifespan (Goblirsch *et al.* 2013)
- Leads to precocious foraging (Goblirsch *et al.* 2013)
- Suppresses immune system (Antúñez *et al.* 2009)
- Slow colony build-up (Higes *et al.* 2008)
- Increases winter colony mortality (Leboeuf *et al.* 2016)





The background of the slide is a microscopic image showing a dense population of Lotmaria passim cells. These cells are small, pear-shaped, and have a distinct blue-stained nucleus and a lighter, more translucent body. They are scattered across the entire field of view.

# *Lotmaria passim*

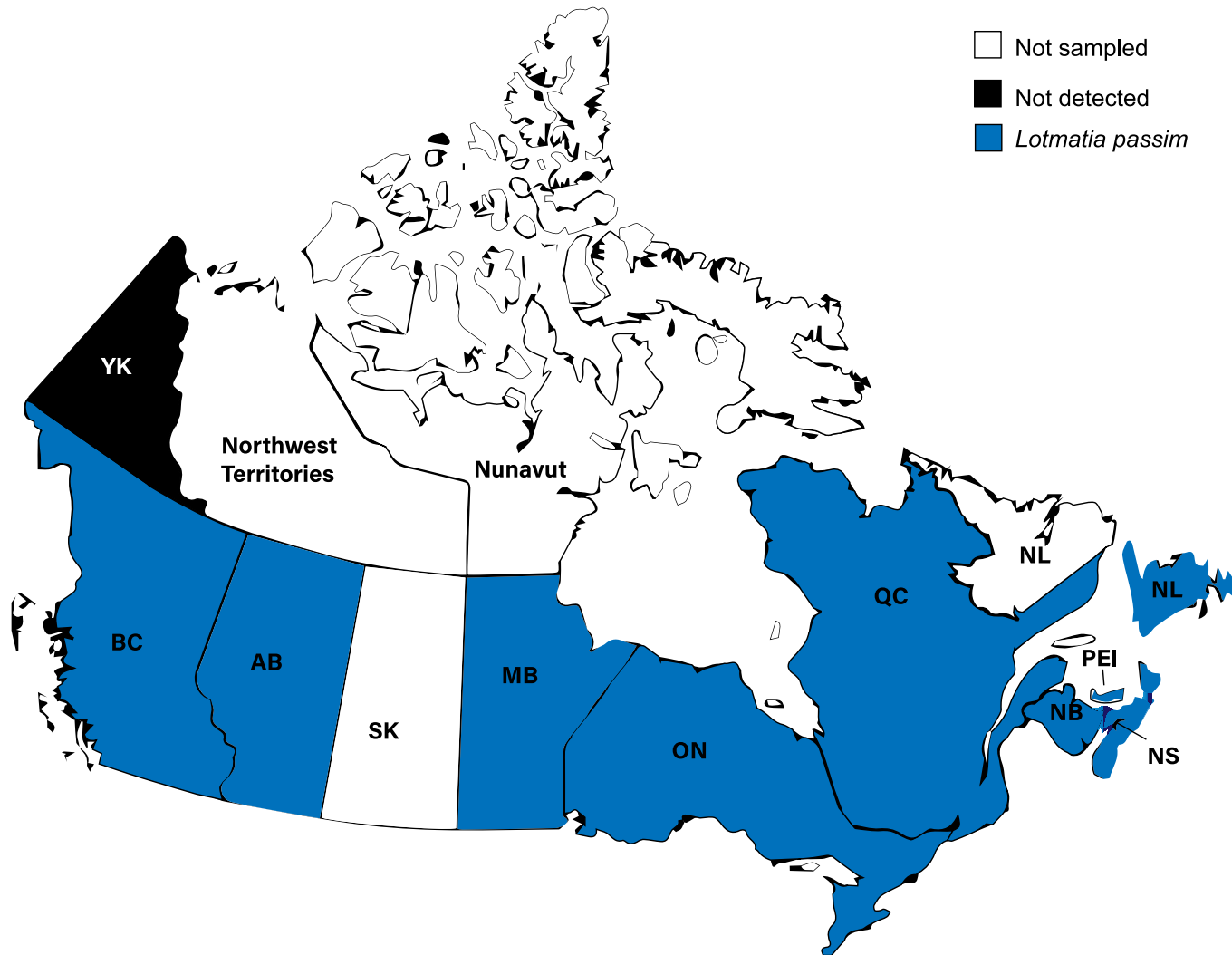
- Unicellular
- Hindgut-infecting
- Trypanosomatid

# Trypanosomes in other insects

- Stimulate the immune system (Schlüns *et al.* 2010)
- Reduce lifespan and fecundity (Hamilton *et al.* 2015)
- Disrupt cognitive abilities (Gegear *et al.* 2006)

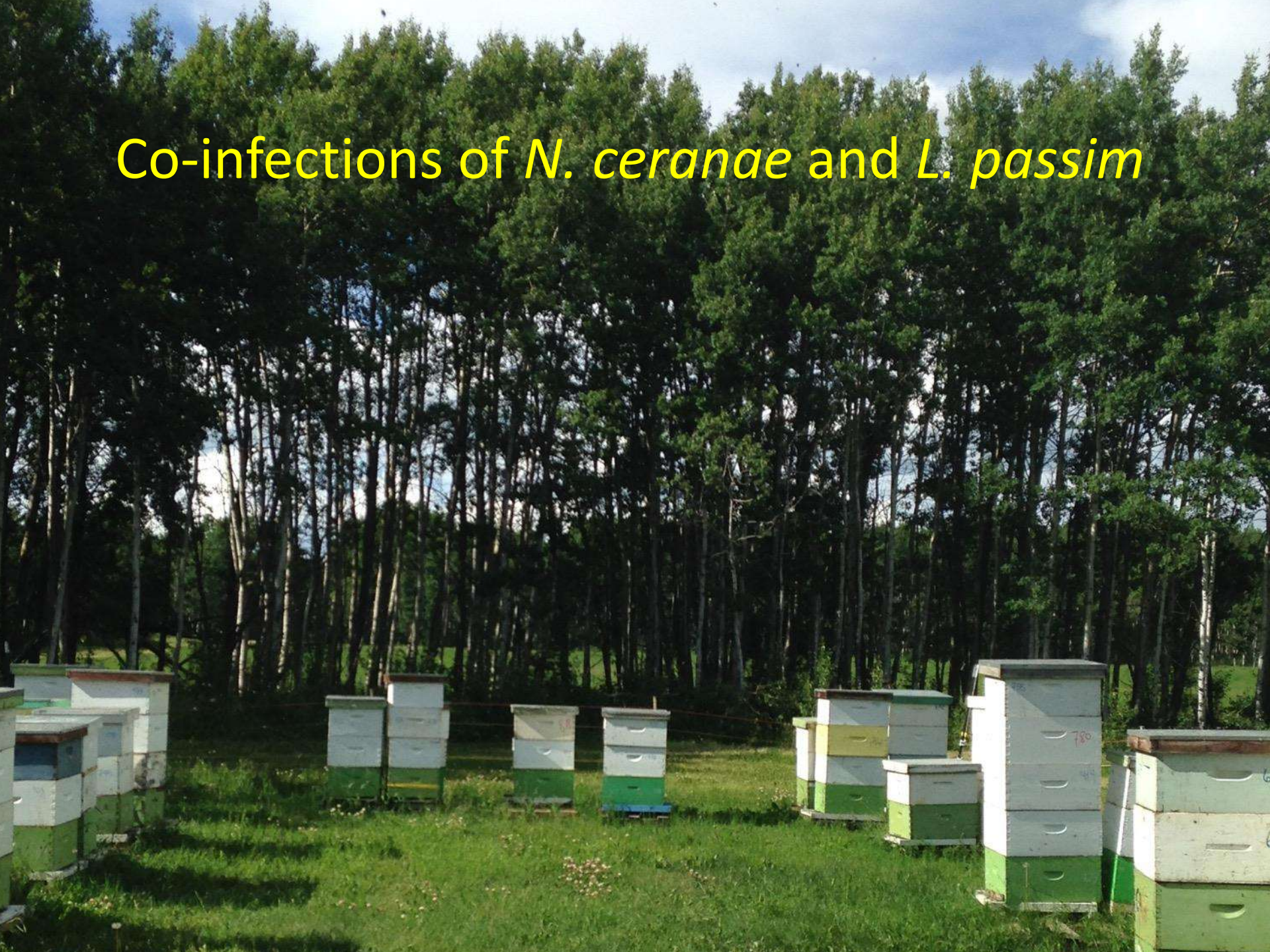


# Why be concerned about *L. passim*?





# Co-infections of *N. ceranae* and *L. passim*



# Objectives

- Evaluate the lethal effects of single and mixed species infections on honey bees



**CTRL**

n=100

**Media CTRL**

n=100

*N. ceranae*

n=100

*L. passim*

n=100

*N. ceranae +  
L. passim*

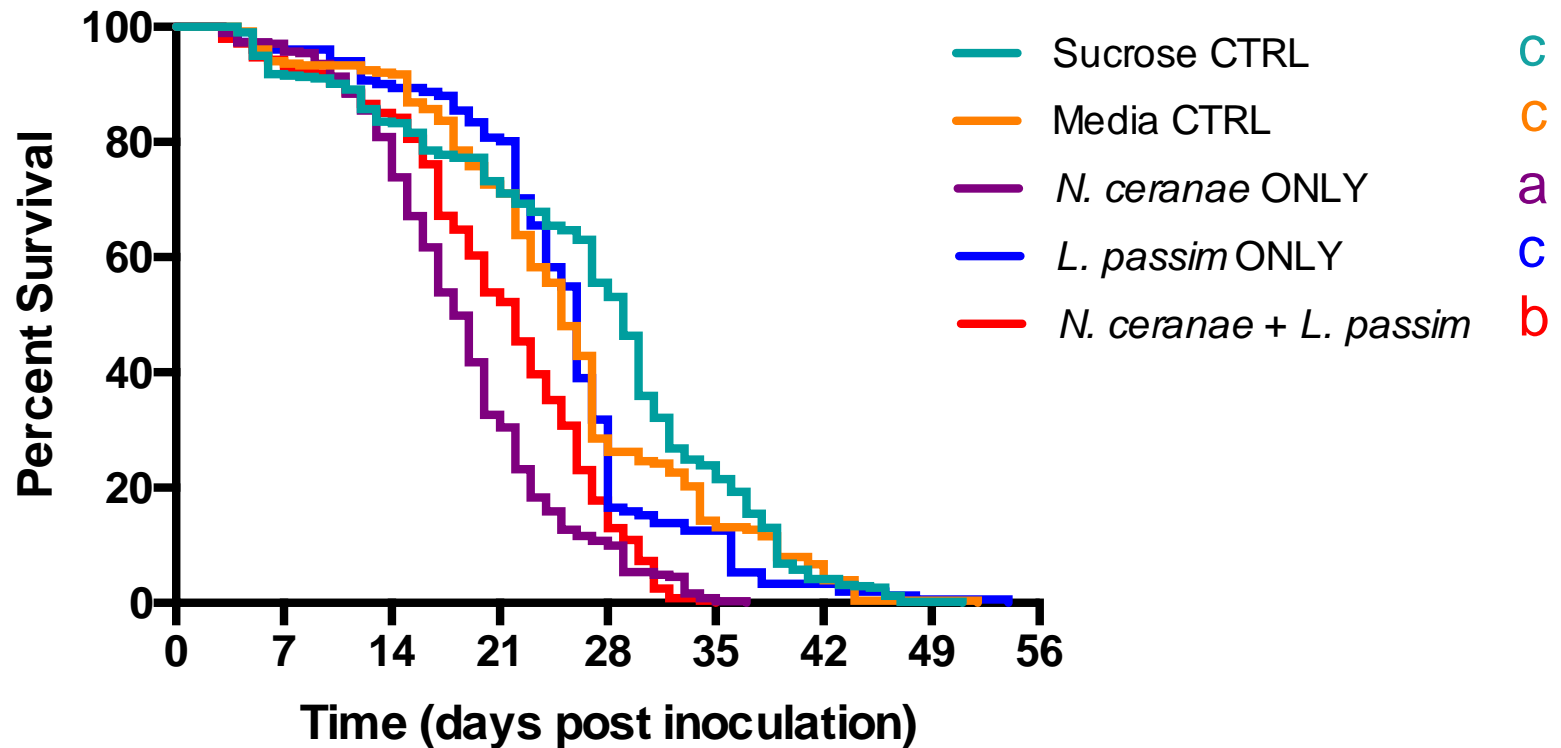
n=100







## Impact of Infection on Honey Bee Lifespan



$\chi^2=315.2$   $P<0.0001$



# Objectives

- Evaluate the lethal effects of single and mixed species infections on honey bees
- Evaluate the sublethal effects of single and mixed species infections on honey bees
  - Behaviour
  - Physiology

**CTRL**

n=10

**Media CTRL**

n=10

*N. ceranae*

n=10

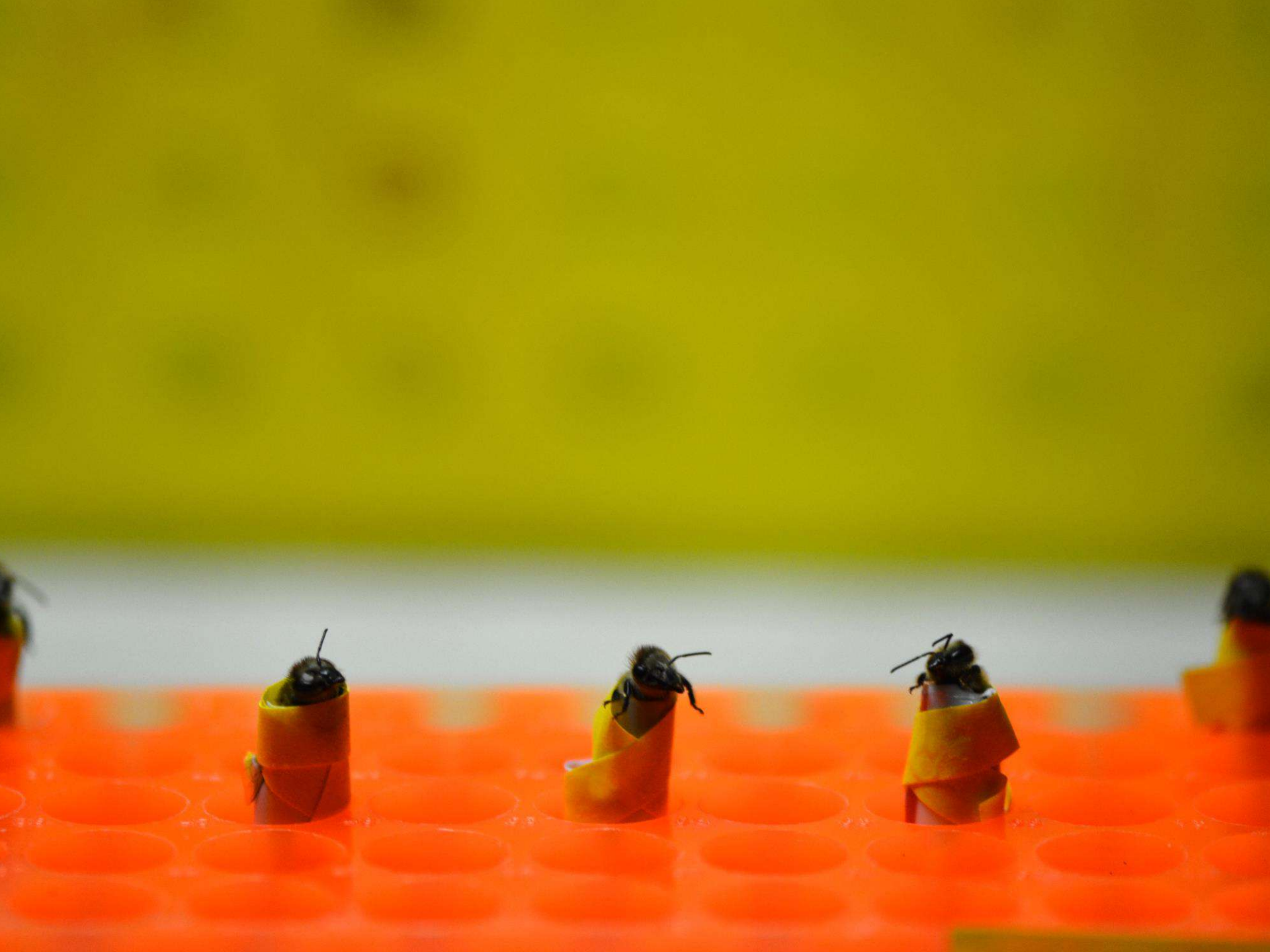
*L. passim*

n=10

*N. ceranae +  
L. passim*

n=10

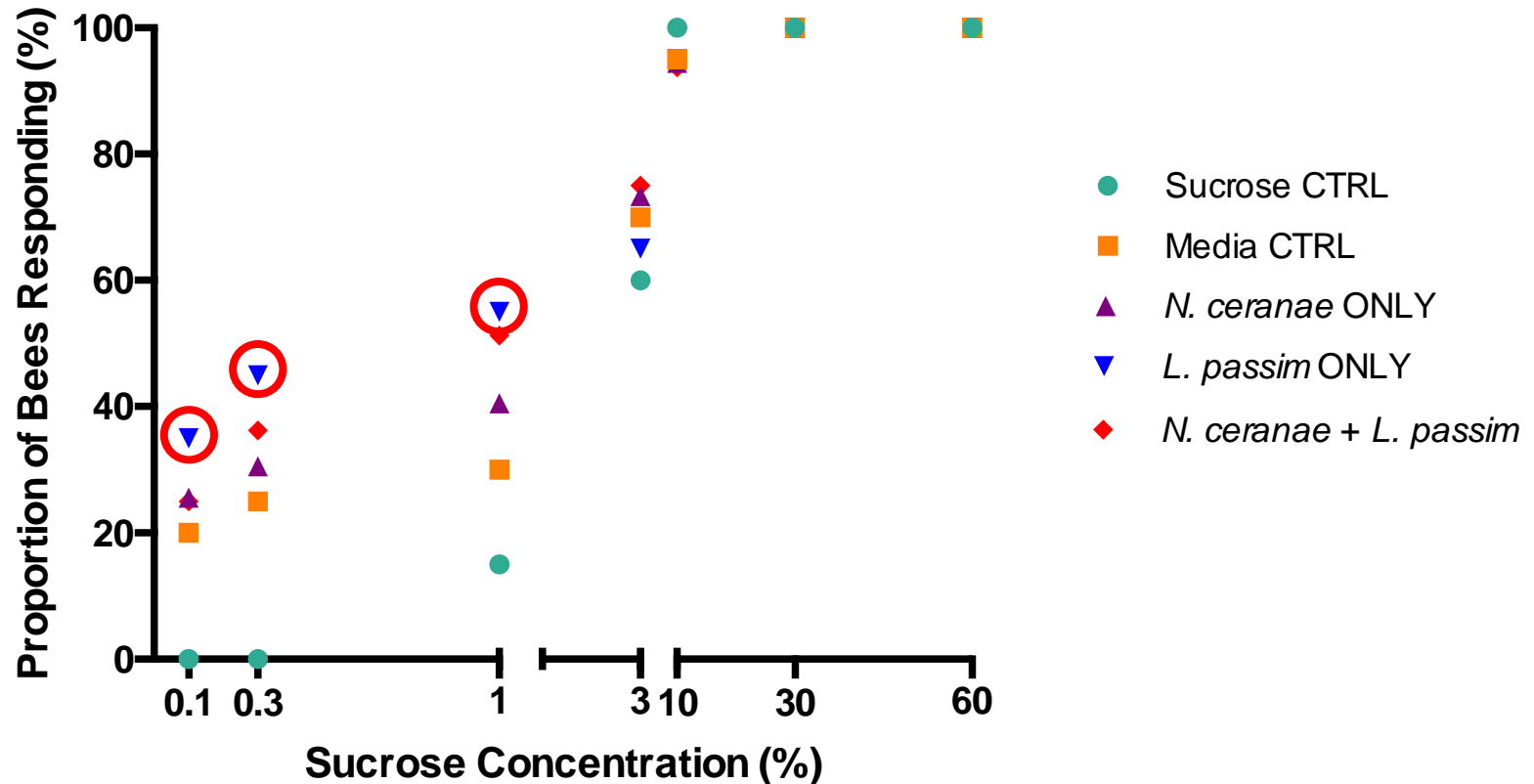




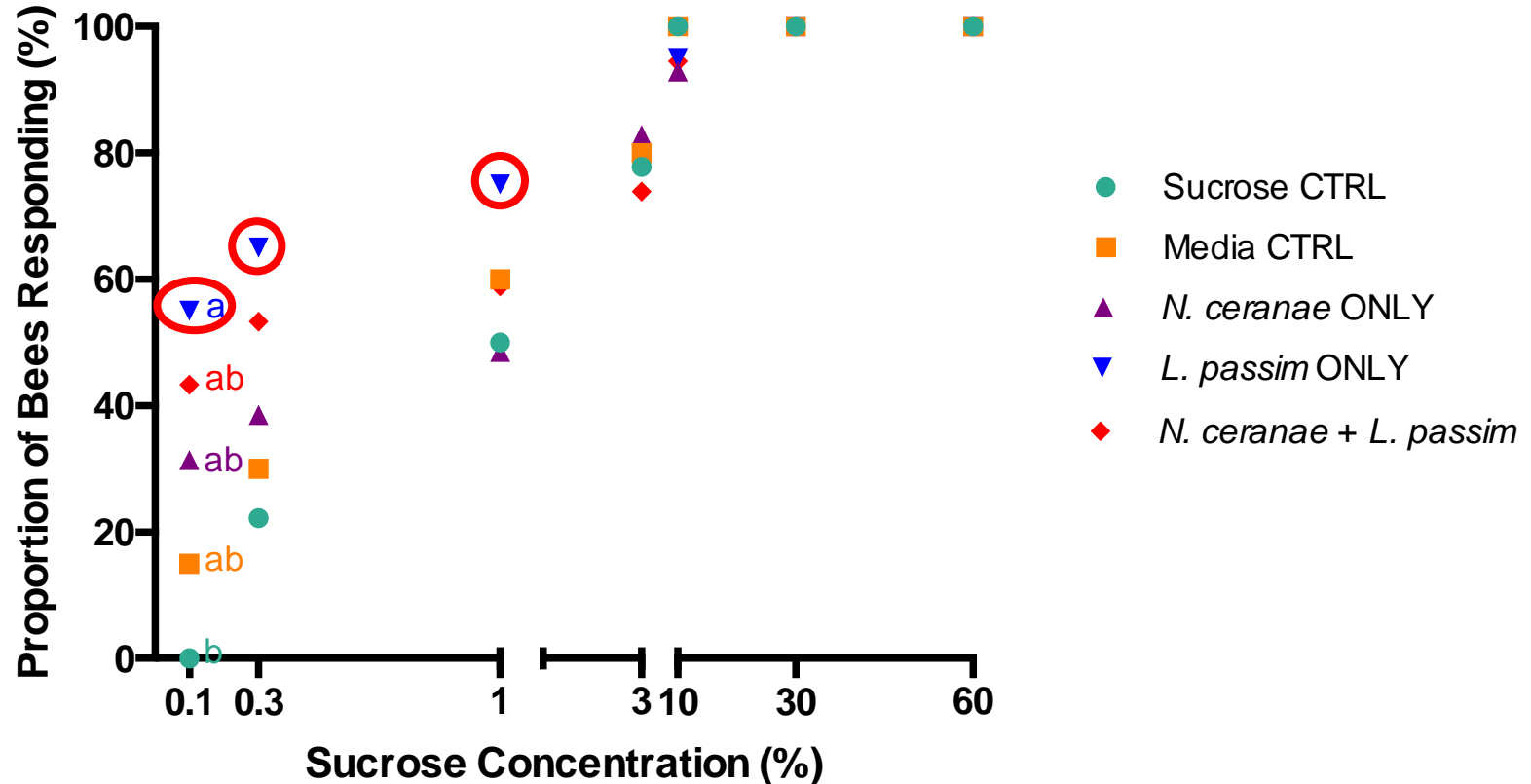




## Effect of Infection on Responsiveness to Sucrose at 10 d.p.i.



## Effect of Infection on Responsiveness to Sucrose at 16 d.p.i.



(0.1%, Fisher's Exact Test  $P=0.00166$ )

# Objectives

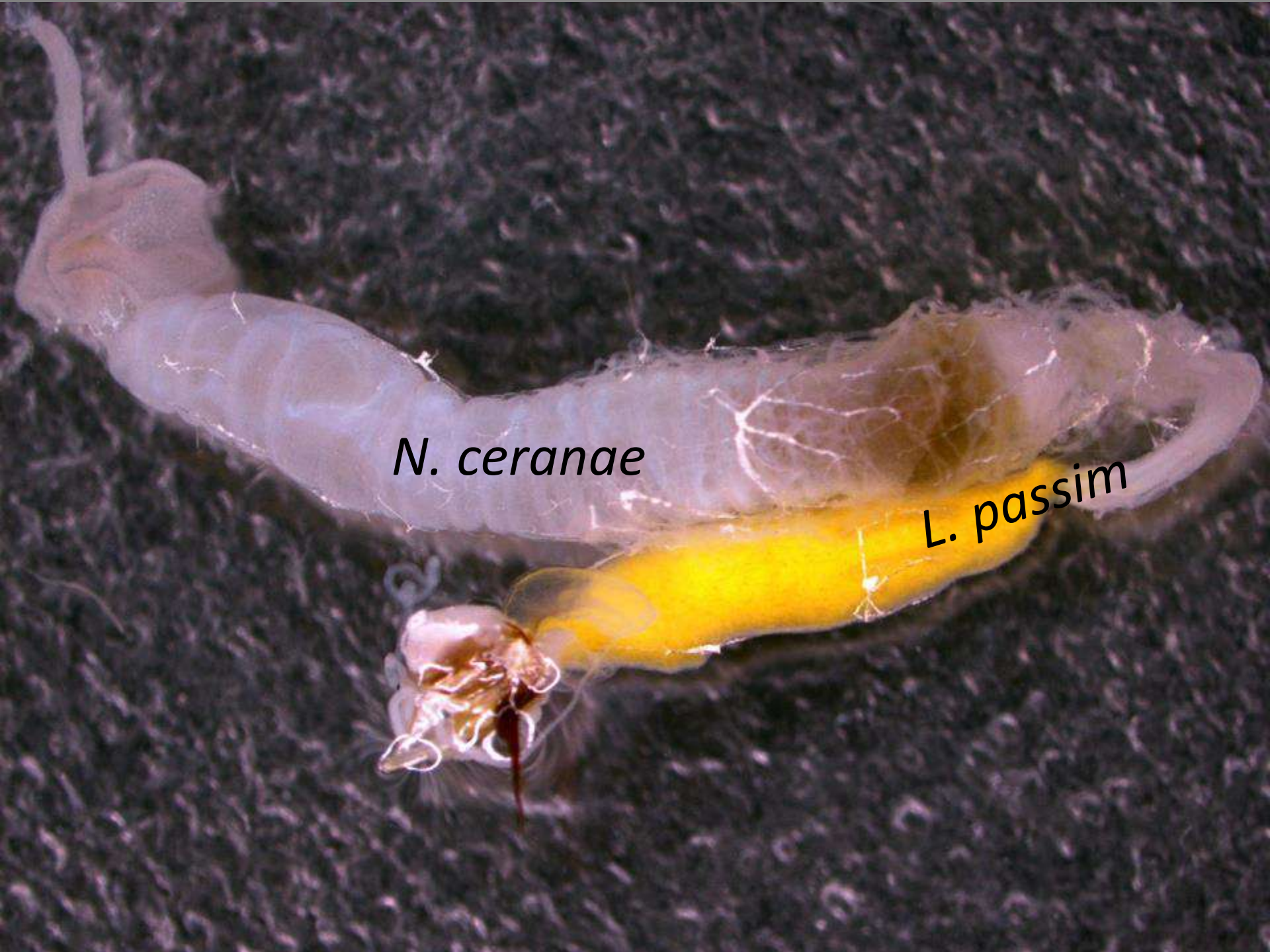
- Evaluate the lethal effects of single and mixed species infections on honey bees
- Evaluate the sublethal effects of single and mixed species infections on honey bees
  - Behaviour
  - Physiology



# Expression of 5 AMPs

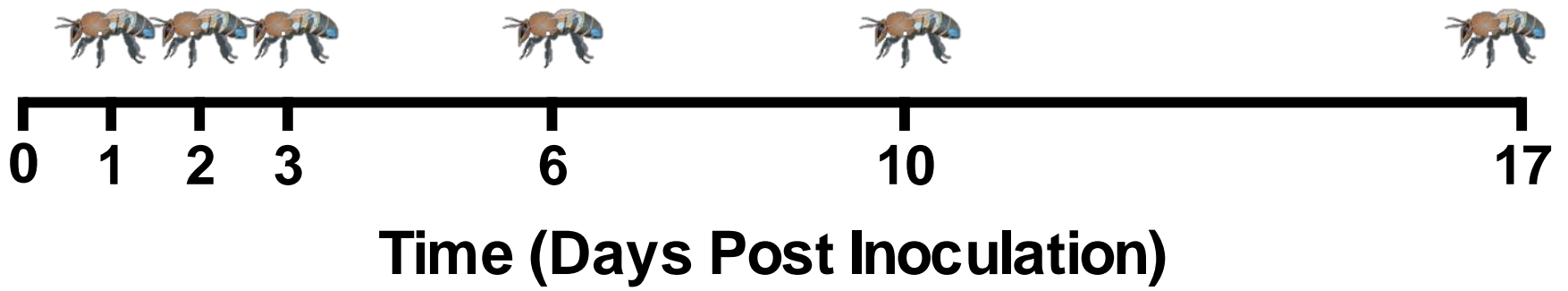
- Abaecin
- Apidaecin
- Defensin 1
- Defensin 2
- Hymenoptaecin

...



*N. ceranae*

*L. passim*





# What have we learned?

- *L. passim* alone does not reduce honey bee lifespan
- *L. passim*-infected honey bees consistently respond to lower quality sucrose more often than all other treatment groups



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