

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

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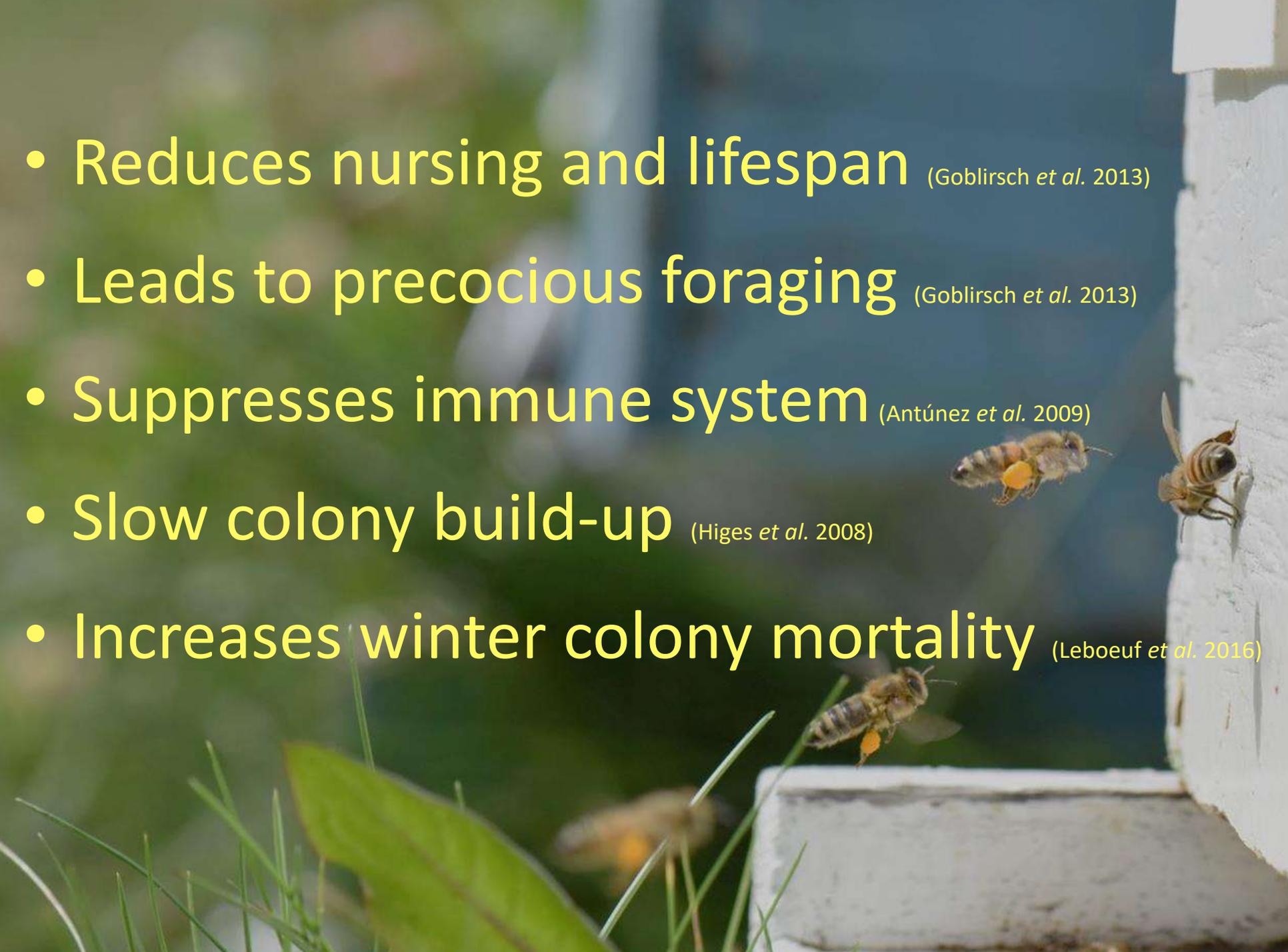


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Nosema ceranae

- 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)



Lotmaria passim

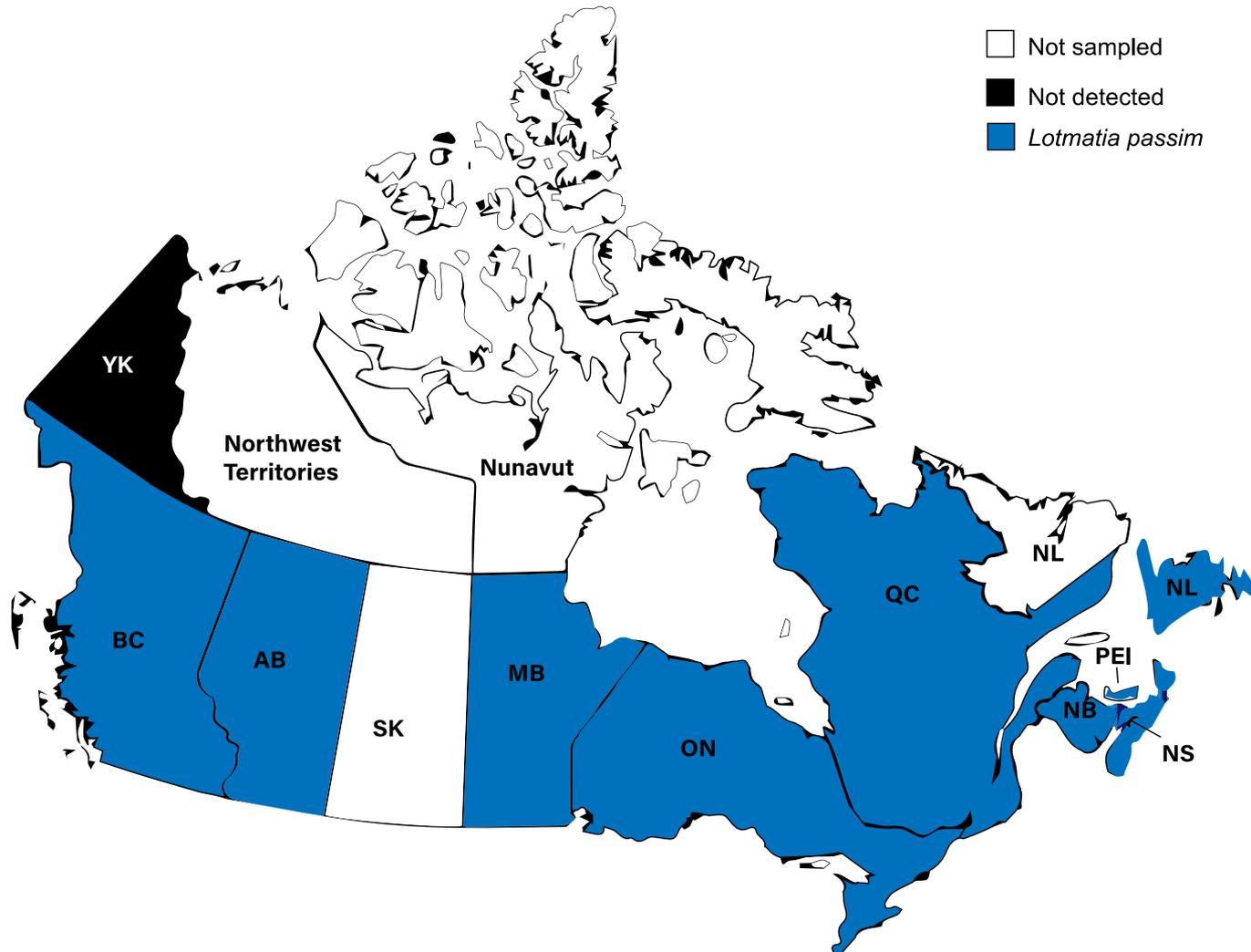
- Unicellular
- Hindgut-infecting
- Trypanosomatid

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*

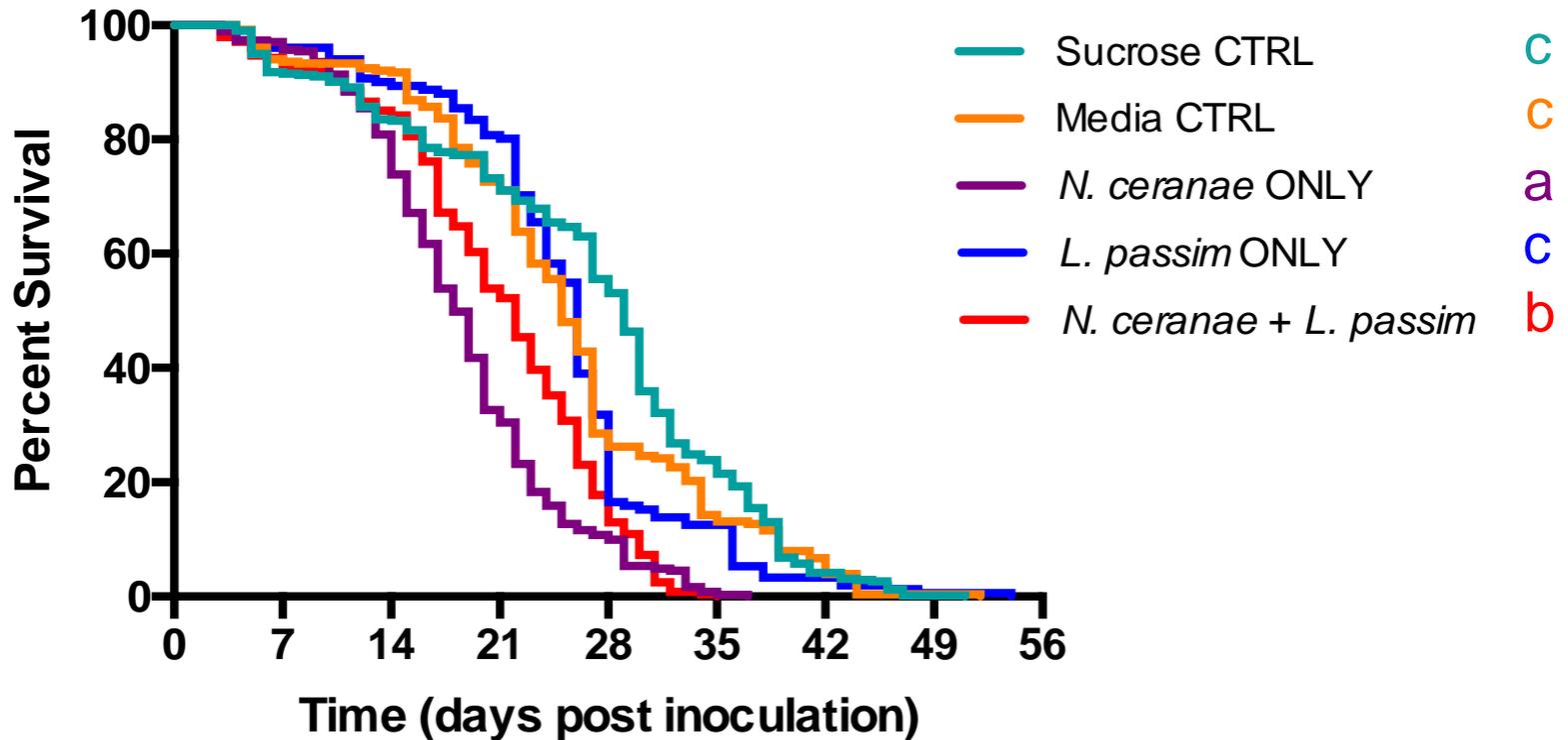
n=100





DANGER
BIOHAZARD
RESEARCH
LABORATORY
NO ENTRY
WITHOUT
AUTHORITY

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





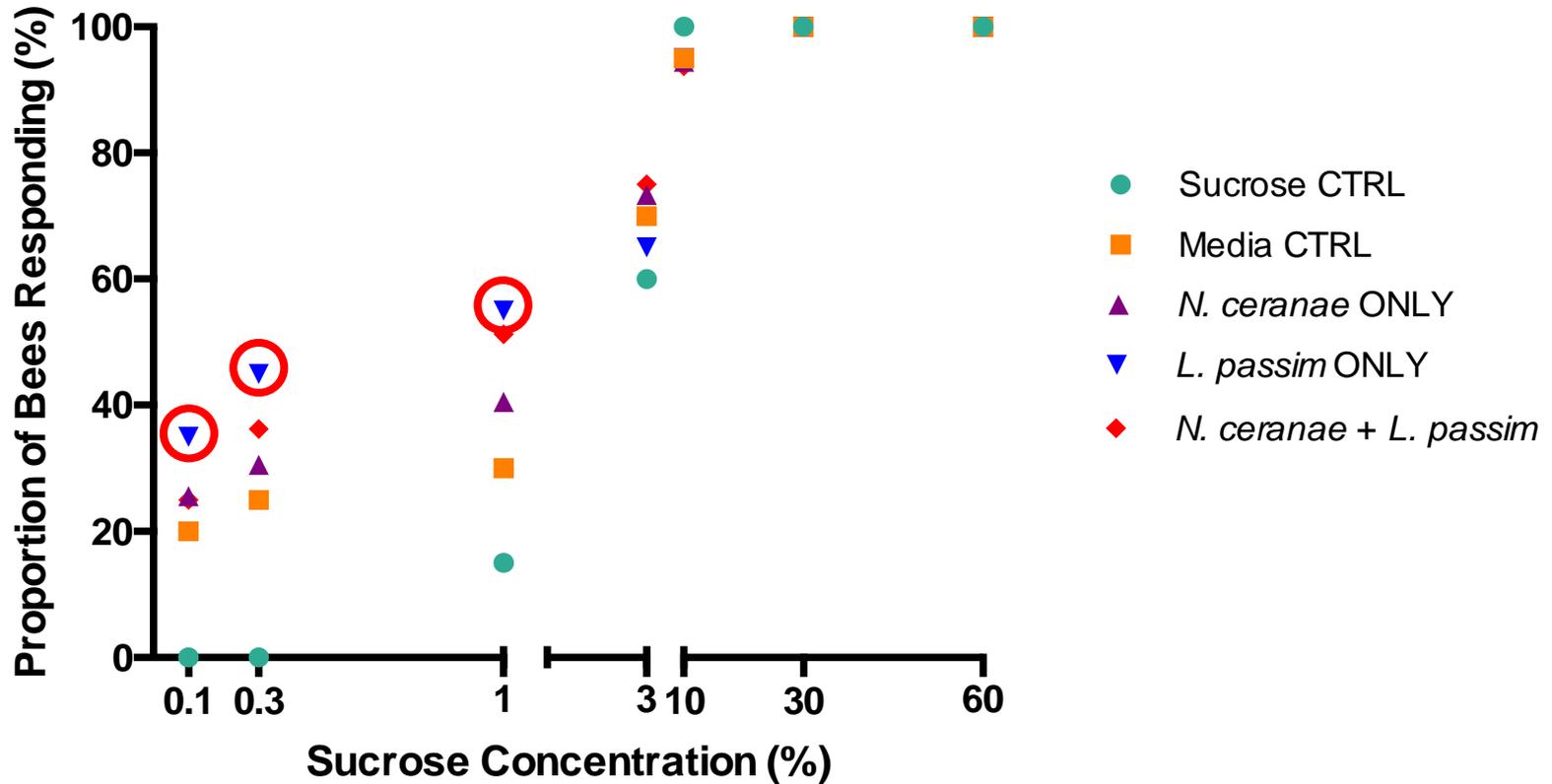
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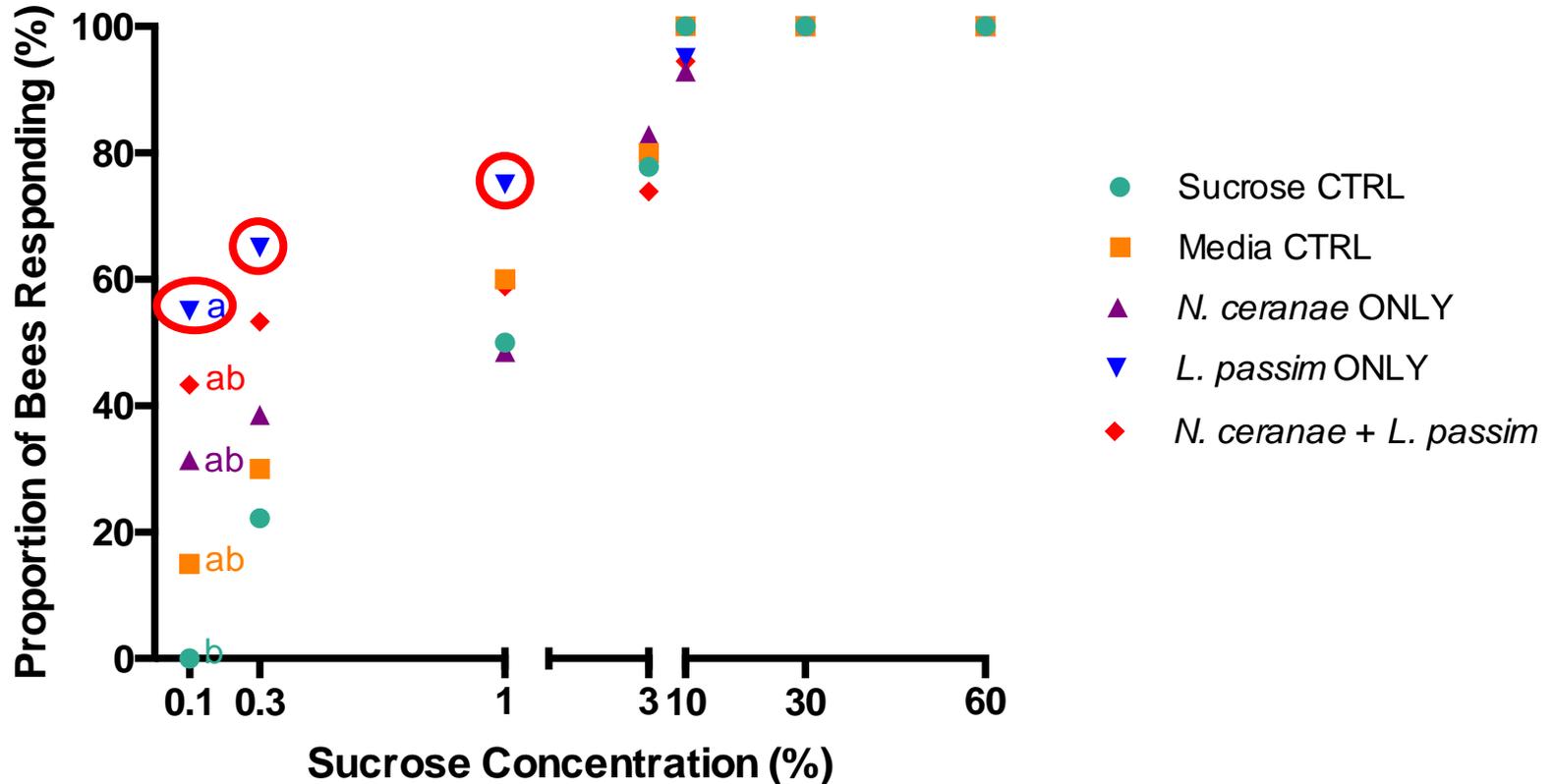
37

44

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 $P=0.00166$)

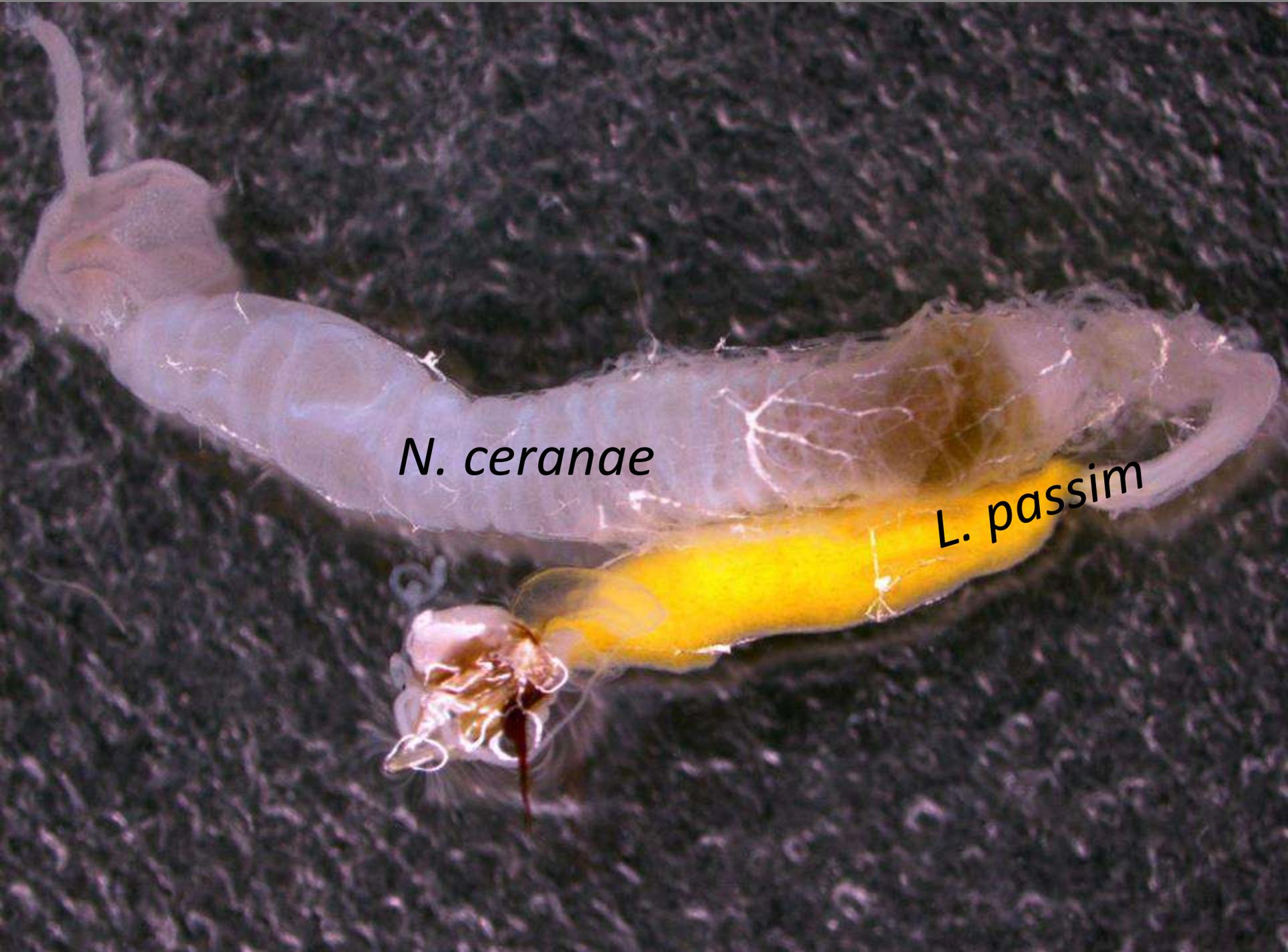
Objectives

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 - Behaviour
 - Physiology

Expression of 5 AMPs

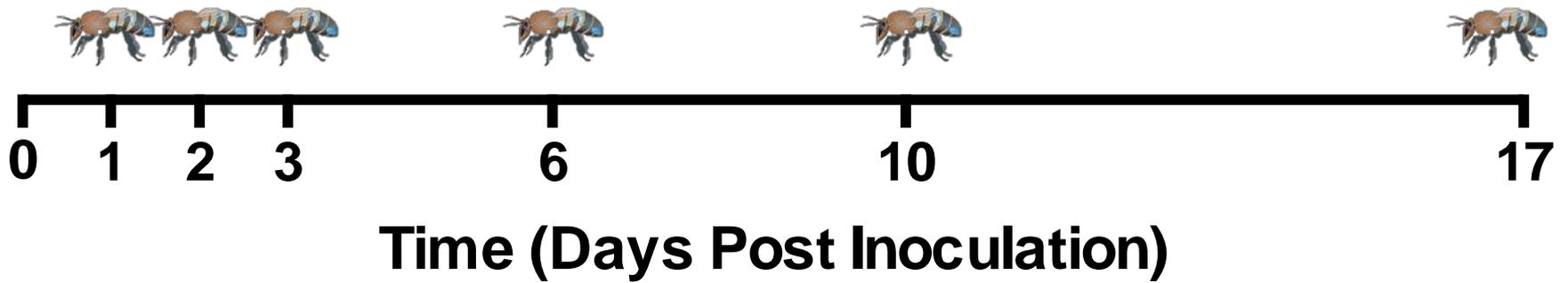
- Abaecin
- Apidaecin
- Defensin 1
- Defensin 2
- Hymenoptaecin

...



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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