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Summer diapause

Authors:
Tougeron K., Le Lann C., van Baaren J. & Brodeur J.

The impact of female
competition on summer
diapause induction in two
aphid parasitoid species

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RENNES 1

Diapause

- Insects = ectotherms
- Seasonal variations in temperature



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- Seasonal variations in temperature



- **Diapause:** Response to environmental signals
- **Ecological role:** Synchronisation between life cycle and favorable period of the year (temperature, resources)

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- Mirror image of winter diapause
- Diet, humidity and **resources**

Parasitoids

- Need a **synchronisation** with the host!
- Ex: Aphid parasitoids



Mating and oviposition



« mummy »



Diapause (if any) and larval development



Hatching



Summer diapause

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 - Called **aestivation** in many organisms, including plants and arthropods
 - Mirror image of winter diapause
 - Diet, humidity and **resources**
- Case of parasitoids: hosts availability
 - **Absolute**: The number of hosts to exploit
 - **Relative**: For each female in competition

Question & hypotheses

- If summer diapause is expressed; is host availability a cue inducing summer diapause?



Question & hypotheses

- If summer diapause is expressed; is host availability a cue inducing summer diapause?
 - ✓ Lower **host density** induces higher summer diapause incidence (Exp. 1)
 - ✓ Higher **competition levels between parasitoid females** induces higher summer diapause incidence (Exp. 2)



Study species



Aphidius rhopalosiphii



Aphidius avenae



Sitobion avenae
(English grain aphid)



Brittany
Western France

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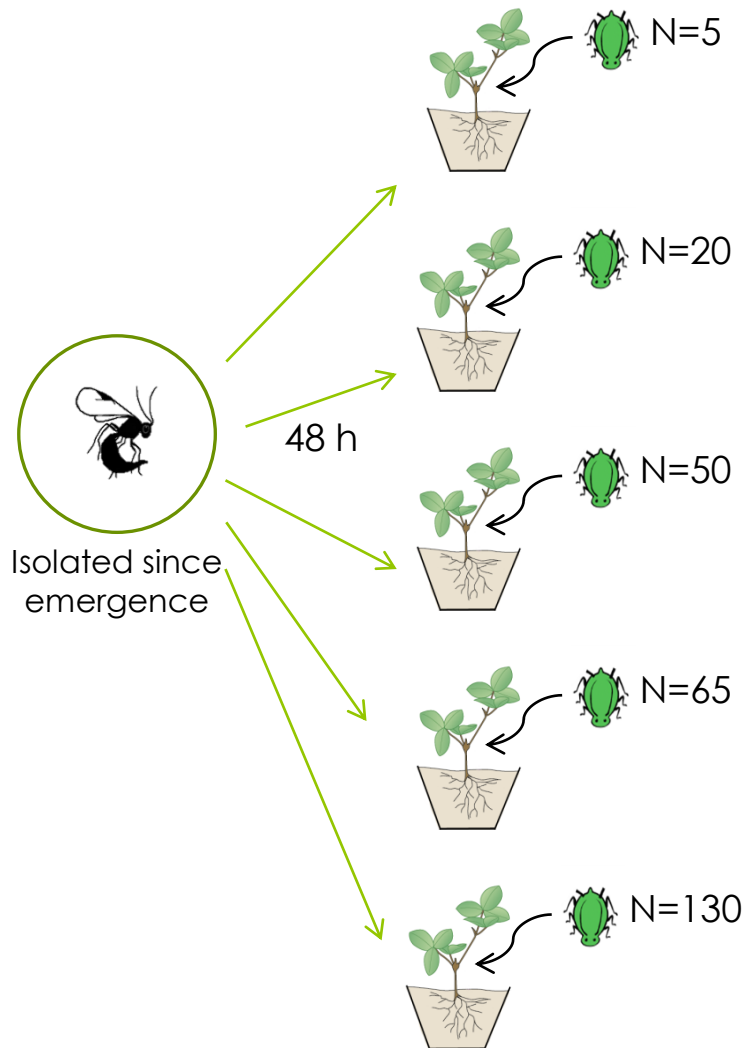
- Is there interspecific differences in diapause incidence ?
 - ✓ *Aphidius rhopalosiphii* enters in higher proportion in summer diapause than *Aphidius avenae*

Protocol (Exp. 1)



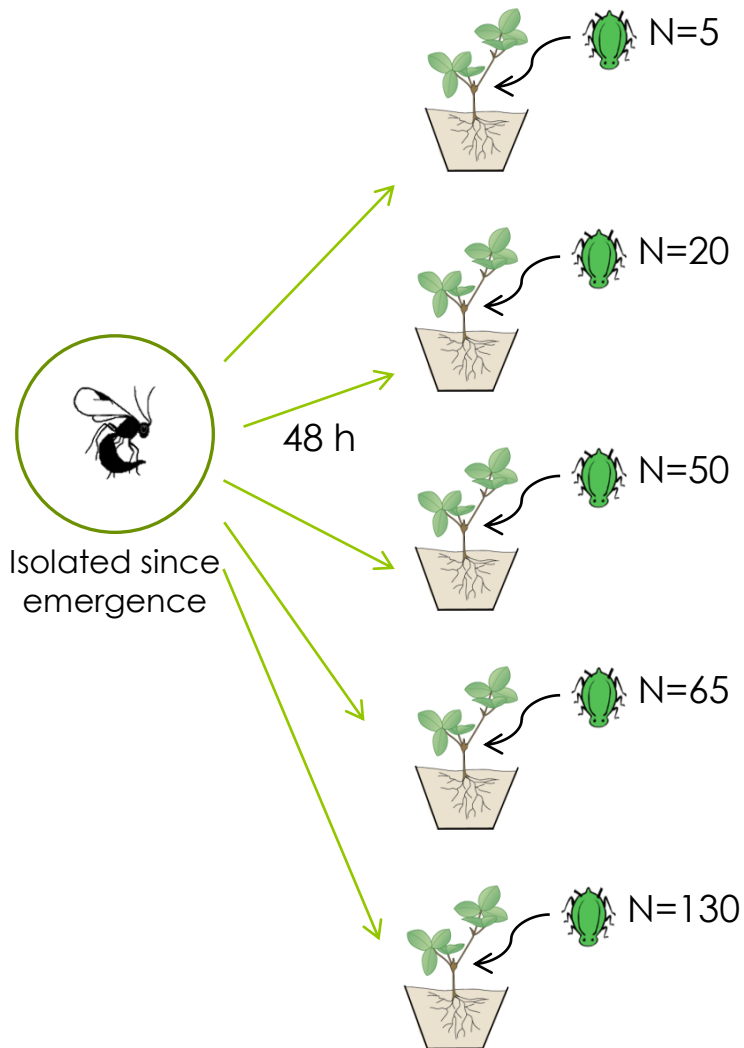
Isolated since
emergence

Protocol (Exp. 1)



24 ° C, 16:8 LD, 55% RH

Protocol (Exp. 1)



24 ° C, 16:8 LD, 55% RH

X 4

Daily check for mummy formation and parasitoid emergence

Dissection of unemerged parasitoids after 20 days

Count of diapausing prepupae

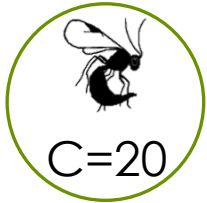
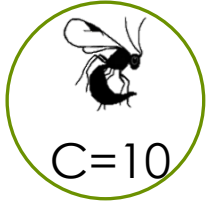
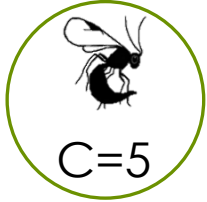
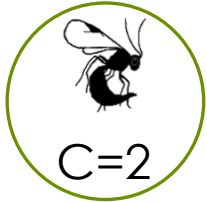


- **No diapausing parasitoids at any of the aphid density treatments** and for both parasitoid species
- (n= 219 and n= 206 offspring produced for *A. avenae* and *A. rhopalosiphi*, respectively)



No effect of the aphid density on summer diapause induction

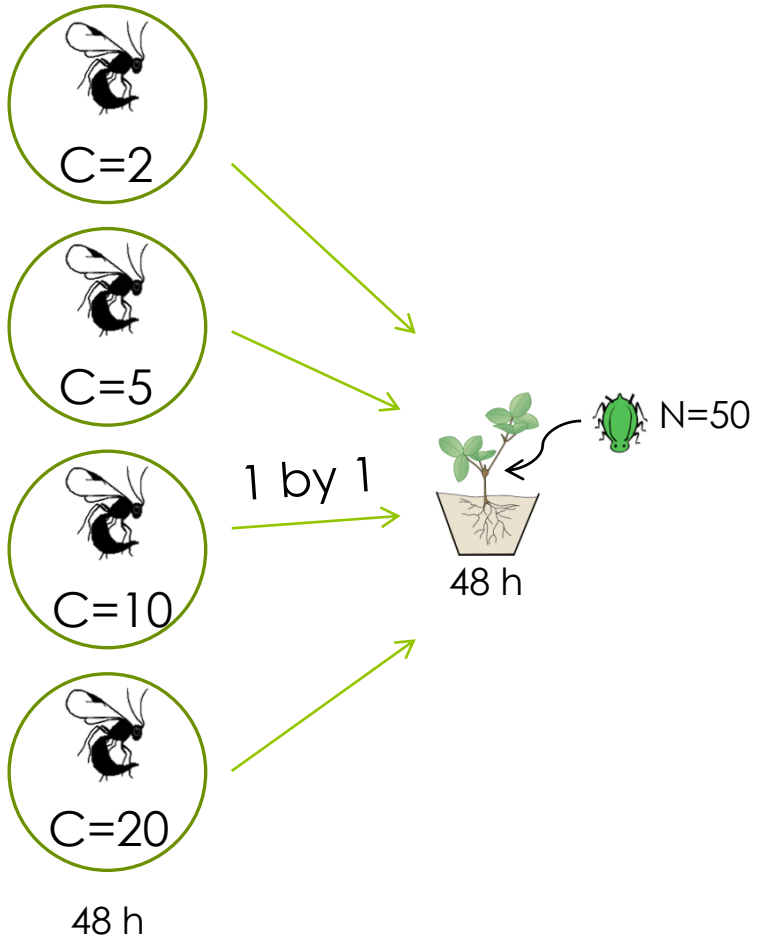
Protocol (Exp. 2)



48 h

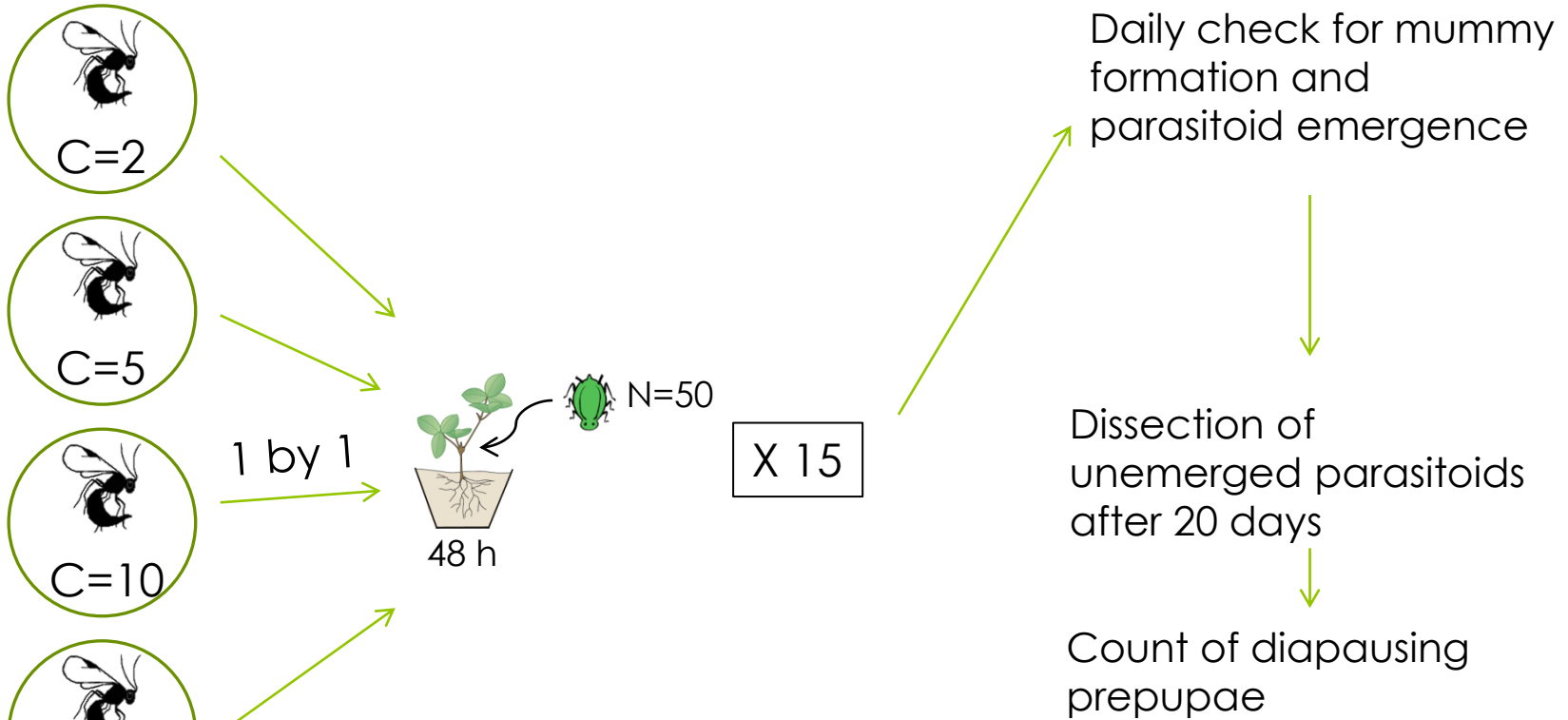


Protocol (Exp. 2)



24 ° C, 16:8 LD, 55% RH

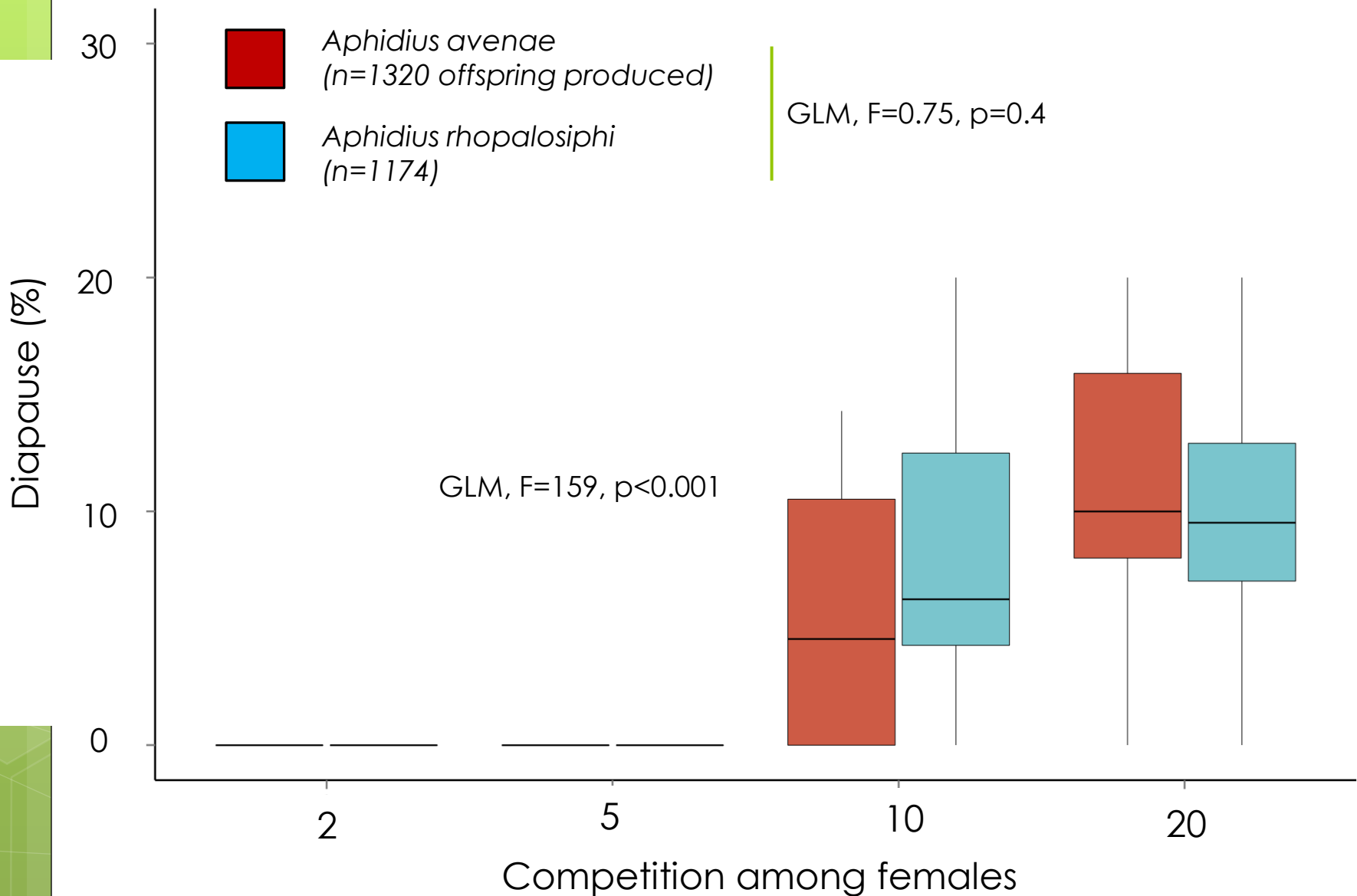
Protocol (Exp. 2)



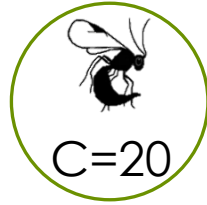
24 ° C, 16:8 LD, 55% RH



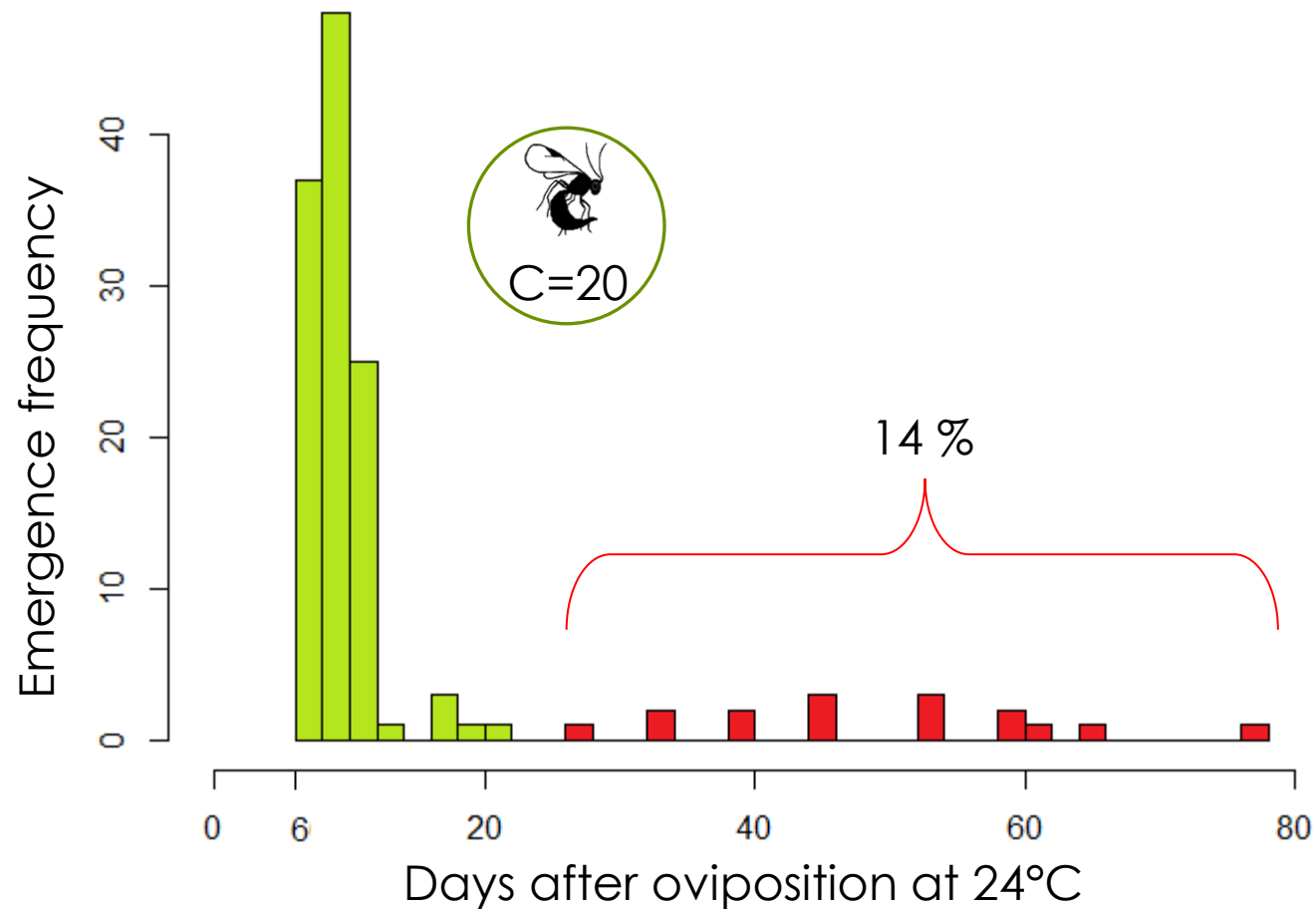
RESULTS (Exp. 2)



Emergence times



Emergence times



- 17 mummies remaining on Nov. 1st

What does it highlight?

- No impact of the **absolute** aphid density
- First observation of a **competition-induced** diapause in parasitoids



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- No impact of the **absolute** aphid density
- First observation of a **competition-induced** diapause in parasitoids
- Adaptation to host decrease in summer in cereal fields
- Bet-hedging strategy (staggering of the emergences)
 - Superparasitism avoidance
 - Competition avoidance for the next generation



Why does it matter?

- Increasing evidences for a **loss of winter diapause in parasitoids** due to climate change

Tougeron *et al.* *in press*, Bale & Hayward 2010



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- Summer diapause may become of increasing importance with **climate warming**, with reduction of host availability and increasing competition for hosts in summer
- Cues for summer diapause expression, and underlying physiological mechanisms are **still unknown** in most insect species





Thank
you!



Supports



Institut de recherche
en biologie végétale



Any questions?
Any suggestions?