Effects of maternal behavior and temperature on plasticity of fat synthesis in parasitoids

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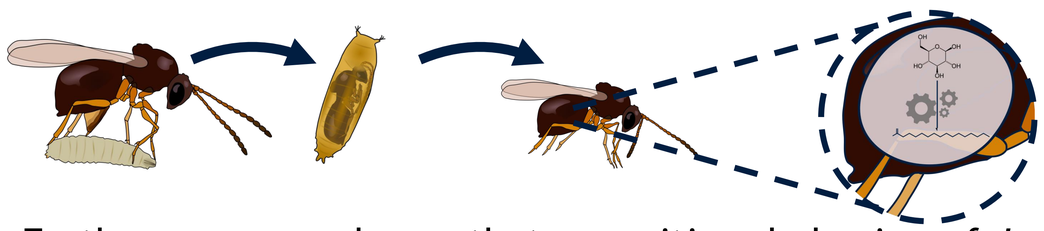
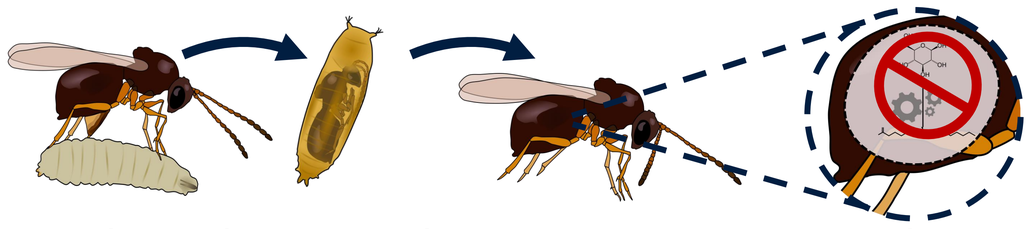
1- Background

- In Europe, winter is characterized by low temperatures and food scarcity. To cope with these stressors, insects that overwinter as adults accumulate fat during autumn (Sinclair, 2015)
- Most parasitoids do not accumulate fat at the adult stage (Visser et al., 2010), but in the parasitoid *Leptopilina heterotoma* lipid synthesis shows extreme plasticity (Visser et al., 2021):

Lean host → Low lipid reserves → Lipid synthesis on



Fat host → High lipid reserves → Lipid synthesis off



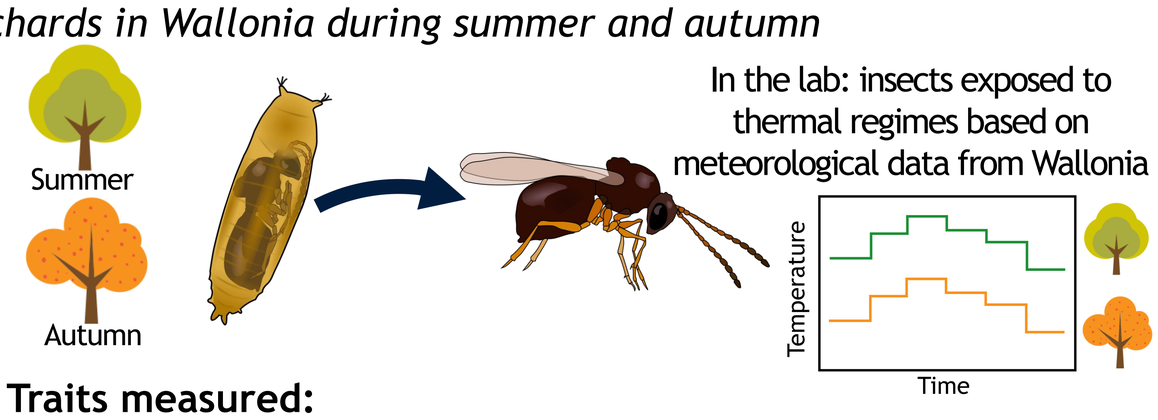
- Furthermore, we know that parasitism behavior of *L. heterotoma* mothers changes with season: in autumn conditions females superparasitize more often (Roitberg et al., 1992). Are *L. heterotoma* females able to differentiate fat and lean hosts like they do for already parasitized hosts? This could influence fat reserves of their offspring in preparation for winter

➢ **<u>Hypothesis</u>: Fat synthesis plasticity and maternal choice should play a role in the overwintering ecology of *L. heterotoma***

2- Project presentation

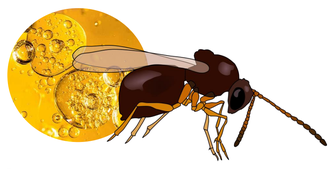
- We are testing female host choice (for fat or lean hosts) and fat synthesis phenotypes using wild parasitoids

→ *Collection of parasitized hosts (Drosophila) from forests and orchards in Wallonia during summer and autumn*

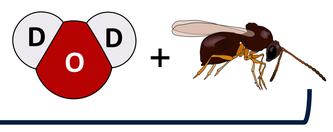


- **Traits measured:**

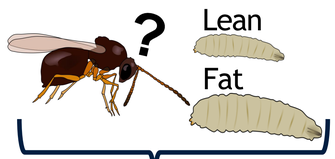
a Fat content



b Fat synthesis (stable isotope tracing using mass spectrometry)



c Host choice + offspring life history traits



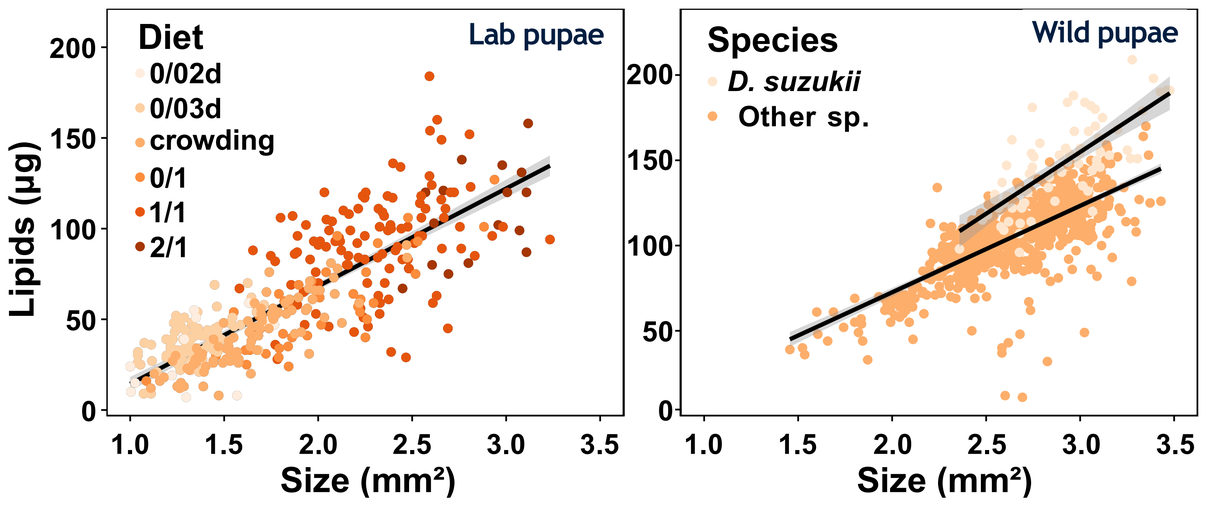
We know that host fat content influences parasitoid fat content and synthesis (Visser et al., 2021)

→ *Need a noninvasive measure of host fat content while the parasitoid is developing*

→ *Need to produce lean and fat hosts*

3- Relation size/fat content of the host

- For this project we need to:
  - Manipulate host quality (fat content)
    → *Diet manipulation*
  - Measure host fat content without killing the parasitoid
    → *Use pupal size as a proxy*

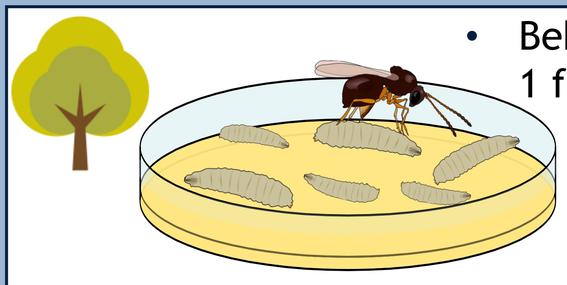


➢ **Diet manipulation allows us to produce fat and lean hosts**

➢ **Host pupal size is correlated with fat content in laboratory and wild *Drosophila***

(<u>Lab pupae, N = 375</u>: LMM, $x^2 = 214.54$, df = 1, p.value < 0.001, marginal R^2 = 0.58, conditional R^2 = 0.88; <u>Wild pupae, N = 810</u>: LMM, $x^2 = 688.08$, df = 1, p.value < 0.001, marginal R^2 = 0.47, conditional R^2 = 0.78)

4- First results on parasitoids

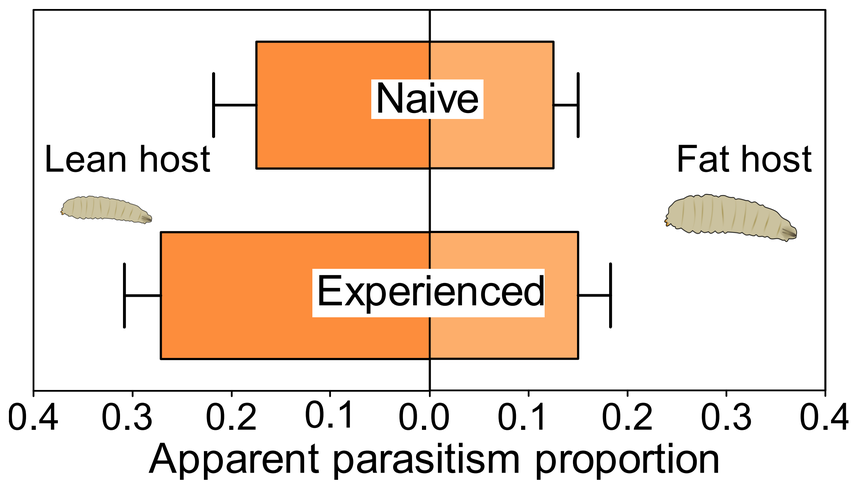


- Behavioral assays:

1 female (mated) + 5 fat and 5 lean hosts

  - Patch investigation
  - Patch probing
  - Host choice

➢ 15 ♀ tested 2 times: naive and experienced



5- Ongoing works

- Fat content: 100 ♀ and 60 ♂
- Fat synthesis: 34 ♀ and 20 ♂

Analyzes to be performed soon

- Behavioral assays :
  - Data are under investigation
  - Life history traits measurements of offspring (fitness consequences of mother choice)
- Trapping of autumn parasitoids

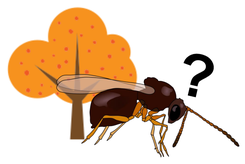
6- Current outcomes

➢ We developed a robust way to manipulate host fat content and estimate it during the parasitoid development (in lab and wild individuals)

➢ Females from summer seems to prefer lean hosts. It may be due to the fact that *L. heterotoma* females prefer early developmental stages of the host (Carton, 1986): size would be a proxy for developmental stage? We are investigating the adaptive value of these choices

➢ How host preference will change in autumn females?

→ ***Work in progress***



Literature - Carton, 1986. *Genet & Biol Droso Parasitoids;* Roitberg et al., 1992. *Behav Ecol* 3:156-165; Sinclair, 2015. J Therm Biol 54:5-11; Visser et al., 2010. *PNAS* 107: 8677-8682; Visser et al., 2021. *Sci Rep* 11:7751

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