Wolbachia variants differentially rescue the fertility of a *bag-of-marbles* mutant in *Drosophila melanogaster*

Paula Fernandez-Begne, Jaclyn Bubnell, Cynthia K.S. Ulbing, Charles F. Aquadro
Cornell University, Department of Molecular Biology and Genetics

Introduction

- The endosymbiotic bacterium *Wolbachia pipientis* infects the germline of many arthropod species.
- In *D. melanogaster, Wolbachia* (wMel) infection rescues female fertility of a *bag-of-marbles* (*bam*) hypomorph (mutant with reduced function).[1]
- *bam* is a key switch for germline stem cell differentiation that shows patterns of episodic adaptive evolution across the *Drosophila* genus.[1,2]
- wMel is of key interest as a potential selective pressure on *bam.*
- wMel is known to be genetically polymorphic.[3]

Objective

- Is there differential rescue of *bam* function by *Wolbachia* dependent on *Wolbachia* genotype?

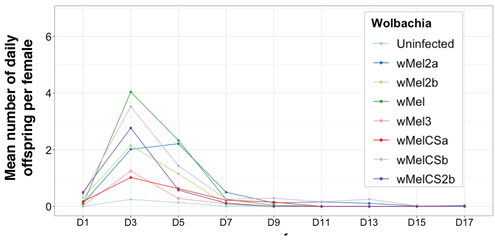
Methods

- Examined fertility, fecundity, and oocyte production of isogenic *bam* hypomorph female flies infected with 9 genetically distinct wMel variants
- Fertility was measured as number of adult offspring produced over 17 days.
- Oocyte production was measured as number of cysts containing nurse cells per ovary through cytology of ovarian tissue.
- Fecundity was measured as number of eggs laid over 3 days (for 2 wMel variants).

Design assumptions

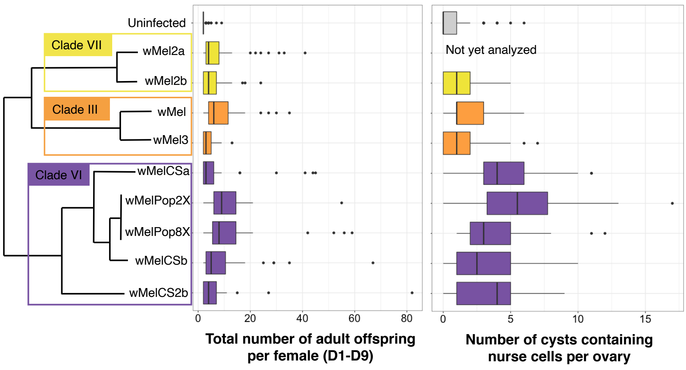
- Oocyte production, egg production, and adult offspring are reliable measures of *bam* function and are expected to correlate with each other.
- Any difference with uninfected control is due to Wolbachia.

Results



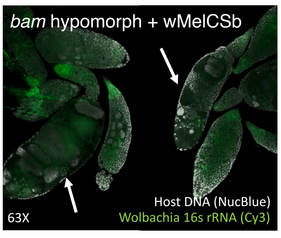
- All wMel variants are able to partially rescue fertility and oocyte production of the *bam* hypomorphs, but some are better than others.
- *bam* hypomorphs produce very few adult offspring after 9 days (mostly zero), despite *Wolbachia* infection.

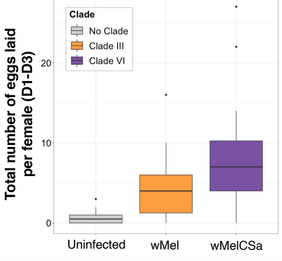
- Infection by wMelCS-like variants (Clade VI) generally resulted in higher rescue of *bam* function.
- wMelCS-like variants typically have higher titer, which may explain this difference.



- There is a disparity between fertility and oocyte production as measures of *bam* function.

- A closer look at ovarian tissue suggests that although *bam*'s differentiation function is rescued, it may not result in viable embryos.
- Nurse cell containing-cysts do not always have the correct morphology or number of nurse cells in *bam* hypomorph ovaries.





- *bam* hypomorphs infected with wMelCS-like variant (wMelCSa) had a higher egg count than those infected with wMel-like variant (wMel), as well as uninfected.
- Egg counts better matched oocyte production counts than adult offspring counts.
- This could be due to various things, including:
  - Eggs laid may not always be viable.
  - Larvae infected with wMelCS-like variants may have decreased survival, resulting in lower adult offspring.

Next steps

- What is driving the differences in rescue of *bam* function by the wMelvariants? Wolbachia titer? Different alleles?
- Are the wMel variants differentially affecting other life history traits, i.e. egg viability or larval survival?

Contact

Questions? Email us!

Paula Fernandez-Begne
pf249@cornell.edu
Jaclyn Bubnell
jeb486@cornell.edu

Acknowledgments

Research reported in this publication was supported by the National Institutes of General Medical Sciences of the National Institutes of Health under the award number 2R01GM095793-05.
Thank you to the Teixiera Lab for providing us with the different wMel-infected w1118 isogenic lines!

Citations

[1]Flores et al, PLOS Genetics 2015. 11(8): e1005453 [2]Civetta A., et al., Mol Biol Evol, 2006. 23(3): 655-662.
[3]Chrostek et al. PLOS Genetics 2013 9(12): e1003896.