

# Are honey bees a suitable model for fetal alcohol spectrum disorders?

Breanne Bevelander\*, Olena Simko\*, Marcelo Camilli\*, Jenna Thebeau, Marina da Silva, Sofiia Markova, Tessa Lester, Oleksii Obshta, Sarah Biganski, Vanessa Brown, Ivanna Kozii, Fatima Masood, Midhun Jose, Igor Moshynskyy, Fahim Raza, Melanie Roulin, Elemir Simko, Sarah Wood\*

<sup>1</sup>University of Saskatchewan; <sup>2</sup>Agriculture and Agri-Food Canada; <sup>3</sup>BC Blueberry Council



## Introduction:

Fetal alcohol spectrum disorders (FASDs) are a continuum of disorders caused by prenatal exposure to ethanol. They affect an estimated 4% of Canadians.<sup>1</sup> FASDs are associated with a host of complications including, but not limited to, cognitive difficulties, developmental delay, increased mortality, smaller birth weight, smaller brain size, as well as gross and fine motor issues.<sup>1-4</sup>

It has been previously established that fruit flies (*Drosophila melanogaster*) are a suitable invertebrate model for FASDs.<sup>5</sup> Honey bees (*Apis mellifera*) share many similarities to *Drosophila* as a research model, but with the distinct advantage of highly social behaviour, similar to that of humans.

In this project we exposed honey bees to incremental, sublethal concentrations of ethanol during larval development and monitored their survival, developmental rate, and weight at adult emergence. We found that larval honey bees exposed to  $\geq 6\%$  ethanol experienced significantly higher mortality, developmental delay, and lower body weight at emergence. Accordingly, these results, in combination with ongoing neurobehavioural analyses of adult bees exposed to ethanol as larvae, suggest that honey bees may be an ideal model for human FASDs.

## Objective:

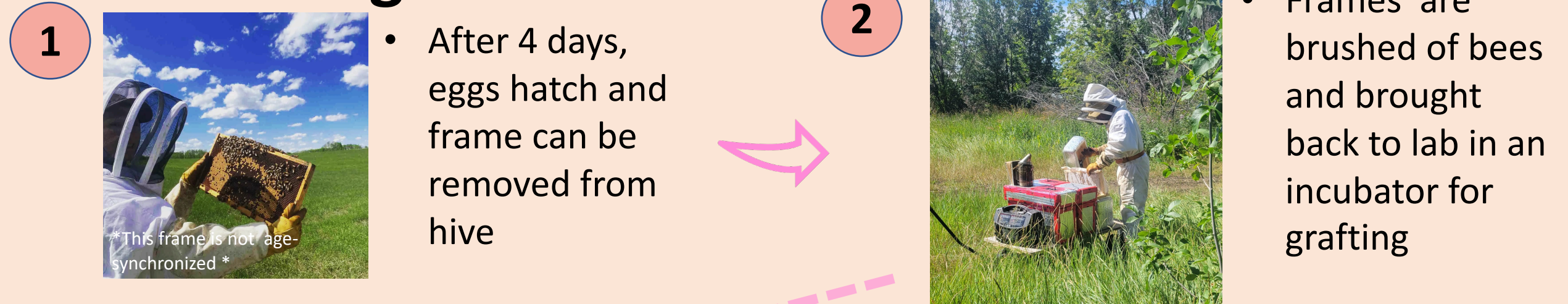
The objective of this pilot project was to determine whether honey bees have the potential to be a suitable model for fetal alcohol spectrum disorders.

## Materials and Methods:

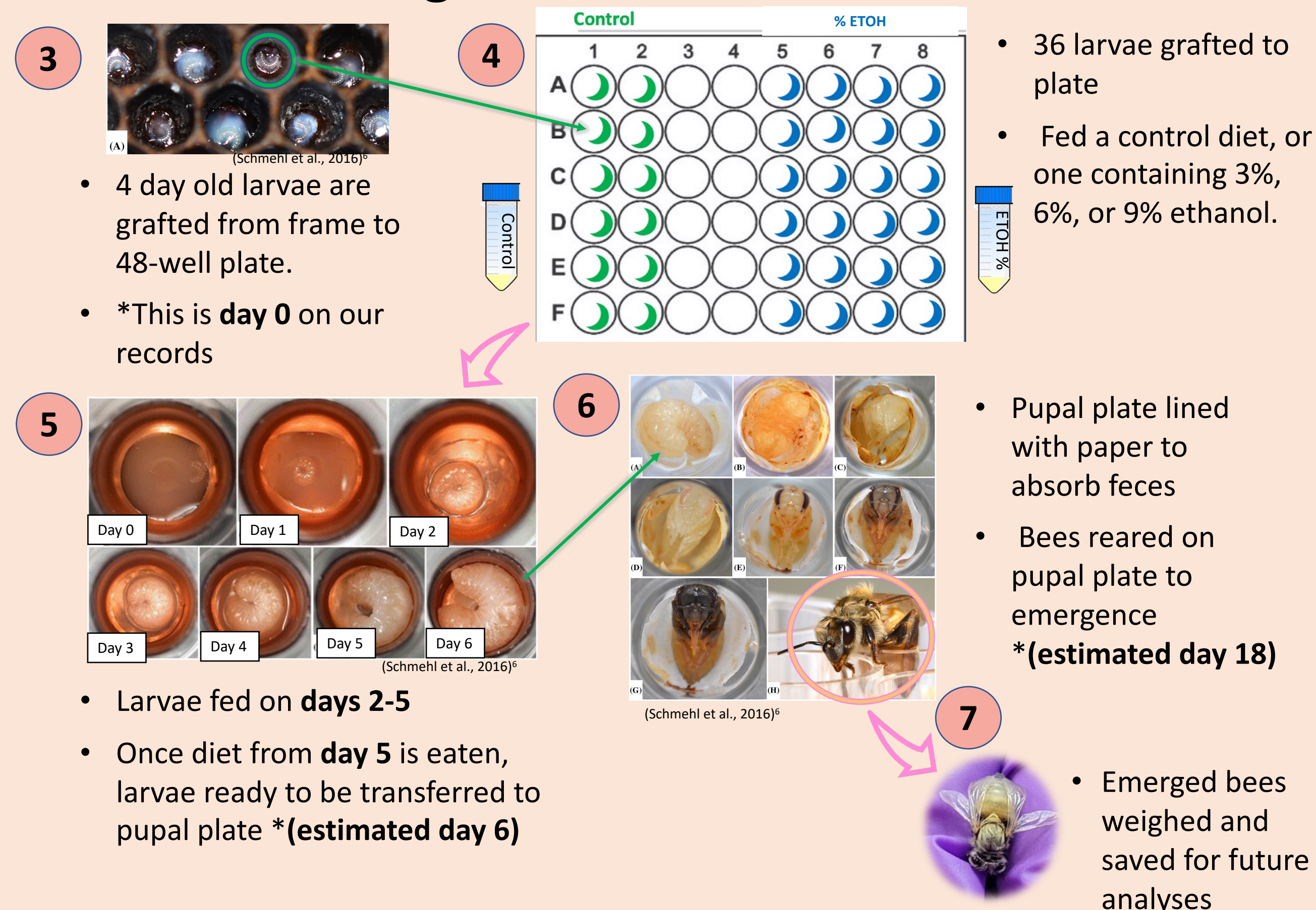
### Hive set up:



### Retrieving larvae:

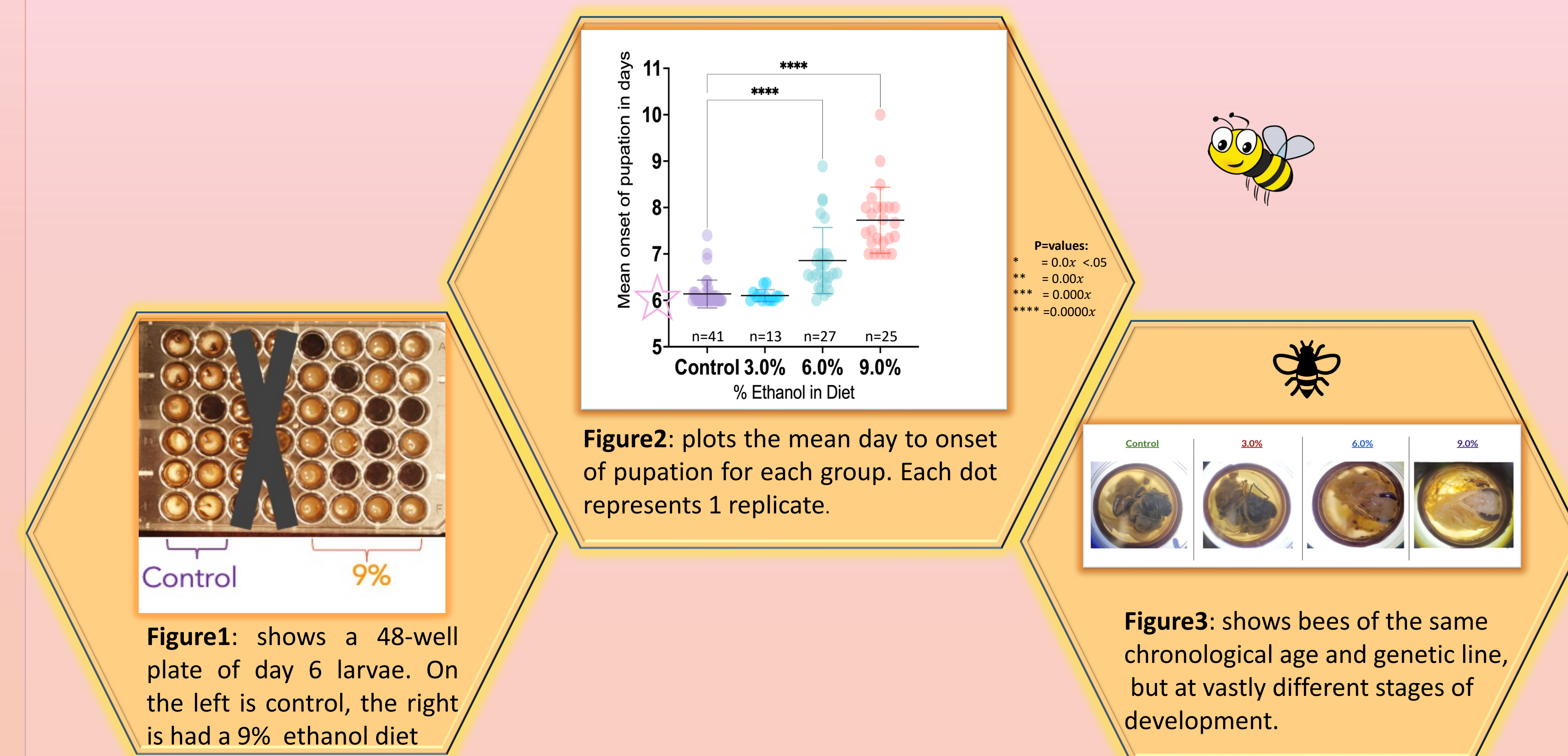


### In vitro rearing:

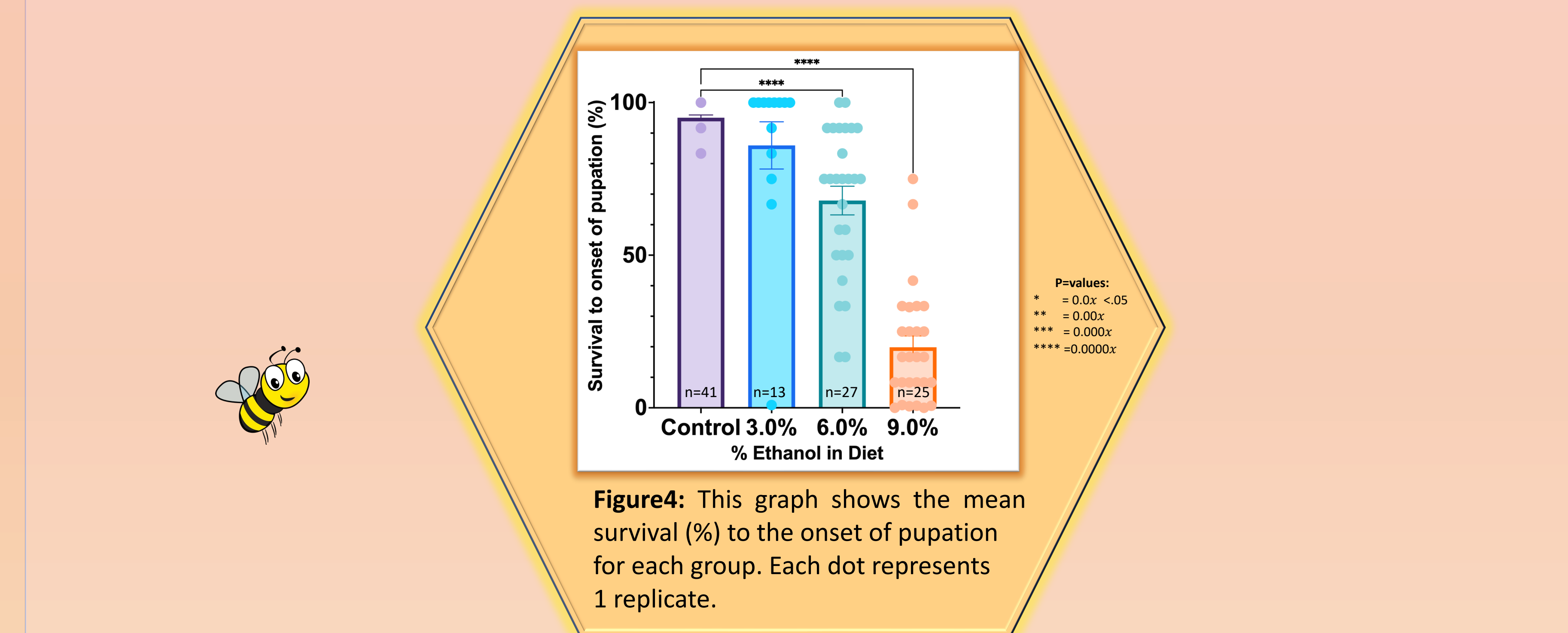


## Results:

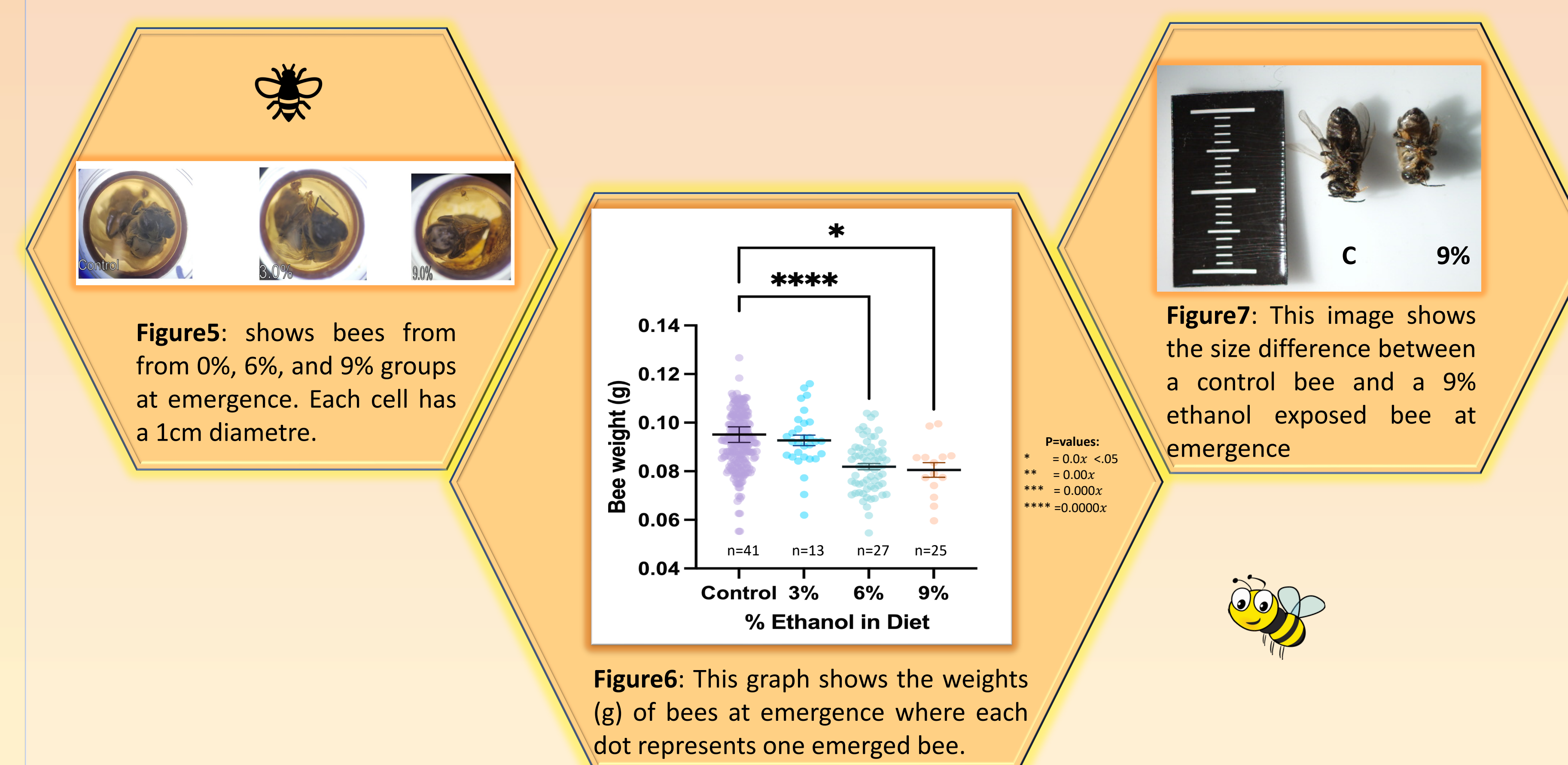
### 1 Ethanol exposed bees are developmentally delayed.



### 2 Ethanol exposed bees have lower survival to pupation.



### 3 Ethanol exposed bees weigh less at emergence.



## Discussion:

### Mean day of pupation onset

Larvae fed  $\geq 6\%$  ethanol diet had significantly slower development. There was a difference of almost 2 days between controls and the 9% ethanol group.

### Mean survival to onset of pupation

Larvae fed  $\geq 6\%$  ethanol diet had significantly lower survival to the onset of pupation.

### Mean weights of bees at emergence

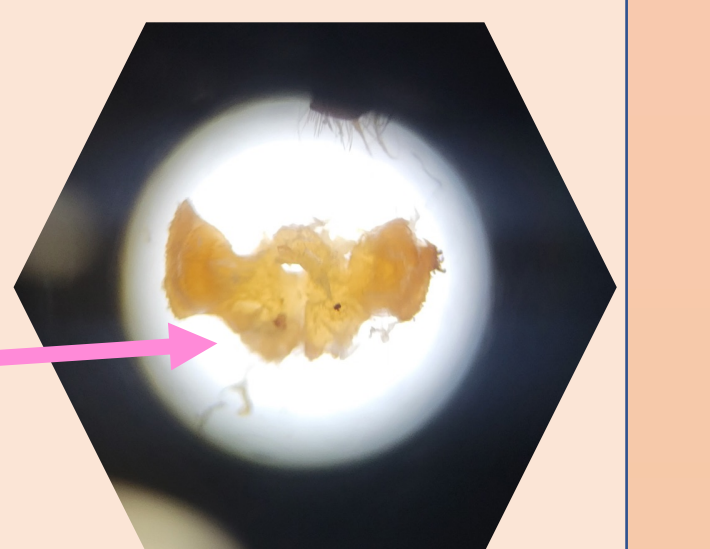
Larvae fed  $\geq 6\%$  alcohol diet were significantly smaller at emergence.

## Conclusion

Bees have the potential to be an ideal model for FASD because like other insect models they're abundant, inexpensive, easy to work with, and have a short turn over rate. However, unlike other invertebrate models, honey bees are extremely social, like humans, which would be invaluable for examining social and neurobehavioural elements of FASDs in humans.

## Future directions

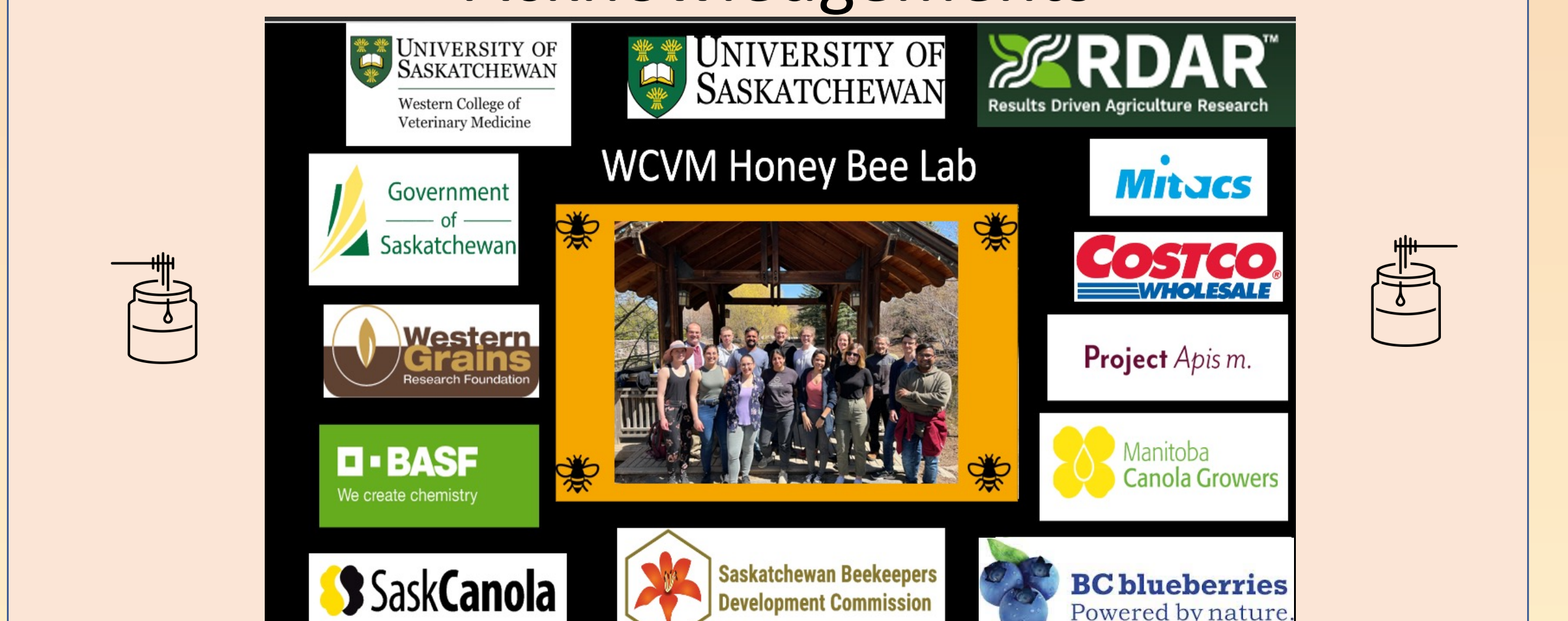
- Compare body measurements
- Compare gross locomotion
- Introduce emerged bees to observation hive
- Reproduce results *in vivo*, within the hive
- Compare brain measurements



## References

1. Sask FASD network. (n.d). <http://www.saskfasdnetwork.ca/learn>
2. Wilhoit L., Scott, D., & Simeka, B. *Fetal Alcohol Spectrum Disorders: Characteristics, Complications, and Treatment*. (2017). Community Mental Health Journal. 53. pp. 711-718.
3. Nunez C, Roussotte F, & Sowell E. *Focus on: structural and functional brain abnormalities in fetal alcohol spectrum disorders*. Alcohol Res Health. (2011).34. pp.121-131.
4. Zhao, S., Young, C., Lam, L., Jones, H., Velez Edwards, D.R. & Hartmann, E.. *Alcohol Use in Pregnancy and Miscarriage: A Systematic Review and Meta-Analysis*. (2019). Alcohol Clin Exp Res. 43: pp. 1606-1616.
5. McClure, K., French, R., & Heberlein, U. *A drosophila model for fetal alcohol syndrome disorders: role for insulin pathway*. (2011). *Disease Models & Mechanisms (DMM)*. 4. pp. 335-346
6. Schmehl, D., Tomé, H., Mortensen, A., Martins, G., & Ellis, D. *Protocol for the in vitro rearing of honey bees (Apis mellifera L.) workers*. (2016). Journal of Apicultural Research. 55. pp. 113-129.

## Acknowledgements



## Contact Information:

Breanne Bevelander  
breanne.bevelander@usask.ca