The Effects of DMPF on Honey Bee Pathophysiology

So Eun Moon, Anthony Nearman, and Dennis vanEngelsdorp

Department of Entomology, College of Computer, Mathematical, & Natural Sciences, University of Maryland, College Park

What We Know

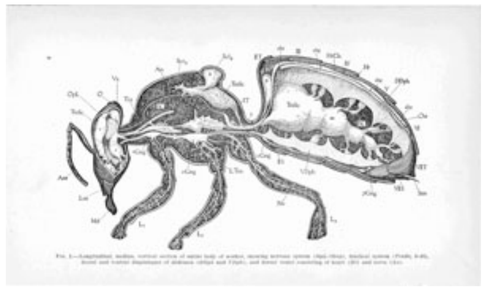
- Honey bees hold great value to agriculture and the economy through their crop pollination services
- Beekeepers in the United States report ~30% colony losses over the winter for the past decade
- The ectoparasite *Varroa destructor* is the leading driver of colony loss in the United States
- Beekeepers apply acaricides such as amitraz to control *Varroa* in the hive
- Acaricides accumulate in bee wax and affect bee health

U.S. National Honey Bee Survey

- The National Honey Bee Survey (NHBS) documents honey bee disease, pests, and pathogens from apiaries across the United States
- N-(2,4-dimethylphenyl) formamide (DMPF) is the active metabolite in amitraz
- DMPF was the highest detected metabolite in the 2017 NHBS pesticide analysis

Methods

Bees sampled during the fall season from the 2017 NHBS were dissected and scored for 19 pathophysiological traits on a binary or ordinal scale.



Question

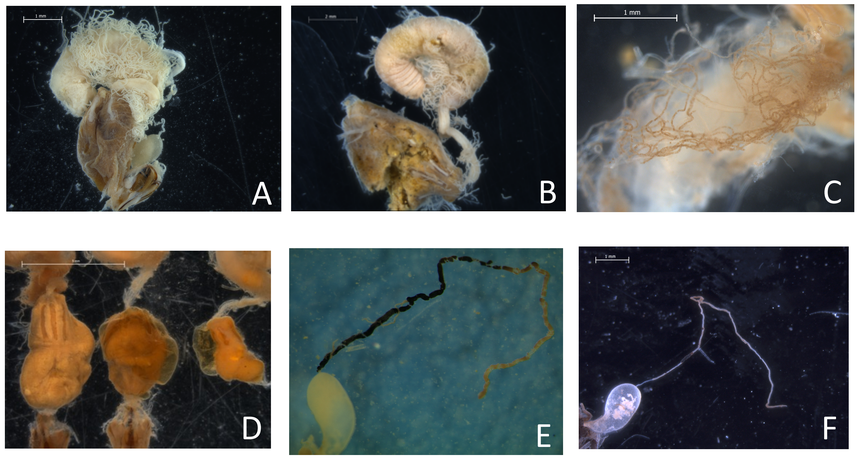
Are there relationships between adult honey bee pathophysiological traits and varying DMPF concentrations in the wax?

Pathophysiology as a Tool

- Pathophysiology is the study of how disease affects the structure and function of tissues and is useful in predicting colony health
- Data set was categorized into three groups based on DMPF concentrations found in the sample wax:
  - No Detection = 0 ppb
  - 0 < Trace <1.5 ppb
  - Detection = 1.5-2,030 ppb

Results

- Linear mixed effect models and Tukey tests revealed bees were significantly different from bees in the No Detection group for six pathophysiological symptoms:
  - Light-colored ventriculus *(A & B)*
  - Darkened Malpighian tubules *(C)*
  - Normal Malpighian tubule quantity *(A)*
  - No rectal distention *(D, rightmost)*
  - Melanized sting gland *(E)*
  - Venom sac debris *(F)*



Statistical Analysis

Least-Squares Means of Six Symptoms

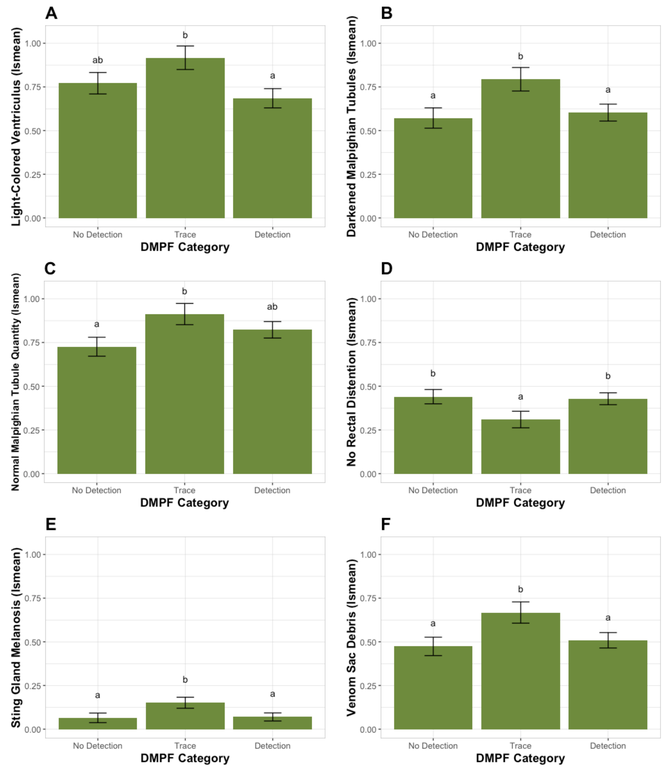


Figure 7. *Barplots of lsmeans per DMPF category with bars representing one standard error: (A) light-colored ventriculus, (B) darkened Malpighian tubules, (C) normal Malpighian tubule quantity, (D) no rectal distention, (E) melanized sting gland, (F) venom sac debris.*

Future Research

This study serves as preliminary work for future experiments to investigate why these six symptoms are associated with bees from colonies with trace amounts of DMPF.

Acknowledgements

I thank Anthony Nearman, Dr. Dennis vanEngelsdorp, Karen Rennich, Dr. Anahí Espíndola, Dr. William Lamp, the Honey Bee Lab, and the UMD Entomology Department for their support and guidance through this research.