Summer 7-31-2023

# The Effect of Integrated Pest Management on Honey Bee Behavior and Colony Level Health

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## Introduction

Honey bees are the world's most commercially valuable pollinators (1), and they face many threats. The greatest challenge facing honey bees is *Varroa* mites, which are parasitic mites that feed on bees' fat bodies, killing bees and spreading diseases (1). While chemical treatments are available to stop the spread of mites, these treatments are insecticides, which are not ideal to put in a hive of insects. A popular organic method of mite management is using drone comb (Fig. 1a). Drone brood is preferentially chosen by mites for ovipositing and development because of its larger size and longer development time (Fig. 2), so removing drone brood can drastically reduce mite numbers in the hive. However, drones are nutritionally expensive, and forcing bees to raise drones could create nutritional stress. It is known that drone comb removal does not detrimentally affect population size (2), but it is not known if foraging behavior is affected by this process. My research investigates if health and foraging behavior change in the presence of drone comb for mite management. The results could help us understand the effects of integrated pest management, and determine what nutrients honey bees need during mite treatment.

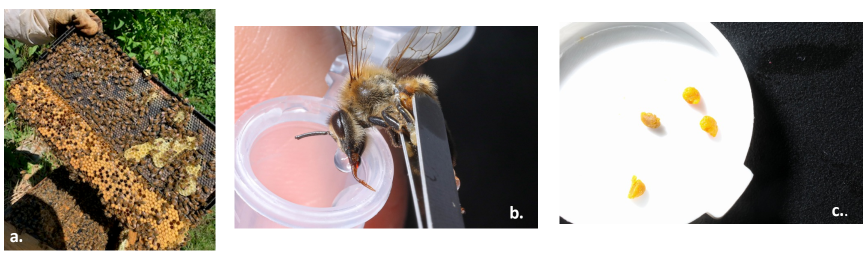


**Figure 1: a)** A frame with drone brood to be removed on the bottom. **b)** A honey bee regurgitating her nectar with gentle pressure on the abdomen. **c)** Pollen pellets taken from a forager.

## Materials and Methods

### Data and Sample Collection

- Data were collected throughout drone development (Fig. 2).
- Population size was determined by counting the number of frames covered by adult bees.
- Foraging rate was determined by counting bees leaving the hive for ten minutes, then counting the bees returning with pollen for ten minutes.
- Foraging nutrition was determined by collecting nectar (Fig. 1b) and pollen (Fig. 1c) from returning foragers.

### Sample Analysis

- Nutrition of pollen and nectar will be determined by combustion (Elementar UNICUBE) to collect percent carbon and percent nitrogen.

## Results

**Population**: There was no significant difference between the baseline populations of treatment hives and control hives (Anova, F= 1.2146, df= 1/10, p= 0.2962) (Fig. 3a).
**Foraging behavior**: There was no significant difference between the baseline proportion of foragers with pollen of treatment hives and control hives (Anova, F= 0.0971, df= 1/10, p= 0.7617) (Fig. 3b).

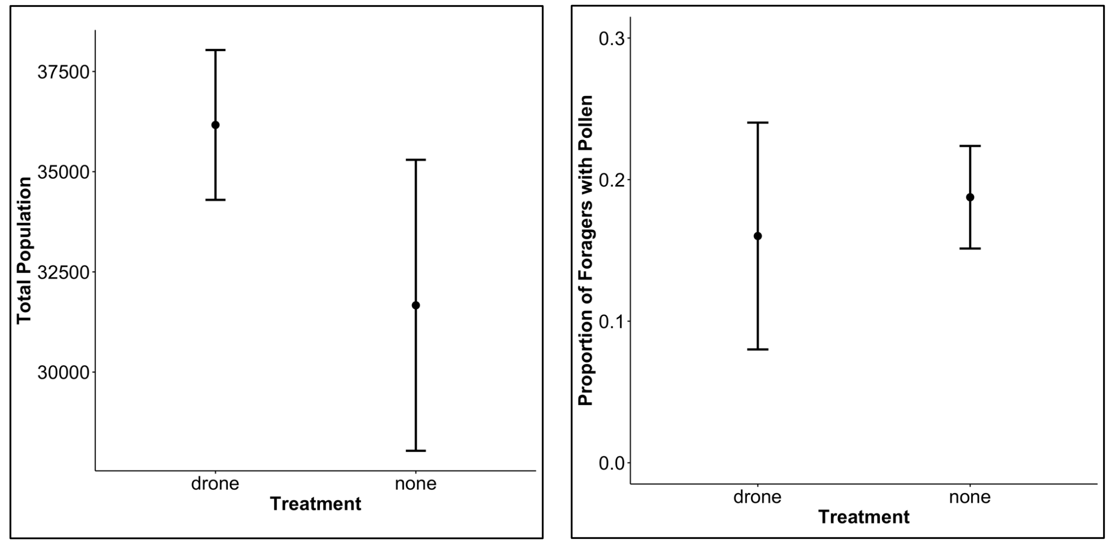


**Figure 3: a)** Baseline total population estimates between hives treated with drone comb (6 hives) and control hives (6 hives). **b)** Baseline proportion of pollen foragers per total foragers between treatment hives and control hives.

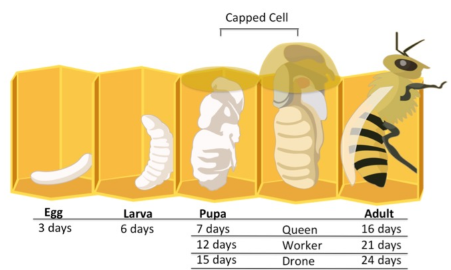


**Figure 2:** Diagram of drone development.

## Conclusion

These results support what we expected to see for our baseline visits to the hives, before drone treatment began. Moving forward, we will analyze second visit data to see change over time in all hives and compare changes among hives. In the coming months, pollen and nectar will be analyzed for nutritional content to determine if the nutritional needs of hives treated with drone comb differ from control hives.

## References

1. Rosenkranz, P., *et al*. (2010). Biology and control of Varroa destructor. *Journal of invertebrate pathology*, *103*, S96-S119.
2. Calderone, N. W. (2005). Evaluation of drone brood removal for management of Varroa destructor (Acari: Varroidae) in colonies of Apis mellifera (Hymenoptera: Apidae) in the northeastern United States. *Journal of Economic Entomology*, *98*(3), 645-650.

## Acknowledgements

This research was supported by the Providence College Biology Department and the Walsh Fellowship. Thank you to the Bonoan lab and our local beekeepers. We also thank the Southeastern New England Educational and Charitable Foundation for the Elemental Analyzer.