

Semi-field tests of repellent and attractant molecules to *Aethina tumida*, a pest of *Apis mellifera*

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Introduction

There are currently no effective chemical treatments for small hive beetle (SHB) control within or outside honey bee hives. At the University of Florida's Plant Science Research Center in Citra, Florida, the Honey Bee Research and Extension Laboratory (HBREL) operates and maintains a building of 12 enclosed, mesh structures, referred to as flight cages (Fig. 1). Each flight cage is 12.8m long, 8m wide, and 3m tall. These flight cages can house honey bee colonies and have walls capable of containing small insects such as SHB. Several compounds have been identified that show promise in laboratory assays of being effective attractants and repellents to SHB¹. Assays need to be developed to test these compounds and determine efficacies in more field realistic environments. Several trap designs have been used in research applications², but more research needs to be conducted to improve trap attractiveness.

Main Objectives

- 1: Develop a semi-field assay to identify compounds that repel SHB from honey bee colonies.
- 2: Develop a semi-field assay to identify compounds that attract SHB more effectively than honey bee colonies.

Methods

Preparation of Colonies: Honey bee colonies must be brought into the flight cages free of SHB (Fig. 2). To do this frames and equipment are visually inspected, frames are gently bumped to remove SHB, and adult bees are shaken onto a screen that is large enough for SHB to pass through but not honey bees. Any SHB found are aspirated.

Nucleus colonies of 5 frames are tested first. These colonies contain a queen, brood, and approximately 5000 adult bees. Nucleus colonies are easier to manage in the flight cages and lower the risk of large amounts of bee death, but still contain all the elements that would normally attract SHB to a honey bee colony.

Small Hive Beetles: Adult beetles are brought to the flight cages from rearing facilities at the HBREL. One hundred beetles are released in a flight cage for all assays (Fig. 4).



Figure 2. Nucleus colonies must be managed regularly in the flight cages. Without access to natural forage, colonies must be fed with supplemental sugar syrup. An aspirator is used to remove adult SHB from this colony 48h after they have been released in the flight cage.

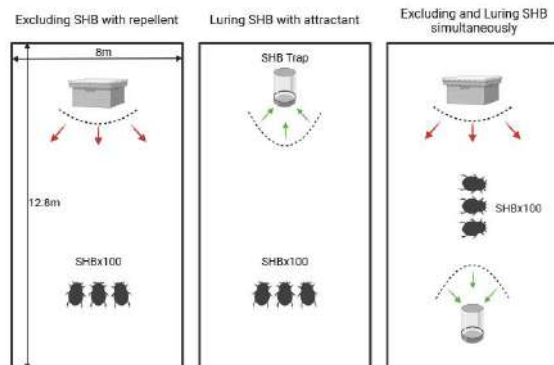


Figure 3. Examples of the three types of assays being developed. Repellent assays testing the exclusion of SHB. Attractant assays testing the effectiveness of SHB traps. An assay that includes both a repellent near a hive and attractant in a trap will be used to test "push-pull" strategies.



Figure 1. A view of the flight cages. Flight cages are fully enclosed and impermeable to insects as small as SHB. In total there are 12 individual cages, with six on either side of the gravel driveway, allowing for multiple assays to take place at once.

Assay Development

Repellent Assay: Pyrrolidine is being tested as the first repellent candidate to develop the assay. Repellent is being tested by lightly soaking an absorbent pad and placing it near the honey bee colony entrance. Repellents will continue to be tested to understand the placement, quantity, and application schedule that is the most effective way to reliably exclude SHB (Fig. 3).

Attractant Assay: Isopentyl Acetate and honey bee pollen substitutes are being tested to develop the attractant assay. Attractants are placed in a trap that has entrances large enough to allow SHB to enter but not honey bees (Fig. 3).

Combined Assay: Within a single flight cage, a honey bee nucleus colony with a repellent and a SHB trap with an attractant are placed at opposite ends (Fig. 3).

Measuring Efficacy: After 48 hours, SHB are counted. Within nucleus colonies, we visually inspect, bump frames and equipment, and shake adult bees over a screen to identify all SHB. Within traps, SHB are removed and counted.

Benefit to Beekeepers

- Our work allows for the continuation of SHB attractant and repellent research by providing a standardized set of methods that can be used to test the efficacy of many compounds under semi-field conditions.
- The flight cage assay also allows for continued research into SHB trap design. An effective environmental trap to catch adult SHB could be used for monitoring in areas on the edge of SHB invasive range, or for control in SHB infested areas.
- This research could ultimately lead to the development of products for beekeepers to better protect their honey bee colonies from SHB damage.



Figure 4. A petri dish of SHB adults is placed on the opposite end of the flight cage from a honey bee nucleus colony. SHB are released. Any SHB that enter the honey bee colony are counted at the end of the assay.

Acknowledgements

We gratefully thank Jennifer Martocci and Christopher Oster for providing technical assistance during the experiment. This research is being supported with funds provided by a USDA-APHIS grant.

References

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2. Arbogast et al. (2007) An effective trap and bait combination for monitoring *Aethina tumida*.

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Worldwide, honey bee colonies are being negatively impacted by pests and pathogens. A pest species, that is difficult to control in apiaries and within colonies around the world is *Aethina tumida*, the small hive beetle (SHB). In the United States of America, there are currently no effective chemical treatments for SHB control within or outside hives. At the University of Florida's Plant Science Research Center in Citra, Florida, the Honey Bee Research and Extension Laboratory operates and maintains a building of enclosed, mesh structures, referred to as flight cages. These flight cages can house honey bee colonies and have walls capable of containing small insects such as SHB. Assays to test the efficacies of SHB repellents and attractants within the flight cages are being developed. Pyrrolidine, an organic compound found in natural alkaloids, is being trialed as a repellent chemical. This chemical has already demonstrated some significant potential as a SHB repellent in laboratory trials but has not yet been tested under field conditions. Isopentyl acetate, the major component of honey bee alarm pheromone, and commercial pollen substitutes are being trialed as attractants. Position, quantity, and application schedule of compounds are being tested to determine how to reliably exclude SHB from hives. For the attractant assays, a trap is being developed to contain beetles drawn to the attractant. This work will allow researchers to develop new compounds or devices and test their efficacy based on standardized methods. With further development, it is possible to develop a push/pull strategy for SHB, moving them away from honey bee colonies and attracting them to other sources.