

Developing a trapping assay to assess the viability of *Trogoderma variabile* as a behavioral surrogate species for the biosecurity threat, *Trogoderma granarium* (Coleoptera: Dermestidae)



Ryan Burr¹, William R. Morrison III², Frank Arthur², and Michael Domingue³

¹Department of Economics, Kansas State University, Manhattan, KS 66502

²USDA - ARS, Center for Grain and Animal Health Research, Manhattan, KS 66502

³USDA-APHIS, OTIS Laboratory, Buzzards Bay, MA 02542



Introduction

The Khapra beetle (KB), *Trogoderma granarium*, is a pest that threatens the biosecurity of the United States¹. This species has not established itself in this country, however in the past few years there has been an alarming increase in the number of interceptions of adults at borders and ports in the U.S. Because researchers in the U.S. are only able to work with KB in specially designated APHIS quarantine facilities, understanding the full extent of the threat from this species would proceed much faster if a behavioral surrogate species could be used that was already widespread in the country. One potential surrogate species is *Trogoderma variabile*, the warehouse beetle (Fig. 1), which is closely related to KB, occurs throughout the U.S., and is a destructive pest of stored products in its own right^{2,3,4}.

Goal

The objective of this study was to optimize the protocols for a trapping assay to assess the behavior of *Trogoderma variabile* to various semiochemical stimuli. These data will eventually be compared to corresponding data from KB.



Fig 1. Large warehouse beetle, *Trogoderma variabile*, larva used in trapping assays.



Fig 2. The treatments used in the trapping assay, namely box traps with the lids on (recommended by the manufacturer) or off (left picture), and four different semiochemical lures and an unbaited control (right picture).

Materials and Methods

Source Individuals. For all assays, large *T. variabile* larvae (4th-6th instars) from a field-derived strain were used that had been continuously reared on pulverized dog food (300 g SmartBlend, Purina One), with rolled oats, and a moistened paper towel on top in a 800 ml mason jar, and held at 27.5°C, 60% RH, and 14:10 L:D. All individuals were starved 24 h prior to use in experiments.

Trapping Assay. Box traps (IL-2300-10, Insects Limited, Westfield, IN) were used in all treatments. One of five different treatments were placed in each trap, including: an unbaited control (ctrl), 0.13 g dermestid pheromone gel (gel, hereafter; IL-2700 from Insects Limited), 0.13 g food attractant tab (tab, hereafter; from Insects Limited), 0.13 g kairomone Storgard Oil (Trécé Inc., Adair, OK; oil, hereafter), or 1 Khapra beetle pheromone Storgard Cap (Trécé, Inc.; KB hereafter; Fig. 2). Each treatment was placed into an 8 × 18 × 16 cm (L × W × H) arena in one corner, while 10 *T. variabile* larvae were released in the corner opposite of the treatment (Fig. 3). The total number of larvae in each trap at the conclusion of the sampling period were recorded. The larvae were given 24 h to respond to the stimuli in a walk-in environmental chamber set at 27.5°C, 65% RH, and 16:8 L:D. A subset of trials were performed with the trap lids on as specified from the accompanying instructions from the company. There were a total of 16 replications for each treatment.

Data Analysis. The number of larvae in each trap were analyzed by 2-way ANOVA using the semiochemical treatment and presence of lid as explanatory factors. Residuals were inspected to ensure assumptions of tests were met, and Tukey's HSD was used for pairwise comparisons. All statistical analyses were performed using R, with $\alpha = 0.05$.

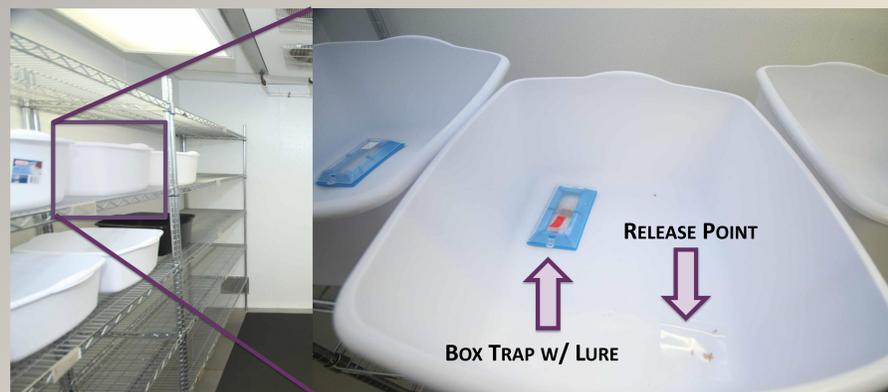


Fig 3. The environmental chamber where the arenas were deployed for 24 h with larvae (A), and the arena setup with box trap on the opposite side from the release point along the diagonal.

Literature Cited

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Results & Discussion

In our trapping assay, we found:

- Use of lid for the box trap prevented captures of large *T. variabile* larvae (Fig 4, top).
- Leaving the lid off allowed large larvae to be captured by the box trap (Fig 4, bottom).
- The most effective attractants for *T. variabile* were the Trécé oil and the pheromone gel, which captured 4-5 times more large larvae than the unbaited control.
- The KB lure was not an effective attractant for large *T. variabile* larvae.

Conclusions

Using the box trap without the lid will be an effective assay to compare the behavior of large *T. variabile* and *T. granarium* larvae.

Future Directions

Because large and small *T. variabile* larvae vary in their response to stimuli, it is necessary to repeat this experiment with small larvae. Once completed, the responses of *T. variabile* larvae should be compared to *T. granarium* larvae to elucidate whether *T. variabile* can be used as a surrogate species for the trapping behavior of *T. granarium*. The latter trapping experiments will have to be performed in a quarantine facility to comply with APHIS procedures.

