

Examining Sublethal Effects of λ -cyhalothrin on Alfalfa Leafcutting Bees (*Megachile rotundata*)

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Introduction

- **λ -cyhalothrin:** pyrethroid, heavily relied on for insect pest control in alfalfa systems.
- **Pyrethroid:** insecticide class, block sodium ion channels.
 - Causes spasming, paralysis, and death.
- **Alfalfa leafcutting bees:** commercially produced pollinator for alfalfa seed production.
- **Sublethal:** less than lethal with potential down stream toxicity.

Sublethal effects of λ -cyhalothrin have been examined in bumblebees and honey bees.

Negative sublethal effects include difficulty foraging, impaired movement, shortened lifespan.

Assessment is lacking in alfalfa leafcutting bees.



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Methods

CDC Bottle Bioassay

- Interior of glass bottle coated with insecticide dilution.
- Insects introduced to bottle for one hour.
- Mortality recorded after 24 hours
- Previous research into toxicity thresholds estimated $1\mu\text{g/ml}$ of λ -cyhalothrin as sublethal concentration.
- 20 bees (10M, 10F) per bottle, 3 replicates

Y-Tube Assay

- Choice assay to assess foraging behavior
- honey water (food source) vs. water (control)
- Bees monitored individually for 10 minutes.
- Time spent at honey, water, and undecided recorded.
- Tested at 48 and 72 hours
- General behavioral observations: spasming, decreased mobility, wandering, etc.



Statistical Analysis

- Time spent choosing honey water, water, or undecided analyzed using MANOVA
- Tested significance of sex, treatment vs. control, and 48 vs. 72 hours

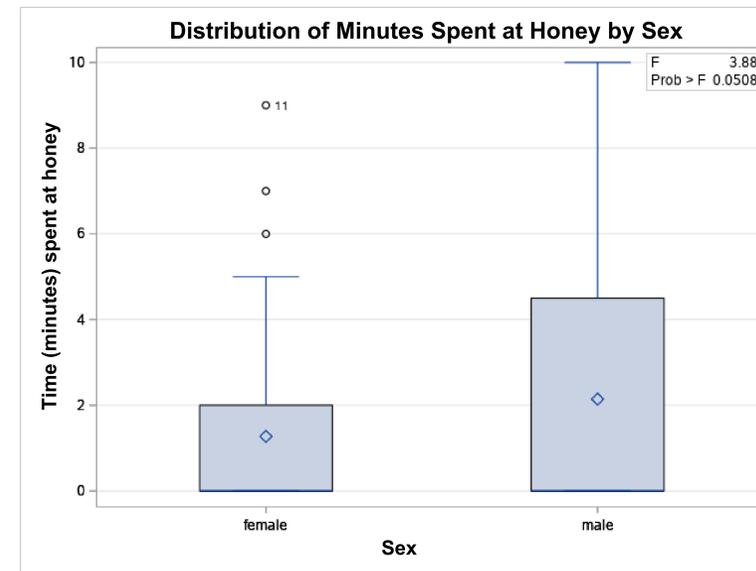


Figure 1: Box plot of the distribution of time spent at honey by sex. Males spent significantly more time at honey than females p-value = 0.0508).

Honey	Mean (Minutes)	Standard Dev.
Male	2.14	3.31
Female	1.28	1.96
P-value = 0.0508		

Table 1: MANOVA for the influence of sex on time spent at honey.

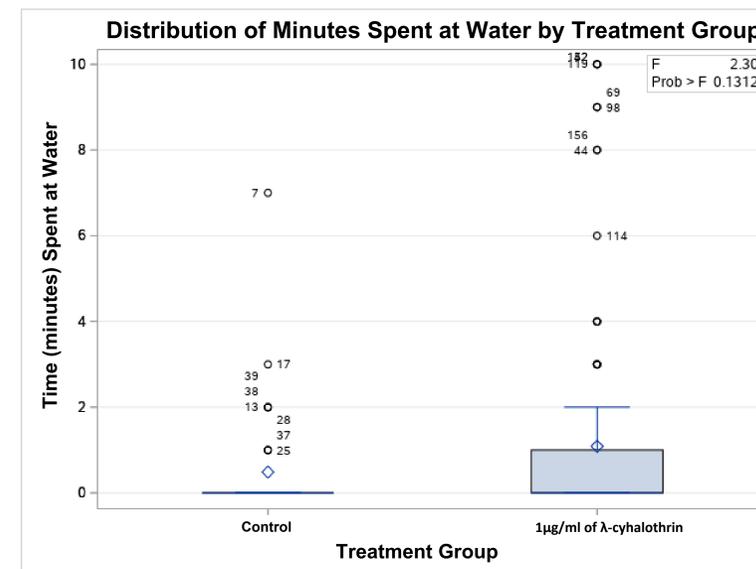


Figure 2: Box plot of the distribution of time spent at water between control and test groups. Although no significance is found, variance in observations is worth further investigation.

Results

- 6 bees (3 female, 3 male) died from 1 test bottle after 48 hours.
- Males spent significantly more time in honey chamber than females ($p = .0508$) (figure 1, table 1).
- Distribution of time spent in water chamber different between test and control replicates (figure 2).
- Impaired mobility and slowed movement observed in treated bees
- Sedentary behavior observed in males after 72 hours.

Conclusions

- Our results suggest sublethal effects on foraging behavior at $1\mu\text{g/ml}$ of λ -cyhalothrin.
- Mobility issues and sedentary behavior could inhibit foraging, reproduction, pollination, and other behaviors essential for survival.
- Intricacies of sublethal effects on natural behavior not easily observed in controlled settings.
- Future studies should examine sublethal effects in a field setting where a concentration is applied and bees can be tracked and observed.
- Bees are essential for food production and their sensitivity to insecticide is concerning.
- Understanding the effects of sublethal toxicity will inform insecticide use strategies.