Evaluation of Spinosad as a Packaging Treatment Against Three Species of Coleoptera

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Undergraduate Research Experience in Entomology

Introduction

- Spinosad is a natural insecticide derived from the fermentation of the soil dwelling bacteria, *Saccharopolyspora spinosa* (Hertlein et al., 2011; Toews et al., 2003)
- Spinosad has been shown to be a highly effective as a surface treatment on concrete, steel, and tile against several stored product insects (Toews et al., 20013)
- Packaged food products are highly susceptible to infestation by stored product insects by penetration or invasion of packaging material
- Infestations of packaged products result in product losses, economic losses, and loss of consumer confidence
- Incorporating traditional contact or low-risk insecticides into packaging materials are new approach to pests management and has been gaining increasing interest among food manufacturing companies (Scheff et al., 2017)
- Incorporating Spinosad into packaging material is a novel technology that could prevent infestations of packaged food products

Purpose

The purpose of this project was to evaluate the reduced-risk insecticide Spinosad, as a new packaging treatment on paperboard or incorporated into polymer packaging for its effectiveness on three common stored product insects.

Methodology

- The experiment was conducted in a laboratory setting and ran in three blocks — every block represented one of the species of insects.
- Ten adult beetles were exposed to each packaging type and were also given food.
- The mortality rate was monitored for up to 14 days. Six replicates were set up for each package and insect combination.

Insects:

Sitophilous oryzae (L.) — Rice Weevil (RW)

Tribolium castaneum (Herbst) — Red Flour Beetle (RFB)

Rhyzopertha dominica (Fabricius) — Lesser Grain Borer (LGB)

Materials:

0.1, 0.3 and 0.5% Spinosad, water-based application on card stock

500 ppm and 1000 ppm Spinosad incorporated into polymer packaging

Rice Weevil

Sitophilus oryzae, or the Rice Weevil, is as stored product pest. As adults, weevils can fly and live to be around 2 years old.

Red Flour Beetle

Tribolium castaneum, or the Red Flour Beetle, is another stored product pest. An adult can live for more than three years and they can fly great distances.

Lesser Grain Borer

R. Dominica, or the Lesser Grain Borer is a food pest. They bore holes into kernels for their larvae.

Results

Often, the toxicity was greatest at a lower load than a higher load. All three species responded relatively similarly to the treatment. The greatest number of deaths was measured at the fourteenth day.

Rice Weevil

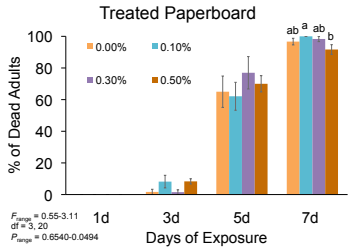

Fig. 1: RW adults had significantly higher mortality at the 0.10% loading rate.

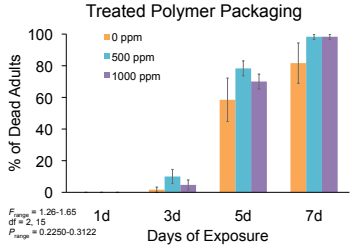

Fig. 2: Mortality began at 3d and increased up to 7d and was similar for both loading rates

Red Flour Beetle

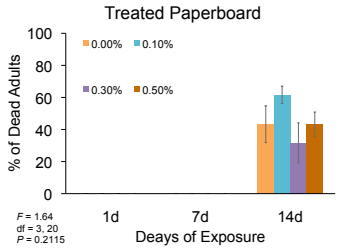

Fig. 3: The highest mortality rate among RFB adults was present at the lowest load rate

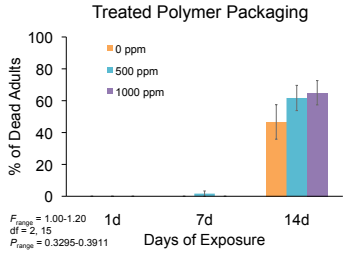

Fig. 4: Adults died at the similar rates, but the 1000ppm had the highest mortality

Lesser Grain Borer

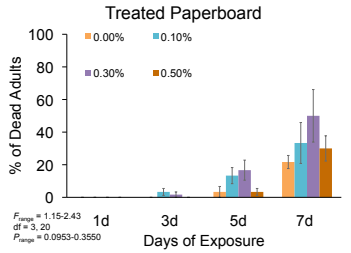

Fig. 5: The highest mortality rate among LGB across all loading rates was 0.3% after 7d

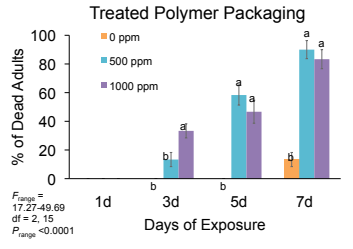

Fig. 6: LGB mortality was significantly higher than the control at 5 and 7d of exposure

Discussion

- Mortality on control bioassay arenas was higher than anticipated, which could be due to low humidity at ambient conditions
- Spinosad's highest mortality rate was at 14 days for all three species exposed to both types of material
- While we knew Spinosad was an effective insecticide, this experiment assisted in narrowing down the amount of the chemical that was the most effective and will in turn help with future endeavors such as estimating costs and understanding what insects respond to the treatment faster and why.
- The results also provide a framework for how long the chemical takes to reach full toxicity and allows for the data to help begin the process of speeding up the rate of mortality.
- More significantly, the results suggest that, while Spinosad may not have the same effect on all three species, it still has an effect and can be studied further to exploit this effect against species that are more resistant to it.

Future Directions

The results compel me to beg the question: how can we speed up the mortality rate against the insects without increasing the amount of Spinosad by more than is considered safe for mammals.

References

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