Young Scholar Enhancement Program
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Biocontrol with Benefits: Enhancing Sustainability by Adding Value

Abstract

A critical pest of concern for peach and other stone fruits in the Southeastern US is the Peachtree borer (PTB), *Synanthedon exitiosa*. PTB larvae bore into roots and cause severe feeding damage. This pest is often controlled with broad spectrum chemical insecticides, particularly chlorpyrifos. The continued use of chemical insecticides can have negative effects on the environment. Effective alternative pest management strategies are needed. Our research has indicated that the entomopathogenic nematode (EPNs), *Steinernema carpocapsae,* can cause PTB mortality at comparable rates to chlorpyrifos. However, EPNs are highly susceptible to desiccation. Therefore, the first objective in this study was to determine an optimum *S. carpocapsae* formulation to achieve efficacy by protecting the nematodes from environmental stress. In addition to PTB, several insect pests feed on peaches and threaten production. Root-feeding weevils cause significant damage to peach roots in Georgia, but no tactics have been developed to control these pests in a peaches. Hence, our second objective was to determine whether *S. carpocapsae* applications targeted toward PTB are also reducing weevil populations. If control of PTB with EPNs also provides suppression of root-feeding weevils that would be an added benefit of the biocontrol approach. Our results indicate that two new formulations were found to be especially promising as Anti-positive desiccants agents (1% Polysno and 1% Water gel). These formulations provided more environmental protection to the nematodes compared with other formulations or with non-formulated nematodes. Additionally, our results indicate that EPNs, when applied for control of PTB, also suppress certain species of root-feeding weevils. These results enhance the attractiveness of a biocontrol solution to pest management within a peach system.

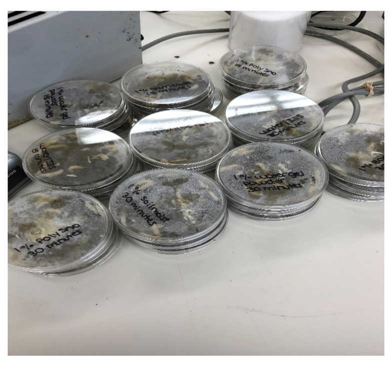

Fig 1(far left) Petri dish of treatments after sunlight

Fig. 2. Peachtree borer and damage it causes

Introduction

Entomopathogenic nematodes (EPNs) are roundworms that are natural parasites of insects (Shapiro-Ilan et al., 2018). EPN's are natural bio-insecticides and do not present the same environmental risks as chemical pesticides. Entomopathogenic nematodes are susceptible to UV radiation and desiccation and therefore protective formulations can be critical to achieving efficacy. Additionally, if EPNs can be shown to kill more than one pest in a particular cropping system then the biocontrol approach will be more attractive to farmers. EPNs have been shown to be effective against a key pest of peaches, Peachtree borer (PTB), *Synanthedon exitiosa* (Shapiro-Ilan et al., 2015), but we are looking at further optimizing EPN applications. In addition to PTB, certain root weevils may also damage peaches in the Southeastern US. For example, *Oedophrys hilleri* (Faust) is a potential new pest of peach in the United States. Therefore, we investigated anti- desiccation formulations to protect the nematodes from harmful environmental conditions. Additionally, we determined if EPN applications targeted for the Peachtree borer are also impacting root-feeding weevils.

Objectives:

Our overall goal is to understand critical aspects to establish biocontrol efficacy using entomopathogenic nematodes within a peach production system.

Our specific objectives are:

1-To determine the optimum entomopathogenic nematode formulation for control of the peachtree borer.

2- Assess the broader impact of this biocontrol strategy on peach orchards by looking at root-weevil populations.

Results

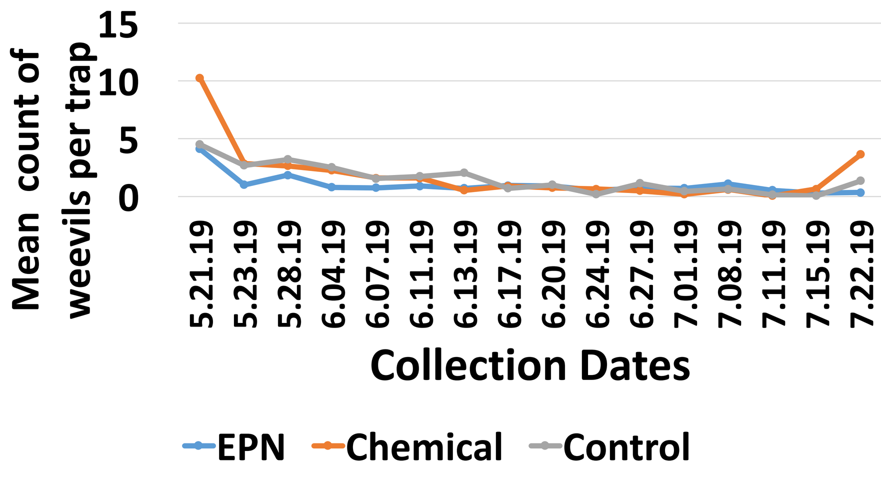

Fig. 3. Mean number of root-weevil captures over time following treatment of nematodes, chemical insecticide or non-treated control; Although numbers tended to be lower in the nematode treatment overall weevil differences were not statistically significant.

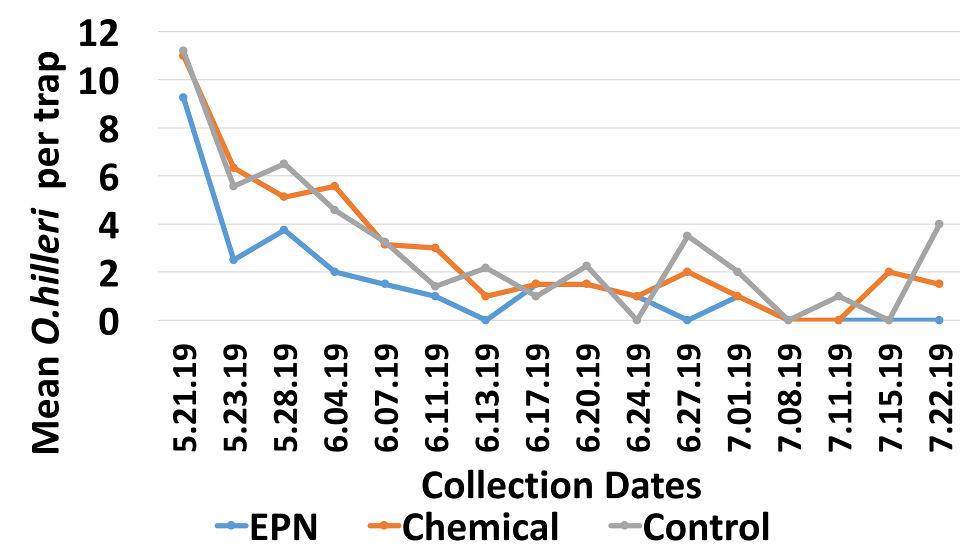

Fig. 4. Mean number of root-weevi, *O. hilleri*, captures over time following treatment of nematodes, chemical insecticide or non-treated control; The entomopathogenic nematode treatment caused a significant population reduction in the *O. hilleri* weevil.

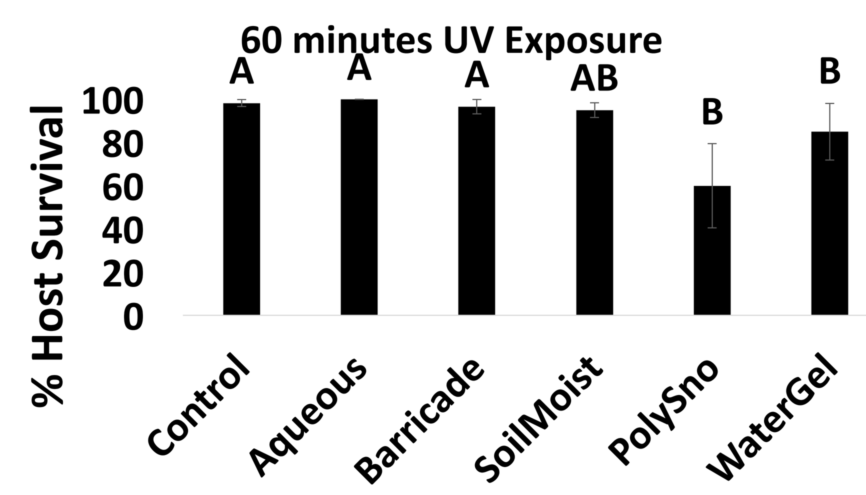

Fig. 5. Percentage survival of wax moth hosts when exposed to entomopathogenic nematodes under natural UV light for 60 minutes. Various protective formulations were tested; Polysno and Watergel were significantly superior in protective ability than the other materials.

Materials/ Methods

Anti-desiccation experiment:
Six treatments were tested in this experiment: 1) Aqueous, 2) 1% Barricade, 3) 1% PolySno, 4) 1% Soil Moist, 5) 1% Water gel, 6) non-EPN negative control. All treatments were applied to Petri Dishes (100 mm dia) containing autoclaved soil at 10% soil moisture. Treatments 1-5 received 1000 EPNs, *S. carpocapsae*, per Petri Dish (100mm dia). Treatments 2-5 received a thin gel layer (5 ml) instantly after standardized EPN inoculation. All treatments were assessed at four time points: 0, 30, 60, and 120 minutes. For the zero-minute time-point (control), treatments were applied in the lab and dishes were assessed immediately after treatment. The other dishes were exposed to natural sunlight beginning at 10 am for 30, 60 and 120 minutes prior to assessment. .Assessment consisted of adding larvae of 10 wax moth larvae, *Galleria mellonella* per dish. Petri dishes were then incubated at 25°C and larval mortality was determined after 48 hours. There were three petri dishes per treatment by time point assessment. Each dish was a replicate a total of 72 dishes per trial. The experiment was repeated once in time for a total of two trials.

Root-weevil experiment:
Peach root-weevil emergence was monitored in three treatments. All treatments were applied in the fall of 2018 during the peachtree borer control window. The treatments were 1) EPN- 1.5 million EPNs/tree, 2) chlorpyrifos insecticide, and 3) negative control. Weevil emergence cages were placed adjacent to the roots of treated trees and monitored weekly beginning in the spring of 2019. There were five trees per treatment per experimental block, and four experimental blocks for a total of 20 trees per treatment. Trapped weevils were brought back to the lab and were identified and quantified. I removed the 24hr info since we are just adding 48 hr. data

Discussion

1. *S. carpocapsae* nematodes produced high levels of control against peachtree borer (data not shown).
2. *S. carpocapsae* nematodes were protected from environmental stress (UV and desiccation) when using formulations of 1% Polysno and 1% Water gel. These gels may have broad usefulness in various nematode applications.
3. Applications of *S. carpocapsae* to control peachtree borer also controlled at least one species of root-feeding weevil (*O. hilleri*). Therefore farmers will gain an extra benefit when using beneficial nematodes for peachtree borer control.

References

Shapiro-Ilan, D.I., Cottrell, T.E., Mizell, R.F. III., Horton, D.L., and Abdo, Z. 2015. Field suppression of the Peachtree borer, *Synanthedon exitiosa*, using *Steinernema carpocapsae*: Effects of irrigation, a sprayable gel and application method. Biological Control 82, 7–12.

Shapiro-Ilan, D. I., Hiltpold, I., and Lewis, E. E. 2018. Ecology of Invertebrate Pathogens: Nematodes IN: Hajek, A. E & D. I. Shapiro-Ilan (Eds.). Ecology of Invertebrate Diseases. Hoboken, NJ: John Wiley & Sons, pp. 415-440

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