Purdue University
Department of Entomology
Undergraduate Capstone
Project Summary

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Project Title:

Comparison of indigenous and commercial strains of the nematode *Heterorhabditis bacteriophora*

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Concerns over environmental and human health risks posed by the widespread use of chemical insecticides have prompted pest managers to seek alternative methods to manage insect pests. In turf grass environments, the use of insect parasitic nematodes may provide a safe alternative to conventional insecticides, but factors associated with nematode efficacy have hindered the widespread adoption of these potentially useful biological control agents. This research compared the virulence, fecundity and field efficacy of three locally-collected strains of the insect parasitic nematode and one commercially-available strain in order to characterize variation in biological attributes of the different nematode strains and clarify how these attributes influence field efficacy. We hypothesized that locally collected strains would be more efficacious than the commercially available strain due to the advantage provided by their adaptation to local climatic conditions. While nematode strain had no significant influence on infectivity in the laboratory, infectivity increased with nematode concentration. Nematode fecundity varied between strains with two of the three local strains outperforming the commercial strain. Local strains also outperformed the commercial strain under field conditions. Results indicate that locally adapted nematode strains may provide a better biological resource for insect pest management than commercially available strains.

Comparison of indigenous and commercial strains of the nematode *Heterorhabditis bacteriophora*

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ABSTRACT

Concerns over environmental and human health risks posed by the widespread use of chemical insecticides have prompted pest managers to seek alternative methods to manage insect pests. In turf grass environments, the use of insect parasitic nematodes may provide a safe alternative to conventional insecticides, but factors associated with nematode efficacy have hindered the widespread adoption of these potentially useful biological control agents. This research compared the virulence, fecundity and field efficacy of three locally-collected strains of the insect parasitic nematode and one commercially-available strain in order to characterize variation in biological attributes of the different nematode strains and clarify how these attributes influence field efficacy. We hypothesized that locally collected strains would be more efficacious than the commercially available strain due to the advantage provided by their adaptation to local climatic conditions. While nematode strain had no significant influence on infectivity in the laboratory, infectivity increased with nematode concentration. Nematode fecundity varied between strains with two of the three local strains outperforming the commercial strain. Local strains also outperformed the commercial strain under field conditions. Results indicate that locally adapted nematode strains may provide a better biological resource for insect pest management than commercially available strains.

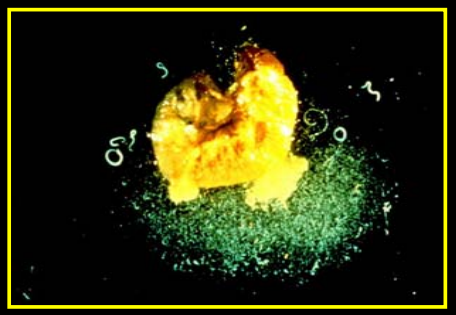


Figure 1. Infective juvenile and adult insect-parasitic nematodes emerging from Japanese beetle larva.

INTRODUCTION

- Insect-parasitic nematodes are microscopic roundworms that are capable of parasitizing insect pests, particularly white grubs.
- Methods for improving these nematodes for insect pest management can result in reduced reliance on synthetic pesticides.
- When applied properly, nematodes can be as effective against lawn pests as chemical treatments, however, many factors contribute to their success or failure in the field. One such limiting factor is adaptation to local climatic conditions.
- Nematodes infect an insect by entering through the natural openings, mainly the mouth, anus and spiracles (Koppenhofer, 2006).
- *H. bacteriophora* exists in metapopulations that can be genetically connected but show variance when collected from different areas, particularly in terms of virulence and reproductive potential (Grewal, 2002).

PROJECT OBJECTIVES

The objective of this research was to examine the effectiveness of locally-collected and commercial strains of *H. bacteriophora* by:

- Comparing virulence and reproductive potential
- Comparing field efficacy against Japanese beetle (*Popillia japonica* Newman) larvae

HYPOTHESIS

I hypothesized that locally-collected strains of *Heterorhabditis bacteriophora* would provide better control of white grubs under field conditions than the commercial strain and that this increase in performance would be related to higher virulence and reproductive potential.

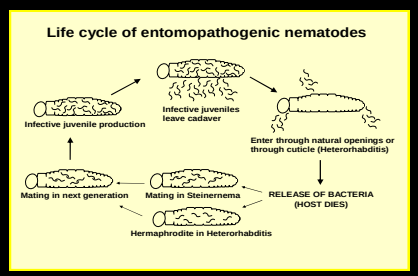


Figure 2. Diagrammatic representation of insect-parasitic nematode life cycle.

Figure 3. Infective juvenile of *Heterorhabditis bacteriophora*.

MATERIALS AND METHODS

Test for virulence

- Four strains of the nematode *Heterorhabditis bacteriophora*, one commercial strain (HP88) and three locally-collected strains (Hb123, Hb109, Hb96) were placed in Petri dishes (9.0 cm diameter) on moist filter paper in three different concentration (1, 5, 10 nematodes/µl).
- Five larvae of the greater wax moth, *Galleria mellonella*, were then added to each Petri dish and infection was monitored over time.

Measuring reproductive potential

- After infection, the larvae were placed on White's traps (White, 1927) so that the juvenile nematode population could leave the cadavers and enter the spring water solution below.
- After the cadavers were in place, the resulting juvenile populations were estimated by averaging the number of infective juveniles in three 10 µl sub-samples taken each day.

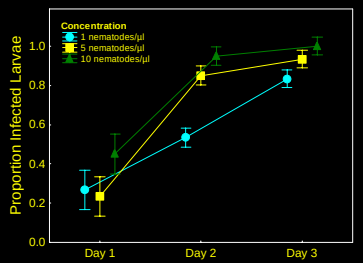
Measuring field efficacy

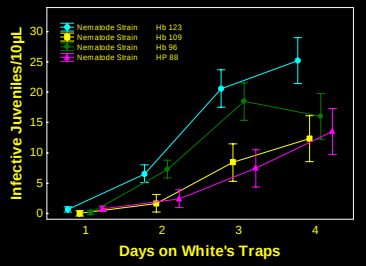
- Japanese beetle adults were trapped and 40 (50:50 sex ratio) were caged on turf using PVC cylinders in order to ensure oviposition in the field plots.
- On July 12, nematodes we applied at the rate of 2.5 billion/ha to each plot in order to control 1st instar Japanese beetle larvae.
- In October, the soil directly underneath each cylinder was examined to a depth of 1 cm and the number of Japanese beetle larvae in each sample was recorded.

Figure 4. Nematode-infected (left) and uninfected (right) Japanese beetle larvae.

RESULTS

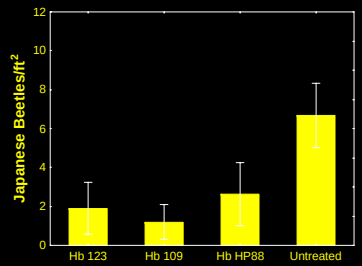
- Nematode strain had no influence on infectivity
- However, concentrations of 5 nematodes/µl and 10 nematodes/µl seemed to result in similar rates of infectivity, the concentration of 1 nematode/µl had a significantly lower rate of infectivity





- Hb123 had the highest rate of emerging infective juveniles of all four strains.
- Hb 123 and Hb 96 both had significantly more emerging infective juveniles than Hb 109 and HP 88 in the first three days.
- The population of emerging infective juveniles of Hb 96 actually decreased on the fourth day due to the presence of a lethal fungus. This disqualified Hb96 from the field trial.
- The rate of emerging infective juveniles of Hb 109 was not significantly different than that of HP 88.

- The results showed that the commercial strain HP88 did provide some control in the field but it was not significantly different from the untreated plots. However, the local strains Hb109 and Hb123 performed well in the field with over 80% control in both cases.



CONCLUSIONS

- In both laboratory and field trials, the local strains performed as well as or better than the commercial strain in terms of virulence, reproductive potential and field efficacy.
- In the field, the local strains were more effective at suppressing a resident grub population.
- Although Hb109 did not perform exceptionally well in the laboratory, it was the most effective in the field. Therefore, reproductive potential does not appear to be a good predictor of field efficacy.
- Nematode strains found in the soil of some residential lawns prove to be more effective against pests than the commercially available strain.
- Results indicate that local nematode strains may have a greater potential for managing local insect pest due to adaptation to local environmental conditions.

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