Ecology of Entomopathogenic Nematodes in Pistachio Orchards

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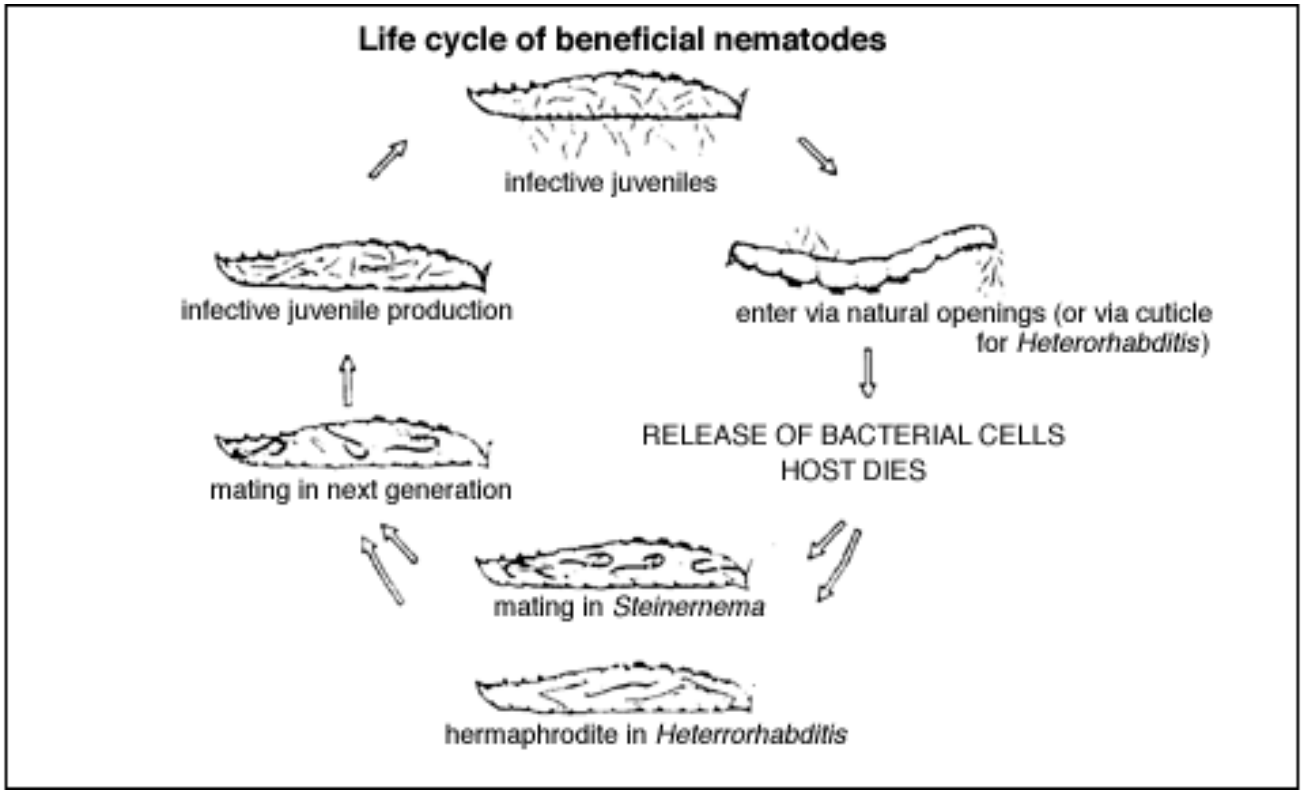
* Image courtesy of Joel Siegel

Life cycle of entomopathogenic nematodes



* Image courtesy of Harry Kaya

Entomopathogenic Nematodes

- Species *Steinernema Carpocapsae* used to control overwintering navel orangeworm larvae (*Amyelosis transistella*)
- Applied through irrigation system



* Images courtesy of Joel Siegel

Possible Effects

- Infection of alternate hosts - reduction of their populations
- Food for native predators - enhancement of their populations
- Effects on nutrient levels and plant health as they die or emerge from hosts

Objectives

- To quantify entompathogenic nematodes' effects on soil arthropod diversity in pistachio orchards.
- To quantify the spatial and temporal distribution of entomopathogenic nematodes in pistachio orchards.
- To measure entomopathogenic nematode effects on local nitrogen levels and root growth in microcosm studies.

Approach/Methods

- Nematodes applied to random trees in orchard in succeeding years
- Adjacent trees used as controls
- Soil samples
- Pitfall traps at each tree

My main contribution – Objective 1

- Quantify entomopathogenic nematode effects on soil arthropod populations
- Sorting and counts of groups of arthropods found in pitfall traps
- So far processed week 1 of 2008 and 2009 and week 3 of 2008.

Groups monitored

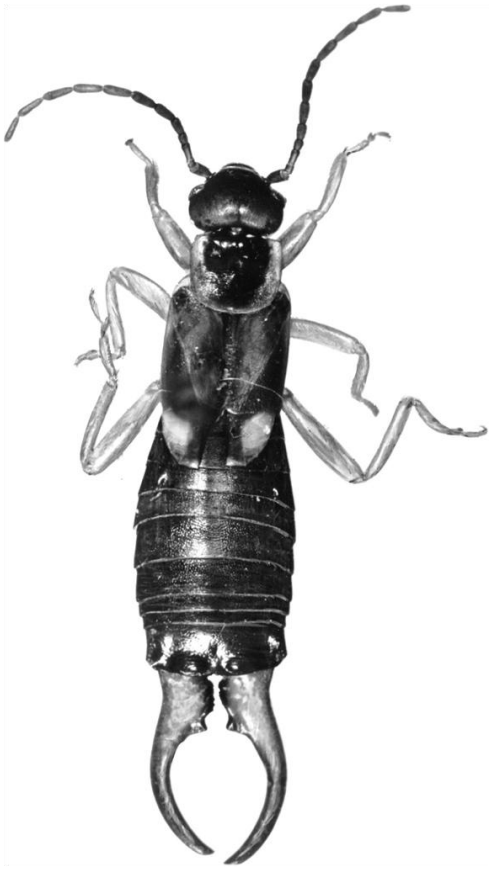
ORDER	Families common in litter/soil
Dermaptera	Forficulidae
Coleoptera	Staphylinidae, Carabidae, Elateridae, Tenebrionidae
Collembola	Entomobryidae, Isotomidae, Hypogastruridae, Onychiuridae
Acari	Laelapidae, Bdellidae, Oppiddae, Rhagidiidae, Anyistidae
Araneae	Lycosidae, Gnaphosidae

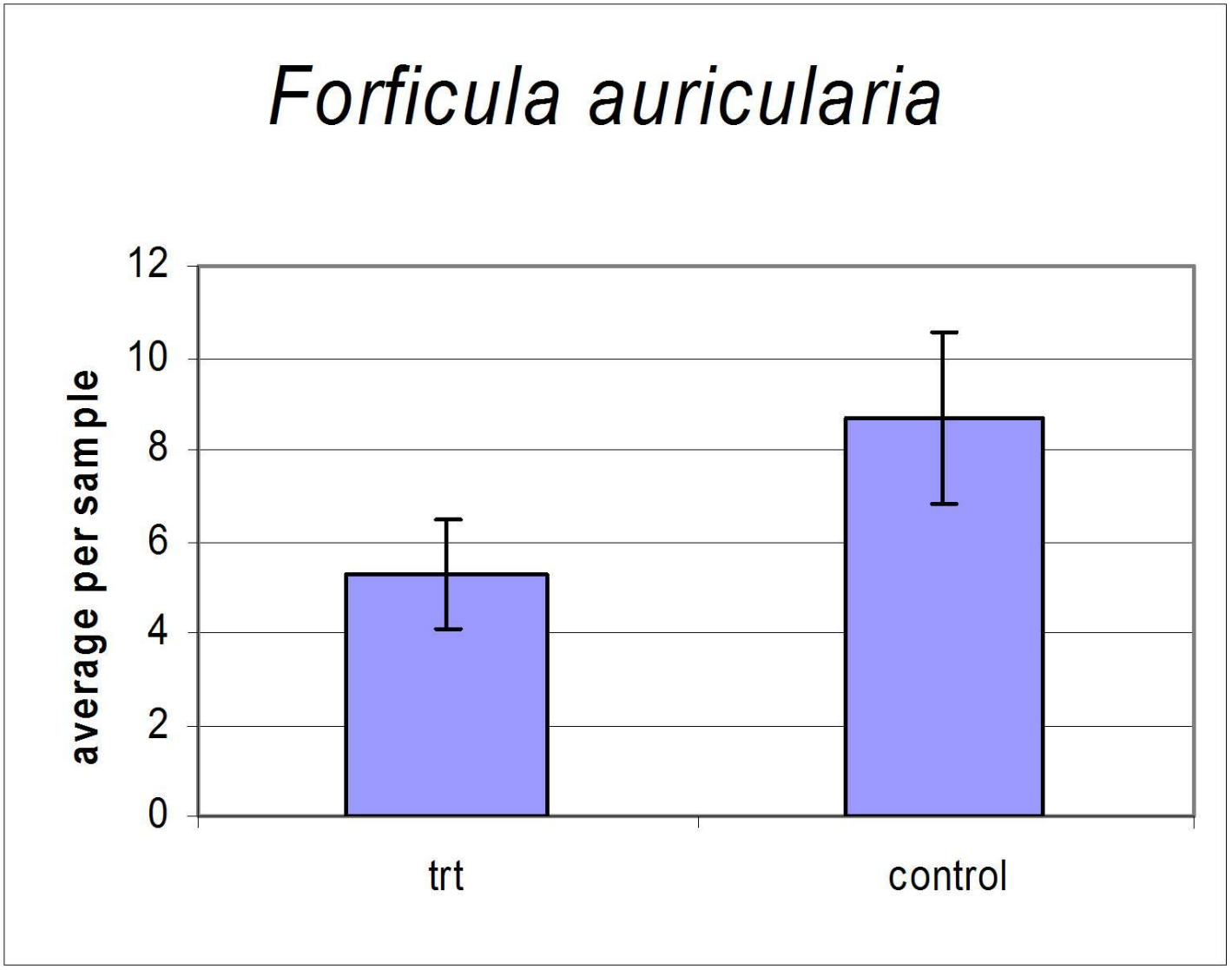
Treatment effects:

– Dermaptera (earwigs)
– Isotomidae – Collembola
– Tenebrionids
– Predatory mites

Earwigs

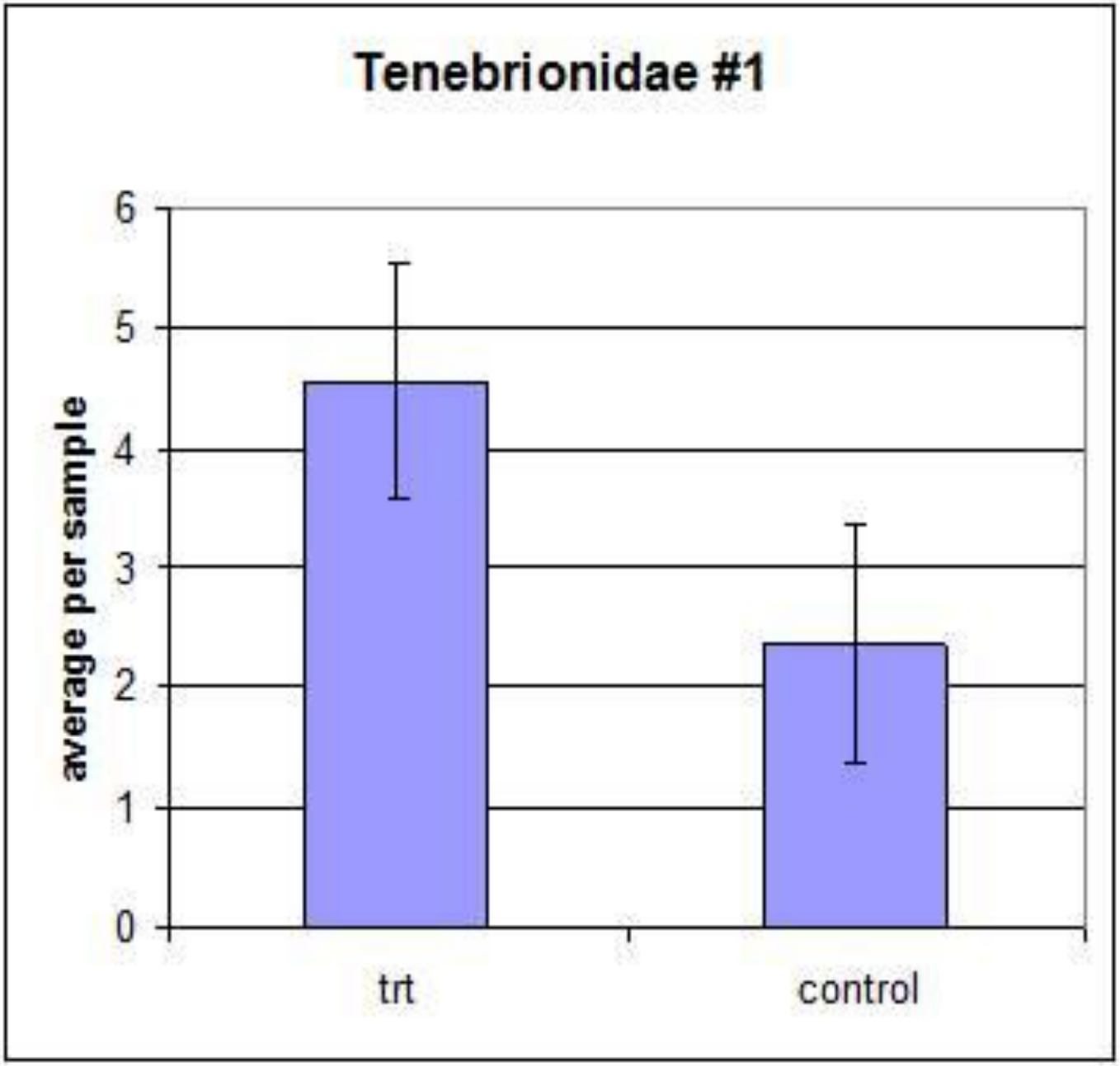
- 2008, significantly more earwigs trapped under control trees (ANOVA p = 0.047 n=30)
- Earwigs being infected or repelled by nematodes?




Forficula auricularia
average per sample
12
10
8
6
4
2
0
trt
control

Tenebrionids

- One species, Blapstinus discolor (~8mm long), found significantly more often under treated trees in 2008. (ANOVA p = 0.02 n=30)
- May be eating nematodes

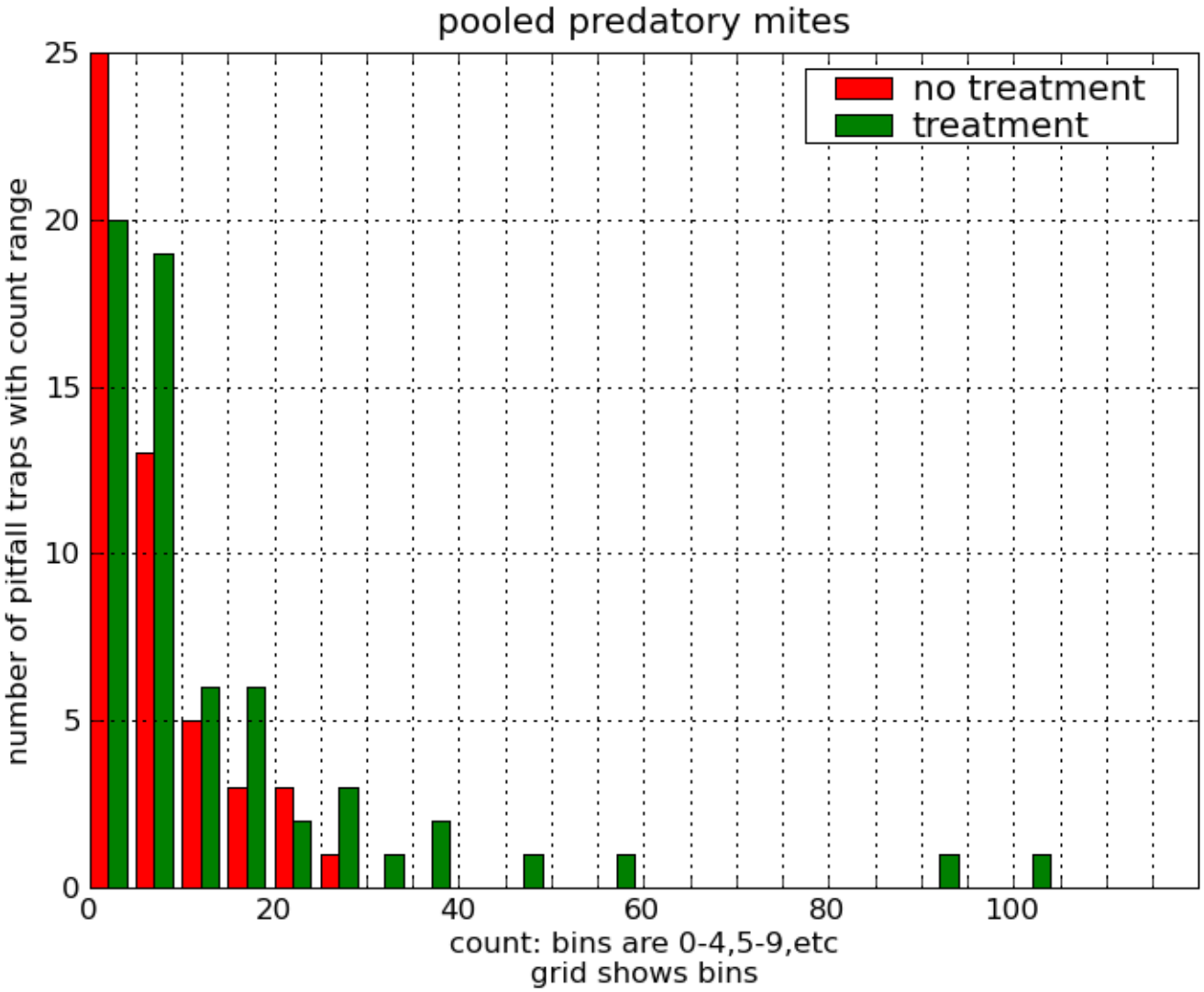

Tenebrionidae #1
average per sample
6
5
4
3
2
1
0
trt
control

Predatory mites

- Expected to eat nematodes and therefore show population increases in treated areas.
- Families: Bdellidae, Gaolaelapidae, Anyhistidae, and Rhagiidae
- Abundance varied significantly between years.
- However, no interaction between year and treatment.

Predatory Mites

- Years pooled
- Predatory mites significantly more abundant under treated trees after week 1 both years ($p = .0285$, Wilcoxon rank sum test)
- Significantly more abundant under treated trees week 3, 2008 ($p = .045$)


pooled predatory mites
no treatment
treatment
number of pitfall traps with count range
0
5
10
15
20
25
0
20
40
60
80
100
count: bins are 0-4,5-9,etc
grid shows bins

Objective 2

- To quantify the spatial and temporal distribution of entomopathogenic nematodes in pistachio orchards.
- Helped bait soil samples with Galleria mellonella to assess presence of entomopathogenic nematodes

Spatial and temporal distribution of nematodes

- 2008 recovered from 71% of treated trees on treatment day, and 6% after 1 week
- 2009 recovered from 80% of treated trees on treatment day, and 37% after 1 week, 11% after 3 weeks, 3% 10 weeks
- 2009 orchard had sandier soil

Objective 3

- To measure entomopathogenic nematode effects on local nitrogen levels and root growth in microcosm studies.
- Entomopathogenic nematodes had no effect of local nitrogen levels and root growth in greenhouse microcosm studies for this experiment

Challenges

- Many species dealt with here do not have well understood behaviors.
- More knowledge of soil ecosystem would help with interpretation of data
- This project makes a contribution to knowledge of soil ecosystem interactions
- Much more work is needed