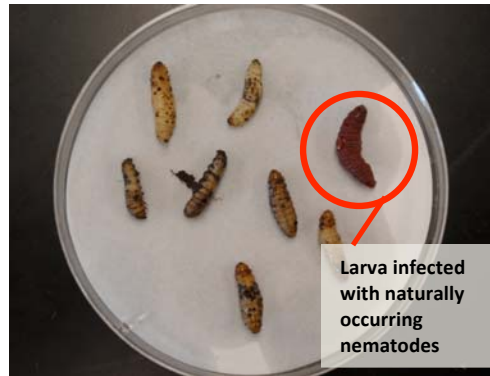


## Next Steps

**Limitation of EPN:** EPN are presently an expensive pest management tactic with an approximate price of \$300/acre/application. This may change as the EPN industry matures. However, for this tactic to be economically viable a great deal of questions need to be answered.

The investigators of this project have initiated a longer term study that will assess the potential of EPN in greater detail. The objectives of this study will be to:

- Determine effects of EPN on overwintering generation of codling moth
- Evaluate new strains of EPN in the field (*Steinernema feltiae*)
- Determine impacts of CM timed EPN applications on Apple Maggot, Plum Curculio, and other pests
- Determine impact of EPN on existing soil dwelling entomopathogens (other nematodes, fungi, bacteria)
- Determine impacts of OMRI approved pesticides on EPN (e.g. sulfur, copper, pyganic)
- Determine the overwintering location of codling moth on rough and smooth barked cultivars



Sentinel larva showing infection from soil dwelling entomopathogens

### Project Support:



### Project Investigators:

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Larry Gut, Nate Walton  
Michigan State University  
Department of Entomology  
<http://www.ent.msu.edu>

This brochure reports the results of research only. Mention of a proprietary product or trade name does not constitute a recommendation or endorsement by the investigators or Michigan State University

## Beneficial Nematodes for Managing Codling Moth



Apple Damaged by Codling Moth



Larva Infested with Adult Nematodes

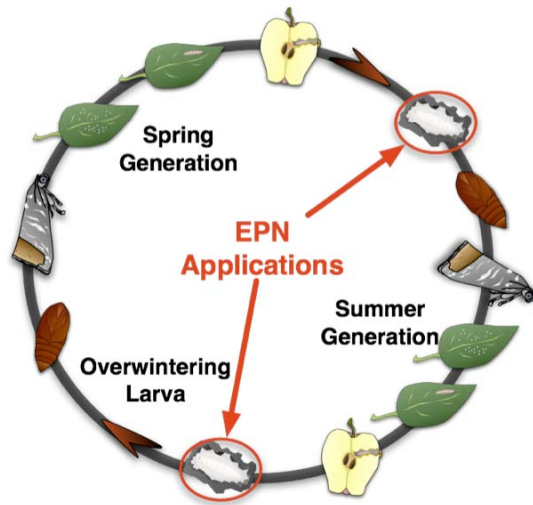


OMRI  
approved  
Nematodes!

## A Biological Control Tactic for Organic Growers

## Codling Moth and EPN

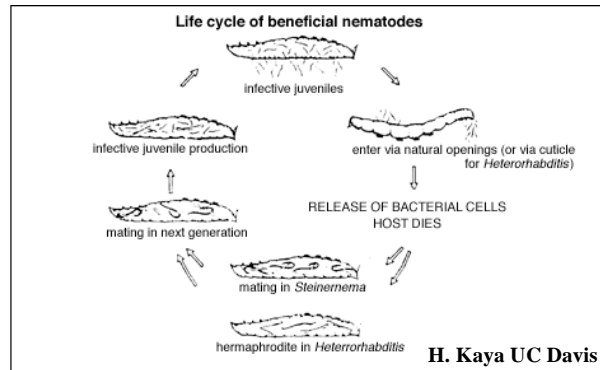
**Codling moth** remains a difficult pest to organically manage. Mating disruption provides the foundation for organic CM management but works best when CM populations are low. Entomopathogenic Nematodes (EPN) may provide a good way to lower CM populations by killing CM larvae and pupae.



**Entomopathogenic Nematodes** are soil dwelling parasites of insects. EPN enter insects through natural openings and release a bacterium that kills the host.



- EPN applications for CM control are targeted against cocooned larvae on the tree and on the orchard floor
- Optimum environmental conditions for EPN applications include warm temperatures (68°-86°F) and relative humidity of at least 25-35%



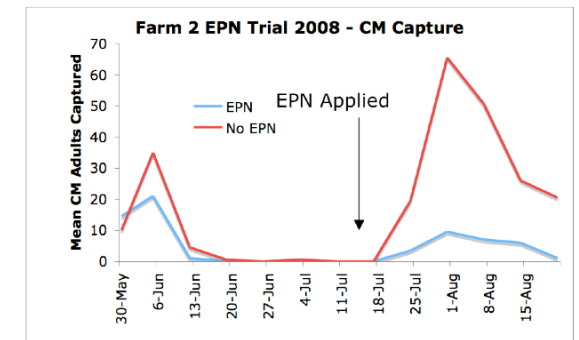
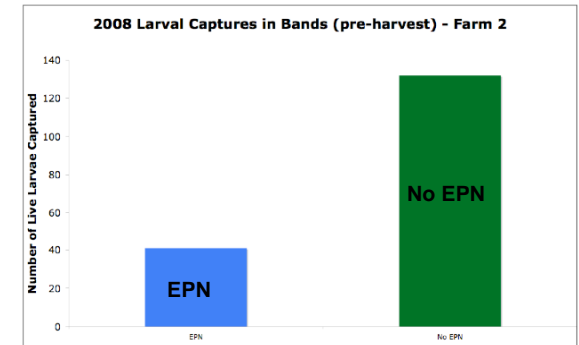
## Methods

Two organic apple orchards applied an organic EPN formulation, BioNem C (OMRI certified *Steinernema carpocapsae*, Becker-Underwood) to 5-acre plots at a rate of 1 billion EPN/acre in 2008. All EPN applications were applied to the tree trunk and ground surfaces under the tree canopy (upper facing nozzles turned off, screens removed from nozzles), targeting larvae that had exited fruit. Tree bands of corrugated cardboard strips were wrapped around tree trunks to sample CM larvae and assess the impact of the nematode treatments on CM larval densities. Pheromone traps were also used to evaluate population densities.



**Tree-Band Containing CM Larvae**

## 1st Year Results



- The impact of EPN treatments on codling moth larval and adult populations, as measured by the cardboard bands and pheromone-baited traps was substantial, with population reductions of 69% at organic site 2
- Reductions in following CM generations are expected to increase the efficacy of Mating Disruption and Virus based CM management
- The impact of nematode application on the following year's codling moth population has been less obvious