Effects of a Commercial Soil Amendment on Plant Parasitic Nematodes

Dr. Amanda Hodson
Soil Ecology and Biological Control Lab
Department of Entomology and Nematology
University of California, Davis

Soil Ecology and Biological Control

The main scientific goal of our lab is to learn how to more sustainably manage agricultural systems to control pests and improve soil health.

Pest Detection

qPCR-Carrot nematodes and Orchard nematodes

Cultural Control

Soil Amendments - compost, food hydrolysate

Innundative Control

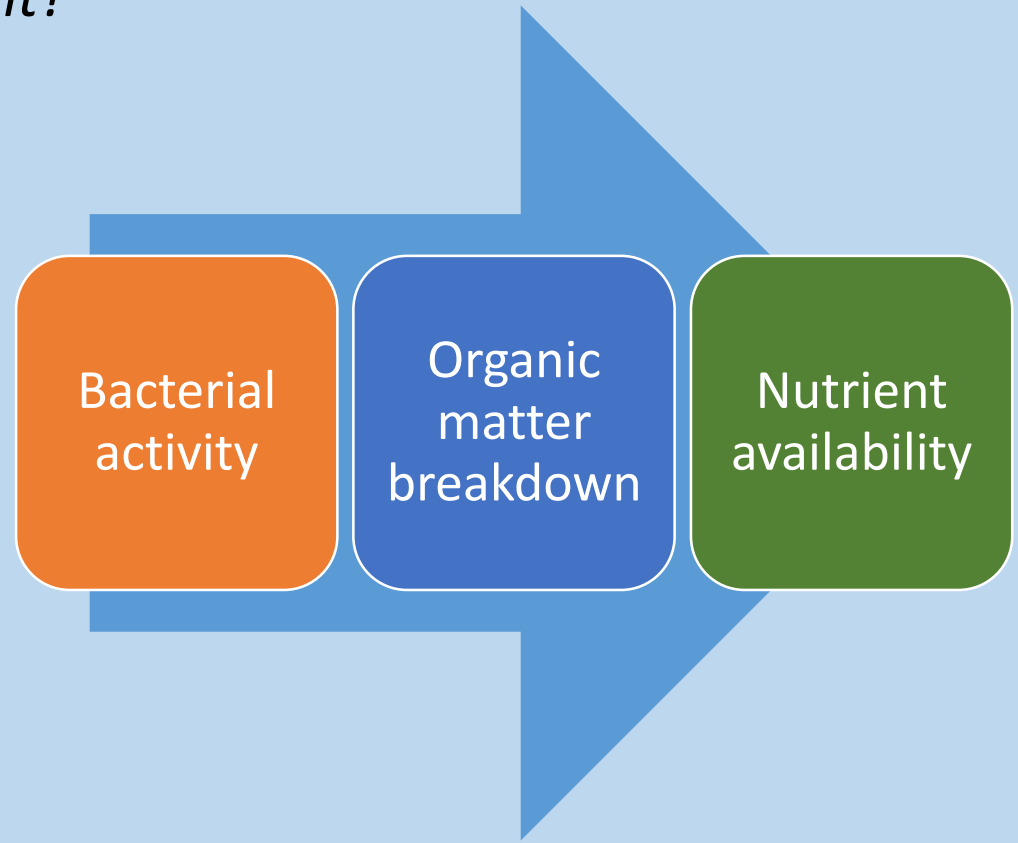
Biobased pesticides, Insect parasitic nematodes

Applied nematode ecology: Ecological effects of an organic Amendment - stabilized food hydrolysate

- Unsold food collected from supermarkets in California.
- Digested with enzymes to produce a stabilized product consisting of amino acids, simple sugars, fatty acids, and minerals
- Marketed as a liquid fertilizer product to improve soil health.

Stabilized food hydrolysate

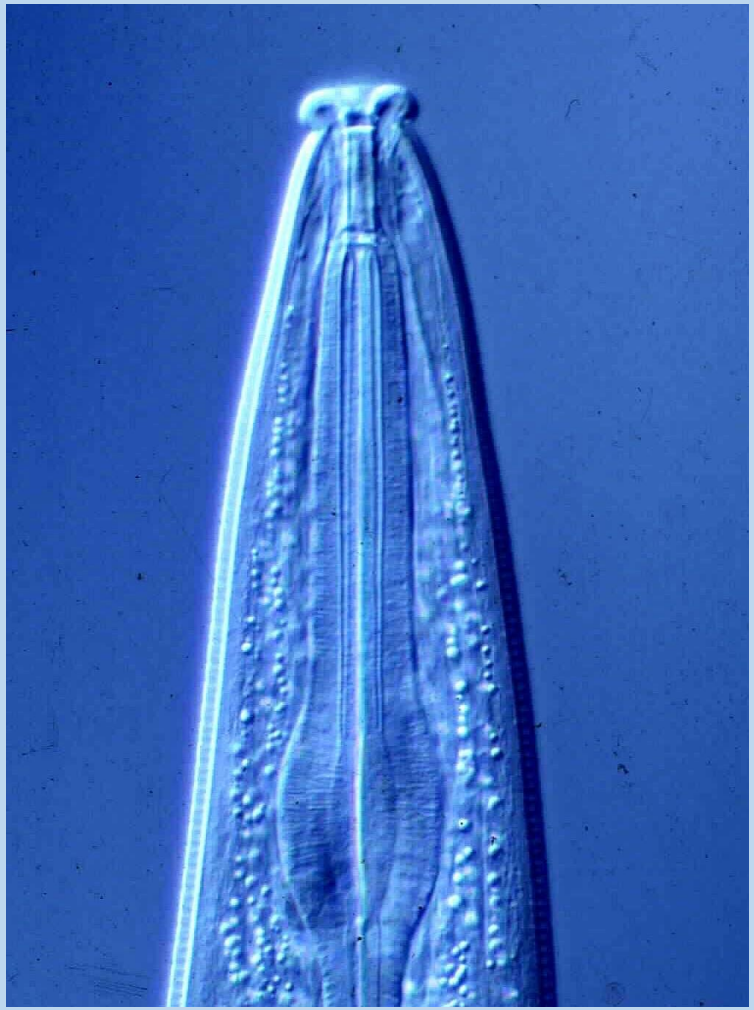
Fertilizer or organic matter amendment?



How does H2H affect soil biological communities?

Nematode life history strategies

- Bacterial feeders
  - Indicate microbial nutrient processing and N mineralization
- Fungal feeders
- Omnivores
- Predators
- Plant Parasites



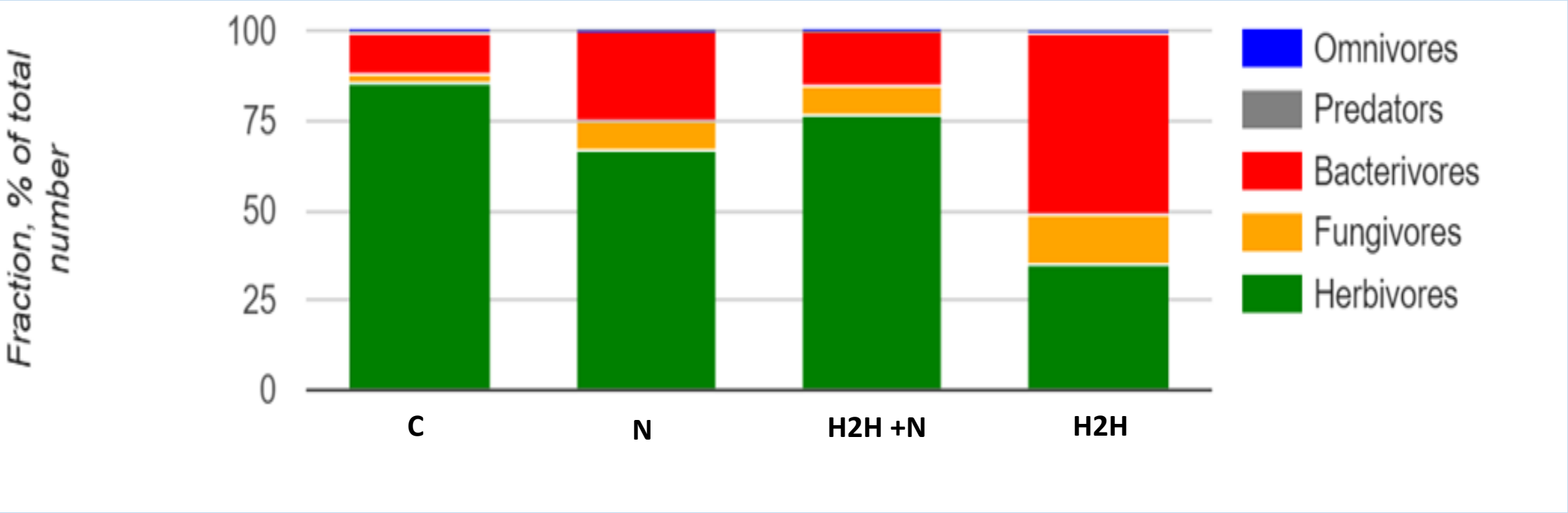
Raised bed experiment

- Four replicated blocks of each treatment
- 11 plants/block

Name	Material	Rate	Source
H2H	Stabilized food hydrolysate	30 gal/acre	California Safe Soil, McClellan CA
UAN-32	Nitrogen fertilizer (7.75% Ammoniacal Nitrogen, 7.5% Nitrate Nitrogen, 16.50% Urea Nitrogen)	150 lbs N/acre	Simplot, Lathrop CA
H2H+UAN-32 (1:1)	Stabilized food hydrolysate + Nitrogen fertilizer (7.75% Ammoniacal Nitrogen, 7.5% Nitrate Nitrogen, 16.50% Urea Nitrogen) (1:1)	(15 gal/acre) + (75 lbs N/acre)	California Safe Soil, McClellan CA; Simplot, Lathrop CA
Control	Water	3.45 gph	Davis, CA

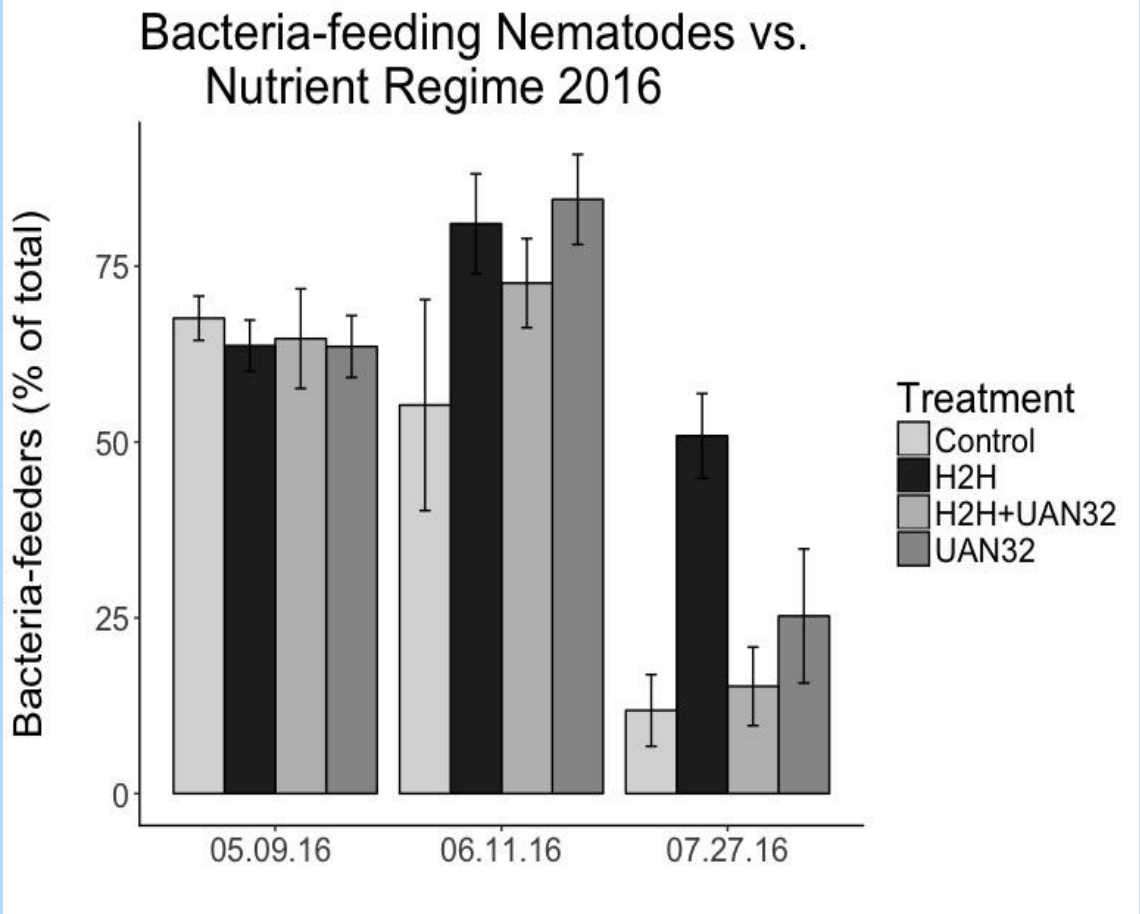
Family	Genus	Feeding habit
Rhabditidae	*Rhabditis*	bacterivores
	Diploscapter	bacterivores
Diplogasteridae	*Diplogaster*	bacterivores
Cephalobidae	*Cephalobus*	bacterivores
	Eucephalobus	bacterivores
	Acrobeles	bacterivores
	Acrobeloides	bacterivores
	Cervidellus	bacterivores
Plectidae	*Plectus*	bacterivores
	Anoplectus	bacterivores
Monhysteridae	*Monhystera*	bacterivores
Prismatolaimidae	*prismatolainus*	bacterivores
Alaimina(Alaimdae)	*Alaimus*	bacterivores
Aphelenchoididae	*Aphelenchoides*	fungivores
Aphelenchidae	*Aphelenchus*	fungivores
Dorylaimidae	*Dorylaimus*	Omniovores
Tylenchidae	*Tylenchus*	Herbivores
	Filenchus	Herbivores
	Tetylenchus	Herbivores
Paratylenchidae	*Paratylenchus*	Herbivores
Tylenchorhynchidae	*Tylenchorhynchus*	Herbivores
Pratylenchidae	*Pratylenchus*	Herbivores
Heteroderidae	*Meloidogyne*	Herbivores

Shifts in nematode community compostion



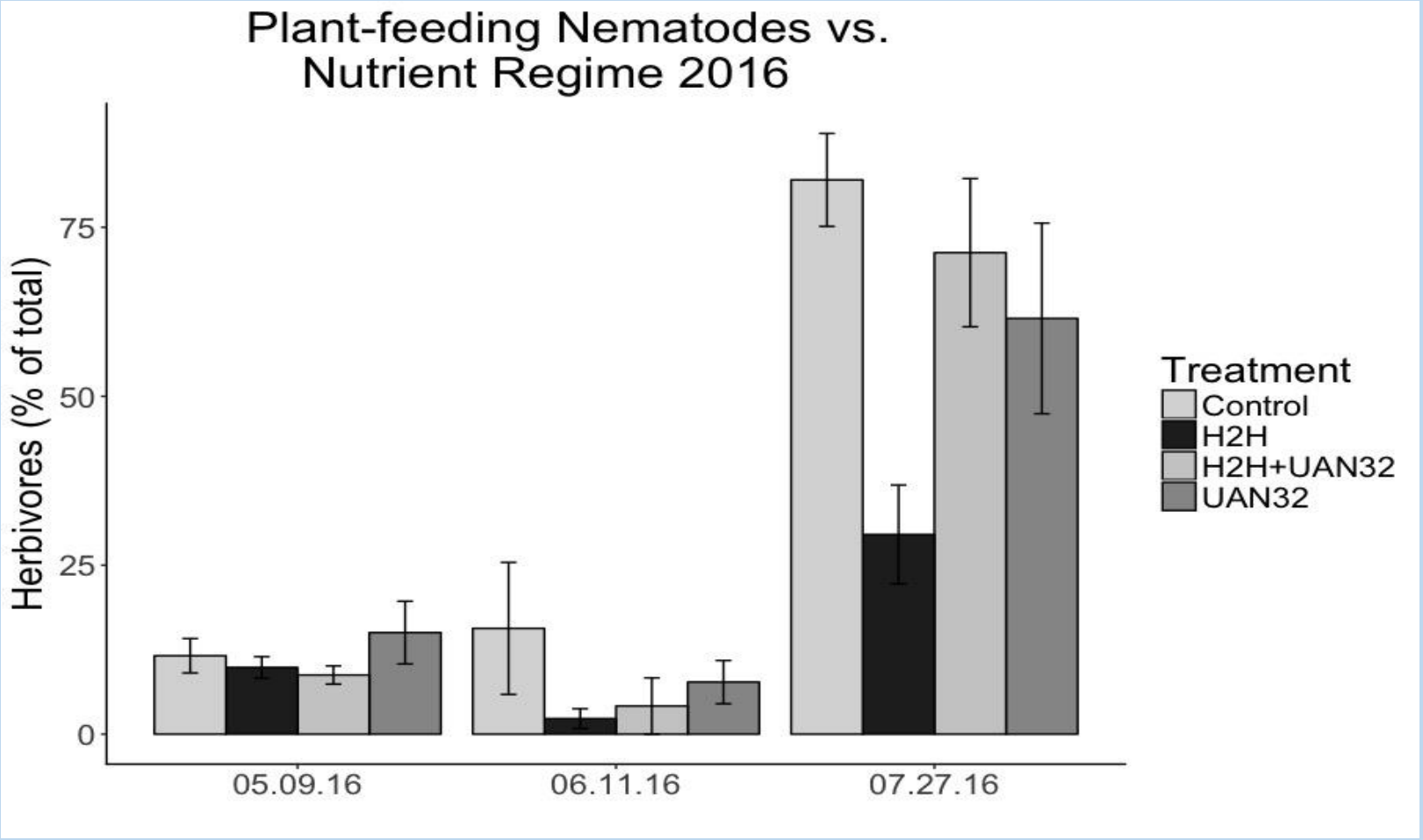
2016- Beneficial bacterial feeding nematodes

- Higher percent bacterial feeders with H2H compared to controls (P=0.03).
- Mainly *Acrobeloides* and *Cephalobus.*
- Responsive to inputs of high quality organic matter such as plant root exudates and detritus in the soil.



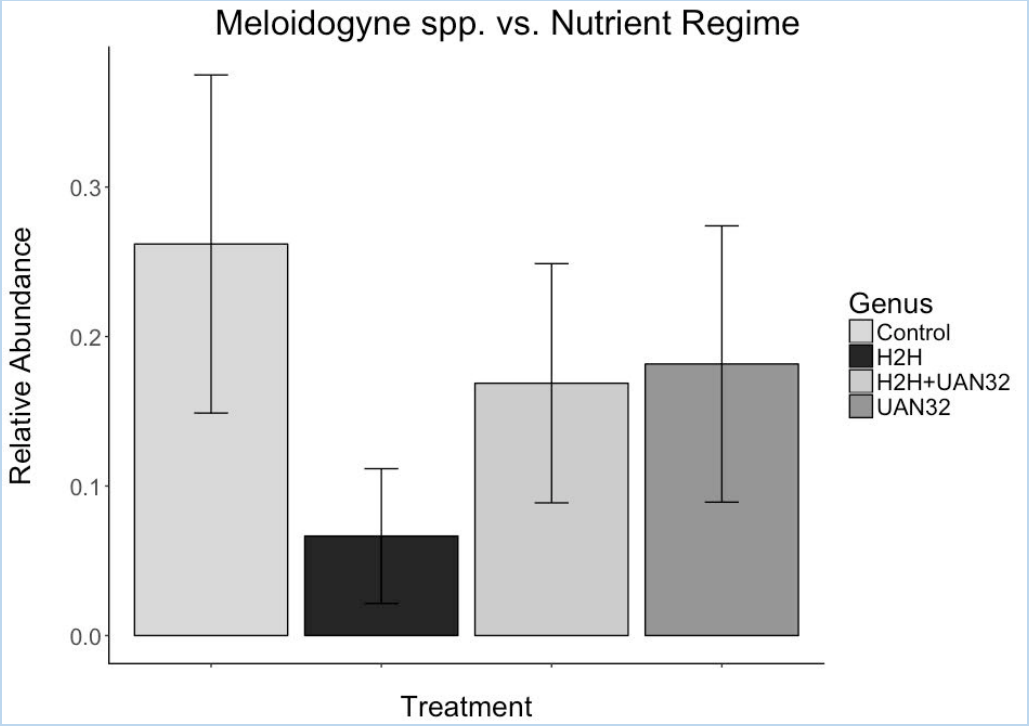
Plant parasitic nematodes

- Decreased abundance of herbivores in H2H treated plots compared to controls (P=0.03).



Root knot abundance/damage

- Root knot nematodes made up the majority of the plant parasites.
- Root knot abundance and galling decreased with H2H.



Next steps…

- *How can an amendment increase some nematodes but decrease others?*
- Food web mediated nematicidal effects
- Organic amendments alter soil communities to become more anatagonistic to nematodes
  - Inputs stimulate microbial biomass and bacterial feeding nematodes
  - Bacterial feeding nematodes transport “helpful” microbes through soil
  - These suppress pests and promote root growth

Pest Detection

qPCR-Carrot nematodes and Orchard nematodes

Cultural Control

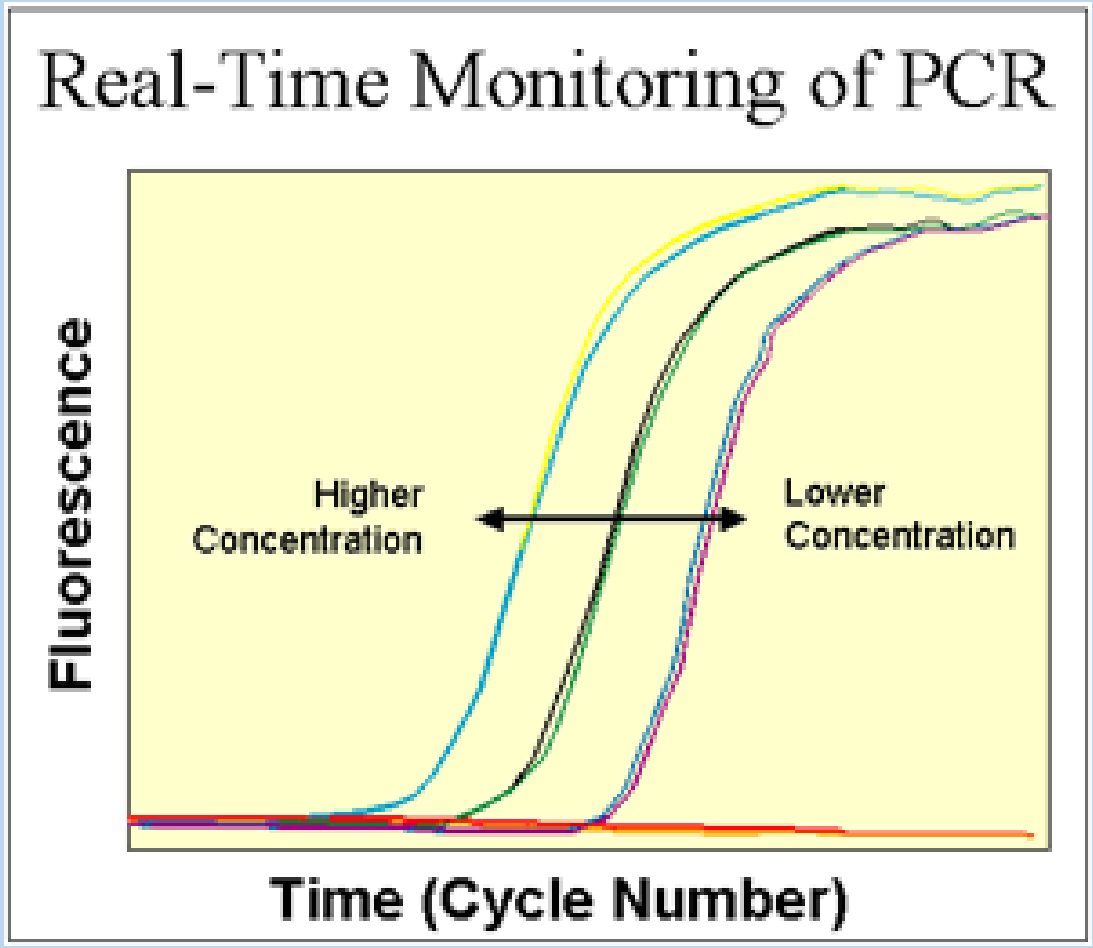
Soil Amendments - compost, food hydrolysate

Innundative Control

Biobased pesticides, Insect parasitic nematodes

Nematode diagnostics using real time PCR (qPCR)

- Simultaneously quantifies and identifies nematodes
- Compares the intensity of the amplified signal to a standard curve calculated from known densities.
- Rapid and inexpensive pest identification and quantification.



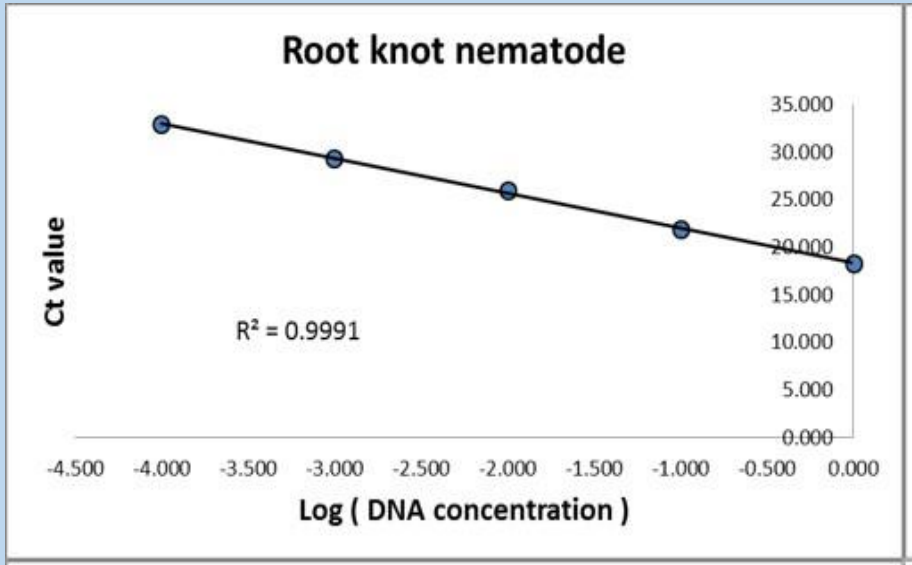
Comparison of traditional and molecular methods

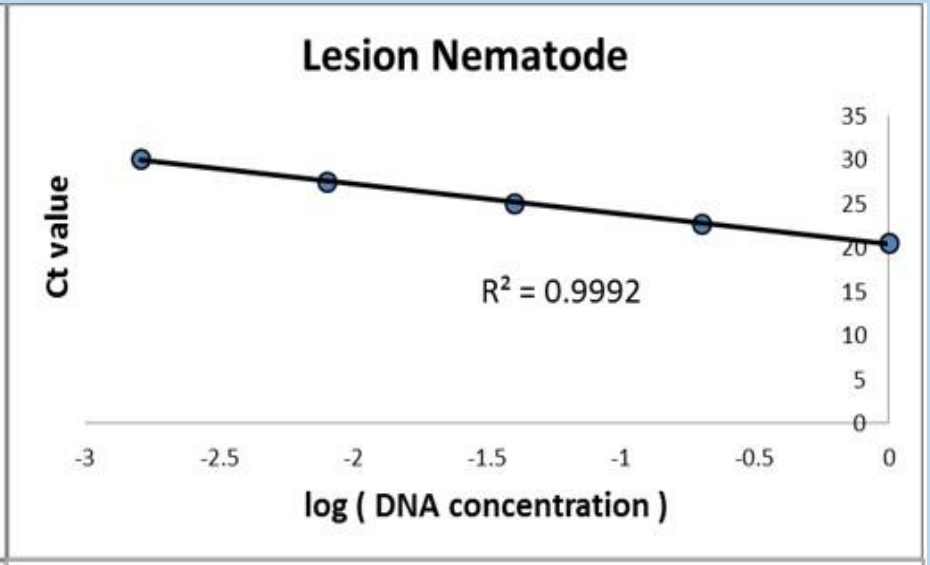
Current method

- Nematode extraction from soil
- Counting and identification (requires training)
- Subjective
- Inefficiencies in soil extraction

Real time (qPCR) method

- Nematode extraction from soil
- Nematode DNA extracted and target sequence amplified by qPCR
- Concentration compared to standard curve
- Objective
- Sensitive-Can detect as little as 1/10 nematode!





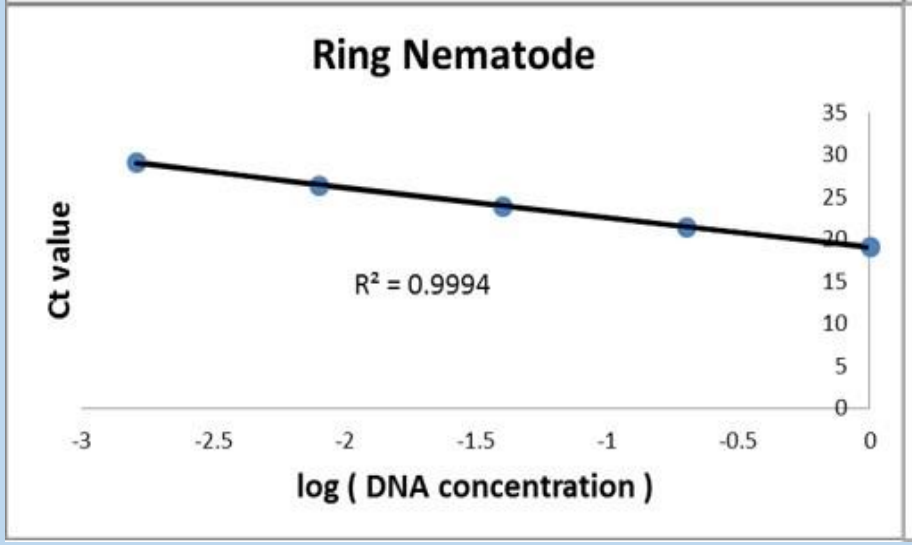


Figure 1. Standard curves generated using qPCR on serially diluted samples of 200 nematodes for each species. The x axis is the log of the %DNA concentration (total nematodes/200) and the y axis is the Ct value, or qPCR signal.

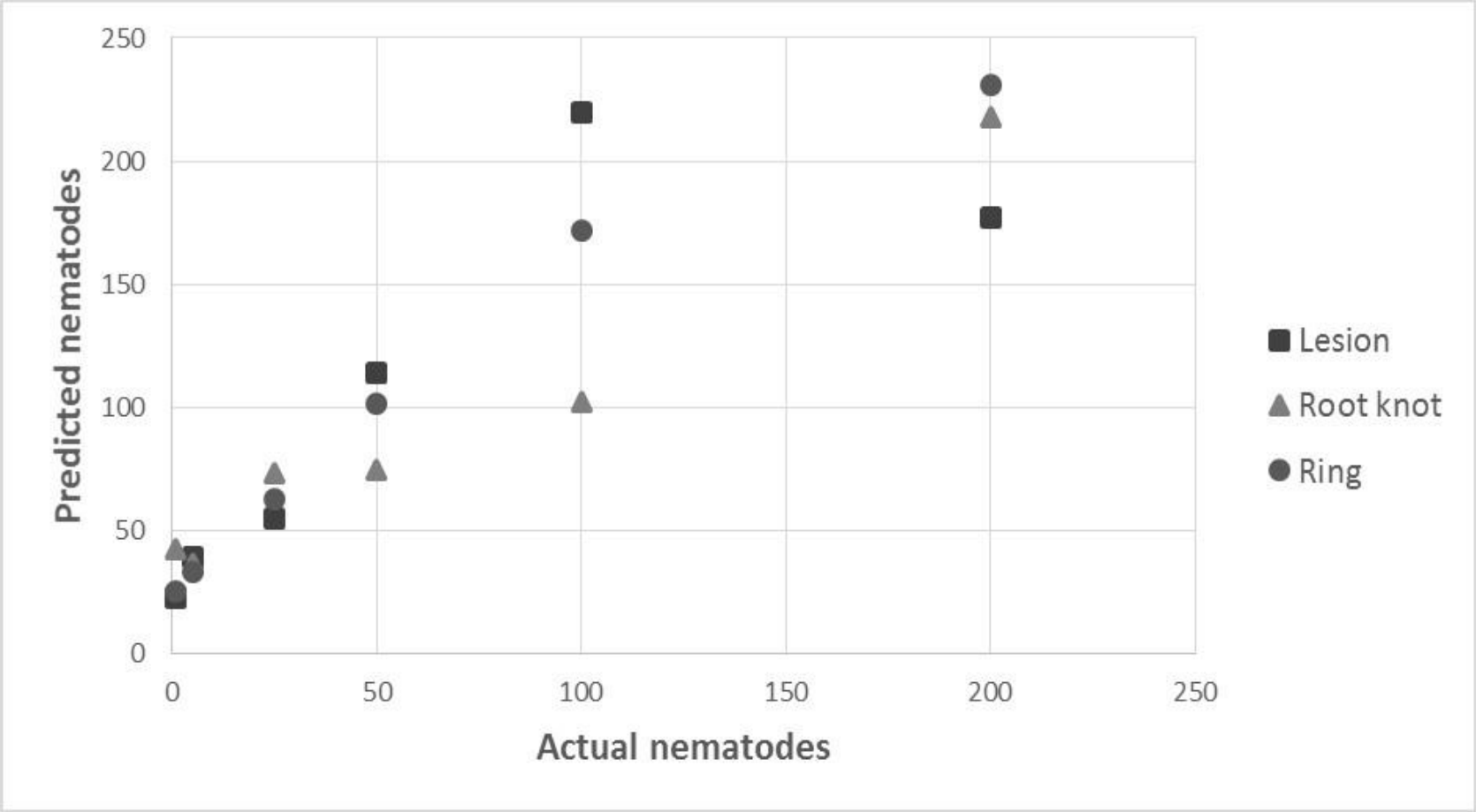


Figure 2. Relationship between known nematodes added to solution and nematode numbers predicted using the currently developed qPCR assay for three pest species of nematodes found in almonds, lesion, root knot and ring.

Rapid detection and damage threshold analysis-decision making tools for nematode management in carrots

- Develop a qPCR panel for root knot nematodes *M. incognita, M. hapla, M. javanica,* and *M. arenaria*.
- In field tests comparing the qPCR assay to traditional methods of microscopic quantification. Other studies have found an 85% increase in assay sensitivity.
- Use qPCR derived nematode densities to model carrot damage thresholds in greenhouse trials.

Thank you!

Questions?

- Amanda Hodson
- akhodson@ucdavis.edu