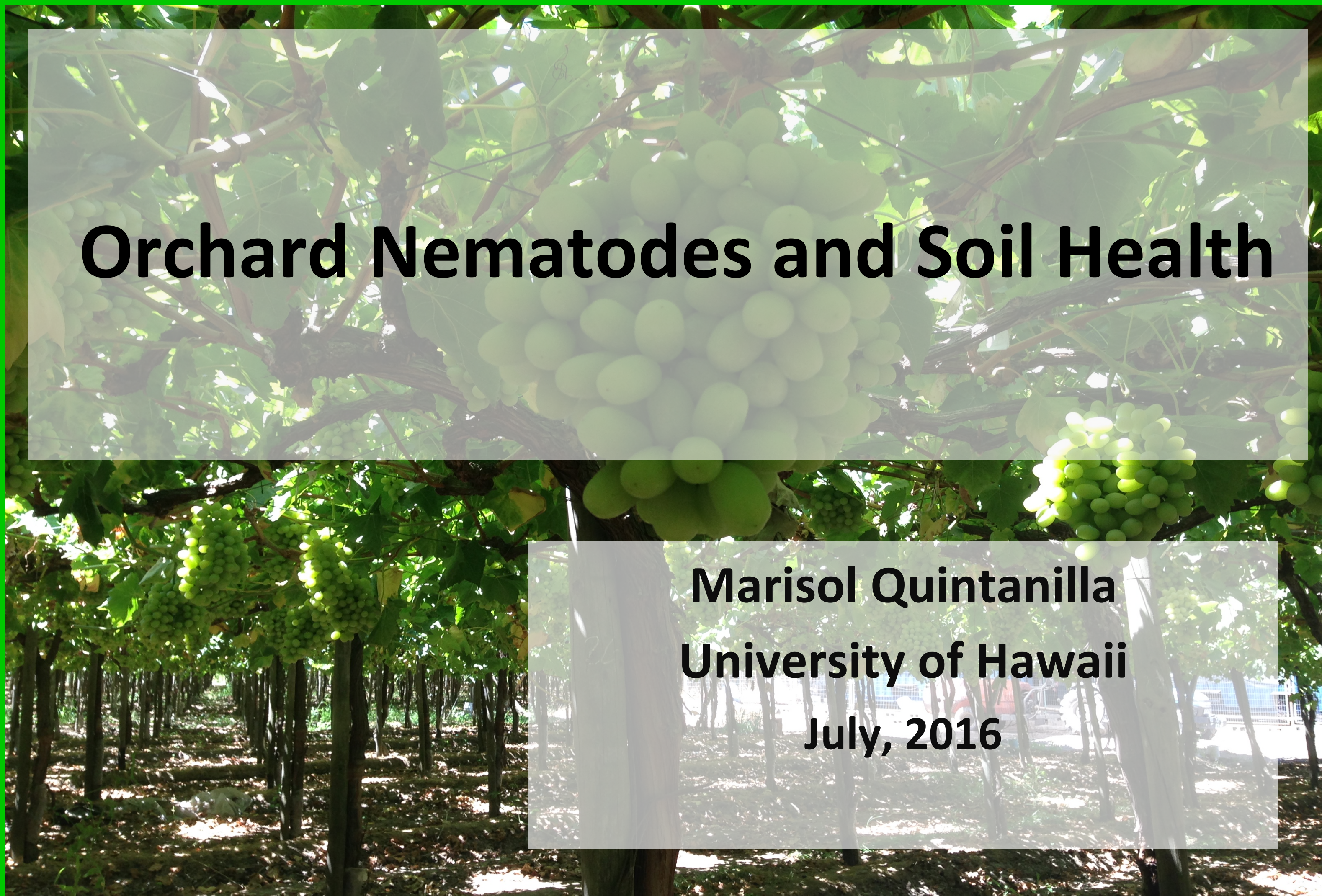


Orchard Nematodes and Soil Health

Marisol Quintanilla
University of Hawaii
July, 2016

Outline

- Introduction: Marisol Quintanilla, Ph.D., new applied nematologist at MSU
- What are nematodes?
  - The bad, the good…
    - Herbivores, bacterivores, fungivores, carnivores, and omnivores

Outline

- What are nematodes?
  - The Bad
    - Herbivores – plant parasitic nematodes affecting orchard crops
    - Replant problem
    - Nematode management strategies
      - Exclusion
      - Soil Health
      - Chemical control
- Research suggestions and needs?
- Conclusion
- Questions?

Introduction

Marisol Quintanilla joins Department of Entomology as new applied nematologist

posted on January 11, 2017 9:07am

The Department of Entomology welcomes Marisol Quintanilla as MSU's new applied nematologist. Quintanilla earned her master's and doctoral degrees at MSU with nematologist George Bird. After leaving MSU, she spent two years at Northern Marianas College and then moved to the University of Hawaii. While in that role, she has collaborated with the University of Maryland with nematode identification and analysis of trials with Koon-Hui Wang and gained extensive experience in working with specialty crop growers. Most recently, she has studied nematode community structure, soil health and pest management in edible crops as part of her research and extension work.

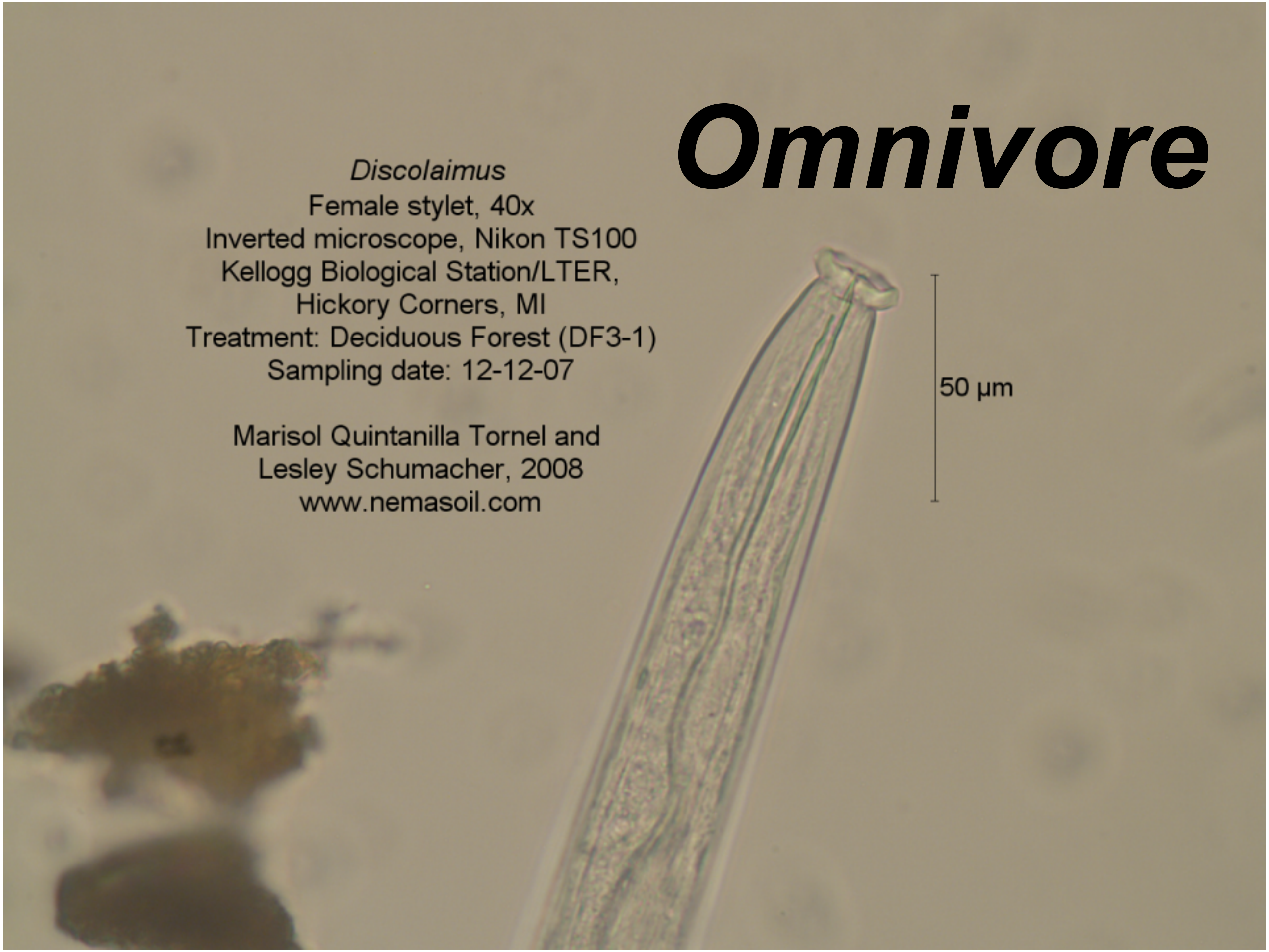
"It is exciting for me to come back to my beloved Michigan State University and what an honor it is for me to work with its excellent faculty," Quintanilla said. "I look forward to contributing to Michigan's agriculture."

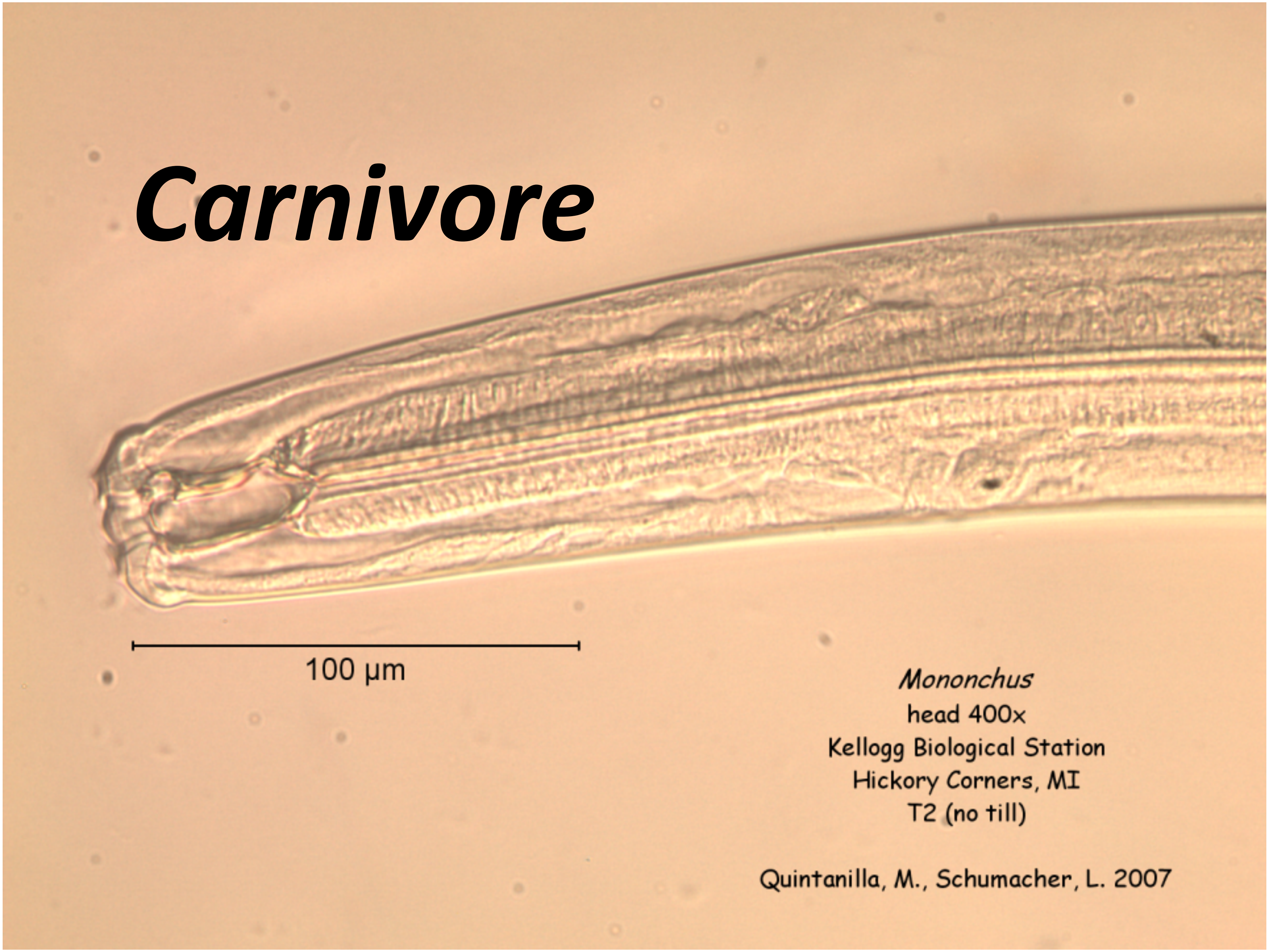
Quintanilla begins her new position at MSU Jan. 15, 2017, and plans to collaborate with faculty in finding applied solutions to plant parasitic nematode problems in the state's key crops. Nematodes are microscopic


The "Bad"
Paratylenchus
Head-esophagus, 100x
Kellogg Biological Station/LTER
Hickory Corners, MI
Treatment: Zero input corn/soybean/wheat
legume cover - tilled (T4-5)
Soil sampling date: 12-12-07
Marisol Quintanilla Tornel &
Lesley Schumacher, 2008
www.nemasoil.com
25 µm
Herbivore


The "Good"
Fungivores
50 µm
Aphelenchoides
Female tail, larvae inside body , 60x
Kellogg Biological Station/LTER
Hickory Corners, MI
Treatment: High input corn/soybean/wheat
conventional till (T1-4)
Soil sampling date: 12-12-07
Marisol Quintanilla Tornel, 2008

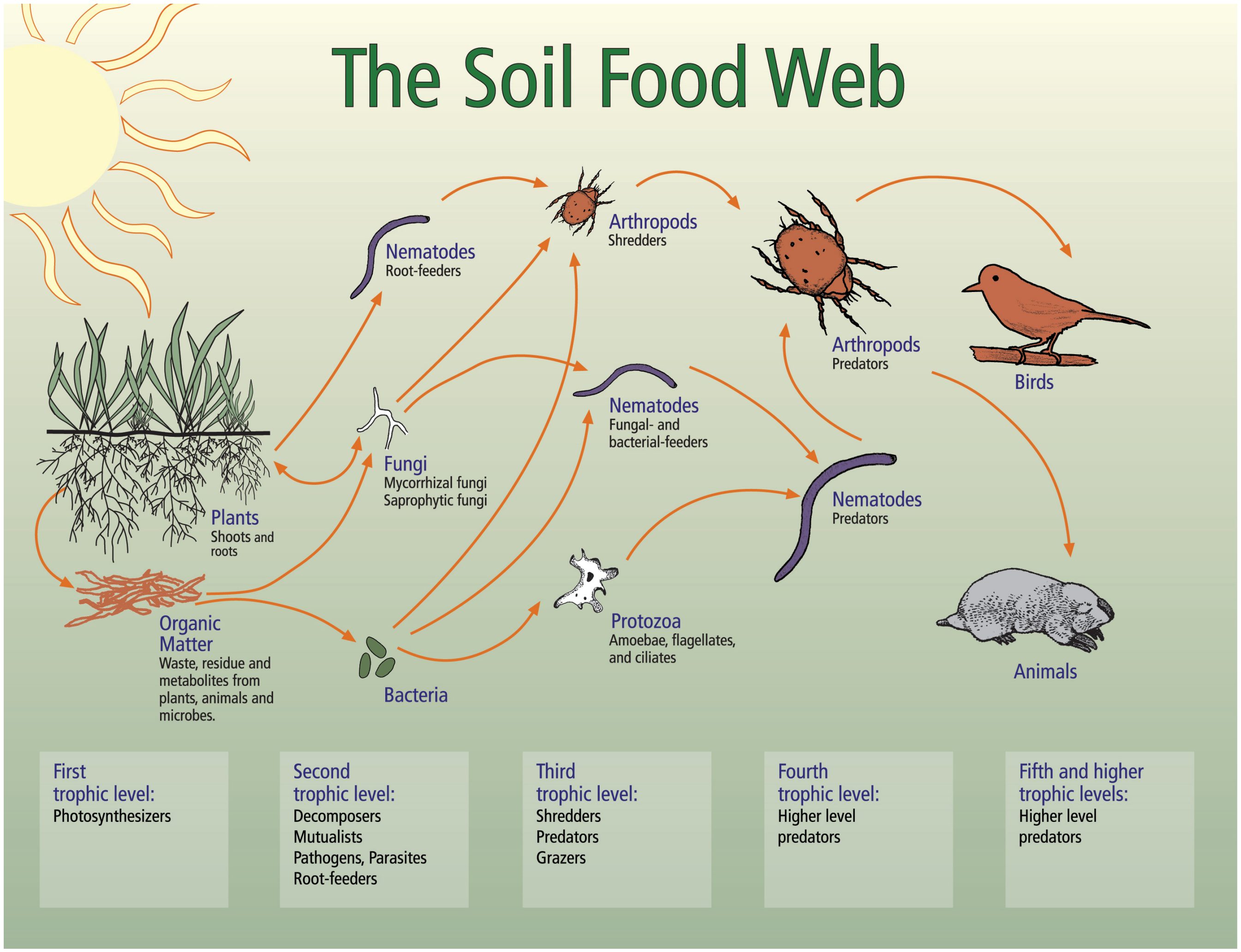

Rhabditidae
Female head, esophagus; 60x
Kellogg Biological Station/LTER
Hickory Corners, MI
Treatment: Successional grasses and forb
historically tilled (T7-4)
Soil sampling date: 12-12-07
Marisol Quintanilla Tornel, 2008
www.nemasoil.com
25 µm
Bacterivore


Omnivore
Discolaimus
Female stylet, 40x
Inverted microscope, Nikon TS100
Kellogg Biological Station/LTER,
Hickory Corners, MI
Treatment: Deciduous Forest (DF3-1)
Sampling date: 12-12-07
Marisol Quintanilla Tornel and
Lesley Schumacher, 2008
www.nemasoil.com
50 µm


Carnivore
100 µm
Mononchus
head 400x
Kellogg Biological Station
Hickory Corners, MI
T2 (no till)
Quintanilla, M., Schumacher, L. 2007

- Why are Nematodes excellent organisms to:
- determine soil health
- study ecosystem disturbance, diversity, structure, and function?

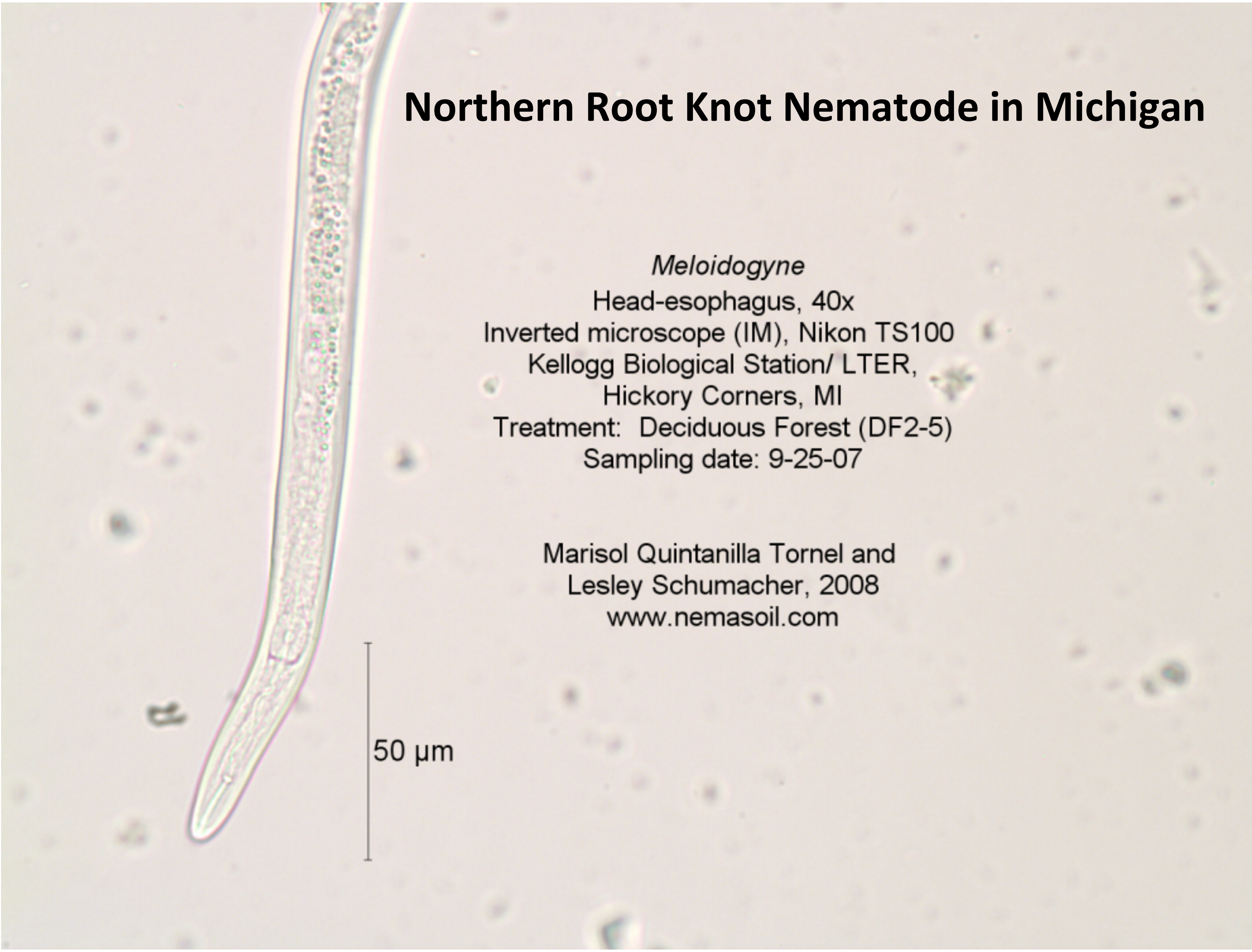
What is Soil Health?



http://www.nrcs.usda.gov/Internet/FSE_MEDIA/nrcs142p2_049822.jpg

Plant Parasitic Pest of Orchard Crops

- Root lesion (*Pratylenchus penetrans*)
- Dagger (*Xiphinema americanum*) – vector viruses such as tomato ring spot virus (stem pitting in peach and cherries, and brown ring union necrosis in apples)
- Ring (*Criconemella xenoplax*) – damage predisposes to disease – canker, winter injury in stone fruit
- Root-knot (*Meloidogyne hapla*)
- Stubby-root (*Paratrichodurus minor*)
- Lance (*Hoplolaimus galeatus*)
- Needle (*Londidorus elongatus*)


Northern Root Knot Nematode in Michigan
Meloidogyne
Head-esophagus, 40x
Inverted microscope (IM), Nikon TS100
Kellogg Biological Station/ LTER,
Hickory Corners, MI
Treatment: Deciduous Forest (DF2-5)
Sampling date: 9-25-07
Marisol Quintanilla Tornel and
Lesley Schumacher, 2008
www.nemasoil.com
50 µm

American Dagger Nematode

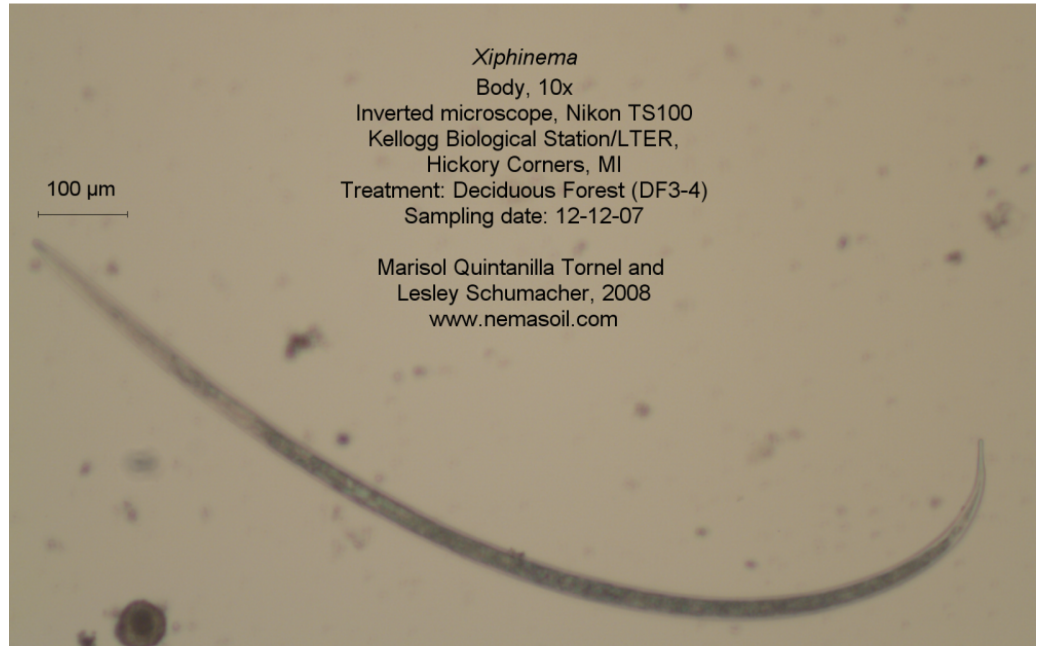
In tart cherries, the American dagger nematode (*Xiphinema americanum)* vectors tomato ring-spot virus that causes pitting (Bird and Warner, 2014)

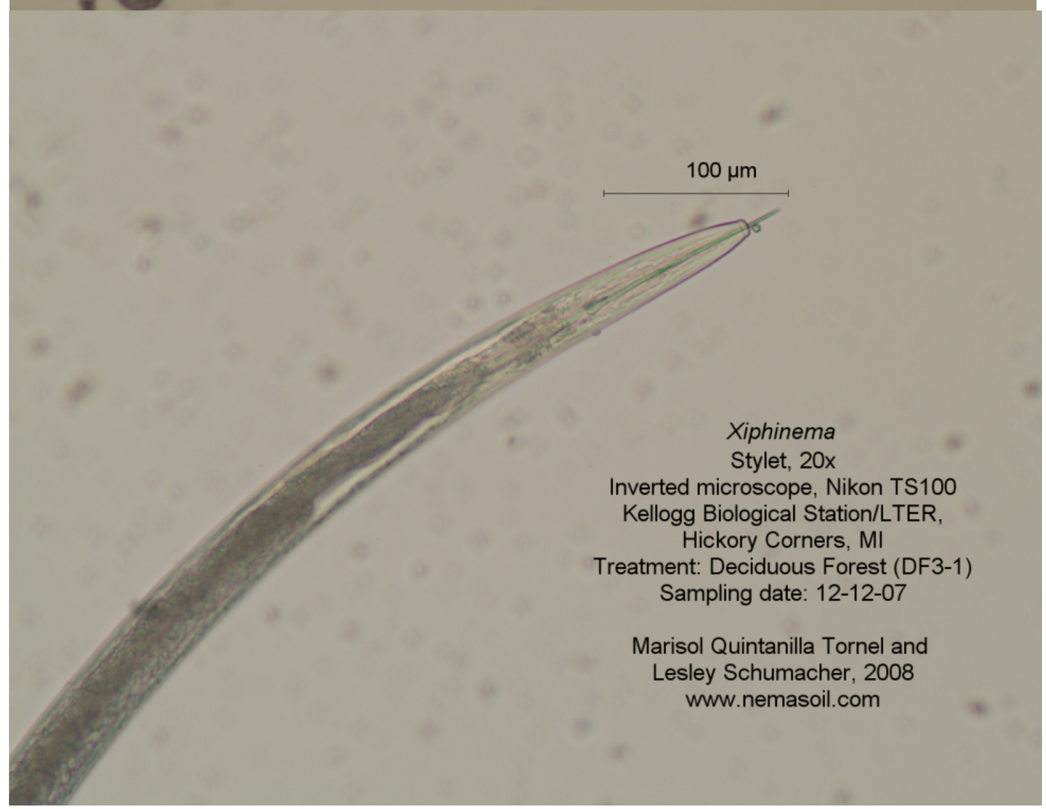
Increasing soil health, using cover crops can reduce nematode populations and increase plant resiliency (https://www.glexpo.com/summaries/2014summaries/Tart_Cherry.pdf)

Several plant extracts reduce populations (Insunza et al., 2001)

Resistant rootstock

Nematicides





Replant problem

Management Strategies

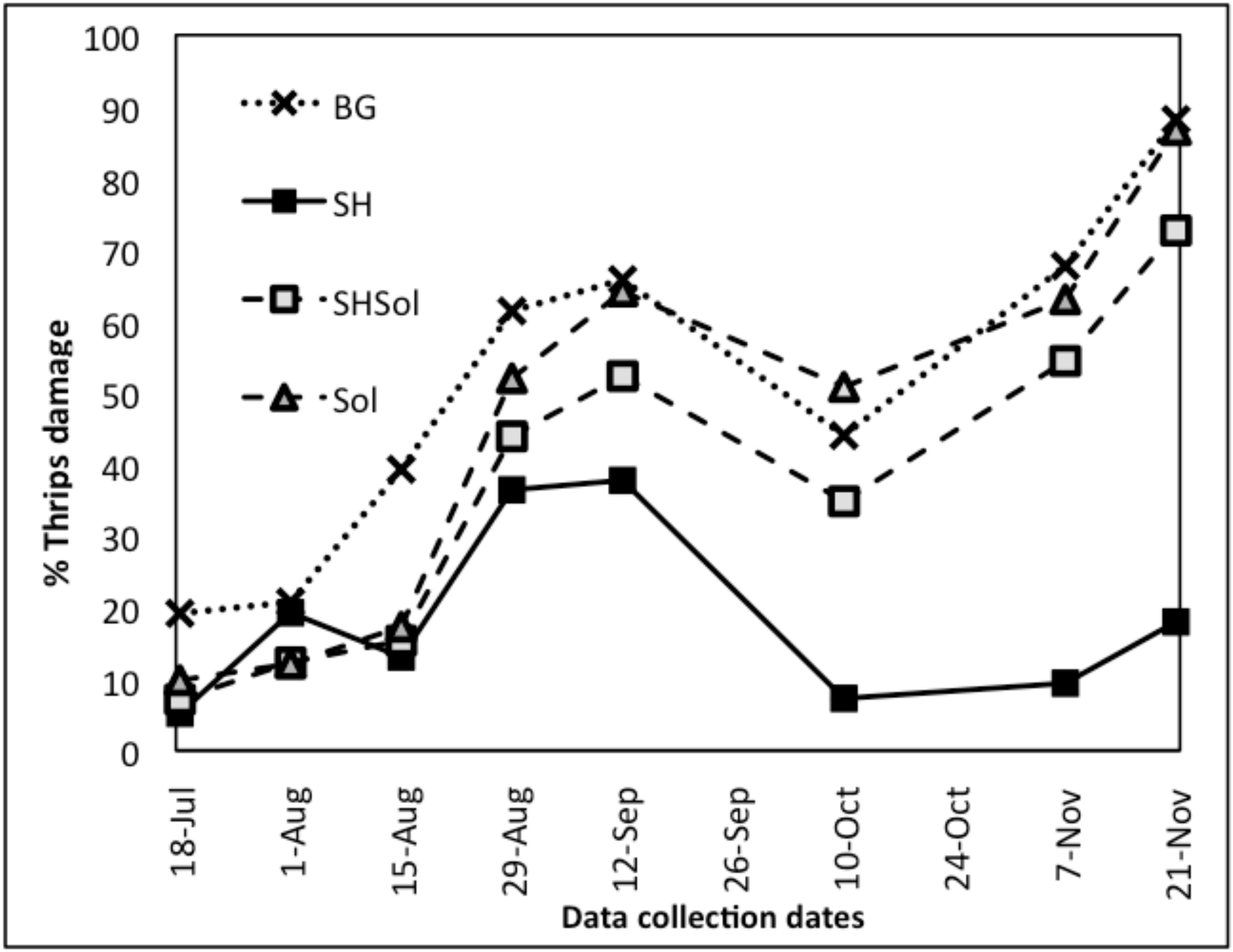
- Exclusion
- Soil health
- Fumigation
- Pasteuria covered seed – some positive results in the literature, but also mixed results (Kokalis-Burelle, 2015)
- Manures
- Increasing soil health and biocontrol organisms
- Solarization
- Cover crops and/or trap crops
- New nematicides and biorational products

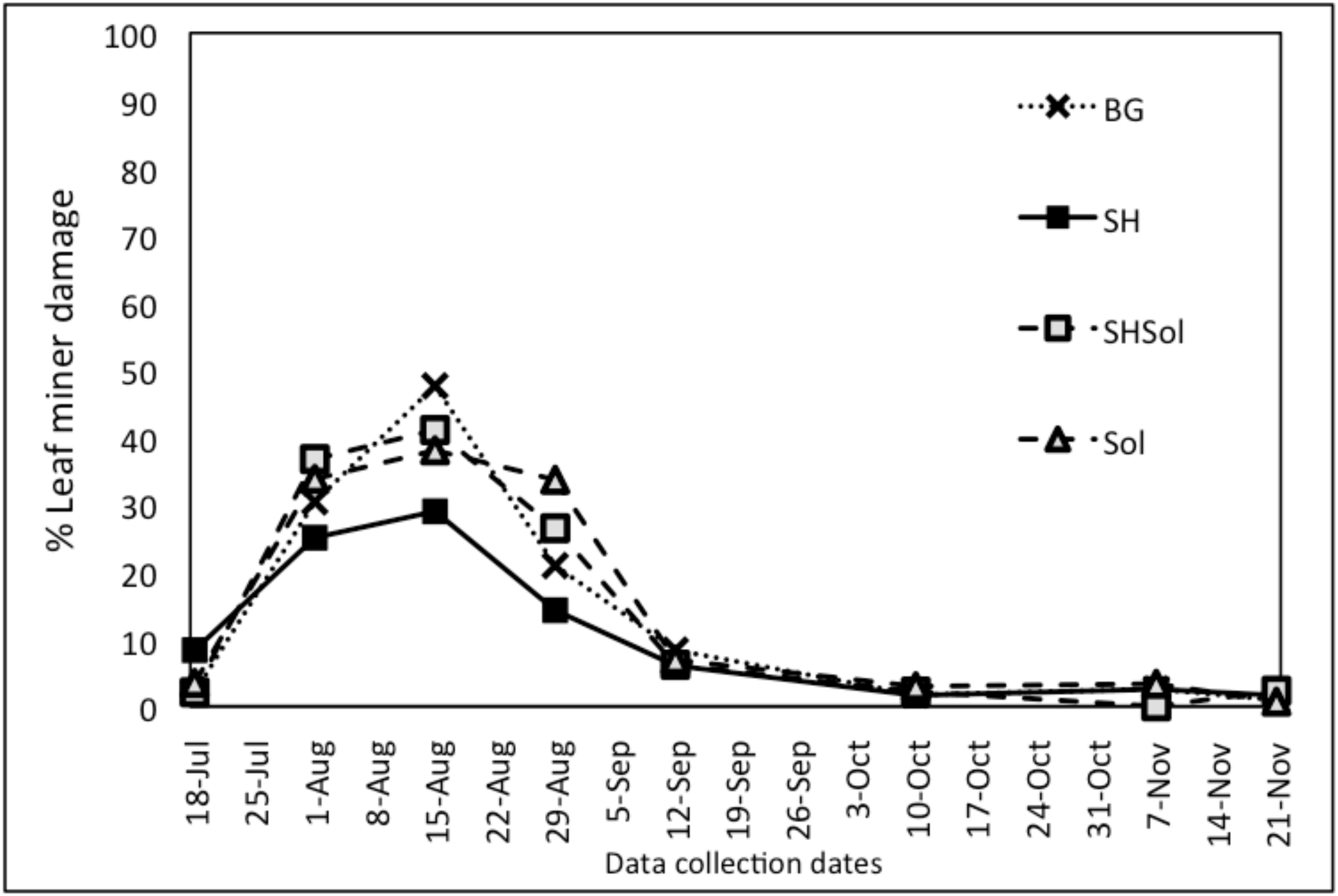
Past Research - Mulch, insectary plants, and soil improvement

Hawaii
Mulch-based Sustainable Pest Management

Marisol Quintanilla and Koon-Hui Wang
University of Hawaii

Methods: Four Green Onion Systems in Hawaii
Trials on 2013 and 2014

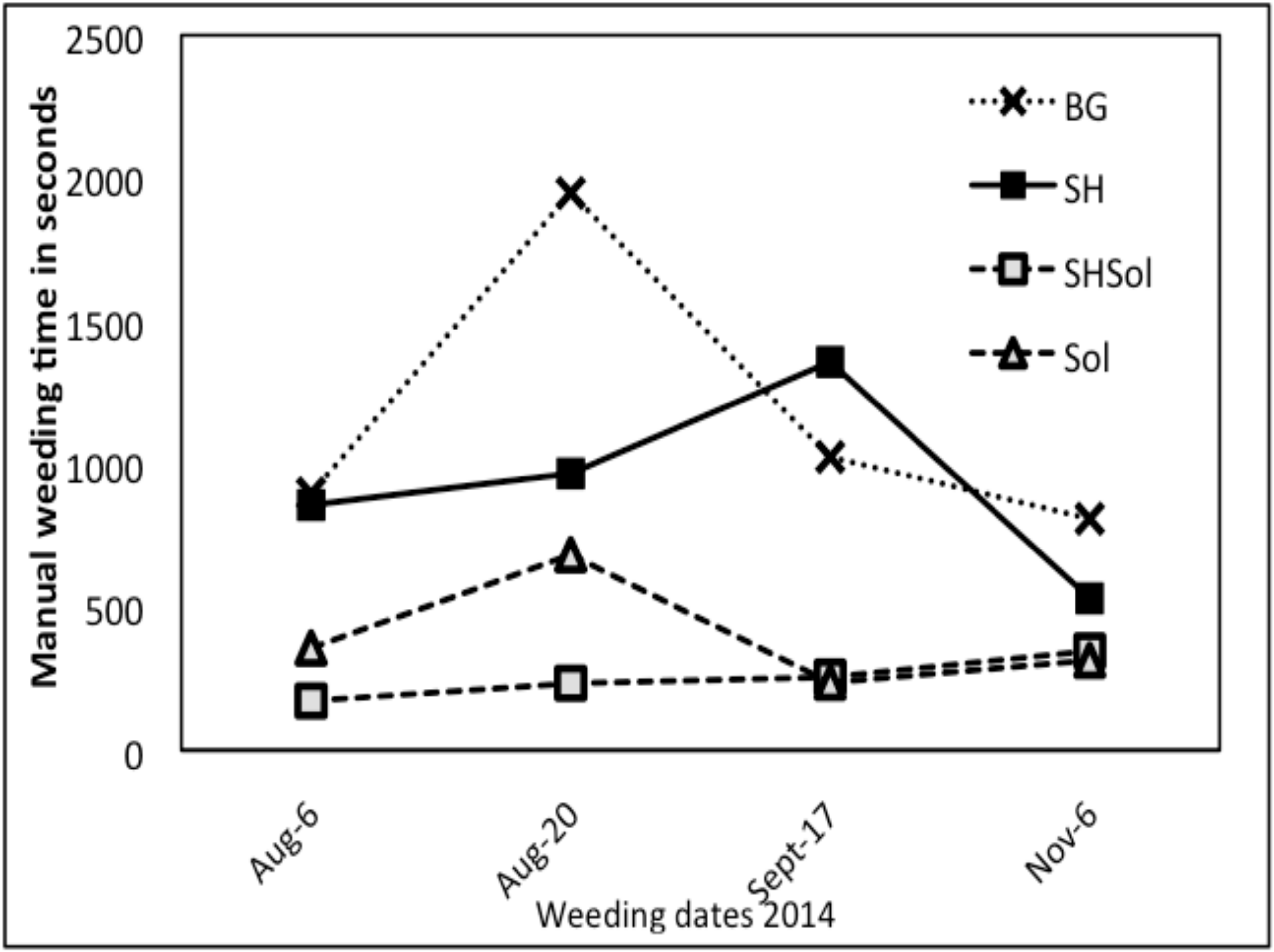

BG
SH
SHSol
Sol
% Thrips damage
100
90
80
70
60
50
40
30
20
10
0
18-Jul
1-Aug
15-Aug
29-Aug
12-Sep
26-Sep
10-Oct
24-Oct
7-Nov
21-Nov
Data collection dates


100
90
80
70
60
50
40
30
20
10
0
% Leaf miner damage
BG
SH
SHSol
Sol
18-Jul
25-Jul
1-Aug
8-Aug
15-Aug
22-Aug
29-Aug
5-Sep
12-Sep
19-Sep
26-Sep
3-Oct
10-Oct
17-Oct
24-Oct
31-Oct
7-Nov
14-Nov
21-Nov
Data collection dates

% damage	Treatments				Contrast analysis		
	BG[z]	SH	SHSol	Sol	SH vs no SH	Sol vs no Sol	Till *vs* no Till
			2013				
Thrips	45.47[y]	41.76	48.38	54.31	NS[x]	@	@
Leaf miner	7.13	5.38	10.52	9.27	NS	*	*
			2014				
Thrips	50.80	18.29	36.62	44.50	**	NS	**
Leaf miner	14.31	11.05	14.62	15.35	NS[y]	@	*
Purple blotch	39.56	20.69	33.54	38.27	*	NS	*


Weed Control - Solarization

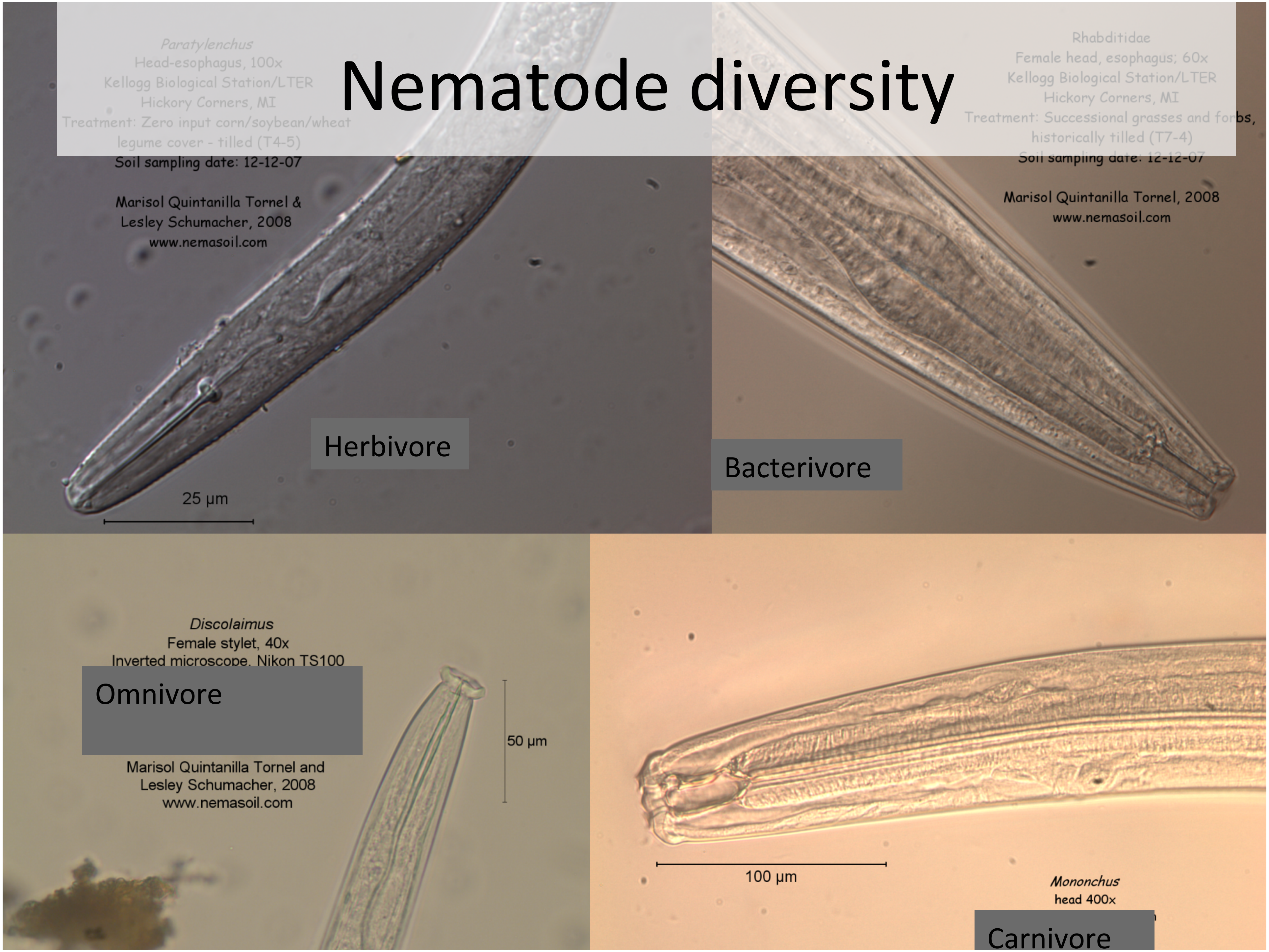

Bare ground,
Tilled +
Insecticides


Manual weeding time in seconds
2500
2000
1500
1000
500
0
BG
SH
SHSol
Sol
Aug-6
Aug-20
Sept-17
Nov-6
Weeding dates 2014

Insect Diversity in Yellow Sticky Traps

Arthropods[z]	Treatments				Contrast analysis[y]		
	BG [z]	SH	SHSol	Sol	SH *vs* no SH	Sol *vs* no Sol	Till *vs* no Till
			2013				
Herbivores	28.22 [y]	29.13	20.57	24.33	NS[x]	*	@
			2014				
Herbivores	17.37	28.35	24.16	20.72	**	NS	**
Predators	0.47	0.95	0.99	0.52	**	NS	NS
Parasitoids	8.46	11.33	11.99	9.03	**	NS	@
Detritivores	0.98	2.37	2.62	1.28	**	NS	*
Richness	11.02[w]	12.62	12.38	10.58	**	NS	**
Diversity	5.88	5.93	6.35	5.14	@	NS	NS

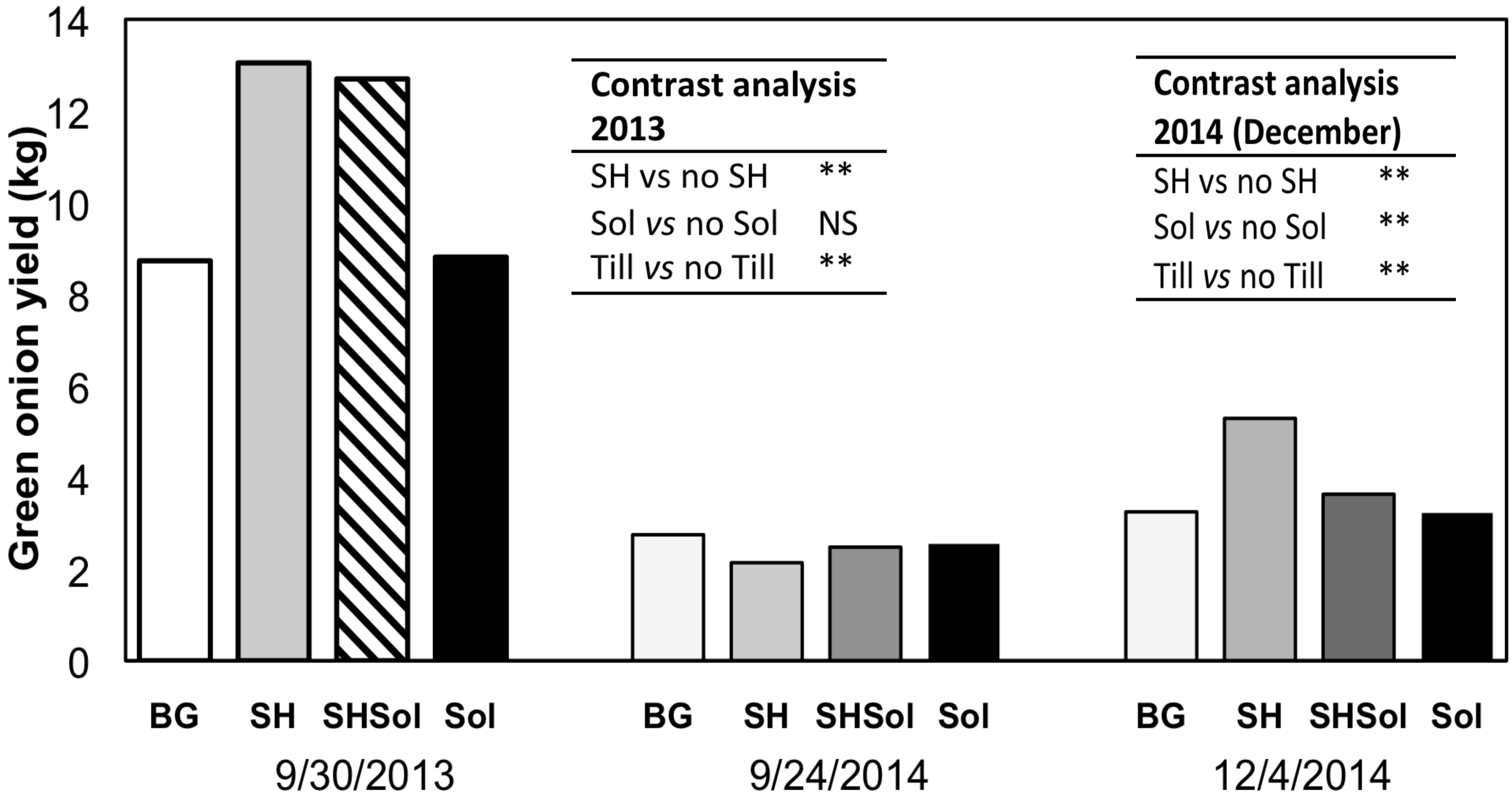
Nematode diversity



Effects of mulching on nematode communities on green onion in the 2014 trial.

Nematodes[z]	Treatments				Contrast analysis F values[x]		
	BG[y]	SH	SHSol	Sol	SH *vs* no SH	Sol *vs* no Sol	Till *vs* no Till
Herbivores[z] (5/27)	292.50	1060.00	80.00	217.50	0.06[w]	7.22*	6.02*
Herbivores (10/8)	1085.00	1975.00	640.00	855.00	0.27[w]	2.68	4.09@
Herbivores (12/4)	950.00	1030.00	1410.00	2550.00	0.31[w]	3.72[@]	0.48
Repeated measure of 5/27, 10/8, and 12/4							
Bacterivores	358	558	438	358	0.57[w]	2.52	3.42[@]
Fungivores	79	167	68	52	3.68[@w]	9.96**	7.04*
Omnivores	41	58	34	38	0.78[w]	2.06	2.05
Predators	0	0	1	1	0.00[w]	1.95	0.65
Richness	12	13	10	9	0.67	11.29**	6.87*
Diversity	4.43	3.26	3.52	3.24	0.91	1.03	0.76
Maturity Index	2.08	1.93	2.20	2.07	0.01	1.28	2.01
Enrichment Index	46.8	56.14	35.55	37.17	0.29	4.52*	3.91[@]
Structure Index	30.19	30.39	38.28	24.16	1.25	0.01	0.08
Channel Index	39.18	28.51	58.80	46.00	0.01	3.22[@]	2.67

Water Management, Yield, and Marketability



Conclusions

- **No-till mulch systems had the highest yield and marketable yield**
- **No-till mulch systems had lower pest and disease damage**
- **Insectary plants and mulch systems increased diversity of above and below ground beneficial organisms**
- **Soil solarization decreased weed pressure**


No-till Sunn hemp
+
Insectary Border

Research Suggestions and Needs?

- Thank you for attending.
- I look forward to answering your questions