College of Tropical Agriculture and Human Resources
University of Hawaii at Manoa

CTAHR Research Update:

Emerging Strategies for Controlling Plant-parasitic Nematodes Organically

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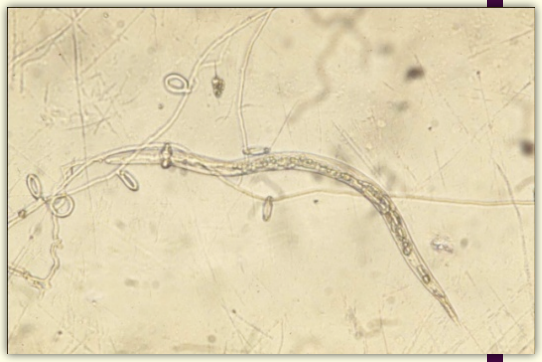
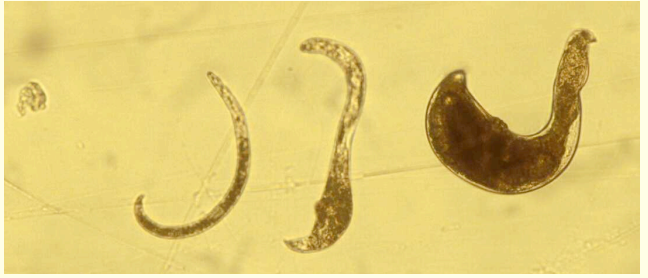



tomato



Emerging Strategies for Controlling Plant-parasitic Nematodes Organically

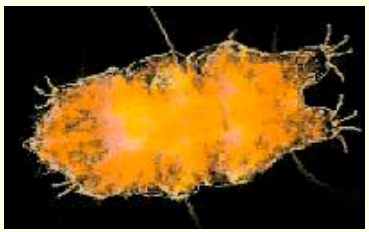
Focusing on Soil Health Management

- Strip-till living mulch
- Targeting on the vulnerable stage of plant-parasitic nematodes
- Adding biologically active soil components
  - drenching vermicompost tea
  - avoiding a biological vacuum in the soil community

Soil Health

Characteristics of a Healthy Soil

1. High biological diversity
2. Maintenance of soil nutrient cycling
3. Stability to disturbance or stress
4. Suppression of multiple pests and pathogens
5. Improvement of plant health



Using nematodes to indicate soil health

Bacterivore **Fungivore** **Herbivore** **Omnivore** **Predator**

EI=Enrichment index

CI=Channel index

SI=Structure index

+ richness, diversity

(Ferris et al, 2001; Neher, 2001)

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Strip-till Planting of Cucurbit Crops in Sunn Hemp Living Mulch System

Sunn hemp (*Crotalaria juncea*)

- Legume, fix nitrogen.
- Rapid growing, > 4 tons dry biomass/ acre, 163 lb N/acre at 60 days of growth (40 lb seeds/acre) during summer in Hawaii.
- Enhance beneficial nematodes, and soil arthropods involved in soil nutrient cycling.
- Suppress plant-parasitic nematodes when incorporated into soil.
- Problem: decomposed quickly, nutrients will not last for whole cropping cycle, conventional cover cropping disturbed soil ecosystem.

Strip-Till Cover Cropping (STCC)

- Preplant Treatment:
  - ❑ Sunn hemp (SH): 40 lb seeds/acre
  - ❑ Marigold (MG): 2.6 lb seeds/acre
  - ❑ Bare ground (BG): fallow with weeds

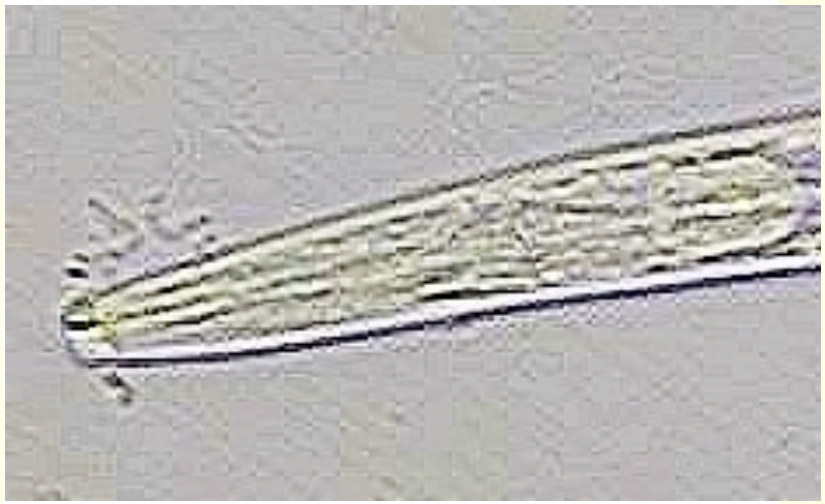
2008, 2009 Trials

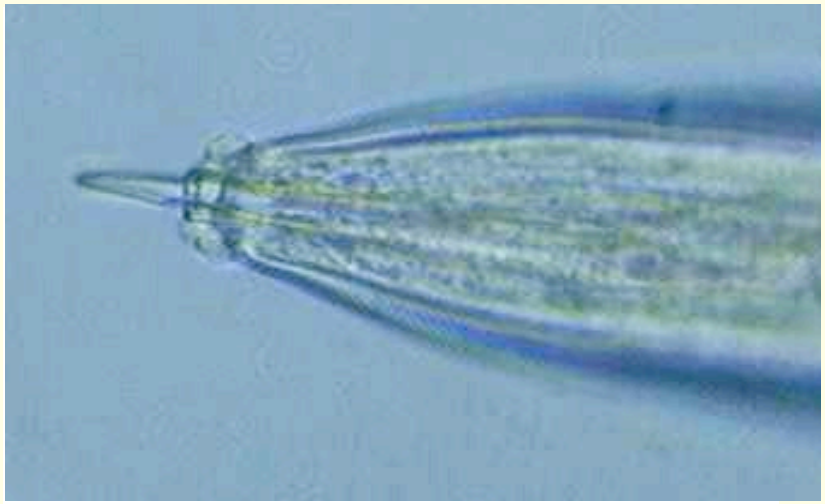
•Advantage:

- •STCC reduced tillage.
- •Periodical clipping of the living mulch as surface mulch provide additional inputs of organic matter over time.

(CSREES, Crop at Risk, 2006-2010)

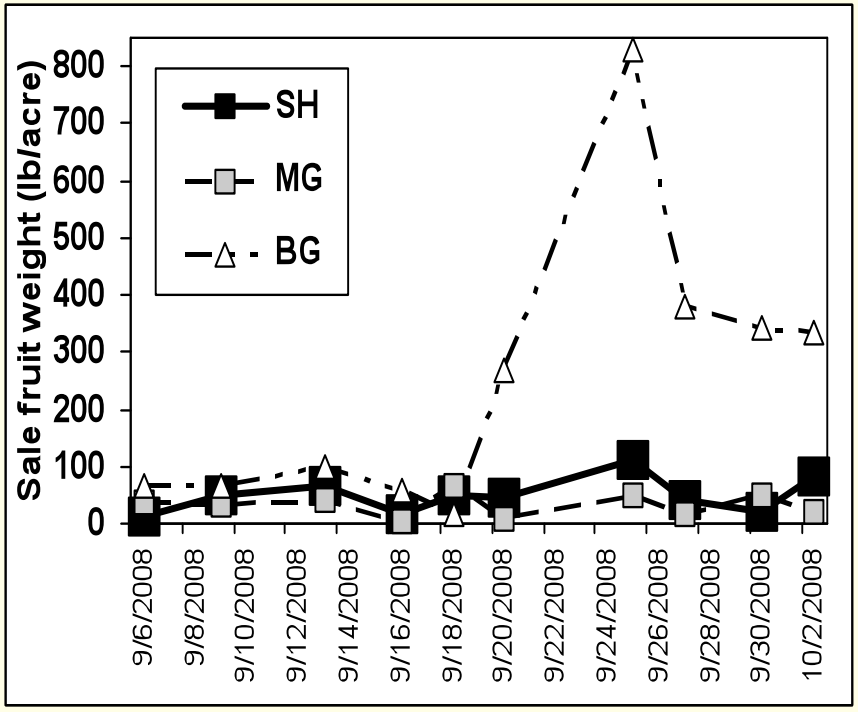
Effect of STCC on Soil Health Using Nematodes as Bioindicators (2008 results)

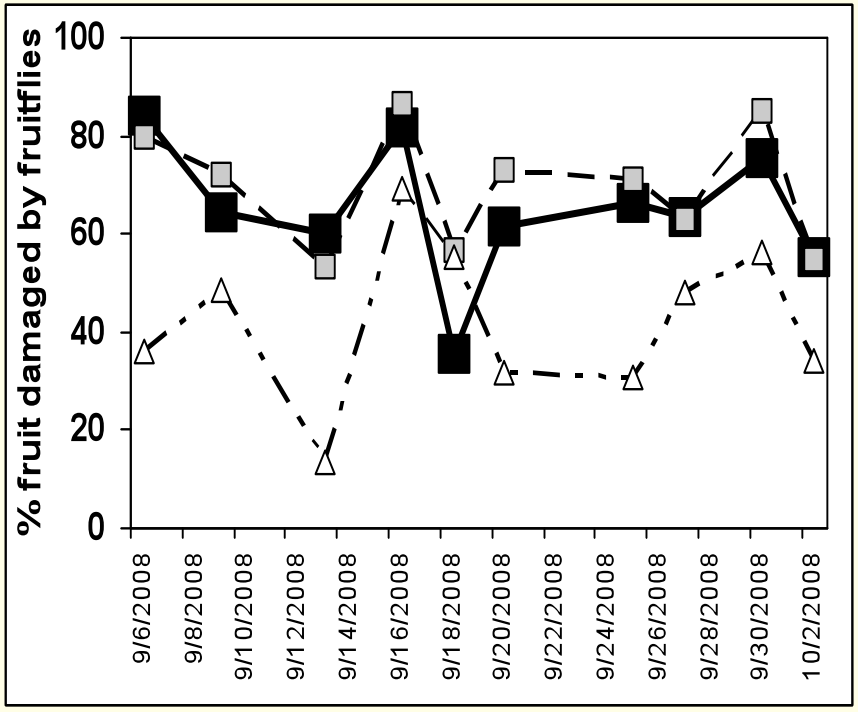




(Wang et al., Applied Soil Ecology)

Cucumber Yield



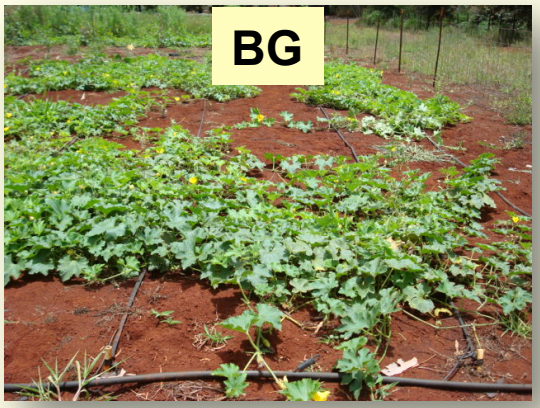


Cucumber yield was lower in SH vs BG partly due to more severe fruitfly damage and shading effect of the cover crops.

STCC Cycle II

- April 2009: Winter gourd intercropping with
  - ❑ Sunn hemp (SH): 30 lb seeds/acre
  - ❑ Marigold (MG): 2.6 lb seeds/acre
  - ❑ Bare ground (BG): fallow with weeds
- Aug 2009: finished harvesting.

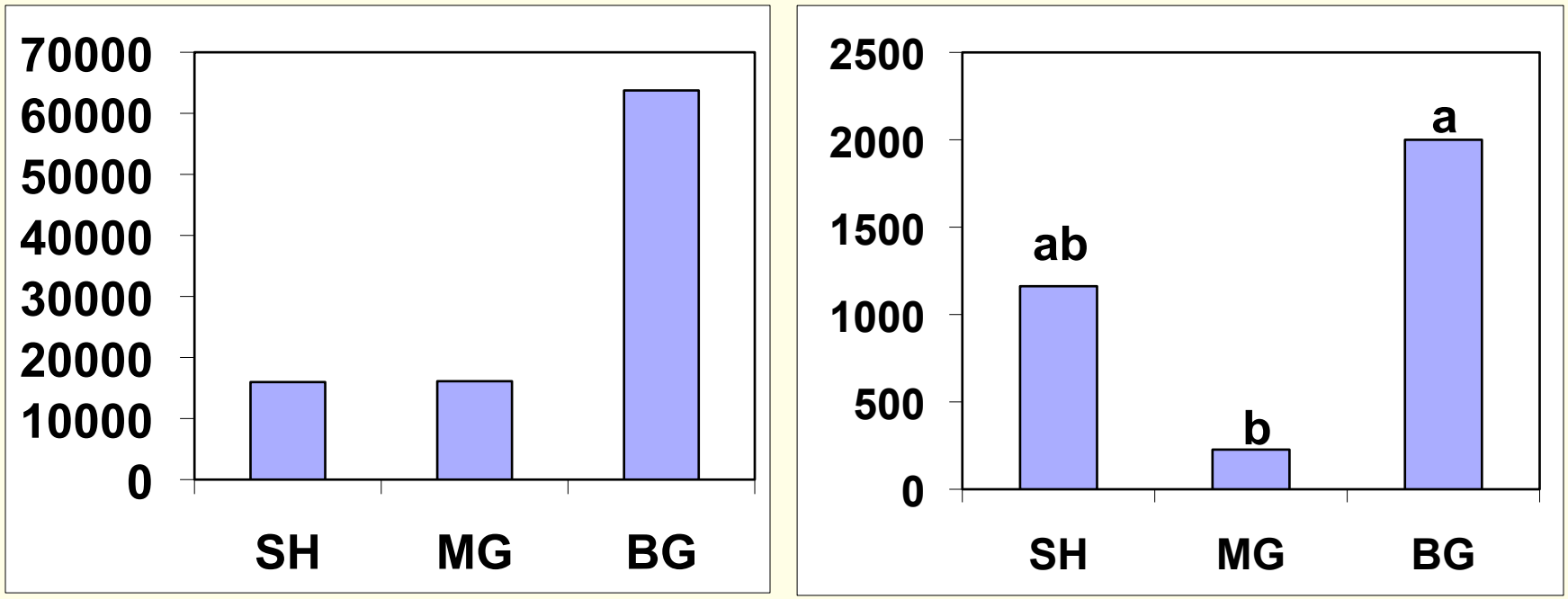
Intercropping with cc



Plant-parasitic Nematodes in Winter Gourd Roots (8/13/09)

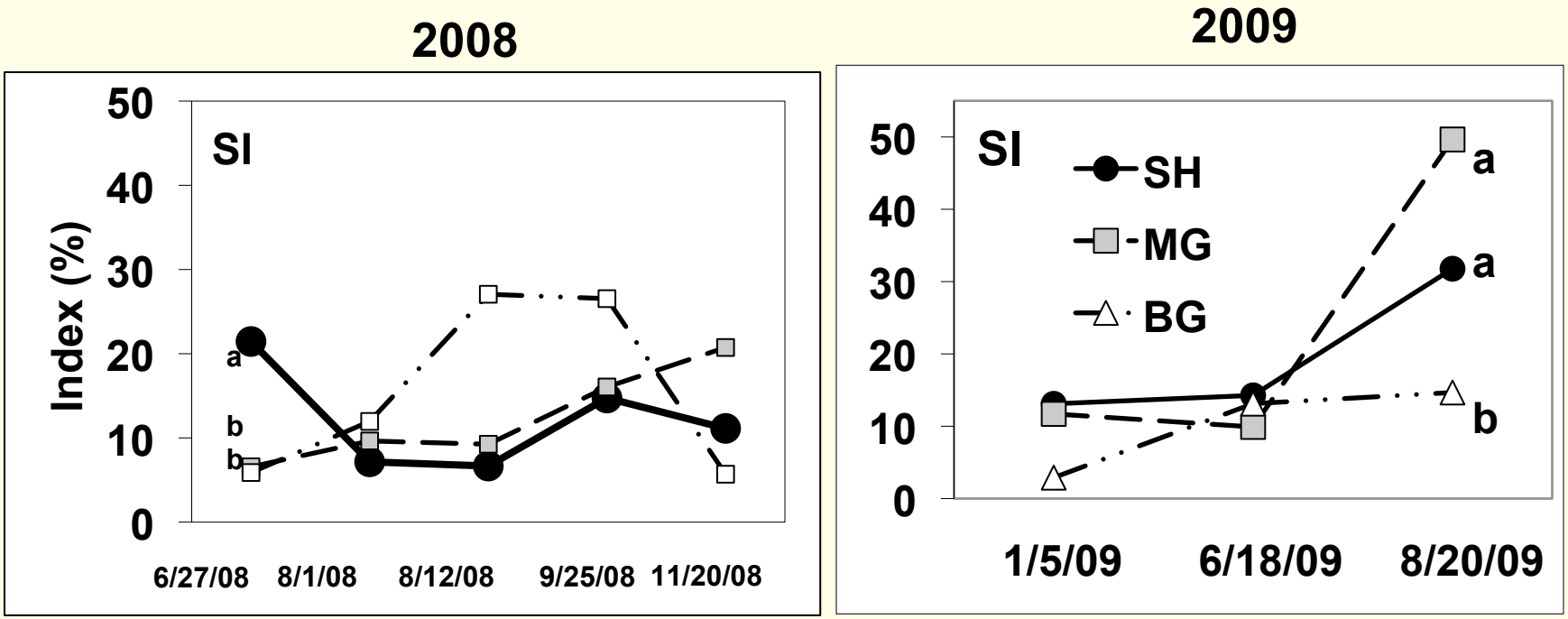
Root-knot nematode

Reniform nematode



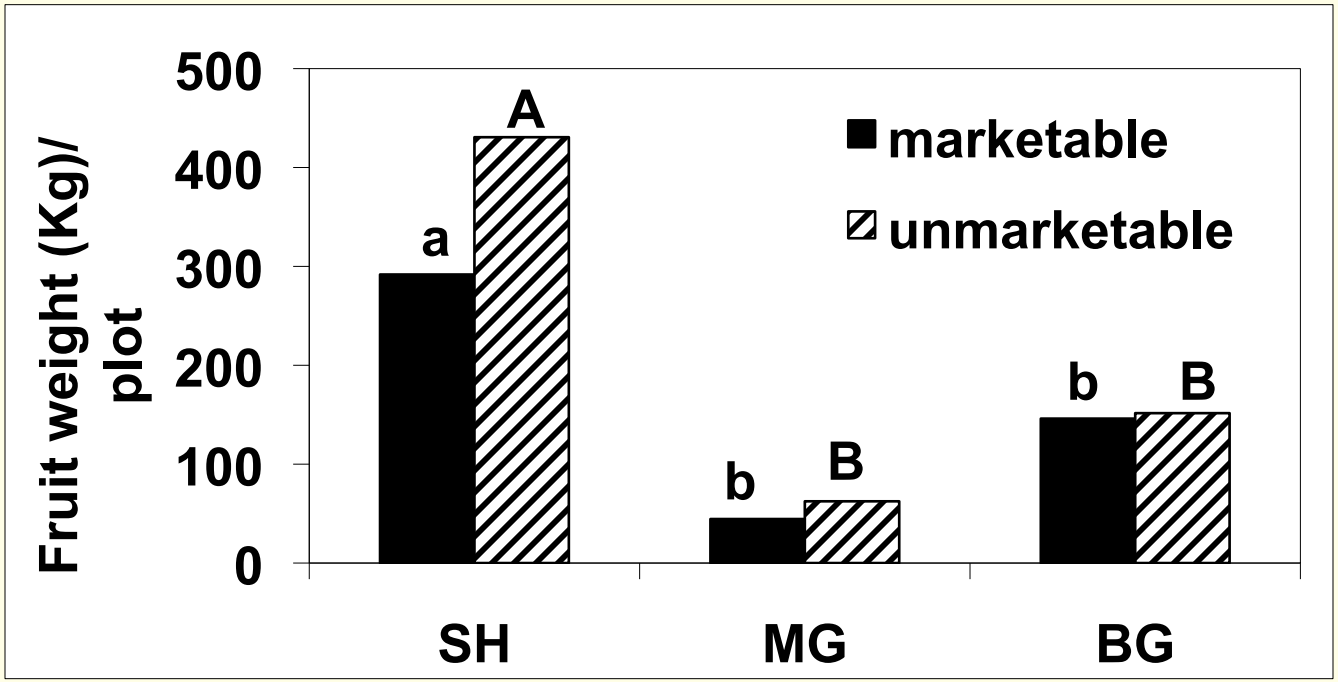
4. SH suppressed multiple plant pathogens and diseases.

Measurement of Disturbance (Structure Index)



3. SH treatment resulted in less disturbed (high SI) and less stressful (low CI) soil conditions.

Winter Gourd Yield



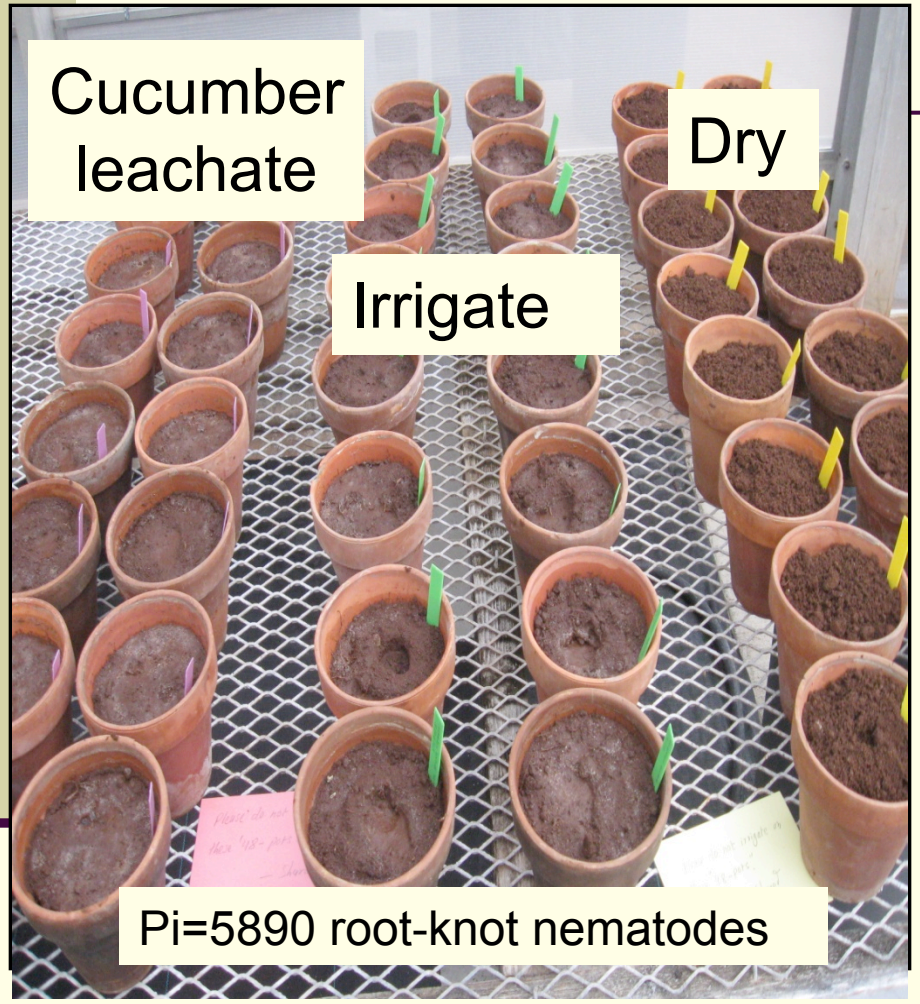
5. SH increased plant health and thus resulted in higher crop yield.

Emerging Strategies for Controlling Plant-parasitic Nematodes

Focusing on Soil Health Management

- Strip-till living mulch
-  Targeting on the vulnerable stage of plant-parasitic nematodes
- Adding biologically active soil components
  - drenching vermicompost tea
  - avoiding a biological vacuum in the soil community

Targeting on vulnerable stages of Root-knot Nematodes



Marigold suppressed root-knot nematodes most efficiently if planted into soil with active stage of nematodes.

(Sharadchandra Marahatta Dissertation)

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Can vermicompost tea speed up the enhancement of soil health?

Integrating STCC withVermicompost Tea in Zucchini Cropping System

Sunn hemp (SH)

SH+CC

Crimson Clover (CC)

Bare ground (BG)

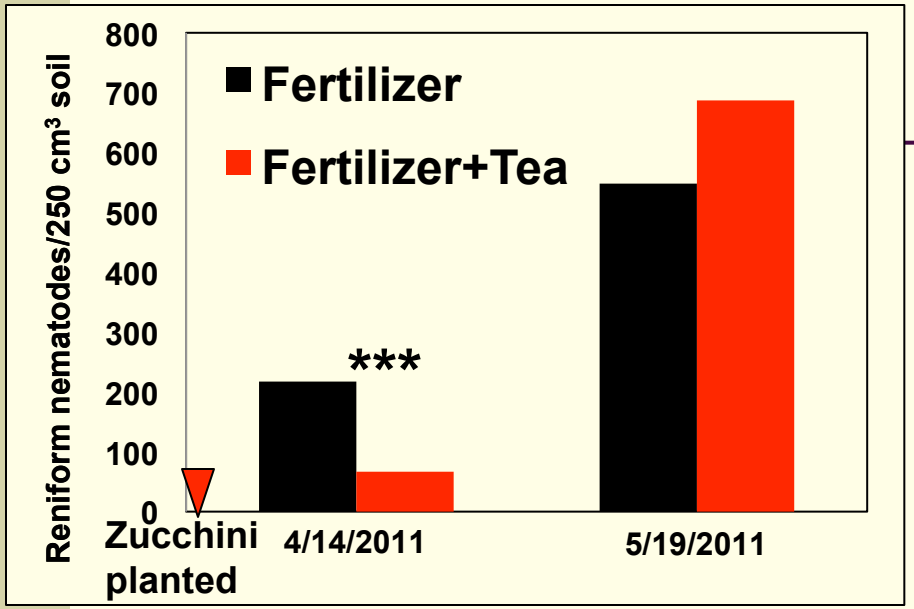
Subplots:

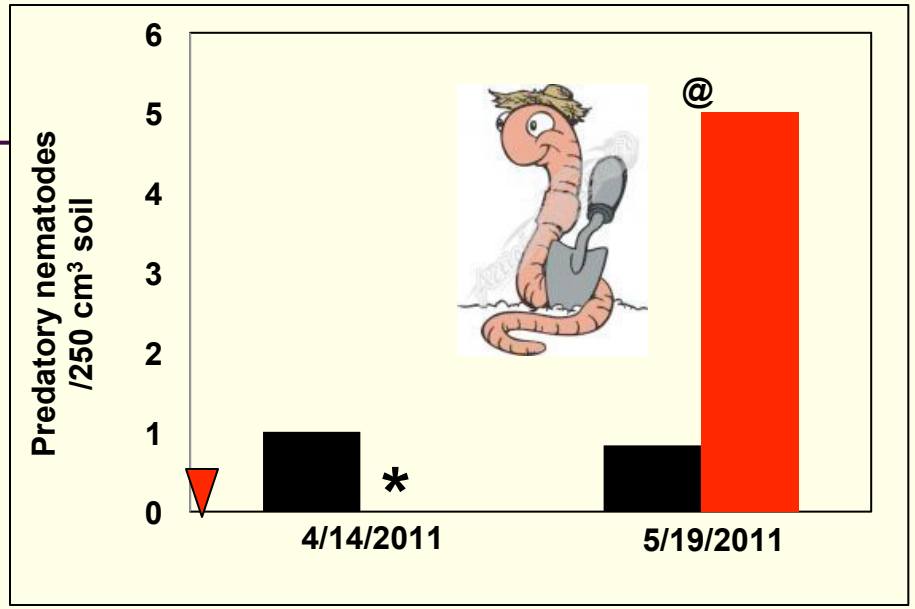
- Chicken pellets (F) =60lb N/acre
- Vermicompost tea (T) --chicken manure based =200 gal/acre
- F+T
- None

- 3 replications
- Twin Bridges Farm, Waialua

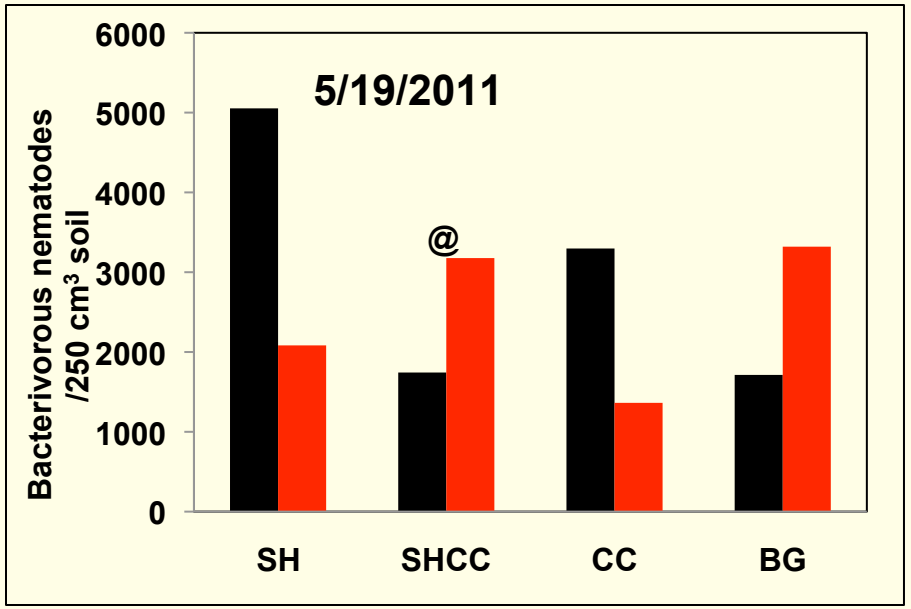
(Wang, Radovich et al NRCS, 2010-2012)

Can vermicompost tea (VT) speed it up?



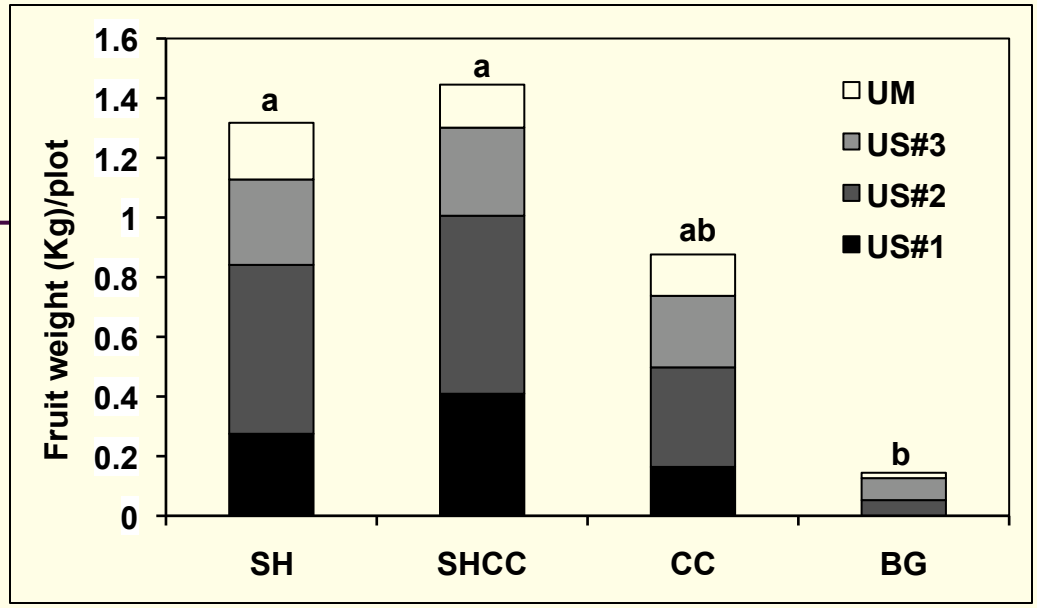


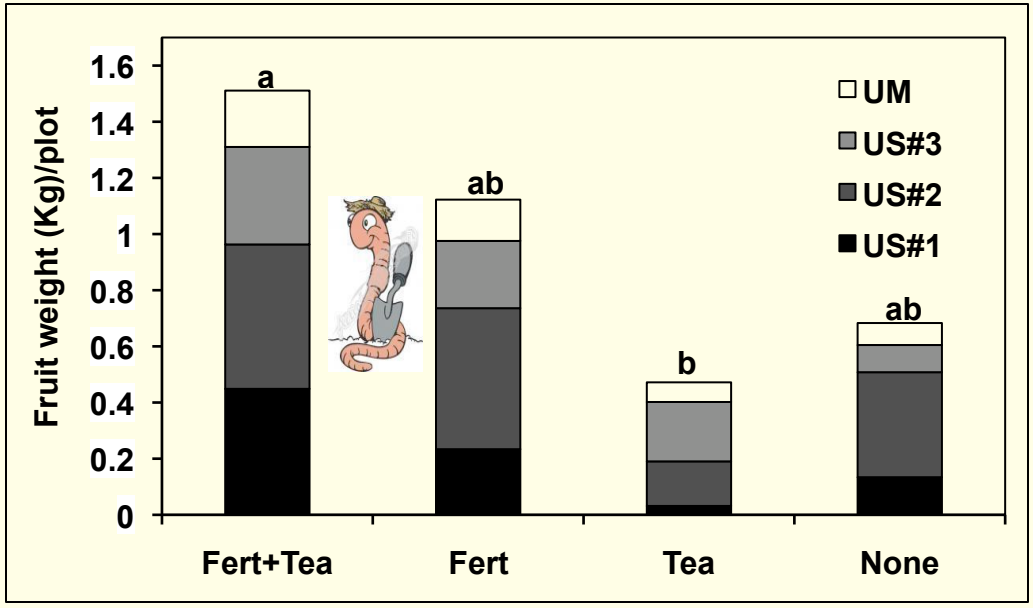
- VT suppressed reniform nematodes early on, but not at crop harvest.
- VT did enhanced (*P < 0.10*) predatory nematodes in one cropping cycle.
- VT only increased (*P < 0.10*) bacterivores in SHCC treatment.



Zucchini Yield

- Zucchini crop produced higher yield in SH planted plots than in BG.
- Adding compost tea to chicken pellets fertilizers slightly increased crop yield vs chicken pellets alone.





US#1 = firm, no damage; US#2 = firm, no major damage;
US#3 = off shape, multiple damages; UM = unmarketable, serious damage.

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avoiding a biological vacuum in the soil community

Emerging Strategies for Controlling Plant-parasitic Nematodes

Focusing on soil health management

- Strip-till living mulch
- Adding biologically active soil components (Vermicompost tea)
- Targeting on the vulnerable state
  - MG after a susceptible crop

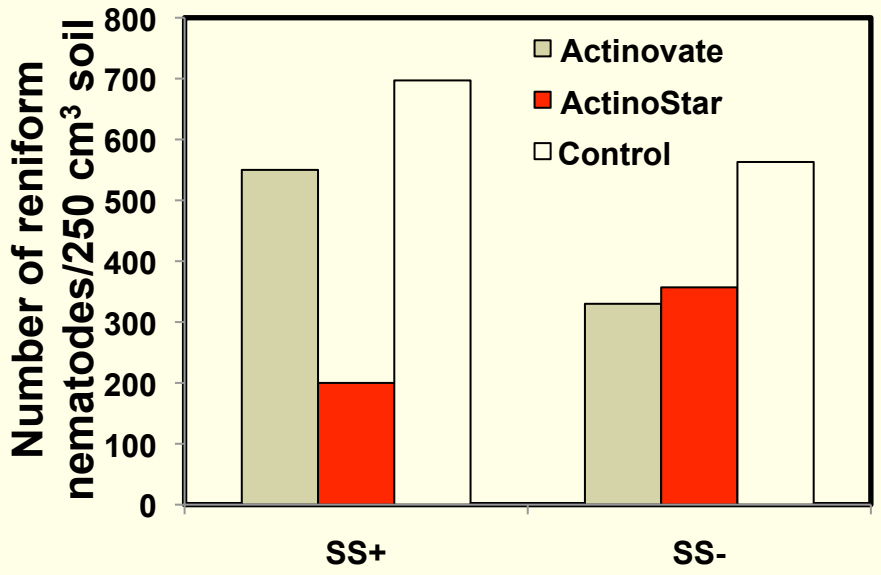
Avoiding a biological vacuum

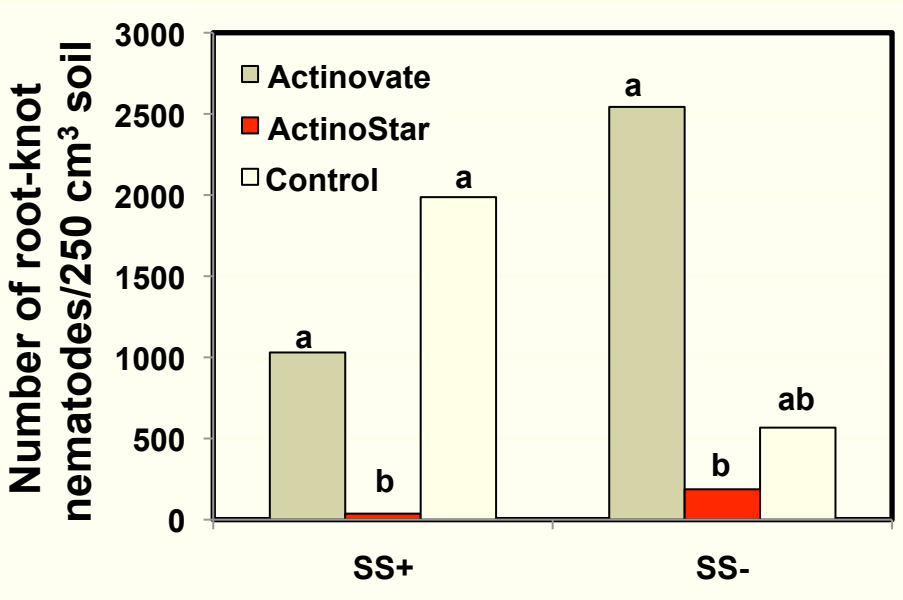
- **Actinovate AG** is a high concentration of a patented beneficial organisms on a 100% water soluble powder.
- a.i. = Streptomyces lydicus strain WYEC 108
- An effective preventative spray for many soil-borne and foliar fungal diseases.
- Effect on nematode suppression is not convincing.

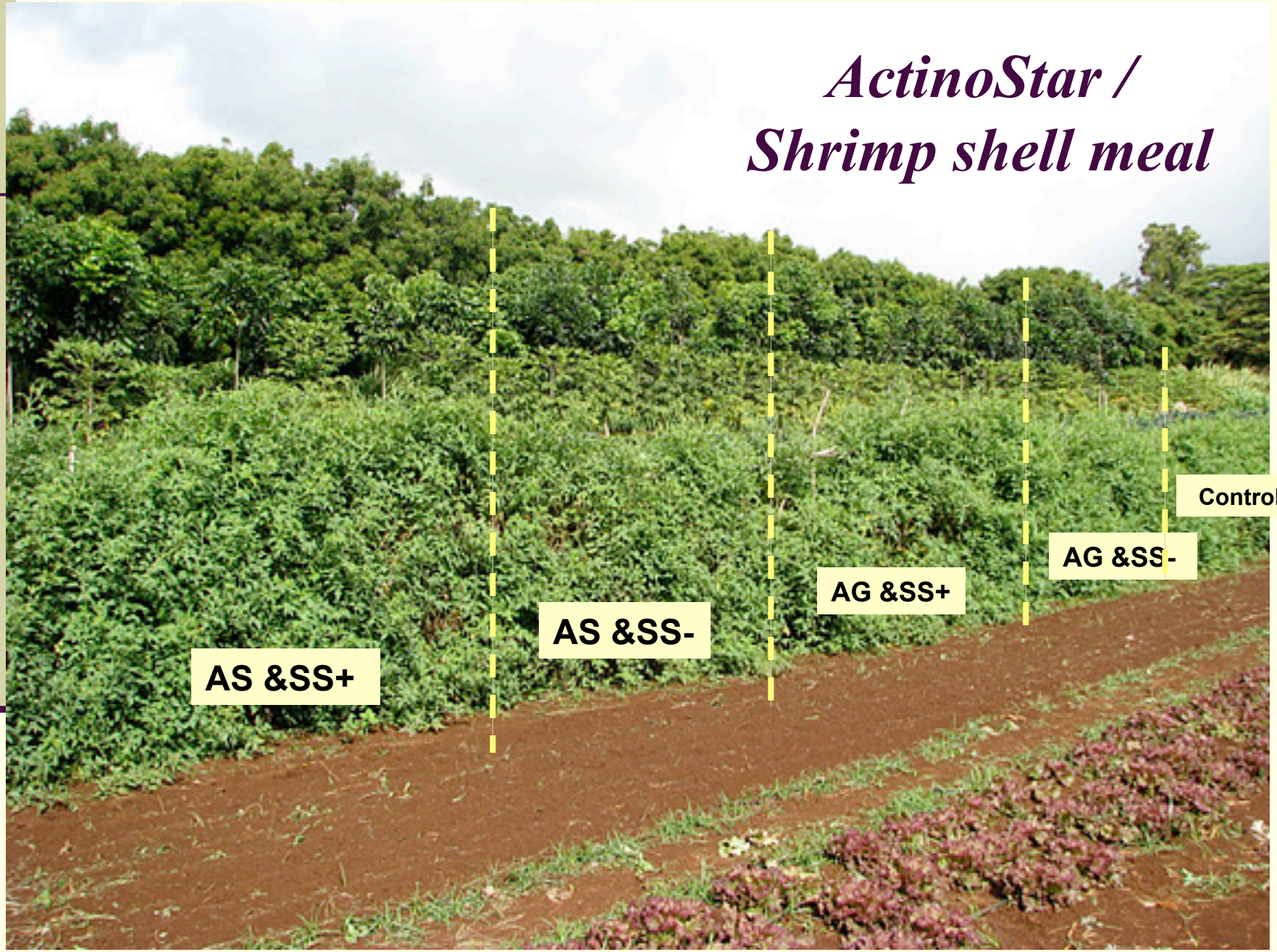
- Shrimp shell meal is a slow-release organic fertilizer (5% N, 8% P, 15% Ca & 18% chitin & trace minerals), derived from ground-up shrimp shells.
- Used in Asia for its nematicidal properties.
- Enhance beneficial soil chitin-feeding microbes.
- Nematode egg shell is composed of chitin.

ActinoStar / Shrimp shell meal

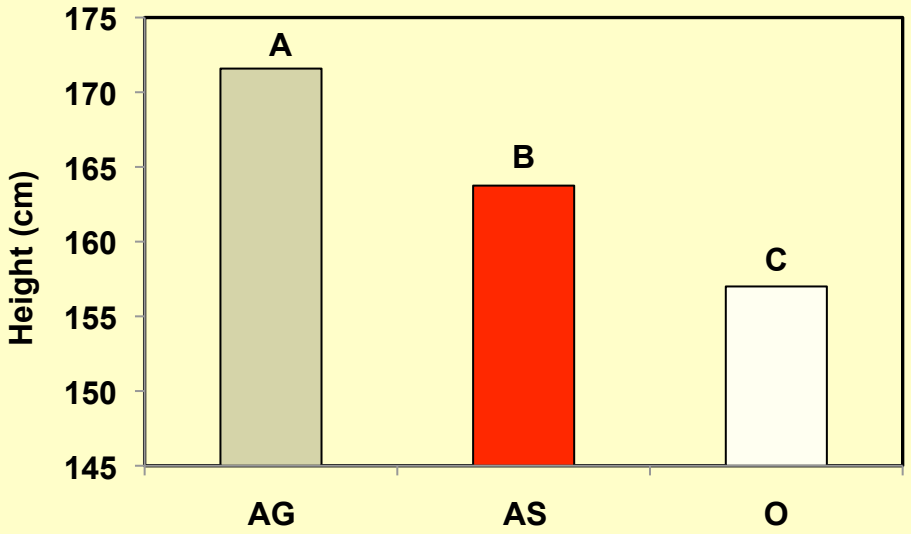
- Shrimp shell meal (SS) +/- (35 lb/1000 sq ft)
- Actino-Star (AS) 6 oz/acre
- Actinovate (AG) 6 oz/acre
- Untreated control (C)

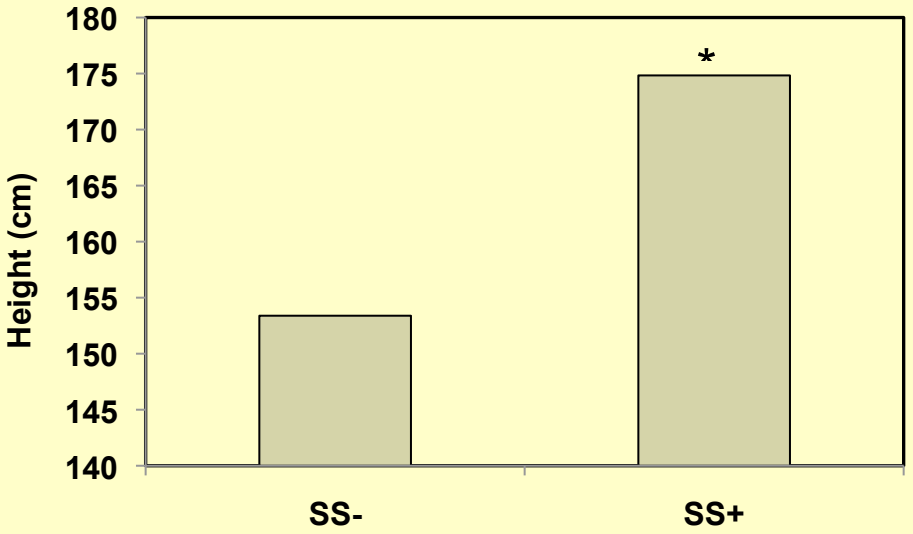





ActinoStar /
Shrimp shell meal
AS &SS+
AS &SS-
AG &SS+
AG &SS-
Control

ActinoStar /Shrimp Shell Meal





Summary

- Demonstrate a few approaches to manage plant-parasitic nematodes organically.
- We target on suppressing PPN while enhancing beneficial free-living nematodes.
- Selecting cover crops that have allelopathic effect against PPN.
- Targeting on planting cover crop during the vulnerable stage of PPN.
- Strip-till cover cropping followed by surface mulching prolong the effect of enhancing beneficial nematodes.
- Adding biologically active soil components such as drenching vermicompost tea or avoiding a biological vacuum in the soil community are additional approaches that are compatible with cc for nematode management.

Acknowledgement

- **WSARE (tracking #08-037).**
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- **EPA**
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